

# ***ELECTRONIC & RADIO ENGINEER***

*Incorporating WIRELESS ENGINEER*

## **In this issue**

*Magnetic Tape Recording*

*Amplifier for Decimicrosecond Pulses*

*Super-Gain Aerial Beam*

*Electromagnetic Wave Problems*

**Three shillings  
and sixpence**

**SEPTEMBER 1959 Vol 36 *new series* No 9**



# high efficiency with low cost

Whatever the aerial or frequency there is a BICC cellular-polythene Downlead to suit every television requirement.

These cables are made under strict process quality control. Yet they are low in cost, providing the most economical method of ensuring high quality performance.

Publication No. 357 gives further technical details.

May we send you a copy?

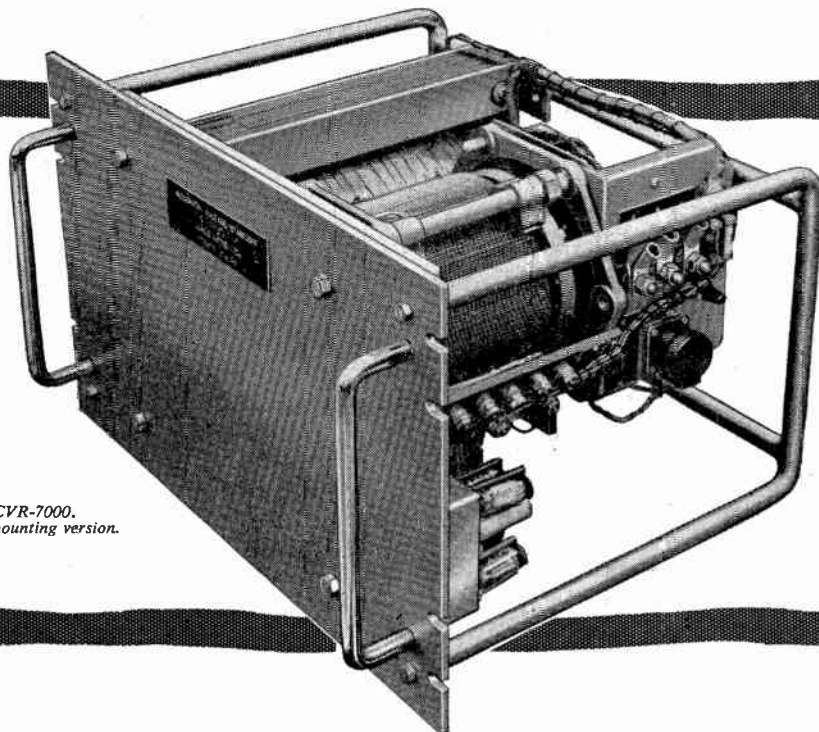


**BICC** TV downleads

BRITISH INSULATED CALLENDER'S CABLES LIMITED, 21 Bloomsbury Street, London, W.C.1

# 40 VOLTS/SEC AUTOMATIC CORRECTION

—with the type TCVR voltage regulator



Type TCVR-7000.  
Rack-mounting version.

The TCVR is a servomechanical automatic voltage regulator having the very high speed of correction of FORTY VOLTS PER SECOND. It provides an *undistorted* output, maintained constant within very close limits (normally  $\pm 0.5\%$ ) from no-load to full-load, for wide variations in frequency and power factor.

A wide range of models from 1.6 to 12 kVA single-phase, and 4.8 to 36 kVA three-phase, is available, to standard or tropical specification, in cabinets or for rack-mounting. Models are also available in which the output voltage is continuously adjustable over a wide range by means of a panel control. Regulators can be supplied to Services' specification, and special models can be designed to order.

For **high-speed, accurate stabilisation without distortion**—specify TCVR.

## Other products of Claude Lyons Ltd. Stabiliser Division

**BMVR:** Motor-driven laboratory and industrial regulators ranging from 1.6 to 29 kVA single-phase, and 4.8 to 87 kVA three-phase. Constancy of output normally  $\pm 0.5\%$ , from no-load to full-load. No distortion. Speed of correction 1 Volt/Sec. A great variety of models, standard, tropical and militarised, for all applications.

**BAVR:** Electronic stabilisers of very high accuracy, and very rapid response, with no moving parts. Input range:  $-10\%$  to  $+5\%$ , output constancy  $\pm 0.15\%$ . Three sizes: 200, 500 & 1000 VA. Exceptionally useful for control of chemical processes, heating, lighting, etc.

**ASR:** Automatic step regulators, small, inexpensive, and with sinusoidal output waveform. Two sizes: 1.15 kVA and 2.3 kVA. Input range  $-10\%$  to  $+5\%$ ; output constancy,  $\pm 2\%$ .

**ATC:** Automatic Tap-Changing Transformers — a development of ASR. Two sizes: 575 VA and 1150VA. Input range  $-20\%$  to  $+10\%$ ; output constancy,  $\pm 5\%$ . Provide adequate stabilisation for many types of apparatus, at low cost. Also useful as pre-regulators, e.g. in conjunction with BAVR.

Claude Lyons Ltd.



For complete information on our entire range of automatic voltage regulators and stabilisers, request Catalogue S-574

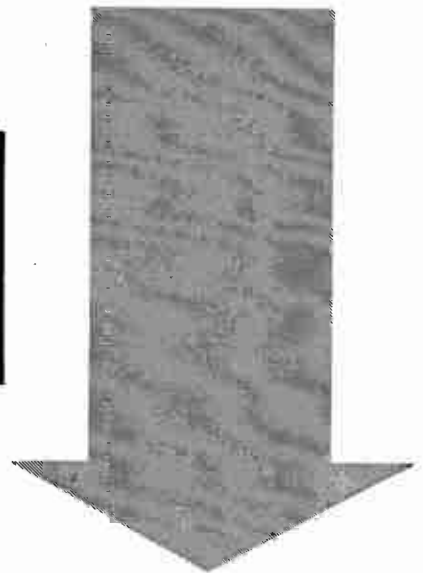
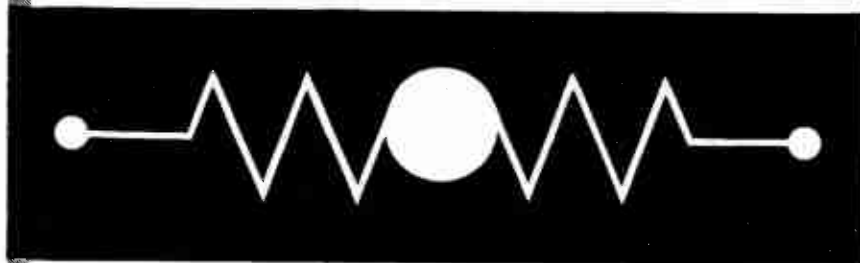
Stabiliser Division

VALLEY WORKS · HODDESDON · HERTS · ENGLAND

Electronic & Radio Engineer

A

# let **STC** thermistors



**Solve these problems —**

TEMPERATURE MEASUREMENTS	BEAD TYPES F, GT & M · DISC TYPES K, KB & KH
TEMPERATURE CONTROL AND COMPENSATION	BEAD TYPES F, G & M · DISC TYPES K, KB & KH SILISTORS (positive temperature coefficient)
SCIENTIFIC AND MEDICAL MEASUREMENTS	TYPES F, G, M, P, U & MANOMETER
FEEDBACK LOOPS & TIMING DEVICES	LOW POWER TYPES A, B & R · HIGH POWER TYPE L
R. F. POWER MEASUREMENTS	UP TO Mc/s TYPE B UP TO 10,000 Mc/s TYPES E & U
DOMESTIC AND ENTERTAINMENT APPLICATIONS	TYPES G, KS & BRIMISTORS
CURRENT SURGE SUPPRESSION AND CIRCUIT PROTECTION	1 max > 1.0A CZ4, CZ9A, CZ11, CZ12 1 max 0.1 to 1.0A, CZ1, CZ2, CZ3, CZ6, CZ8 1 max < 0.1A CZ10



**Standard Telephones and Cables Limited**

Registered Office: Connaught House, Aldwych, London, W.C.2

**TRANSISTOR DIVISION: FOOTSCRAY · SIDCUP · KENT**

# Pocket size... pocket wise!

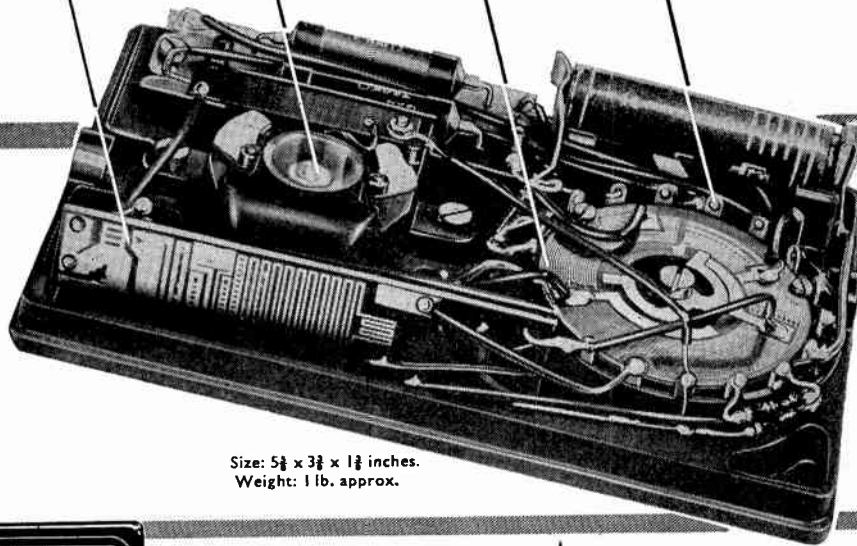
This sturdy multi-range test meter is remarkable for the wide range of test facilities which have been so neatly incorporated. Full advantage has been taken of printed resistor techniques to produce a compact instrument of low weight.

Printed resistance panel for universal meter shunt.

Composite printed resistors and auxiliary switch.

Meter movement is enclosed to give protection against the infiltration of dust.

Robust range switch similar to that used in the famous Avometer. Eighteen fixed silver-plated contacts embedded in a ring of high-grade moulding material are swept by a double contact rotor arm.



Regd. Trade Mark.

Size:  $5\frac{1}{2} \times 3\frac{1}{2} \times 1\frac{1}{2}$  inches.  
Weight: 1 lb. approx.



7 D.C. Voltage Ranges: 0-1,000 V.

5 A.C. Voltage Ranges: 0-1,000 V.

5 D.C. Current Ranges: 0-1A.

2 Resistance Ranges: 0-20,000  $\Omega$ .  
0-2M  $\Omega$ .

Sensitivity:  
10,000  $\Omega$ /V on D.C. voltage ranges.  
1,000  $\Omega$ /V on A.C. voltage ranges.

Accuracy:  
3% of full scale value on D.C.  
4% of full scale value on A.C.

For a small additional charge, instruments can be supplied to a higher degree of accuracy.

List Price:

**19 Ranges · Single Knob Control · £9:10s.**

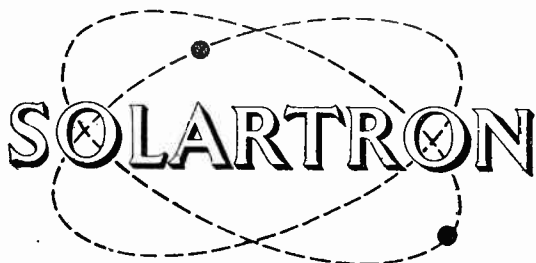
Complete with test leads and clips.  
Leather case if required 32/6.

• Write for fully descriptive leaflet.

THE  
**MULTIMINOR**

**AVO Ltd.** AVOCET HOUSE · 92-96 VAUXHALL BRIDGE ROAD · LONDON · S.W.1.

VICtoria 3404 (12 lines)



## DIGITAL VOLTMETERS

**WRITE FOR  
FULL DETAILS**

**THE SOLARTRON ELECTRONIC GROUP LTD.**  
THAMES DITTON · SURREY

Telephone: EMBerbrook 5522.

Cables: Solartron, Thames Ditton

International Telex 23842 Solartron T.Dit.

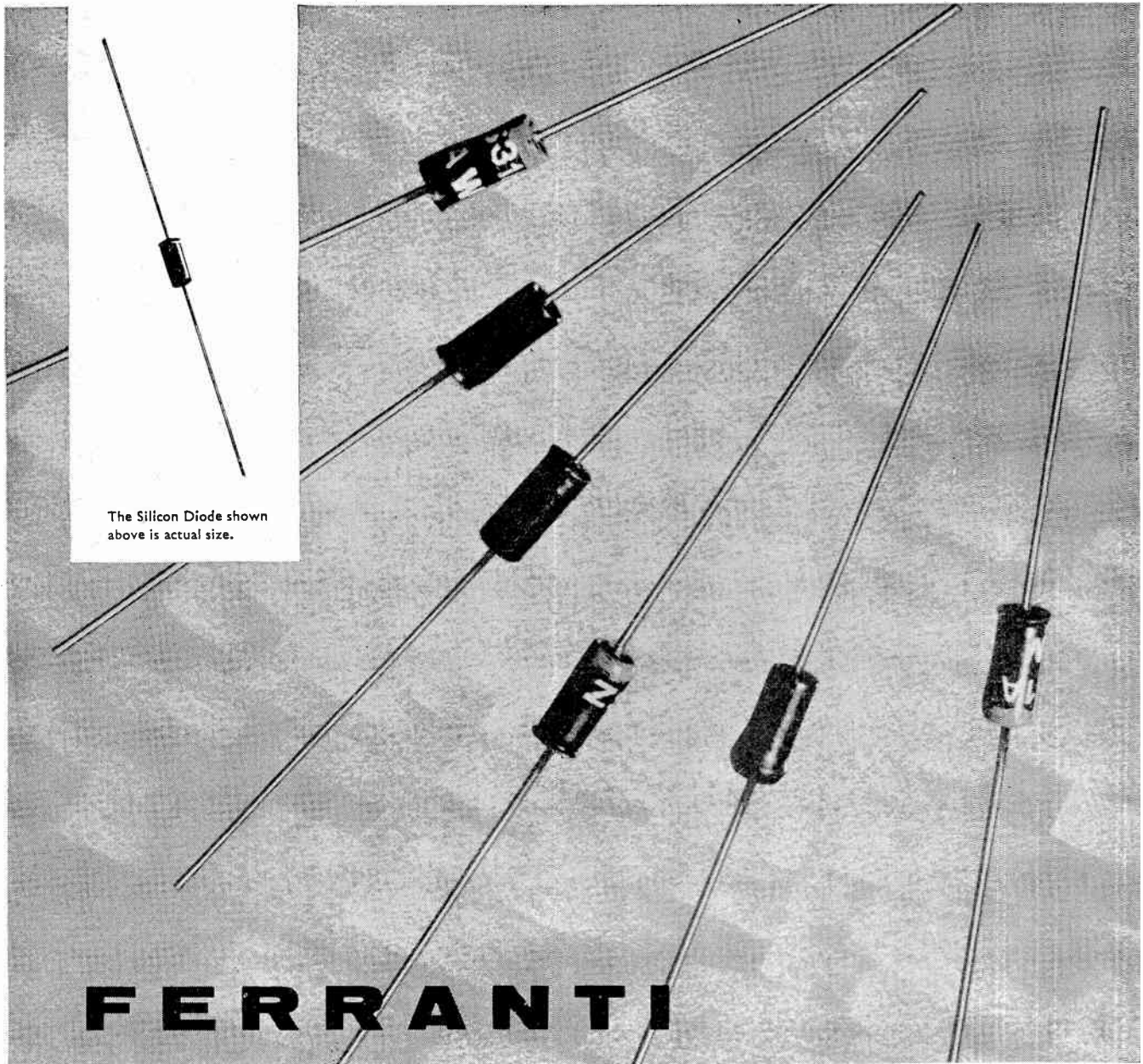
### ACCURATE DIGITAL DISPLAY

The problem of unsteady readings on conventional meters, or errors due to misinterpretation and parallax are entirely solved by the clear presentation achieved in this new series of transistorised instruments. Characters displayed are over an inch in height and unmistakably clear even at a distance, owing to the high efficiency of the optical projection system incorporated. There is thus no possible ambiguity of reading.

The LM901 Solartron Digital Voltmeter is one of a range of digital type instruments available shortly. This range includes the LM902 with a range of 0 to 159.9 volts; TM923—a five window instrument of 159.99V full scale for computing use, and LM904 with automatic ranging from 1.599V to 1599.9V. All these instruments have facilities for remote indication of the digital values displayed and may therefore be used as accurate analogue-to-digital converters.

#### BRIEF SPECIFICATION OF '999' DIGITAL VOLTMETER TYPE LM901

Voltage ranges:	0 to 0.999V; 0 to 9.99V; 0 to 99.9V.
Range extension:	An 'add 10' button extends the digital count to 1099.
Input impedance:	1 megohm; 100 kilohms on 0.999V range.
Accuracy of indication:	Absolute 0.25% long term. Short term 0.1%.
Reading time:	280 milliseconds for any change of indication.
Polarity & decimal display:	Both the polarity and decimal point position are clearly displayed.
Printing output:	Coded decimal output is provided.



The Silicon Diode shown above is actual size.

# FERRANTI

## *Silicon* Diodes ZS30 series

### for MINIATURIZED Circuitry

#### SPECIAL FEATURES

- AUTOMATIC WIRING TECHNIQUES
- HIGH TEMPERATURE OPERATION
- HIGH RECTIFICATION EFFICIENCY
- HIGH POWER TO SIZE RATIO
- HIGH FORWARD CONDUCTANCE
- RUGGEDISED CONSTRUCTION

Ferranti Miniaturized Circuit Diodes are designed for automatic wiring techniques. These diodes, in addition to being run at maximum ratings for forty-eight hours, are rigorously tested to satisfy the following conditions:

Vibration	Grade I (Aero Engines)
Shock	> 500 g.
Humidity	Class HI
Temperature Range	-70°C to + 135°C.

P.I.V. Range 50-400 Volts: Max. Mean Rectified Current 500mA.

**FERRANTI LTD · GEM MILL · CHADDERTON · OLDHAM · LANCS** ' Tel: MAIn 6661  
 LONDON OFFICE: KERN HOUSE, 36, KINGSWAY, W.C.2. Telephone: TEMple Bar 6666



FE194

# 116

## SMOOTHING CHOKES\*

\* for general use (AVON and HENGIST series) for commercial use (SOLENT series) for services use (DELTA and GAMMA series).

with inductances  
ranging from  
100h at 10mA  
to  
50mH at 10 amps  
are fully described in the  
NEW

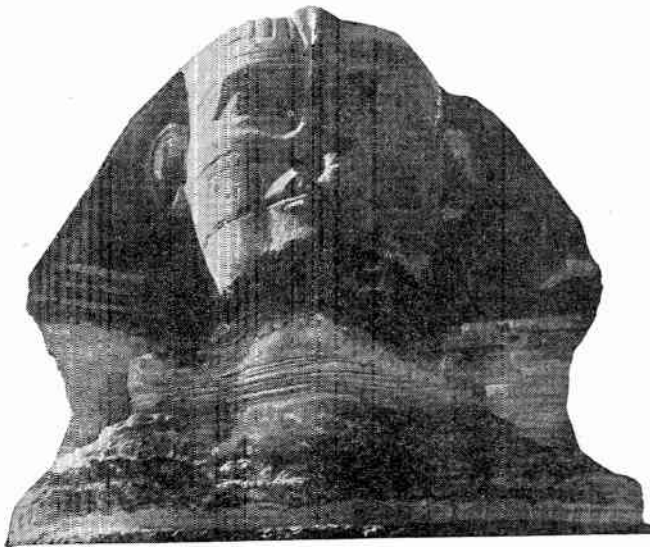
**Gardners** loose leaf catalogue

Every copy of the catalogue sent out is numbered and registered in the name of the holder to ensure it is regularly brought up to date by the supply of amendment sheets covering every addition to Gardners standard ranges.

*Catalogue available on request from:*

GARDNERS RADIO LTD., SOMERFORD, CHRISTCHURCH. Tel. 1734





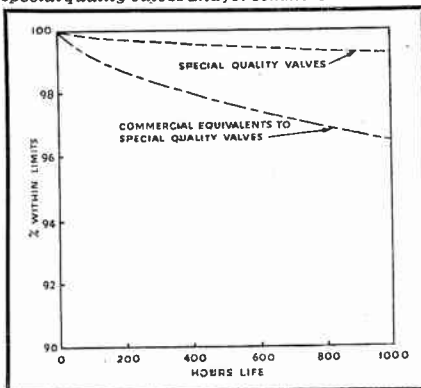
# SURVIVAL BC4000/CV4000

**TESTS PROVE M-O.V.  
SPECIAL QUALITY  
VALVES ARE  
SEVEN TIMES MORE  
RELIABLE THAN  
COMMERCIAL  
EQUIVALENTS**

In his article (given at the 4th National Symposium of Reliability and Quality Control in Electronics in New York). Mr. R. Brewer\* describes the tests carried out on M-O.V. Special Quality valves. In comparing the reliability of these Special Quality valves with that of their commercial equivalents, he states:—"the Special Quality valves are about *seven times better* than their commercial equivalents."

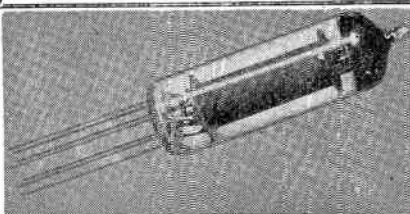
*\*Research Laboratories of the General Electric Co. Ltd., Wembley. Reprints of Mr. Brewer's article, which first appeared in the April 1958 issue of "British Communications and Electronics", are available on request from the M-O. Valve Co. Ltd.*

"Percentage within limits curves for M-O.V. special quality valves and for commercial valves."



The table shows in detail the results obtained by the comparative life-testing of special quality valves and their commercial equivalents. Of this and the vibration-fatigue test, Mr. Brewer writes:—"... tests carried out on four types of Special Quality valves have shown a high order of reliability in both types of test. The development of these valves has benefitted from the study of the causes of failures occurring in the life tests of commercial valves. This study has shown how valve assembly, processing and design faults can affect life, and it has thus provided an important feedback path by which improvements in valve reliability have been made."

"Comparison between Special Quality valves and commercial equivalents on 500-hour electrical life test."



Type references		Reliable			Commercial		
Reliable	Commercial	No. run	No. outside limits	% outside limits	No. run	No. outside limits	% outside limits
CV4005	U78	1,185	2	0.17	474	9	1.9
CV4014	Z77	1,245	4	0.32	991	22	2.2
CV4062	N78	185	2	1.1	960	22	2.3
Totals ...		2,615	8	0.31	2,425	53	2.2

**THE M-O.V. VALVE CO. LTD.**  
BROOK GREEN · HAMMERSMITH · LONDON, W.6.

A subsidiary of the



Please write for further information on the range of Special Quality valves manufactured by the M-O. Valve Co. Ltd.

# Hermetic Sealing

STEATITE & PORCELAIN  
NICKEL METALLISING

Quality Approved (Joint Service R.C.S.C.)

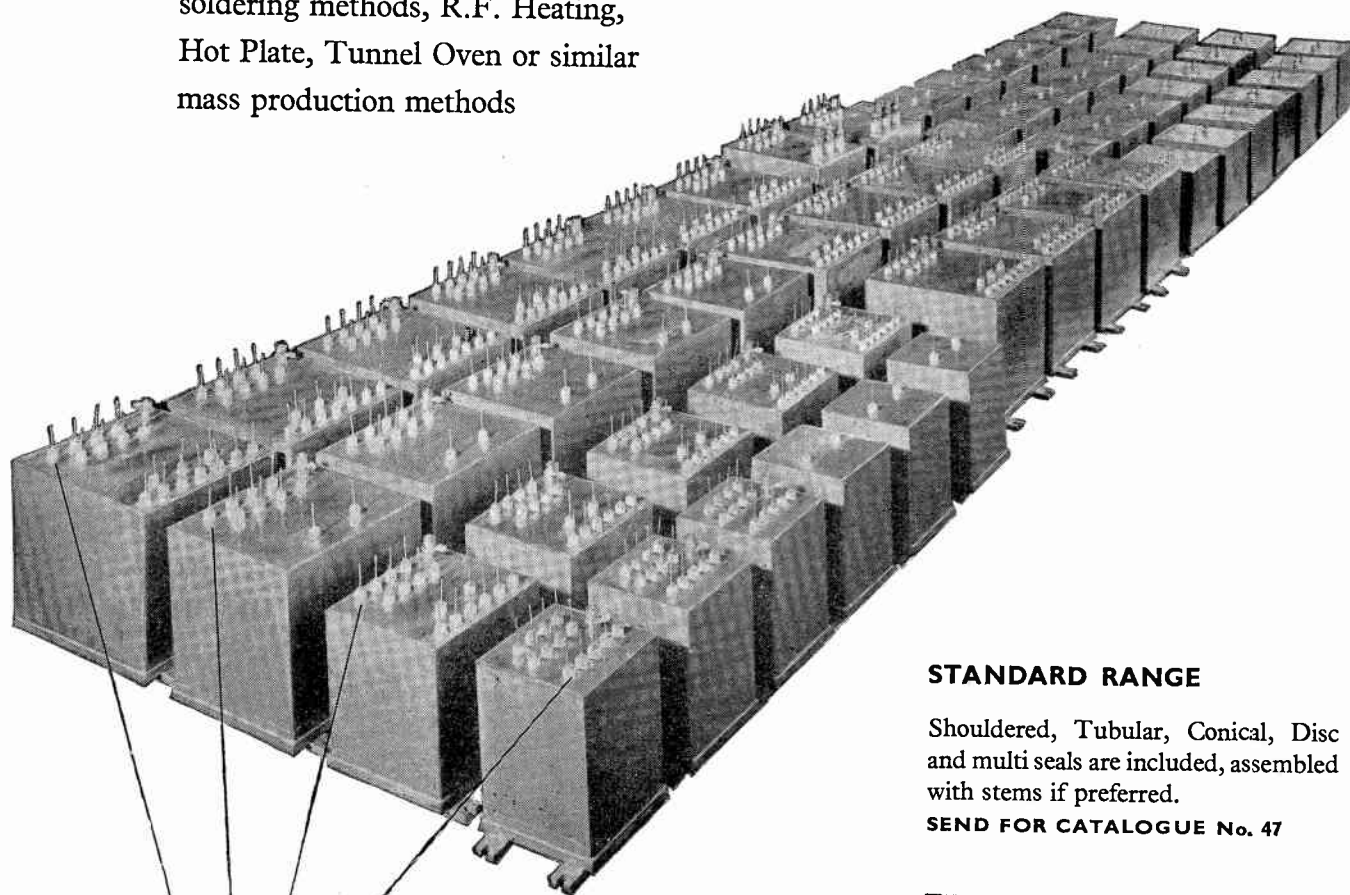
WILL MEET THE MOST EXACTING REQUIREMENTS



**METALLISED  
BUSHES**

## Perfect Terminations

—made readily without special precautions by semi-skilled labour, employing simple hand soldering methods, R.F. Heating, Hot Plate, Tunnel Oven or similar mass production methods



### STANDARD RANGE

Shouldered, Tubular, Conical, Disc and multi seals are included, assembled with stems if preferred.

SEND FOR CATALOGUE No. 47

### TECHNICAL SERVICE

Always available, do not hesitate to consult us. Samples for test will be supplied on request.

# STEATITE & PORCELAIN PRODUCTS LTD.

STOURPORT ON SEVERN, WORCS.

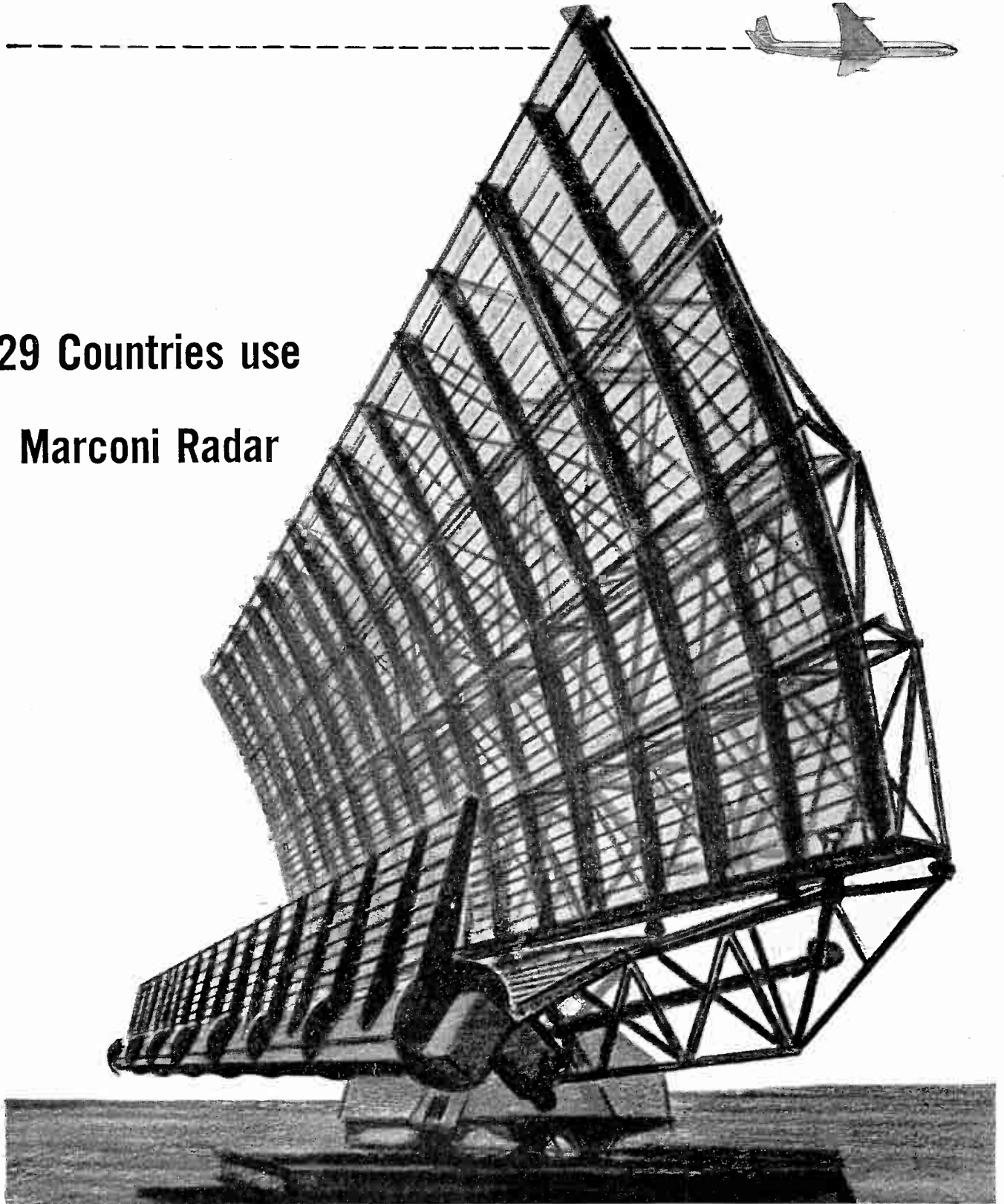
Telephone: Stourport 2271.

Telegrams: Steatoin, Stourport

# Marconi in Radar



29 Countries use  
Marconi Radar



## MARCONI

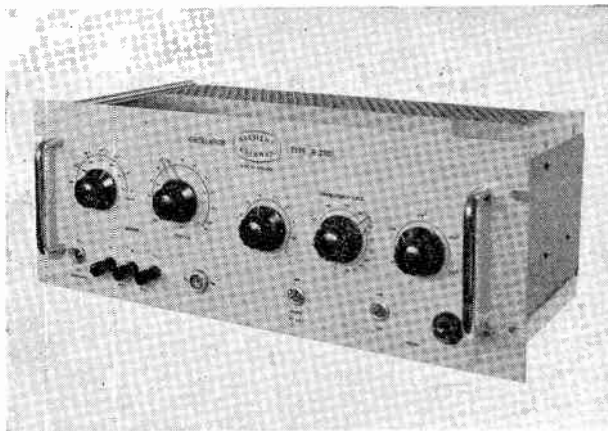
COMPLETE CIVIL AND MILITARY  
RADAR INSTALLATIONS

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

*Electronic & Radio Engineer, September 1959*

# Oscillographic recording and testing equipment from Siemens Ediswan

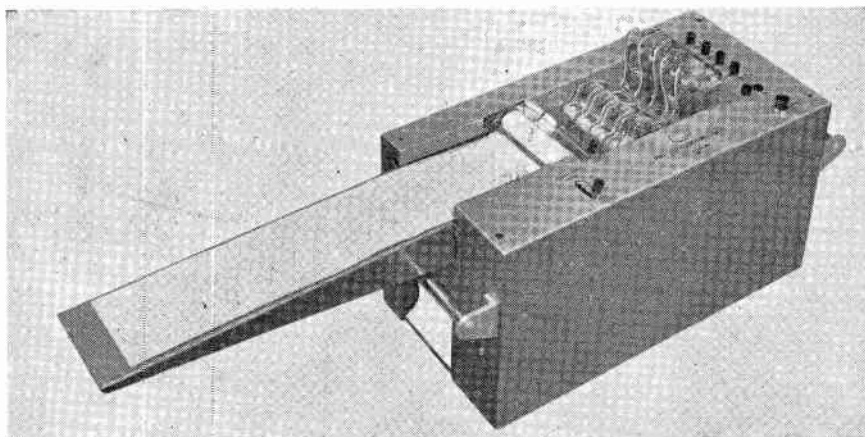
If your work involves the study of fluctuating or intermittent phenomena, you should know more about these instruments. The versatile High Speed Pen Recorder unit can be supplied singly or grouped in multiples of four up to a maximum of 16 channels and suitable amplifiers having a sensitivity of  $1\mu\text{V}/\text{mm}$  a.c. or  $10\text{ mV}/\text{mm}$  d.c. can also be supplied. These combinations are already making permanent economical records in industrial, physiological and physical research.



## LOW FREQUENCY OSCILLATOR TYPE R.2125

The Low Frequency Oscillator is a general purpose R.C. instrument designed for testing, calibrating and setting up amplifiers, recorders, and low frequency wave analysers.

Frequency Range	1 c/s to 132 Kc/s
Frequency accuracy	2%
Output	Balanced push pull, 50 volts p.p., maximum on open circuit.
Attenuator	5 x 20 dB steps plus 0—20 dB continuously variable.
Output Impedance	600 $\Omega$ —0—600 $\Omega$



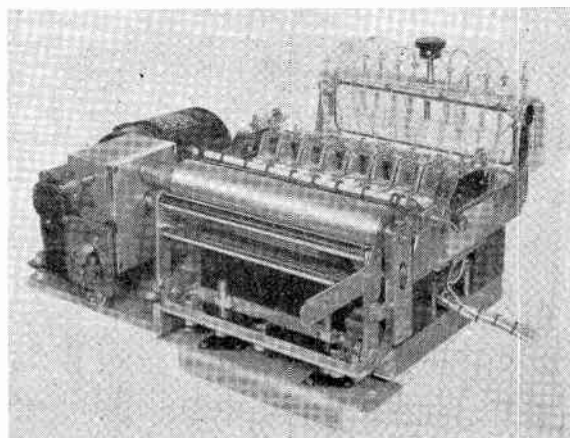
## PORTABLE RECORDER TYPE EPR

The Siemens Edison Swan pen oscillograph is a portable 1 to 4 channel, high speed, direct ink writing, recorder. The pen motor coil is 1450 ohms centre tapped. Frequency response within 10% from 0—70 c.p.s. Pen motors can be supplied with coil resistances of 230 ohms for use with transistors. Maximum deflection of pen tip 4 cms peak to peak. An electrical time and event marker is provided, writing on the lower edge of the paper. The 4" wide paper is driven by a rubber covered capstan roller and speeds of 0.75 cms/sec. to 12 cms/sec. can be obtained.

## 8 CHANNEL PEN RECORDER UNIT

The pen motors incorporated in this unit are identical to those used in the 4 channel pen oscillograph. The unit includes 8 pen motors fitted into a magnet block, two time markers, ink system and paper drive mechanism.

Three speeds of 1.5, 3 and 6 cms/sec. are available. The unit is offered as shown in the photograph and is intended for incorporation into the users own equipment. A 16 channel version of the above unit is also available.



CRC 17/19

We shall be pleased to send you particulars of these products

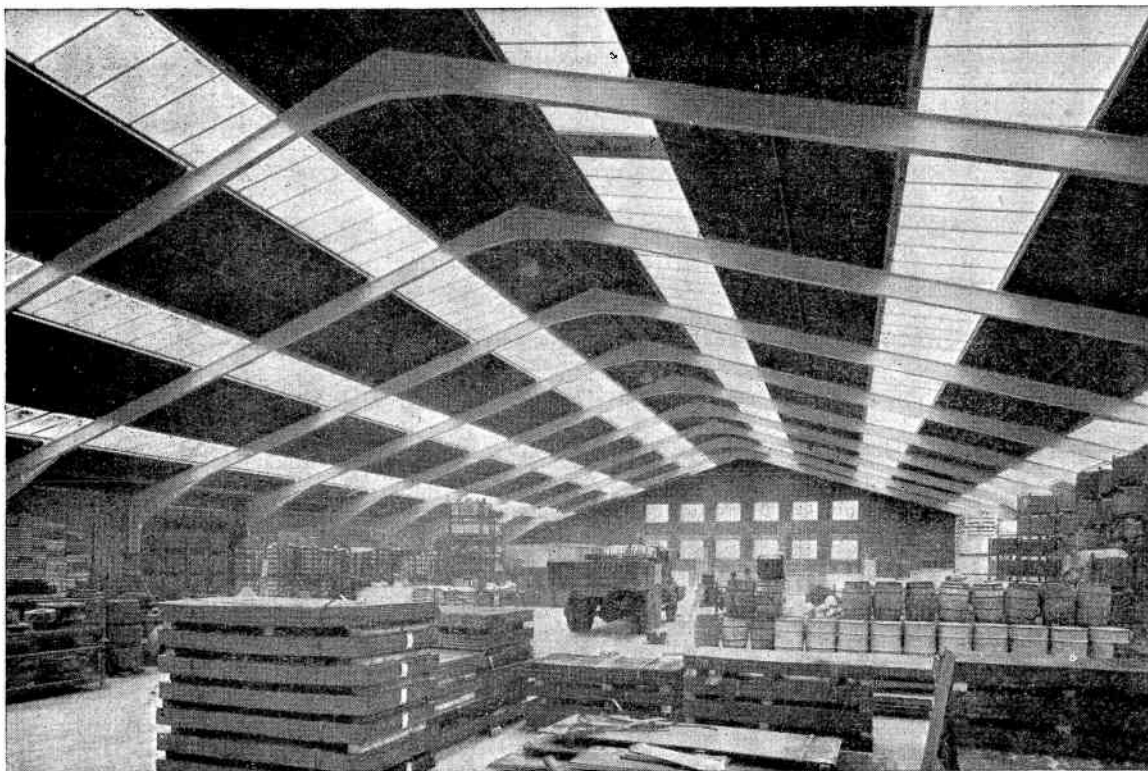


## SIEMENS EDISON SWAN LTD.

An A.E.I. Company  
 PD 17, 155 Charing Cross Road, London WC2  
 Telephone: GERrard 8660  
 Telegrams: Sieswan, Westcent, London

# CONDER CLEARSPAN

SLASHES BUILDING COSTS—OUTDATES TRADITIONAL CONSTRUCTION



Warehouse 110 ft. span, Gresham & Craven Ltd., Manchester.

Architects:- Francis Jones & Sons, Manchester.

CLEARSPAN Buildings have established a brilliant new conception of Industrial Building Design. Hitherto "Standard" type buildings have been largely confined to the "Shed" variety; and their use limited accordingly.

Now CLEARSPAN brings all the great advantages of Standard Construction to a very wide range of Industrial Buildings. CLEARSPAN sets a new standard of design and efficiency.

- Spans 25 ft. to 150 ft.
- Roof Slopes 12°-17°-22°
- Cranes 5 tons and 10 tons.
- Virtually maintenance free.

(Variations to order)

Brochure with 32 pages of facts, drawings and photographs sent on request.

CLEARSPAN BUILDINGS are used by many leading Industrial concerns including:—

Atomic Energy Commission.

British European Airways Ltd.

De Havilland Engine Co.

Esso Petroleum Co. Ltd.

Imperial Chemical Industries Ltd.

Imperial Tobacco Co. Ltd.

J. Lyons & Co. Ltd.

Ministry of Works

National Coal Board.

Shell Mex & B.P. Ltd.

Southern Electricity Board.

George Wimpey & Co. Ltd.

CONDER ENGINEERING CO LTD WINNALL WINCHESTER HANTS TEL: 5095  
CONDER ENGINEERING CO (MIDLANDS) LTD PEEL HOUSE BURTON-ON-TRENT TEL: 5411

*Miss Neasden says  
she does not know  
what a resistor is*

**Electrothermal**

*she should ask us...  
we know quite a lot  
about them*



# Wire wound resistors by



**Electrothermal**

WRITE FOR CATALOGUE No. A/330

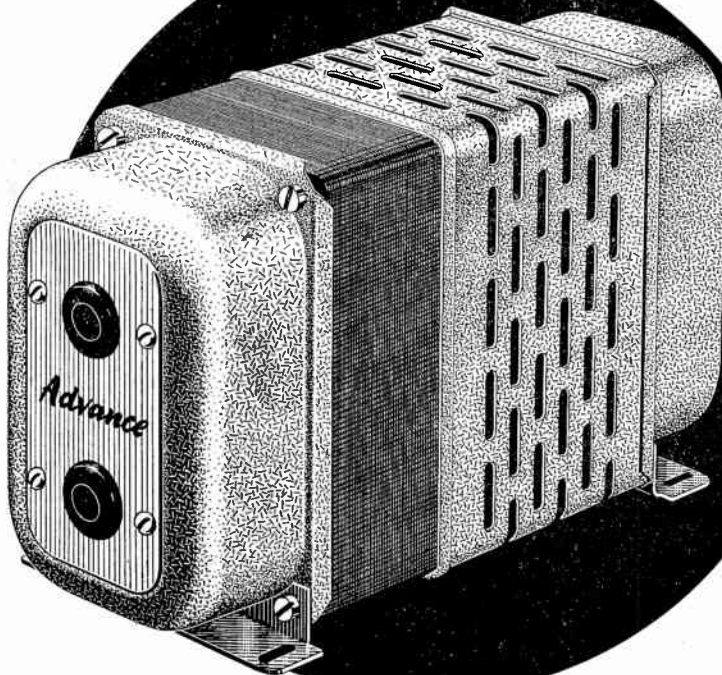
ELECTROTHERMAL ENGINEERING LTD., 270 NEVILLE ROAD, LONDON, E.7.

Telephone: GRA 9911    Telegrams: Electrotop, London

# More WATTS PER

£

lb



with the *New*

## CV SERIES

Take the best in Constant Voltage Transformer design and practice . . . maintain all those features proven by years "in the field" . . . add still greater efficiency . . . reduce size and weight . . . and then drastically cut the cost — and you have the NEW CV Series.

Models now available with output capacities of 25, 50, 75 and 100 watts and range of outputs from 6 to 240 volts — all providing assured output voltage regulation within  $\pm 1\%$  for input variations of up to  $\pm 15\%$

- WEIGHT REDUCED by over 25%
- SIZE REDUCED by over 40%
- STRAY FIELD REDUCED by over 75%
- OPERATE AT ANY LOAD from 'NO LOAD' to 'FULL LOAD'
- WILL OPERATE CONTINUOUSLY AT AMBIENT TEMPERATURES from  $-10$  to  $+50^{\circ}\text{C}$ .

# CONSTANT VOLTAGE TRANSFORMERS

*They are* **SMALLER - LIGHTER**

*and* **COST LESS!**

*Here's a typical example-*

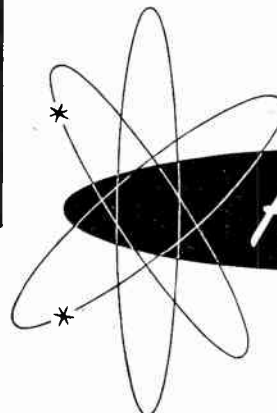
	MODEL CV.25/E	MODEL MT.281/E
Input Voltage	190-260V	190-260V
Output Voltage	6V	6V
Output Capacity	25W	25W
Dimensions	5½" x 3 1/8" x 4 1/8"	7" x 5½" x 4 1/8"
Weight	5lb	7lb
PRICE	£6.5.0	£8.0.0

Full details in Folder R-63 available on request.

**Advance** COMPONENTS LIMITED

**MAINS STABILIZATION DIVISION**

ROEBUCK ROAD • HAINAULT • ILFORD • ESSEX • TELEPHONE : HAINAULT 4444



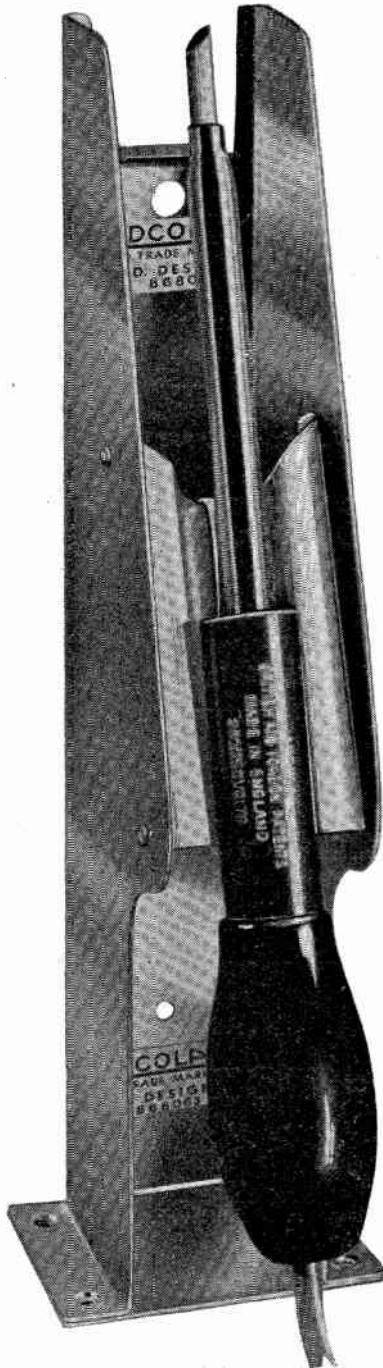
by

**Advance**

*- to be sure!*

**ADCOLA**  
(Regd. Trade Mark)

**Soldering Instruments  
and Equipment**



**Comprehensive  
Range of Models**  
**P.V.C. Cable Strippers**  
**Solder Dipping Pots**  
**Supplied in  
ALL VOLT RANGES**

**A PRODUCT  
FOR  
PRODUCTION**

**RADIO, TV  
RADAR  
ELECTRONICS  
TELECOMMUNICATIONS  
ETC.**

(Illustrated)  
**Protective Shield  
List No. 68**

**3/8" Detachable  
Bit Model  
List No. 64**

Traditional British Quality and Workmanship

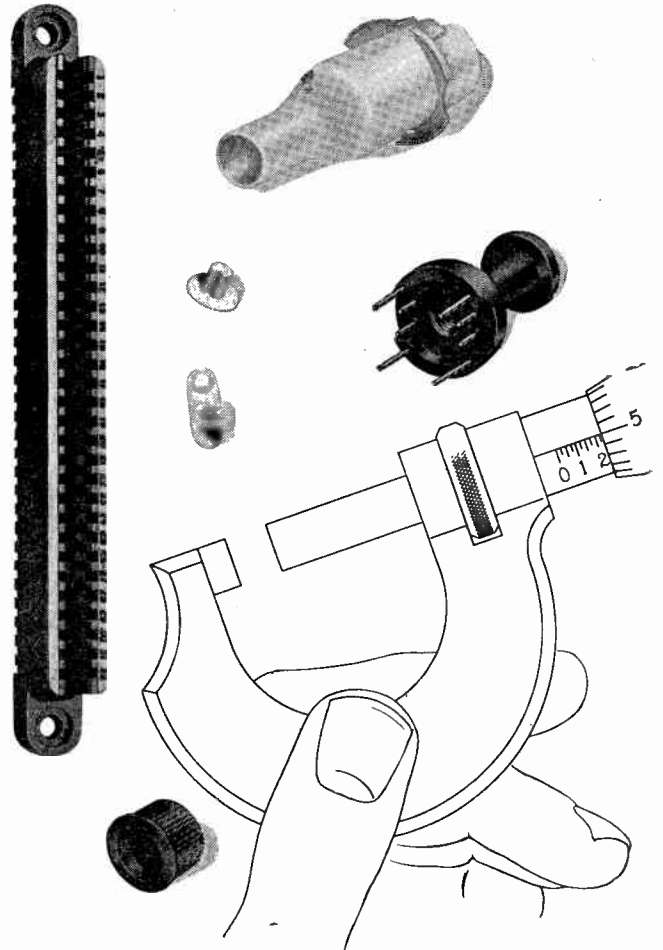
**ADCOLA PRODUCTS LIMITED**

Head Office, Sales and Service:  
**GAUDEN ROAD, CLAPHAM HIGH STREET  
LONDON, S.W.4** Telephones MACAULAY 3101 & 4272

**Where Precision  
is essential**

**MC GRATH PLASTICS  
MOULD TO FINE LIMITS  
FOR INDUSTRY**

With a team of technicians, each member being selected for his specialist knowledge and experience in the field of plastics, we are able to offer industry the best possible service in the production of mouldings, irrespective of the shape, size or complexity. Your enquiries are invited.



**MC GRATH PLASTICS LTD**  
**PRECISION MOULDERS**  
TRADING ESTATE, CHENEY MANOR SWINDON WILTS  
TELEPHONE SWINDON 6541-2



# NEW 20,000 o.p.v. ! Model '127A' TAYLORMETER

*Pocket Size*

PERFORMANCE EQUAL TO A HIGH PRICED INSTRUMENT

**OUTSTANDING FEATURES:**

- ★ Sensitivity 20,000 o.p.v. D.C., 1,000 o.p.v. A.C.
- ★ Very robust—shock-proof moulding
- ★ Portability
- ★ 20 Ranges
- ★ D.C. Current: 50 $\mu$ A, 1 mA, 10 mA, 100 mA, 1 Amp
- ★ Volts D.C.: 0-3, 2-5, 10, 25, 100, 250, 1,000 V (25 kV by probe)
- ★ Volts A.C.: 10, 25, 100, 250, 1,000
- ★ 3 Resistance Ranges: from 0-20 megohms (self-contained)
- ★ 40 $\mu$ A Meter 3 $\frac{1}{4}$ " arc.
- ★ Accuracy: D.C. 3%, A.C. 4%, Ohms 5%
- ★ Dimensions: 5 $\frac{1}{4}$ " x 3 $\frac{1}{2}$ " x 1 $\frac{1}{2}$ "
- ★ Weight: 14 oz.

TRADE PRICE **£8.10.0**

Credit Sale Terms available



Write for full details and free Catalogue  
**TAYLOR ELECTRICAL INSTRUMENTS LTD.**  
 MONTROSE AVENUE, SLOUGH, BUCKS.  
 Telephone: Slough 21381 Cables: Taylins, Slough

Member of the **M** METAL INDUSTRIES Group of Companies

accuracy  
 is essential  
 —specify

**VACROM**

(nickel-chrome)

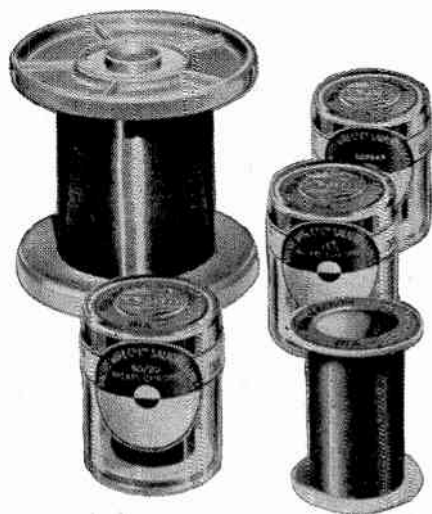
**EUREKA**

(cupro-nickel)

**resistance wires and tapes  
 for all types of resistor**

'Vacrom' and 'Eureka' are supplied fully annealed in either a bright or oxydised finish in accordance with British Standard specifications or to customers' own special requirements.

'Vacrom' and 'Eureka' resistance wires can be supplied *bare* or with *standard coverings* of cotton, silk, rayon, enamel and glass.



*insulated wires*



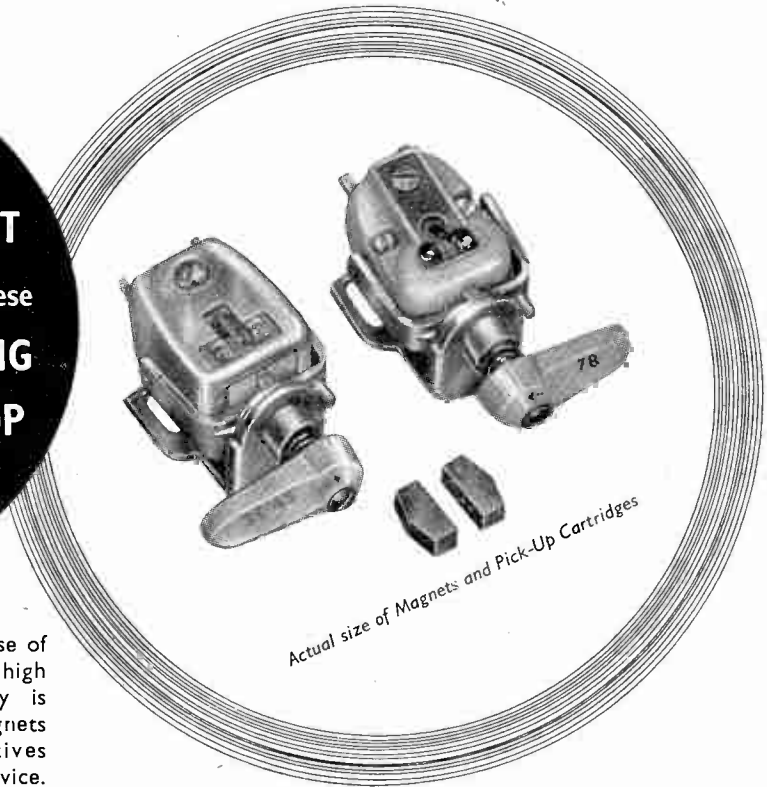
*bare wires*

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED · LEYTON · LONDON, E.10

VACTITE WIRE COMPANY LIMITED · 75 ST. SIMON STREET · SALFORD 3 · LANCS. L.VI

**MUREX**  
**SINTERED PERMANENT**  
**MAGNETS** are used in these  
two world famous **GOLDRING**  
Variable Reluctance **PICK-UP**  
**CARTRIDGES**

Another typical example of the use of Murex Sintered Magnets where high Magnetic stability and efficiency is essential. Write for Standard Magnets Booklet. Technical representatives available for consultation and advice.



Actual size of Magnets and Pick-Up Cartridges

Photograph by courtesy of Goldring Manufacturing Co. Ltd.

**MUREX LIMITED** (Powder Metallurgy Division) RAINHAM · ESSEX

Telephone: Rainham, Essex 3322. Telex 28632. Telegrams: Murex, Rainham-Dagenham Telex

LONDON SALES OFFICE: CENTRAL HOUSE, UPPER WOBURN PLACE, W.C.1. Telephone: EUSon 8265

A NEW HIGH SPEED

# OSCILLOSCOPE

MODEL 301

D.C. to 40 Mc/s.

## CATHODE RAY TUBE

Five-inch diameter flat faced with a window area of 4 x 10 cms. Total accelerating voltage applied by means of a helical system is 10 KV, resulting in a small beam spot and a trace capable of resolving fine detail.

## TIME BASE

Calibrated sweep times from 0.5 sec. to 0.1  $\mu$ sec. per cm. accurate within 2% by direct reading of time per cm. An uncalibrated fine control increases the maximum sweep time to 1.2 sec./cm. or 12 secs. for a full sweep of 10 cms. Sweep expansion x 10 reduces the minimum sweep time to 10  $\mu$ sec./cm., equivalent to a sweep speed of 1 mm. per  $m\mu$ sec. Versatile and highly efficient triggering circuitry provides both repetitive and single stroke conditions.

## Y AMPLIFIER

Band width . . . . D.C. to 40 Mc/s (-3dB)

Rise time . . . . 9  $\mu$ sec.

Sensitivity . . . . 1 cm. per 100 mV.

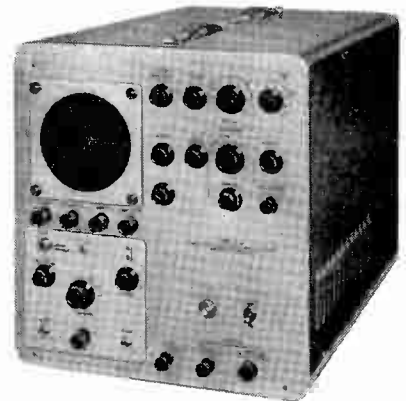
By switch control the sensitivity can be increased to 1 cm. per 10 mV over a bandwidth of 2.5 c/s to 20 Mc/s. A nine-step attenuator and a fine gain control extend the sensitivity range to approximately 1 cm. per 12 V. An RC probe is available with 10-1 reduction factor, extending the range to a minimum of 1 cm. per 120 V. A balanced signal delay is incorporated in the amplifier enabling the observation of pulse leading edges.

## VOLTAGE MEASUREMENT

A calibrator is provided giving output of 40 mV and 400 mV accurate within 2%.

## POWER SUPPLIES

Both H.T. and E.H.T. voltages are stabilised over a wide range of mains input voltage variations, and the power supplies are built into the case of the oscilloscope.



Designed around the latest type of high sensitivity cathode ray tube, this instrument provides all the essential features of a wide band oscilloscope with accurate measuring facilities and an exceptionally wide range of sweep speeds.

The aim has been to get these features incorporated in the least complicated manner, resulting in a compact, rugged and reliable design produced to the highest standard of workmanship at an economical price.



18 AVENUE ROAD · BELMONT SURREY  
TELEPHONE: VIGilant 9161-2

# From I.C.I. AMMONIA- Nitrogen and Hydrogen for Industry

I.C.I. Ammonia provides industry with a cheap and reliable source of pure nitrogen and hydrogen. And I.C.I. gas generating plants are available to convert ammonia into a wide range of nitrogen/hydrogen gas mixtures.

## **Anhydrous Ammonia**

with a guaranteed minimum purity of 99.98%, to meet more exacting requirements, is offered in bulk and in a wide range of cylinder sizes.

HYDROGEN  
NITROGEN

**Liquefied Ammonia** (*Industrial Quality*), a cheaper grade, is available in bulk and in two-ton containers for the larger consumer, and makes possible substantial economies in gas costs.

*A bulk delivery of 10 tons of ammonia provides over 1 $\frac{3}{4}$  million cu. ft of nitrogen.*

*Full information on request.*

IMPERIAL CHEMICAL INDUSTRIES LIMITED,  
LONDON, S.W.1.



BI.7

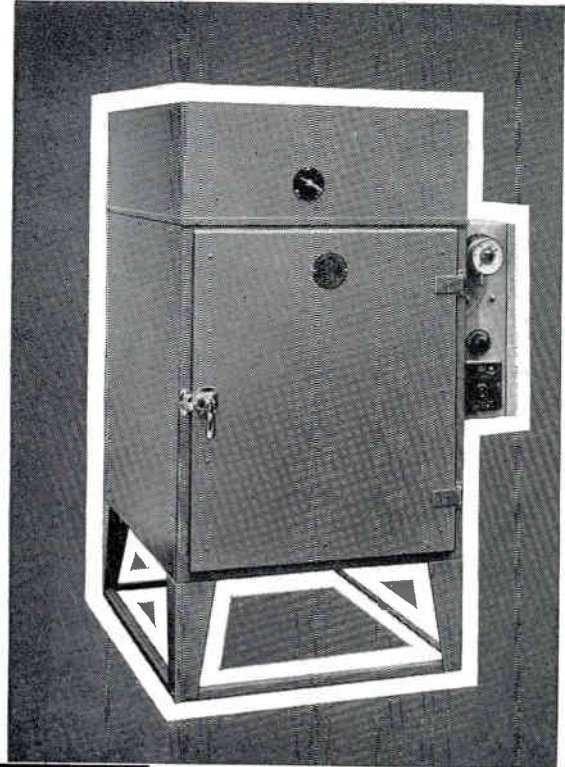
for the heat  
treatment of

## EPOXY RESINS

Epoxy resins are now employed extensively in the manufacture and assembly of many types of electric and electronic components, etc. The setting and curing of the resin may necessitate a heat treatment period which in one system is about 12 hours at 120°C, and with another is 2 minutes at 300°C. This calls for an oven giving constantly uniform heat, regulated within close temperature limits with variable control of the air exchange to the atmosphere. A.E.W. Electric Ovens fully meet this requirement. They incorporate the most advanced features of design including:

- AUTOMATIC TEMPERATURE CONTROL
- FORCED AIR CIRCULATION
- EXTRA HEAVY CHAMBER INSULATION
- VARIABLE AIR EXCHANGE TO THE ATMOSPHERE

*Where required, we build to customers' specifications. Our Technical Advisory Staff is readily available for consultation on all heat treatment problems.*



**A E W ELECTRIC OVENS**

A.E.W. LIMITED  
IMPERIAL WORKS, EDGWARE  
MIDDLESEX

Tel.: EDGware 5278.



*Be Wise*

**Price** *Wise*  
**Reliability** *Wise*  
**Delivery** *Wise*

*Contact* **ELECTRONIC COMPONENTS** \*

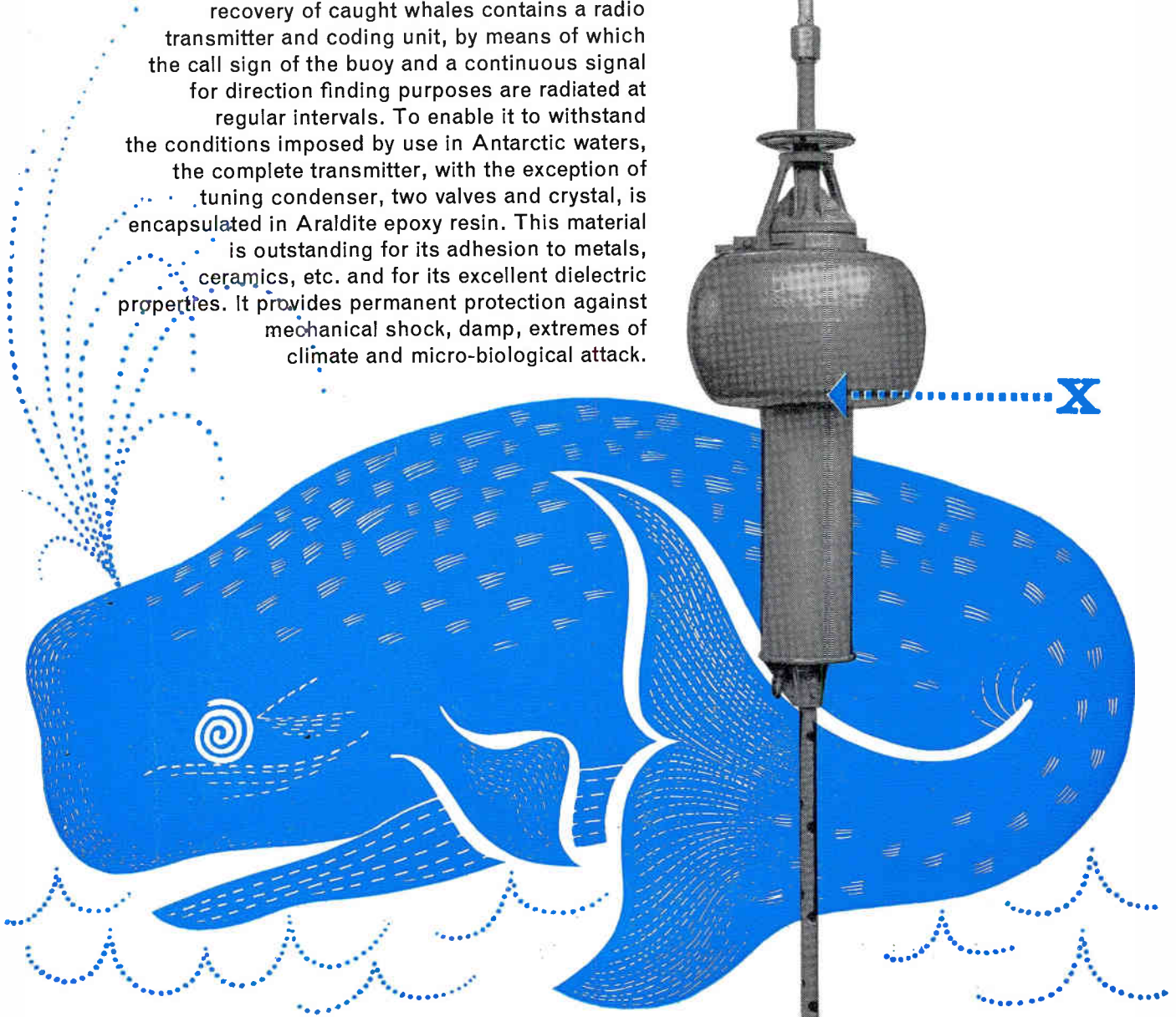


*For Plugs and Sockets, Rotary Stud Switches,  
Wire Wound Resistors,  
Printed Circuitry Connectors,  
Attenuators, Faders, etc.*

\* **ELECTRONIC COMPONENTS**  
Weedon Road Industrial Estate  
Northampton. Phone N'ton 2467 & 1873.

# X marks the spot

The Venner Electronic Marker Buoy for the recovery of caught whales contains a radio transmitter and coding unit, by means of which the call sign of the buoy and a continuous signal for direction finding purposes are radiated at regular intervals. To enable it to withstand the conditions imposed by use in Antarctic waters, the complete transmitter, with the exception of tuning condenser, two valves and crystal, is encapsulated in Araldite epoxy resin. This material is outstanding for its adhesion to metals, ceramics, etc. and for its excellent dielectric properties. It provides permanent protection against mechanical shock, damp, extremes of climate and micro-biological attack.



Araldite epoxy resins have a remarkable range of characteristics and uses.

They are used

- ★ for casting high grade solid electrical insulations
- ★ for impregnating, potting or sealing electrical windings and components
- ★ for producing glass fibre laminates

- ★ for producing patterns, models, jigs and tools
- ★ as fillers for sheet metal work
- ★ as protective coatings for metals, wood and ceramics surfaces
- ★ for bonding metals, porcelain, ceramics, etc.

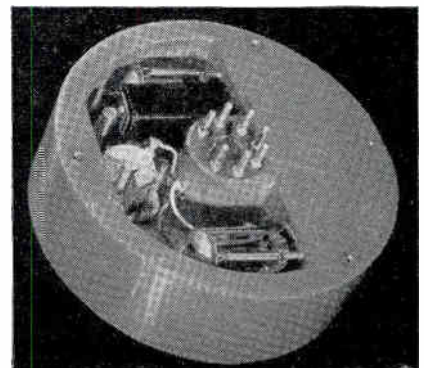
*may we send you full descriptive literature*

## Araldite

*epoxy resins*

Araldite is a registered trade name

*The photograph, showing the Venner Mark II Whaling Buoy, is reproduced by courtesy of Venner Electronics Limited*



### CIBA (A.R.L.) LIMITED

Duxford, Cambridge. Telephone: Sawston 2121

**Pulse Repetition Rate to 10 Mc!**

AMBIENT TEMPERATURE = 25° C

GAIN-BANDWIDTH PRODUCT (MC)

Curves illustrate typical delay time per stage vs. gain-bandwidth product and fonout for the switching circuit shown below.

NOTE: ALL RESISTANCE VALUES ARE IN OHMS.  
\* 8-VOLT ZENER DIODE

## WITH 3 NEW RCA **DRIFT** TRANSISTORS FOR COMPUTER APPLICATIONS!

RCA continues to pioneer superior-quality semiconductor devices with the new RCA-2N643, RCA-2N644 and RCA-2N645 "Drift" transistors. These three new units feature controlled minimum gain-bandwidth products permitting the design of extremely high-speed not-saturating switching circuits with rise, fall and propagation time in order of 20 millimicroseconds.

For your high-speed switching circuits requiring pulse repetition rates up to 10 Mc, investigate the superior design possibilities and benefits available to you with the new RCA "Drift" transistors—RCA-2N643, RCA-2N644 and RCA-2N645—hermetically sealed in cases utilizing dimensions of JEDEC TO-9 outline.

**RCA-2N643, RCA-2N644, and RCA-2N645 feature controlled minimum gain-bandwidth products of 20, 40 and 60 Mc.**

TYPE	2N643	2N644	2N645
Minimum gain-bandwidth product* Mc	20	40	60
Minimum collector** breakdown volts	30	30	30
Minimum DC current transfer ratio*	20	20	20
Maximum collector capacitance $\mu\mu\text{f}$	5	5	5

\*Collector Volts = -7, collector ma = -5  
\*\*Collector Current = 100  $\mu\text{a}$

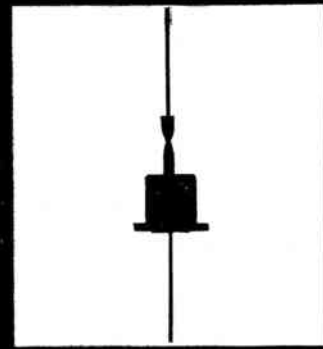
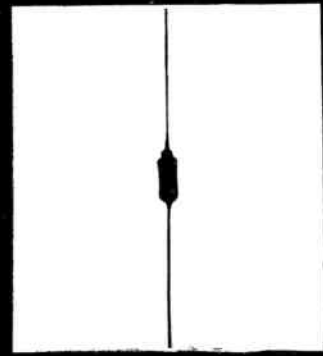


For technical data write to:  
**RCA GREAT BRITAIN LTD., ENGINEERING PRODUCTS SALES DEPARTMENT ER2**  
 (An Associate Company of Radio Corporation of America.)  
 Lincoln Way, Sunbury-on-Thames, Middlesex. Tel: Sunbury-on-Thames 3101

# SILICON RECTIFIERS

up to 600 Volts P.I.V.

3 amps



TEXAS SILICON RECTIFIERS offer excellent high temperature characteristics. For example the stud-mounted type gives an output of 3 amperes at 50°C and will still provide 1 ampere at 150°C with no change in the rated peak inverse voltage. The rugged, welded housing with glass-to-metal seal provides high resistance to shock and vibration. Listed in the table below are the

characteristics of representative devices of each type.

Have you received your copy of the latest Texas Application Report "D.C. Power Supply Circuits using Silicon Rectifiers"? If not, or if you require fuller details of Texas Rectifiers, please write your name and address in the margin and return this advertisement to us.

Symbol	1S001	1S005	1S111	1S115	1S401 1S401R	1S405 1S405R
<b>MAXIMUM RATINGS</b>						
Peak Inverse Voltage at -65°C to +150°C	PIV	200V	600V	200V	600V	200V
Average Rectified Forward Current at +50°C	$I_o$	750mA	750mA	† 400mA	† 400mA	*3A
Average Rectified Forward Current at +150°C	$I_o$	250mA	250mA	150mA	150mA	*1A
Recurrent Peak Forward Current at +50°C	$i_i$	† 2.5A	† 2.5A	† 1.25A	† 1.25A	*10A
Surge Current for 10 Milliseconds	$I_{PK}$	16A	16A	6A	6A	33A
Operating Temperature, Ambient	$T_A$	-65°C to +150°C				
<b>SPECIFICATIONS</b>						
Minimum Breakdown Voltage at +150°C	$V_z$	240V	720V	240V	720V	240V
Maximum Reverse Current at P.I.V. at +25°C	$I_{rb}$	10μA	10μA	0.2μA	0.2μA	10μA
Maximum Forward Voltage Drop at +25°C	$E_b$	1.0V	1.0V	1.0V	1.0V	1.1V
		(I <sub>o</sub> =500mA)		(I <sub>o</sub> =400mA)		(I <sub>b</sub> =1Amp)

\* Rectifier mounted on 2" x 2" x 1/8" aluminium Heat Sink

† @ 25°C

## TEXAS INSTRUMENTS LIMITED

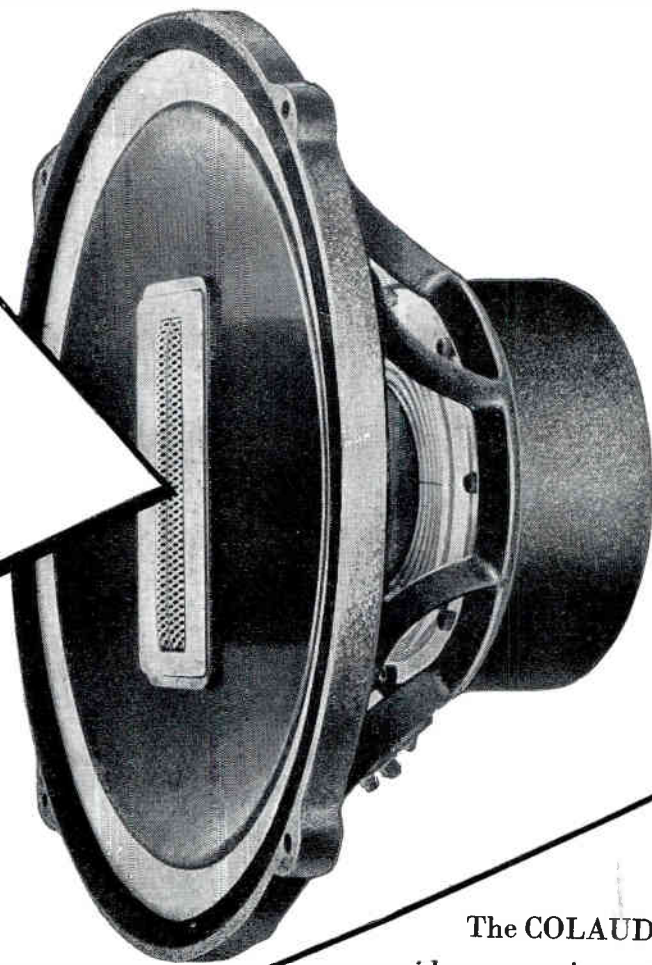
TELEPHONE: BEDFORD 68051

DALLAS ROAD BEDFORD

CABLES: TEXINLIM BEDFORD



... a new  
 approach  
 to better  
 listening



**ESSENTIAL DATA**

NOMINAL SIZE	15"
PEAK POWER HANDLING CAPACITY	25 watts.
VOICE COIL DIAMETER	3"
TOTAL FLUX	290,000 Maxwells
FREQUENCY RESPONSE	30-15,000 c/s
BASS RESONANCE	35 c/s
IMPEDANCE AT 400 c/s	15 ohms.

**CELESTION**

The COLAUDIO provides a new incentive to listening, creates a new realism in reproduced sound, adds a new beauty to music and the finer nuances of speech. Combining a 15 in. direct radiator bass loudspeaker with two direct radiator, pressure-type high frequency reproducers in column form, the COLAUDIO is the culmination of over thirty years research, development and manufacture of loudspeakers for all purposes. Its perfection of tone can be truly appreciated only by an aural test—once heard, you will never be satisfied until you instal one in your own reproducing equipment

**COLAUDIO**

Rola Celestion Ltd. THAMES DITTON, SURREY, ENGLAND.

Telephone: Emberbrook 3402/6



**OPERATIONAL RELIABILITY**



**EDDYSTONE**

**VHF & UHF  
(AM & FM)  
Communications  
Receivers**

**Model 77OR.  
19-165 Mc/s.**

**Model 77OU.  
150-500 Mc/s.**

*Agents in all parts of the world*

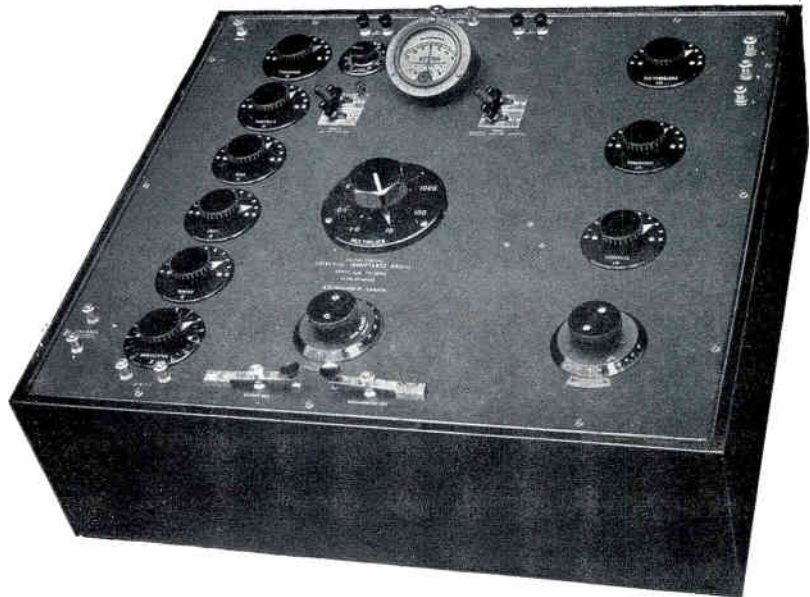
*Please write for full Technical Specifications to the Manufacturers*

**STRATTON & CO. LTD., BIRMINGHAM, 31**

## INDUCTANCE MEASUREMENT

One of the most outstanding technical developments of  
**H. W. Sullivan Limited**  
is the Sullivan and Griffiths Precision Inductance Bridge.

Its range 1  $\mu$ H to 100H; its direct reading accuracy 0.1% or 0.1  $\mu$ H (quite unaffected by temperature and having good frequency characteristics) and facilities—provided for the direct reading measurement of resistance 0.01 ohm to 10 Megohms, capacitance 10  $\mu\mu$ F to 1  $\mu$ F and the inductance and losses of iron-cored inductances with superposed direct current up to 2 amperes . . . make this bridge invaluable to any factory or laboratory concerned with inductance measurement. By using substitution methods, an accuracy of 0.01% is obtained.



Immediate delivery from stock.

An advertisement of H. W. Sullivan Limited, London, S.E.15. Telephone: New Cross 3225 (Private Branch Exchange).

# **ELECTRONIC & RADIO ENGINEER**

*incorporating WIRELESS ENGINEER*

HUGH S. POCOCK M.I.E.E. *Managing Editor*  
W. T. COCKING M.I.E.E. *Editor*

## *Editorial Advisory Board*

H. E. M. BARLOW B.Sc. (Eng.), Ph.D. (Science), M.I.E.E., M.I.Mech.E. (*Pender Professor of Electrical Engineering, University College, London*);  
E. B. MOULLIN M.A., Sc.D., M.I.E.E. (*Professor of Electrical Engineering, University of Cambridge*); A. H. MUMFORD O.B.E., B.Sc. (Eng.), M.I.E.E.  
(*G.P.O. Engineering Department*); A. R. A. RENDALL O.B.E. Ph.D., B.Sc., M.I.E.E. (*British Broadcasting Corporation*); R. L. SMITH-ROSE C.B.E.,  
D.Sc., Ph.D., M.I.E.E. (*Department of Scientific and Industrial Research*).

## **C O N T E N T S** VOLUME 36 NUMBER 9 SEPTEMBER 1959

Parametron	319	Editorial
Magnetic Tape Recording	320	by L. H. Bedford, C.B.E., M.A.
Linear Amplifier for Decimicrosecond Pulses	323	by J. F. Golding and L. G. White
The Fringe of the Field	328	by Quantum
Electromagnetic Wave Problems	332	by J. D. Lawson
Super-Gain Aerial Beam	338	by R. F. Kyle
Transistor High-Frequency Parameter $f_1$	341	by L. G. Cripps, B.A.
Mathematical Tools	347	by Computer
Coaxial Cable Performance	349	by W. A. Cameron, B.Sc.
Correspondence	352	
New Books	353	
Standard-Frequency Transmissions	355	
New Products	356	
Abstracts and References	A137-A154	

**Established 1923**

**Published on the fifth of each month**

### ANNUAL SUBSCRIPTION

(including Annual Index to Abstracts and References)  
Home and Overseas £2 9s 0d Canada and U.S.A. \$7.50  
Second-class mail privileges authorized  
at New York, N.Y.

© Iliffe & Sons Ltd. 1959

Permission in writing from the Editor must first be  
obtained before letterpress or illustrations are reproduced  
from this journal.

Brief abstracts or comments are allowed provided  
acknowledgement to the journal is given.

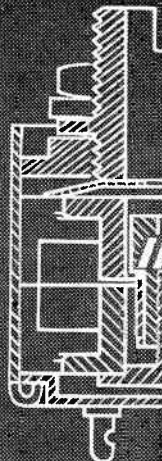
**Published by**

ILIFFE & SONS LTD. DORSET HOUSE STAMFORD STREET LONDON S.E.1  
Telephone · Waterloo 3333 Telegrams · Wirenger, Sedist, London

### Branch Offices

COVENTRY · 8-10 Corporation Street—Telephone · Coventry 25210; BIRMINGHAM · King Edward House, New Street, 2—Telephone · Midland 7191  
MANCHESTER · 260 Deansgate, 3—Telephone · Blackfriars 4412 and Deansgate 3595; GLASGOW · 26b Renfield Street, C.2—Telephone · Central 1265

**A NEW CONCEPT**



**IN POT CORE DESIGN**

**Mullard**

**VINKOR**

**range of**

**adjustable pot cores gives you**

***outstanding***

**advantages**

- Wide range of sizes
- Easily assembled
- Close tolerance permeability
- Precise and easy inductance adjustment
- Stability
- Single hole chassis mounting

Mullard Vinkors are the most efficient adjustable pot core assemblies commercially available. In addition to high performance, they have the distinct advantage of close tolerance permeability, thus enabling designers to precalculate to within  $\pm 3\%$  the inductance of the core when wound. Final adjustment, taking into account normal capacitor tolerance, can be easily effected to an accuracy of better than 0.02%, by means of a simple self-locking device built into the core.

Write today for full details of the wide range of Vinkors currently available.

# Mullard

**VINKOR POT CORES**



MULLARD LIMITED · COMPONENT DIVISION · MULLARD HOUSE · TORRINGTON PLACE · LONDON W.C.1  
MC280

# **ELECTRONIC & RADIO ENGINEER**

VOLUME 36 NUMBER 9

SEPTEMBER 1959 *incorporating WIRELESS ENGINEER*

## **Parametron**

**I**N our field, strange new words crop up almost daily and few people will be startled by this one. Some may guess that it is a device operating on the principle of the parametric amplifier, and they will be right.

Basically, the parametron is a resonant circuit in which either the inductance or capacitance varies periodically. When an exciting current of a certain frequency is applied to the inductance, say, an oscillation of one-half the frequency builds up in the circuit and this oscillation has one of two possible phase relations with the exciting current. These two phases can be used to represent 0 or 1 binary digits and so the parametron finds application in computers.

It appears to be widely used in this way in Japan and the parametrons employed have ferrite cores to furnish non-linear inductances. Exciting frequencies up to 6 Mc/s are used. Logical operations can be carried out and binary counters, adders and multipliers obtained without the use of valves or transistors. Even diodes are said to be unnecessary, since limiting effects are obtained by core saturation.

Quite an extensive literature on the subject exists, going back to 1954, and mainly in the *Journal of the Institute of Electrical Communication Engineers of Japan*. A recent article in *Control Engineering* (April 1959) gives a good deal of general information on the subject.

Devices of the type described do not appear to be electronic at all, any more than a magnetic-core memory is electronic. Parametric principles are being applied, however, with the capacitance of junction diodes as non-linear capacitance elements, and these are certainly electronic. It is rather uncertain whether or not these devices should be called parametrons. We ourselves think not and suggest that the term be reserved for non-electronic elements.

Is it being pedantic to point out that parametric, which is actually used in the sense of 'variable parameter', is really quite the wrong word? A parameter is a quantity which is constant in the case being considered, but which may vary in different cases. Inductance, capacitance and resistance are all parameters of a circuit; more strictly, they are parameters in the describing equation. As soon as one of them is made a variable, surely it ceases to be a parameter!

# Magnetic Tape Recording

HOW IS TAPE MAGNETIZED?

By L. H. Bedford, C.B.E. M.A.\*

In view of the highly developed state of the tape-recording art and of the existence of a number of advanced analytical papers on the subject, the writer has been puzzled for some years by the apparent absence of a clear and convincing account of the basic mechanism of the process. That such is indeed the position is confirmed by the fact that much questioning on the subject has invariably produced a negative answer and, further, by the following quotation from a recent comprehensive account of the subject<sup>1</sup>:

"Three interpretations of the mechanism of h.f. bias have been given. Either through a suspicion of over-simplification or through unavoidable complication none is thought to be completely satisfactory". The writer would go further by saying that all are highly unsatisfactory.

This state of affairs is somewhat surprising in view of the fact that the introduction of the h.f. bias method was the 'break-through' on which the useful development of magnetic recording is based.

The situation is somewhat analogous to that in television in which the break-through occurred with the introduction of the storage camera tube, the Iconoscope, by Zworykin. The mechanism of the Iconoscope, however, proved to be quite different from what Zworykin imagined when he first conceived this epoch-making tube. Similarly, in the case of magnetic recording, the writer suspects that the h.f. bias method was tried out on the basis of a loose or inaccurate theory, and that its immediate success caused practical application to go ahead on an empirical basis, and to hell with the theory.

Some two years ago the writer, in desperation,

formulated for his own use a half-baked theory of the recording process. Recently the baking operation has been continued to a stage where, although incomplete, the theory seems to offer a sufficiently coherent picture to be worth presenting. It is accordingly given below but, as the conclusions are rather striking, it may be desirable to state these in advance:

## Conclusions

1. What is fundamentally written on the tape is a distorted version of the *bias waveform*, consisting of alternately polarized quarter-cycles of *constant magnetization* separated by quarter-cycles of transition.
2. In the case of saturation bias, a possible but unusual condition, the *signal* is written as a variation of the mark : space ratio of this distorted bias waveform.
3. In the case of normal bias, the above mechanism also applies, but to it is added a variation in the relative magnitudes of opposite quarter cycles of constant magnetization.

## Axiom

*Recording takes Place at the Trailing Edge of the Recording Gap.*

This is to say that the length of the recording gap is not of primary importance; it is possible to write a pattern whose wavelength relative to the length of the recording gap is indefinitely short. This means in particular that the bias frequency is recorded on the tape in toto though subject to attenuation in the permanent record by the mechanism of 'self-demagnetization of short magnets'. [Daniel<sup>2</sup>, has shown

that this attenuation does not increase indefinitely with reduction of wavelength but reaches a saturation value, which for practical tape constants may amount to about 8 dB.]

## Theory

Fig. 1 (a) represents an arbitrary hysteresis loop for the magnetic material of the tape. It is slightly non-standard in that the ordinate plotted is 'intensity of magnetization'  $J$ , rather than the usual 'flux density'  $B$ .

Consider now what is the distribution of residual magnetization  $J_r$ , which results when the tape is drawn uniformly across a recording gap applying

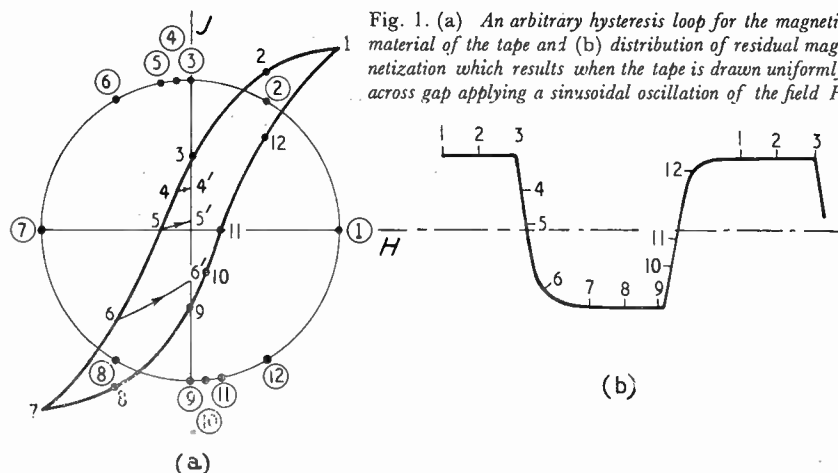


Fig. 1. (a) An arbitrary hysteresis loop for the magnetic material of the tape and (b) distribution of residual magnetization which results when the tape is drawn uniformly across gap applying a sinusoidal oscillation of the field  $H$

\* English Electric Aviation Ltd.

a sinusoidal oscillation of the field  $H$ . The frequency of this oscillation is not important, but to fix our ideas let us suppose that this frequency is the bias frequency, whose wavelength on the tape is small compared to the gap length. Then any one element of tape finds itself cycled round the hysteresis loop some finite number of times during its passage through the gap until it arrives at the trailing edge where the field collapses abruptly from its current value to zero. (We here discount fringing effects.)

Points 1-12 have been numbered round the hysteresis loop and we consider the value of  $J_r$  corresponding to the collapse of the field to zero from each of these points in turn. Consider the conditions corresponding to point 1, that is to say the state of affairs for an element which arrives at the trailing edge when  $H$  is a maximum. The residual condition of the tape thereafter is that corresponding to point 3. The same applies to any point 2 intermediate between 1 and 3. It follows that the whole of this quarter cycle writes as *constant intensity of magnetization*, the remanence corresponding to  $H_{max}$ .

The next quarter cycle is more difficult to analyse because we do not know to what values of remanent magnetization the points 4, 5 and 6 collapse. They are arbitrarily shown as the points 4', 5' and 6'.

The following two quarter cycles are repeats of the above in mirror image.

This figure allows us to plot the distribution of residual magnetization. For clarity, we introduce a circle whose radius describes  $H$  in vector fashion, and points (1) to (12) on the circle correspond to points 1 to 12 on the hysteresis loop. The distribution pattern then follows as Fig. 1(b). [The careful drawing out of this waveform is recommended as far more instructive than any amount of reading!]

As already remarked, the frequency is not of primary importance. If we regard it as signal frequency then the nature of the distortion revealed by Fig. 1(b) would indicate the uselessness of any attempt at direct (unbiased) recording. Note that the main feature of this distortion, namely the quarter-cycle flats, is quite unavoidable.

Now turn attention to Fig. 2, in which we regard the oscillation of  $H$  as occurring at bias frequency, and consider the effect of superposing a *signal* of relatively low amplitude and frequency—in fact we consider a d.c. signal. To simplify the discussion, and also to bring out the point that this is a perfectly possible mode of operation, we also consider initially the case of saturation bias; i.e., a bias amplitude sufficient to take the tape material well into saturation.

Again, points 1-12 are numbered around the hysteresis loop and again the circle indicates the magnetizing

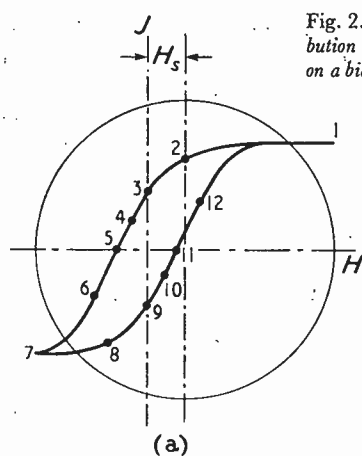


Fig. 2. (a) An arbitrary hysteresis loop and (b) resulting distribution of residual magnetization when a d.c. signal is superposed on a bias signal which is of sufficient amplitude to saturate the tape

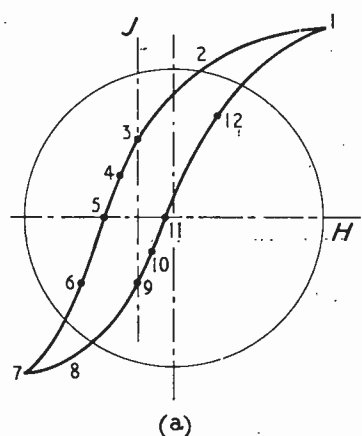
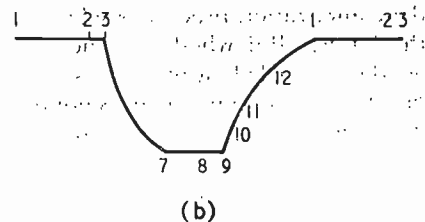
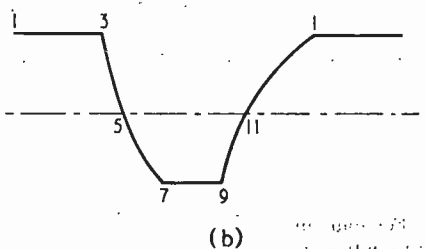


Fig. 3. (a) An arbitrary hysteresis loop and (b) resulting distribution of residual magnetization when a d.c. signal is superposed on a normal bias signal



field in vector fashion. The centre of the circle is now off-set from the zero of  $H$  by the amount  $H_s$ , the d.c. signal field.

Fig. 2(b) plots the resultant distribution of remanent magnetization. Note now that the regions of opposite constant magnetization are now of unequal length. The waveform thus contains a d.c. component of remanent magnetization. Thus it is that the signal is written in a form which is most conveniently described as a variation of mark : space ratio.

Finally, in Fig. 3, we revert to the bias conditions relevant to Fig. 1 and indicate the effect of superposing a d.c. field  $H_s$ . It is clear that we now have two effects :

- (a) The unequal mark : space ratio as before, and
- (b) A difference of magnitude of the opposite values of constant magnetization.

Both effects co-operate to produce a d.c. signal component in the written waveform.

At this stage, it may be well to introduce a distinction between the terms 'written' and 'recorded'. By the former we mean the state of magnetization occurring immediately after the geometrical and magnetic discontinuity at the trailing edge; by the latter, whatever magnetization may finally result after any self-demagnetization has occurred.

It has already been indicated that vanishingly short magnets; e.g., of  $\frac{1}{4}$  bias-wavelength, may be expected to decay in magnetization to the extent of some 8 dB.

What is not clear is whether or not the long-signal wavelengths are exempt from such decay; in other words, whether it is legitimate to resolve the written magnetization into a low-frequency component and bias-frequency components, and to consider the demagnetization process as selective to the detriment of the latter. But whether or not the signal components of the recorded waveform survive better than the bias-frequency components is not of ultimate importance since the latter are subsequently lost in the reproducing system in at least two other ways. First they are attenuated by the usual 'aperture effect' of the reproducing gap, which is several bias wavelengths long. Secondly, bias frequencies are well attenuated in the normal audio circuits of the reproducing amplifier.

In a very simplified experimental approach, whose unexpected results gave rise to the above theory, the writer examined the waveform resulting from a low-frequency sinusoidal signal without bias. The immediate and striking observation was that the waveform changed very little in *shape* over a wide range of amplitudes. 'Flats' on the waveform were a prominent feature and these retained a constant proportion of the cycle with increase of amplitude. However, in other respects, the actual waveform differed markedly from what is

predicted above. The discrepancy can be explained by assuming a phase error in the reproducing amplifier, this being compensated only for amplitude. Alternatively, the discrepancy may turn on the fact that the recording gap is short compared to the audio wavelength so that the tape elements are not subject to their normal cycling exercise<sup>3</sup>.

The above theory is aimed at clarifying the basic process of recording, and does not cover the more subtle points. Further, it has the following shortcomings:

1. Although it renders plausible the linear amplitude characteristic of a biased recording, it does not give a quantitative treatment of this.

2. Fringing effects, which may have serious repercussions, are ignored.

3. It is still not impossible that some minority effect (such for example as fringing) may over-ride the mechanism here described.

If the above theory has any value this may rest less on either novelty or mode of expression than on the fact that it is expressed at all.

#### REFERENCES

- <sup>1</sup> H. G. M. Spratt, "Magnetic Tape Recording", Heywood & Co. Ltd., 1958.
- <sup>2</sup> E. D. Daniel, *Proc. Instn elect. Engrs*, Pt. III, 1953, Vol. 100, p. 108.
- <sup>3</sup> P. E. Axon, *Proc. Instn elect. Engrs*, Pt. III, 1952, Vol. 99, p. 109.

### MOTION PICTURE FACSIMILE EQUIPMENT

For some months the B.B.C. has been using a special system for transmitting brief television news-picture sequences and other short television films over a circuit of the transatlantic telephone cable normally used for sound.

Developed by the B.B.C. Engineering Division, the process employs a slow-speed flying-spot film scanner, the video signal from which is used to modulate a carrier for transmission over the cable. At the receiving end the signals are demodulated and used to operate a slow-speed film telerecording equipment.

Transmission is over a normal cable which has a nominal bandwidth of 6.4 kc/s but, in order to limit the variation in the group delay/frequency characteristic to a value which can be corrected, it is necessary to restrict the usable video bandwidth to 4.5 kc/s. It has therefore been necessary to effect as many economies in the bandwidth of the video signal as are compatible with acceptable picture quality. These economies are: restriction of the horizontal definition to that corresponding with a bandwidth of 1.75 Mc/s in the 405-line system; a reduction to 200 lines using sequential scanning, and the scanning at the transmitting end of only alternate film frames with each frame-scan reproduced on two adjacent film frames at the receiving end.

These measures result in reducing the 3-Mc/s bandwidth of the British system to approximately 450 kc/s, the remainder of the bandwidth reduction is obtained by decreasing the scanning speed until the maximum video frequency corresponds with the available 4.5-kc/s upper limit. The time required to scan the film is approximately 100 times the normal and thus a half-minute news flash takes approximately 50 minutes to transmit.

The effective picture repetition frequency of  $12\frac{1}{2}$  per second results in satisfactory reproduction of most material excepting that in which rapid movement occurs.

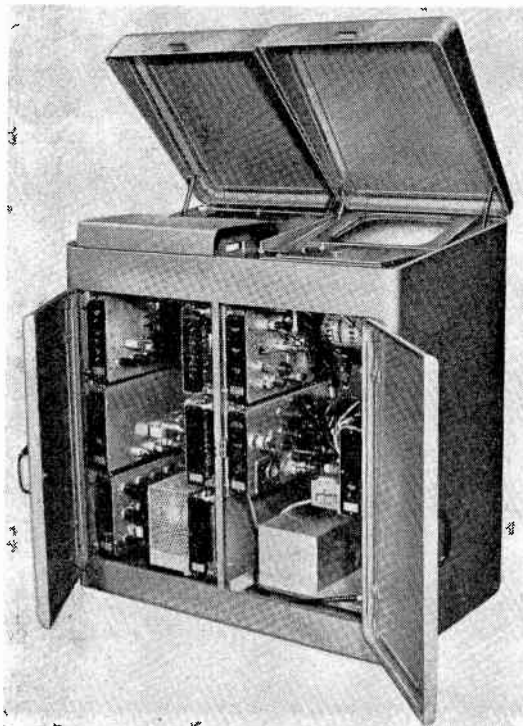
Vestigial-sideband transmission is used with a special form of negative-going amplitude modulation. The carrier frequency is 5 kc/s and the whole of the lower sideband is transmitted, the vestige of the upper sideband extending from 5 kc/s to 5.5 kc/s.

A special form of modulation has been used in which the maximum depth of modulation considerably exceeds 100%. This method results in an increase in the effective depth of modulation and thus also in the signal-to-noise ratio of the system—a necessary improvement, particularly as volume-range compressors and expanders are not used.

In order to achieve the synchronous detection needed, a regenerated carrier at the receiving terminal is used and is locked in phase to the original transmitted carrier.

The full amplitude of the video signal is used for the triggering edge of the synchronizing signal. The full synchronization signal consists of four similar pulses and protection is provided against these pulses interfering with the bursts of reference carrier which are used for oscillator locking.

*Film-scanning equipment with doors open to show the electronic apparatus*





# Linear Amplifier for Decimicrosecond Pulses

By J. F. Golding\* and L. G. White\*

**SUMMARY.** This article deals with a novel linear amplifier for pulse signals where rise times of the order of 0.1 microsecond are required into fairly large capacitive loads. The conventional method of amplifying such pulses is by the use of low value anode load resistors or by the application of negative feedback to obtain the required bandwidth. In the system described, the bandwidth is increased by increasing the output power of the amplifier for the duration of the leading and trailing edges of the pulse.

The conventional methods of designing pulse amplifiers devolve upon the analysis of a step function into its constituent frequency components; the amplifier is then designed to have a frequency response of such a form as to produce minimal degradation of the pulse shape. The aspects of the design of such amplifiers have been dealt with very comprehensively by Brockelsby and others<sup>1,2,3,4</sup>. The amplifier described in this article, however, was devised after considering its action from a rather different viewpoint.

In any amplifier intended for use with pulse waveforms the limit to the steepness of the edges of the output pulse is imposed by the charging time of the output capacitance. This charging time can be reduced by making the source impedance of the amplifier (when regarded as a voltage generator) as low as possible. And this is normally done either by the application of negative feedback or by the reduction of the value of the anode load resistor.

A brief quantitative analysis of the behaviour of a simple amplifier may be illuminating as an introduction to the line of reasoning adopted by the authors. Fig. 1(a) shows a typical pentode output stage with the stray output capacitance  $C$  indicated by dotted lines. The equivalent circuit of this amplifier is shown in Fig. 1(b).

The valve is regarded as a constant-current generator in which  $I$  is equal to  $g_{me}e_g$ . Now, if  $e_g$  takes the form of an instantaneous step function, the voltage developed across the load will be equal to  $RI$  only after the capacitance  $C$  has fully charged; that is to say, when the charging current has dropped to zero. Theoretically, of course, the capacitor takes infinite time to charge completely; but it will charge to a given proportion of the final output voltage in the time  $t$  given by

$$t = CR \cdot \log_e (I/i_c) \quad \dots \quad (1)$$

where  $I$  is the output current of the valve,  $i_c$  is the instantaneous charging current.

If the time of rise is to 90% of the pulse height, time  $t$  is given by

$$t = CR \log_e (I/0.1I) = 2.3026CR \quad \dots \quad (2)$$

Now,  $C$  is determined by the stray capacitance. So, in order to achieve a specified time of rise,  $R$  must be adjusted accordingly. If, then, a particular pulse

height is required, the necessary current will be given by  $V/R$ ; where  $V$  is the required pulse height.

Apart from the large valve required to handle this current, the total current drawn from the power supply becomes uneconomically high. Furthermore, it can be reasoned from the above argument that the rise time of the output pulse is inversely proportional to the

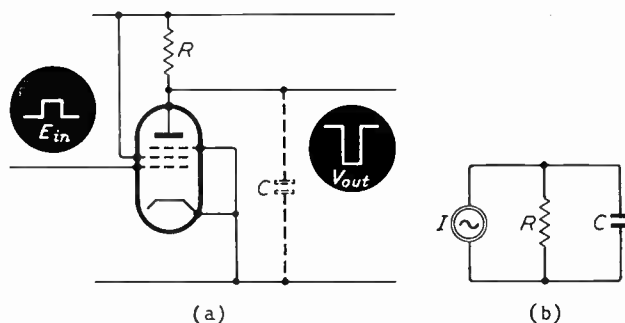


Fig. 1. (a) Typical pentode output stage; (b) equivalent circuit regarding the valve as a constant-current generator having negligible shunt conductance

available output current from the valve regardless of any conventional means of achieving wide frequency bandwidth, such as negative feedback.

As an example, consider an amplifier for supplying a 100-volt pulse to a capacitive load which, together with circuit strays, amounts to 100 pF. And let us suppose that a rise time of 0.1  $\mu$ sec. is required.

From (2) we can calculate  $R$ .

$$R = t/2.3026C = 10^{-7}/(2.3026 \times 10^{-10}) = 460 \Omega.$$

Therefore, for 100 volts pulse height

$$I = 100/460 = 0.2176 \text{ A.}$$

If the amplifier is to handle positive and negative-going pulses, the valve must be operated under class A conditions, and this implies a standing anode current of the order of half an amp.

The difficulty can be overcome by the use of a separate valve which supplies the charging current for the output capacitance. Such an arrangement is shown in Fig. 2. Valve  $V_1$  is the pulse amplifier. The total capacitance shunting the output is represented by capacitor  $C_s$ , shown dotted. The current in the shunt capacitance is sampled by inserting a low-value resistor in series with part of it. This is done by means of the

\* Marconi Instruments Ltd., St. Albans, Herts.

network  $C_1$  and  $R_1$ , where the capacitance of  $C_1$  actually forms part of the shunt capacitance. Providing the time constant of this network is small compared with the rise time of the output pulse, the instantaneous voltage across  $R_1$  will be directly proportional to the instantaneous current in the total shunt capacitance.

The differentiated voltage pulse developed across  $R_1$  is amplified and inverted by valve  $V_2$ ; and the output from the anode of this valve is fed to the grid of a class B amplifier  $V_3$  connected in parallel with  $V_1$ .

If, then, a sharp positive-going step voltage is applied to its grid, valve  $V_1$  will immediately begin to draw an increased current, discharging  $C_s$  and  $C_1$ . The pulse output voltage, however, will not increase—in the negative direction—to its peak until the shunt capacitance has fully discharged. But, due to the amplified differentiated pulse appearing at its grid, valve  $V_3$  will conduct very heavily during the discharge period, giving a very rapid leading edge to the output pulse.

### Quantitative Analysis

The circuit shown in Fig. 2 can be represented as that shown in Fig. 3(a). Valve  $V_1$  is a constant-current generator, its output  $I$  being equal to  $g_{me}e$ . The current  $i_a$  is equal to the product of the voltage developed across  $R_1$  and the effective mutual conductance of the auxiliary boost amplifier ( $V_2$  and  $V_3$ ); i.e.,

$$i_a = A \cdot i_{C_1} R_1 \quad \dots \quad (3)$$

where  $i_{C_1}$  is the current in capacitor  $C_1$ ,  $A$  is the effective mutual conductance of the auxiliary amplifier; i.e., the current output of  $V_3$  divided by the voltage input to  $V_2$  and

$$i_{C_1} = i_{C_s} [C_1 / (C_1 + C_s)] \quad \dots \quad (4)$$

where  $i_{C_s}$  is the current flowing in the total shunt capacitance. N.B. The total shunt capacitance includes  $C_1$ .

Therefore

$$i_a = i_{C_s} [A \cdot R_1 \cdot C_1 / (C_1 + C_s)] \quad \dots \quad (5)$$

For convenience let us call the factor within the large brackets  $k$ . So  $i_a$  then becomes  $k \cdot i_{C_s}$ .

The circuit in Fig. 3(a) is, in turn, equivalent to that

shown in Fig. 3(b). If the input voltage to the grid of  $V_1$  is assumed to be an instantaneous step function, we can say that  $I$  is equal to  $V/R_L$ , where  $V$  is the height of the output pulse.

It will readily be appreciated that ideally  $k$  should be equal to unity. For, if this is so, the whole of the charging current will be supplied by the boost amplifier ( $V_2$  and  $V_3$ ) so that the pulse output voltage rises instantaneously with the input voltage. This is, of course, not a practical possibility; but it is interesting to analyse the action of the circuit in order to assess how nearly the ideal condition can be approached.

The current in  $R_L$  is given by the expression

$$i_R = I + k \cdot i_C - i_C = I + i_C(k-1) \quad \dots \quad (6)$$

where  $i_R$  is the current in  $R_L$ ;  $i_C$  is the current in  $C_s$ .

From basic energy-transfer theory we can derive an expression for the instantaneous voltage as follows:

$$I = i_R + i_C(1-k) = \frac{q}{CR} + \frac{dq}{dt}(1-k)$$

where  $q$  is the charge in  $C_s$ .

This can be rewritten

$$\frac{dq}{q - CRI} = \frac{dt}{CR(1-k)}$$

Integrating both sides,

$$\log_e(q - CRI) = \frac{-t}{CR(1-k)} + K$$

where  $K$  is the constant of integration.

To evaluate  $K$ , take the condition when  $t = 0$ ; then  $q$  also equals 0.

Therefore

$$K = \log_e(-CRI)$$

so that

$$(q - CRI) / -CRI = e^{-t/CR(1-k)}$$

This can be rewritten

$$1 - (q/CRI) = e^{-t/CR(1-k)}$$

But  $RI$  is the pulse height  $V$ ; and  $q/C$  is the instantaneous voltage  $v$ .

Therefore

$$v = V [1 - e^{-t/C_s R_L (1-k)}] \quad \dots \quad (7)$$

It would appear from the above that, if  $k = 1$ , the voltage across  $R_L$  will be equal to the pulse height and independent of time. So long as  $k$  is less than unity the circuit will remain stable; but, if  $k$  is allowed to exceed unity, the factor within the large brackets becomes negative and the circuit will tend to ring. Taken to extremes, of course, if the gain of  $V_2$  and  $V_3$  is increased sufficiently the circuit will oscillate.

It must be remembered, however, that the derivation of expression (7) is based upon the assumption that the time constant  $C_1 R_1$  is negligible. This approximation simplified the reasoning and is virtually true for most practical pulses. But it is obvious that it is not possible to make  $v$  equal to  $V$  unconditionally. To establish the ultimate limitations it is necessary to take all the circuit parameters into consideration. This may not be entirely possible because it is difficult to account for all the stray impedances. Nevertheless, a close approximation can be made because by far the most important limitation is due

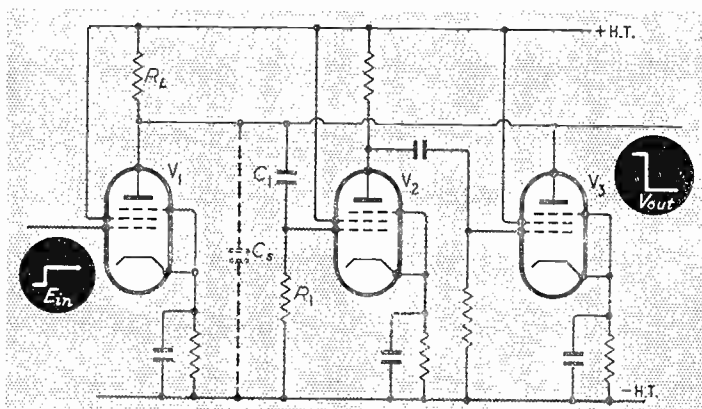


Fig. 2. Basic arrangement of auxiliary boost circuit

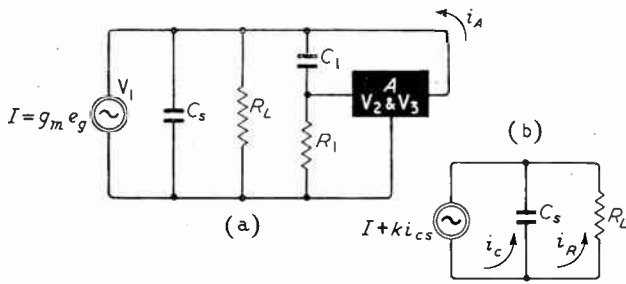


Fig. 3. Equivalent circuits of Fig. 2

to the time constant  $C_1R_1$ ; and, if this parameter is taken into account, it can be shown that the fastest rise time obtainable is given by the expression

$$v = V \left[ 1 - \left\{ 1 + (\sqrt{x} - 1) \frac{t}{T} \right\} e^{-\frac{t\sqrt{x}}{T}} \right] \quad \dots (8)$$

where  $x$  is  $C_sR_L/C_1R_1$ ;  $T$  is  $C_sR_L$

It can also be shown that the ultimate condition of stability is given by the expression

$$k \leq 1 + [C_1R_1/R_L(C_1 + C_s)] \quad \dots (9)$$

As the time constant  $C_1R_1$  tends to zero so the limiting value of  $k$  tends to unity; but, so long as the value of  $C_1R_1$  is not negligible,  $k$  can exceed unity slightly without producing instability.

The mathematical derivations of expressions (8) and (9) are given in the appendix to this article.

### The Positive-Going Edge of the Output Pulse

The circuit shown in Fig. 2 provides for negligible deterioration of the negative-going edge of the output pulse. It does not, however, operate when the input voltage to the grid of  $V_1$  is a negative-going step. The complete circuit of a system suitable for linear amplification of positive-going and negative-going pulses is shown in Fig. 4.

Two additional valves,  $V_4$  and  $V_5$ , form a second boost circuit which provides the charging current for the shunt capacitance during the positive-going output step. The operation of valves  $V_4$  and  $V_5$  is similar to that of  $V_2$  and  $V_3$ . Since the second pair of boost valves operates in the reverse direction from the first pair, it is necessary to connect them between the output line and a separate 500-volt h.t. line.

The circuit shown in Fig. 4 is of an experimental

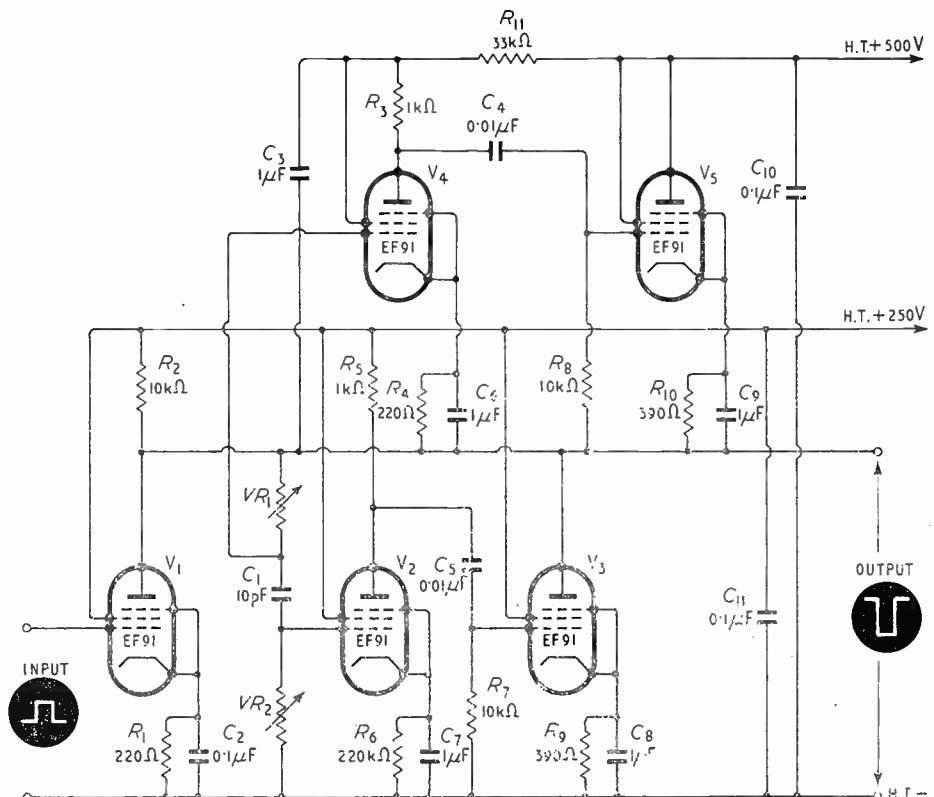


Fig. 4. Practical circuit of amplifier

amplifier designed to use type EF91 valves. This amplifier was designed to provide a 50-volt output pulse with a rise time and fall time of  $0.1 \mu\text{sec}$  across a capacitive load of the order of  $100 \text{ pF}$ .

With a  $10,000\text{-}\Omega$  anode load and an h.t. of  $250 \text{ V}$ , valve  $V_1$  has a dynamic  $g_m$  of  $2.5$ , giving a stage gain of  $25$ . The shunt capacitance having been set artificially at  $100 \text{ pF}$ , the value  $10 \text{ pF}$  was chosen for capacitor  $C_1$ . Then, if the time constant of the sampling network is to be small compared with  $0.1 \mu\text{sec}$ , a series resistance of the order of  $500 \Omega$  can be used for each of the boost circuits, giving an overall time constant of  $0.01 \mu\text{sec}$ . In practice, a pair of  $1,000\text{-}\Omega$  variable resistors ( $VR_1$  and  $VR_2$ ) were used.

The figure for  $k$  can then be obtained by substituting the constants given above in (5).

Thus

$$k = A \frac{5 \times 10^2 \times 10^{-11}}{11 \times 10^{-10}} = 50.A$$

Therefore, if  $k = 1$ ,  $A = 0.02$ .

This means that  $1\text{-V}$  input at the grid of  $V_2$  or  $V_4$  must give an anode current of  $20 \text{ mA}$  in  $V_3$  or  $V_5$ . This figure is only about three times the  $g_m$  of the valve so that the voltage gain of  $V_2$  and  $V_4$  need only be of the order of  $4$ . This gain is easily achieved with the use of a  $1,000\text{-}\Omega$  anode load. The stray capacitance shunting the anode loads of  $V_2$  and  $V_4$  should not exceed  $10 \text{ pF}$  even allowing for wiring strays. This gives a time constant for the anode circuits of these valves of the order of  $0.01 \mu\text{sec}$  so that there will be negligible deterioration of the differentiated pulse if the rise time of  $0.1 \mu\text{sec}$  is adequate.

In order to obtain linear amplification of the pulses

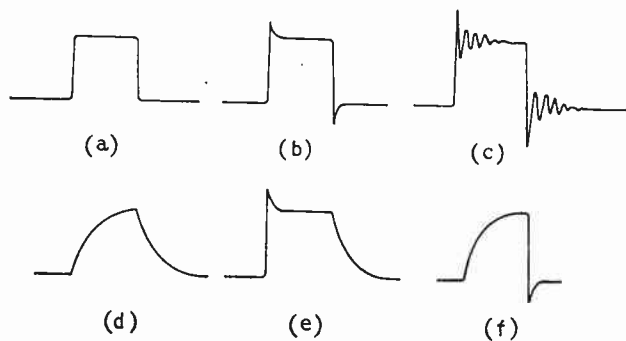


Fig. 5. Output pulses for various settings of linearity controls for positive output pulse; i.e., negative input pulse.

- (a)  $VR_1$  and  $VR_2$  correctly adjusted;
- (b)  $VR_1$  and  $VR_2$  too high;
- (c)  $VR_1$  and  $VR_2$  very much too high, causing ringing;
- (d)  $VR_1$  and  $VR_2$  too low;
- (e)  $VR_1$  too low and  $VR_2$  too high;
- (f)  $VR_1$  too high and  $VR_2$  too low.

N.B.— $VR_1$  controls negative-going edge;  $VR_2$  controls positive-going edge

signals it is, of course, important that the circuit should be so adjusted that  $k$  is in fact equal to unity. This adjustment is made by means of the variable resistors  $VR_1$  and  $VR_2$ . These resistors control the voltages applied to the respective boost circuits, and thus they control the effective gain of each of these circuits.

The amplifier is set up by empirical means. A pulse signal having a rise and fall time of less than  $0.1 \mu\text{sec}$  is fed to the grid of  $V_1$ . The output pulse is monitored by means of a suitable cathode-ray oscilloscope. With the desired capacitive load connected, variable resistors  $VR_1$  and  $VR_2$  are adjusted for the sharpest obtainable output pulse with no overshoot on the leading and trailing edges. Overshoot indicates that  $k$  is greater than unity. Fig. 5 indicates the forms of oscillograms of the output pulse for various settings of the variable controls. It will be found that the settings of the controls are interdependent, and that it is necessary to adjust both controls simultaneously.

If the value of  $k$  is adjusted to exceed unity by an appreciable amount, the circuit becomes unstable. This instability takes the form of damped oscillation superimposed upon the pulse or upon the baseline following the pulse.

The EF91 is not by any means the ideal valve for this purpose; it was used because it was the most suitable valve available to the authors when the experimental amplifier was constructed. The maximum instantaneous cathode current of this valve is of the order of only 300 mA. With a valve such as the 6F17, which is specially designed for exceedingly heavy instantaneous currents, a very high standard of performance should be obtainable with large capacitive loads.

### Conclusion

The circuit described has several advantages over the conventional feedback type of amplifier. The most important of these is probably the fact that both positive-going and negative-going transients are amplified by driving a valve into conduction.

When a positive-going step voltage is applied to the

grid of a feedback amplifier, the valve will conduct very heavily due to absence or reduction of feedback during the transient period. But, when the negative-going step is applied to the grid, the anode current will be reduced—perhaps to cut-off—and the stray capacitance will charge through the load resistance at a rate determined by the time constant  $C_s R_L$ . This means, of course, that  $R_L$  must be a comparatively low value to produce a steep edge with the result that the standing current of the feedback amplifier will probably be very little different from that of the simple amplifier in Fig. 1. For, even if the amplifier is required for positive-going input pulses only, it cannot be run fully in class B; it would be driven beyond cut-off during the negative-going trailing edge of the pulse.

To the best of the authors' knowledge, the system devised, using a boost amplifier to provide the charging current for the stray capacitance, is original. The system is perhaps related to the shunt-regulated amplifier devised by Cooper<sup>5,6</sup>, in which a boost valve is connected in series or in parallel with the output valve in order to compensate for a load which varied with voltage applied to it.

Also, the method of sampling the charging by means of a small  $RC$  circuit in parallel with the stray capacitance is not unlike the system used by Gouriet<sup>7</sup> for compensating for frequency distortion in a transmitted signal.

### APPENDIX

#### Mathematical Analysis of the Amplifier

Referring to Fig. 3(a), let  $i_{cs}$  be the current in  $C_s$ , let  $i_r$  be the current in  $R_L$ , and let  $i_c$  be the current in  $C_1$  and  $R_1$ .

Then

$$g_m e_g + AR_1 i_{c1} = i_r + i_{cs} + i_{c1}$$

$$v = i_r R_L = i_{cs} / p C_s = i_{c1} (R_1 + 1/p C_1)$$

where  $v$  is the instantaneous output voltage;  $p$  is the Heaviside operator.

$$\therefore g_m e_g = v [1/R_L + p C_s + (1 - AR_1)/(R_1 + 1/p C_1)] \quad \dots (10)$$

Then

$$\frac{v}{e_g} = g_m R_L \frac{p/C_s R_L + 1/C_1 R_1 C_s R_L}{p^2 + p[1/C_1 R_1 + 1/C_s R_L + (1 - AR_1)/C_s R_1] + 1/C_1 R_1 C_s R_L} \quad \dots (11)$$

$$\text{Let } C_s R_L / C_1 R_1 = x$$

$$\text{and } C_s R_L = T$$

So that

$$\frac{v}{e_g} = g_m R_L \frac{p/T + x/T^2}{p^2 + \frac{p}{T} \left[ 1 + x + \frac{R_L}{R_1} (1 - AR_1) \right] + \frac{x}{T^2}} \quad \dots (12)$$

$$= g_m R_L \frac{p/T + \omega_0^2}{p^2 + 2\alpha p + \omega_0^2} \quad \dots (13)$$

This is a standard form which is readily interpretable as a time function by means of a table of Heaviside transforms. There are three solutions, depending on the relative values of  $\alpha$  and  $\omega_0$ . The condition for stability is that both roots of the denominator must be negative and real or have negative real parts. The roots are:

$$p_1, p_2 = -\alpha \pm \sqrt{\alpha^2 - \omega_0^2} \quad \text{if } \alpha^2 > \omega_0^2$$

$$p_1, p_2 = -\alpha \pm j\sqrt{\omega_0^2 - \alpha^2} \quad \text{if } \alpha^2 < \omega_0^2$$

In both cases stability demands that  $\alpha$  be a positive number, and this requires

$$1 + x + \frac{R_L}{R_1} > AR_L \quad \dots (14)$$

If  $\alpha^2$  is less than  $\omega_0^2$  the step response will be oscillatory. In order to avoid this  $\alpha^2$  must be equal to or greater than  $\omega_0^2$ . For circuits having this form of characteristic equation, the fastest rise time for a

non-oscillatory response is obtained with  $\alpha^2 = \omega_0^2$ . For this condition

$$\frac{v}{e_g} = g_m R \left[ \frac{t}{T} e^{-\alpha t} + 1 - (1 + \alpha t) e^{-\alpha t} \right] \\ = g_m R \left[ 1 - \{1 + (\alpha - 1/T)t\} e^{-\alpha t} \right] \dots \dots \dots (15)$$

Since  $\alpha^2 = \omega_0^2$ , we can write  $\alpha = \sqrt{x}/T$ ; so that

$$\frac{v}{e_g} = g_m R_L \left[ 1 - \left\{ 1 + (\sqrt{x} - 1) \frac{t}{T} \right\} e^{-\sqrt{x}t/T} \right]$$

The condition for  $\alpha^2 = \omega_0^2$  amounts to

$$\left| \frac{\sqrt{x}}{T} \right| = \left| \frac{1}{2T} \left[ 1 + x + \frac{R_L}{R_1} (1 - AR_1) \right] \right|$$

or  $2\sqrt{x} = 1 + x + \frac{R_L}{R_1} (1 - AR_1)$

$\therefore 0 = (1 - \sqrt{x})^2 + \frac{R_L}{R_1} (1 - AR_1)$

or  $AR_L = \frac{R_L}{R_1} + (1 - \sqrt{x})^2 \dots \dots \dots (16)$

From (14) we can find the limiting value of  $k$  for stability.

$$k = AR_1 \cdot \frac{C_1}{C_1 + C_s} = AR_L \cdot \frac{R_1/R_L}{1 + C_s/C_1}$$

But stability demands

$$AR_L \gg 1 + x + \frac{R_L}{R_1}$$

So the limiting value of  $k$

$$= \left[ 1 + x + \frac{R_L}{R_1} \right] \cdot \frac{R_1/R_L}{1 + C_s/C_1} \\ = 1 + C_1 R_1 / R_L (C_1 + C_s) \dots \dots \dots (17)$$

However, the limiting condition for a non-oscillatory step response is given in (16), and this can be interpreted as a lower value of  $k$  as follows:—

$$k < \left[ \frac{R_L}{R_1} + (1 - \sqrt{x})^2 \right] \cdot \frac{R_1/R_L}{1 + C_s/C_1} \\ = \left[ \frac{R_L}{R_1} + 1 - \frac{2\sqrt{C_s R_L}}{\sqrt{C_1 R_1}} + \frac{C_s R_L}{C_1 R_1} \right] \cdot \frac{C_1 R_1}{R_L (C_1 + C_s)} \\ = 1 + \frac{C_1 R_1 - 2\sqrt{C_1 R_1 C_s R_L}}{R_L (C_1 + C_s)} \dots \dots \dots (18)$$

It is evident that the limiting values of  $k$  as determined in (17) and (18) tend to unity as the time constant  $C_1 R_1$  tends to zero. But, whereas the limiting value for circuit stability exceeds unity when  $C_1 R_1$  is not negligible, the limiting value for a non-oscillatory step response is slightly less than unity for values of  $C_1 R_1$  less than  $C_s R_L$ .

### REFERENCES

- 1 C. F. Brocksby, "Negative Feedback Amplifiers", *Wireless Engineer*, Vol. 26, February 1949, p. 43.
- 2 H. Mayr, "Feedback Amplifier Design", *Wireless Engineer*, Vol. 26, Sept. 1949, p. 297.
- 3 J. E. Flood, "Negative Feedback Amplifiers", *Wireless Engineer*, Vol. 27, July 1950, p. 201.
- 4 V. J. Cooper, "Negative Feedback Amplifiers of Desired Amplitude Frequency Characteristics", *J. Television Soc.*, Vol. 6, April-June 1951.
- 5 V. J. Cooper, "New Amplifier Techniques", *J. Brit. I.R.E.*, June 1952, p. 371.
- 6 V. J. Cooper, "Shunt Regulated Amplifiers", *Wireless Engineer*, Vol. 28, May 1951, p. 132.
- 7 G. G. Gouriet, "Spectrum Equalization", *Wireless Engineer*, Vol. 30, May 1953, p. 112.

## ELECTROCHEMICAL RELAY

A recent discovery by Stanford R. Ovshinsky of Ovivron Corporation, U.S.A., promises a new and interesting control component—the electrochemical relay.

It comprises two large electrodes immersed in an electrolyte and a third central control electrode. Initially, the a.c. resistance between the two large electrodes is high but, when a direct current is passed through the control electrode, it falls to a very low value. When the direct control current is interrupted, the relay reverts to its initial condition.

The schematic diagram of Fig. 1 shows the necessary circuitry for the on/off mode of operation and the component parts of the relay. The relay chamber contains a solution of acid and free ions, immersed in which are the load electrodes which are made of a film-forming material such as tantalum. The control electrode is an acid-resistant platinum rod, located half-way between the load electrodes. The large electrodes are connected to the load and the a.c. supply in series. Two rectifiers are connected back to back to the large electrodes to provide the d.c. bias for the control electrode. With the switch  $S_1$  open there is no energizing voltage applied to the control electrode and, therefore, the relay is 'open' and presents a high resistance between its load terminals.

With  $S_1$  closed, the control electrode becomes positive with respect to the load electrodes and the resistance between the main electrodes falls to a low value. The alternating current then depends mainly on the magnitude of the load resistance.

One prototype model is completely sealed in an inert plastic case measuring 1.5 in. high by 1.5 in. diameter, with a plug-in base termination. It has a contacts rating of 4 A, 70 V r.m.s. The peak voltage that can be handled is 140 V; if the supply voltage exceeds this, the electrolyte conducts regardless of whether or not the control electrode is energized. The minimum supply voltage is 3 V.

Typically, with an applied voltage of 30 V a.c. and a load resistance of 65  $\Omega$ , the alternating load current is 450 mA and the direct control current 18 mA. The load current remains a true sine wave and is apparently unaffected by passage through the electrolyte. When the relay is energized and current is flowing, the

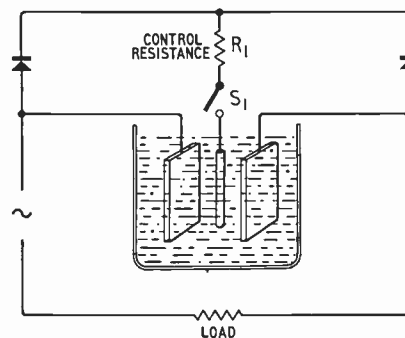


Fig. 1. Construction of electrochemical relay and circuitry for on/off mode of operation

impedance between the electrodes is approximately 2  $\Omega$ . At the instant of make the impedance is higher but it stabilizes at a constant value after a short time.

The impedance changes slightly with variations of load current, but this characteristic is less marked for high values of load current.

The load current varies with the magnitude of its control current. In consequence, the electrochemical unit will function not only as a relay but also as a power-modulating device. The design of a given relay can be modified to provide any one of a wide range of ratios between the load current and control current; at present, typical values range from 10:1 to 50:1 and, as would appear logical, the speed of response is greater at the lower ratios.

The speed of response of load current to control current of the electrochemical relay is somewhat similar to the magamp in that the response is definitely related to the frequency of the applied voltage. During tests, the load circuit has been opened within  $\frac{1}{2}$  to 3 c/s of the 60-c/s applied voltage. The magnitude of the applied voltage does have a slight effect on the speed of de-energization but varying the load current, within limits, has no measurable effect.

Initial tests of the electrochemical unit show that the rated temperature rise is 50  $^{\circ}\text{C}$  and the operation is relatively stable over ambient temperatures from -10  $^{\circ}\text{C}$  to 150  $^{\circ}\text{C}$ . These tests also show that the units are unaffected by vibration, moisture, mounting position, external electrostatic or electromagnetic fields.

\* Based on an article "The Electrochemical Relay: A remarkable New Switching Form", by John D. Cooney, *Control Engineering*, July 1959, p. 121.

## NEWS FROM NEUTRONS

Some of the matters to be mentioned here recapitulate what was said about strong and weak interactions earlier this year. Be patient about this. It is not an easy sort of subject, and it is something even to get the vocabulary straight. I do not profess to be able to follow the details of the theory of  $\beta$ -decay, but I began to be worried when the mere volume of experimental information about it (or the fraction that has come my way, to be honest) got beyond me to sort out at all. Then a bit of sense broke in, and I realised that I was trying to do things the hard way. For the main principles are, I think, laid bare by some not over-involved experiments on one particle only—the neutron.

Since the article on Glasstone 1958 that appeared in this journal in April, two very good articles on elementary particles have been published. The first of these, "Elementary Particles—the Present Situation", by P. E. Hodgson, appeared in *Science News*, Vol. 52, May 1959. The author concentrates on the experimental side of the production and classification of the thirty-odd named particles. He gives a table of the various modes of formation and decay of the charged and neutral K-mesons; magnificent bubble-chamber pictures of typical events—mentioning incidentally that results are pouring out from the high-energy machines so abundantly that the bottle-neck appears to be in scanning the pictures, for which automatic processes have been devised. He refers to the new conservation laws, and to the new 'strangeness' quantum number attaching to certain hyperons which, so to speak, outlive their welcome, and gives a table of the particles with their spins, isotopic spins, strangeness (where applicable), Q-values for decays, and energies of decay products. But he does not say much about what some of these attributes mean.

The second, a contribution by Prof. D. H. Wilkinson to the most admirable book, "Turning Points in Physics" (North-Holland Publishing Co., 1959), approaches the matter from the other side. His article, "Towards New Concepts—Elementary Particles", explains the ideas that have emerged from the experimental work. He does go very fully into the origin of the terms isotopic spin and strangeness, and also mentions the matters of parity conservation (which amounts to the assumption that space is symmetrical towards events) and time-reversal (which amounts to saying that if we could run time backwards, a process would be expected to happen in the reverse order). The importance of the latter is quite considerable, for the uncertainty principle shows that there are 'holes' in observable time in which virtual processes can occur; if it doesn't behave itself when we are standing over it with a stop-watch, where are we? Fortunately it appears that time does

behave symmetrically as far as experiments go; it seems to stand the test of time.

He also explains the difference between strong and weak interactions, a point taken up in the next section of this article. If you take together Mr. Hodgson's account and that of Prof. Wilkinson, you have a good picture of the theoretical and the practical sides, both expressed lucidly in simple terms. For those of you who would look further, there is an article on "The New Particles" by Prof. O. R. Frisch in the June 1959 number of the *Bulletin of the Institute of Physics*, which discusses schemes for correlating slow decay processes and predicting those that might be found. And I should mention also the publication in June of J. Hamilton's book, "The Theory of Elementary Particles" (Clarendon Press: Oxford University Press), which is on the scale of Heitler and Dirac, and which at a first glance I found far too difficult for me. I shall have to try to do my duty by you and get round to this in time if I can. It confirmed my belief that the best way to start on this sort of topic at my level is to take on something relatively simple like a single solitary neutron.

### Strong and Weak Interactions

The most familiar particle-particle interaction is the electrostatic action between a proton and an electron. It is also the easiest for the mathematician to handle, as the figure which can be taken to represent its size is  $2\pi e^2/hc$ , which is the fine-structure constant  $1/137$  whose square and higher powers can be neglected. Actions between nucleons—n, n; n, p; p, p—appear to be independent of charge, to involve a high energy, to happen very quickly, and to be represented on the same scale by a figure of the order 1 to 10. They are called strong interactions. The third class, of which the  $\beta$ -decays of the  $\pi$ -meson and the  $\mu$ -meson and the neutron are typical, involve very much less energy, take place more slowly in the sense that the excited particle has a relatively long half-life (that of the neutron, for example, is about  $10^3$  seconds though the

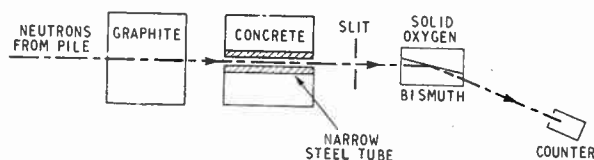


Fig. 1. Scheme of apparatus used to measure the neutron-electron interaction by determining the relative refractive index between bismuth and liquid oxygen. The critical angle for total internal reflection at the interface enables this refractive index to be calculated, as in simple geometrical optics

others mentioned come nowhere near this) and are represented by a figure more like  $10^{-12}$ . They are called weak interactions. The  $\Lambda^0$  hyperons and other 'strange' particles were given this name originally because their decay releases a great deal of energy, but their half-life is consistent with a weak interaction. Any kind of  $\beta$ -emission, such as that of  $^{60}\text{Co}$ , is weak.

Now, once the meson had been introduced as the means by which strong interactions occurred, it was a more or less straightforward task to frame a theory which seemed to fit them. The weak interactions gave, and are giving, all the difficulty. It was realized that they probably involved some hitherto unsuspected principles, or departures from accepted ones.

Strong interactions treat all directions in space alike, and have always been regarded as conforming admirably with the laws of conservation of energy and of angular momentum. Weak interactions did not fit in with these conservation laws, and the suspected reason, namely the neutrino (or antineutrino), was eventually found. Weak interactions do not treat all directions in space alike, or need not necessarily do so. In seeking a reason for this, it may be that the ground shifts somewhat from the properties of particles and the nature of their interactions by means of fields to the properties of space—which may amount, I suppose, to the same thing in the end.

The  $\beta$ -decay of the neutron,



which releases about 1 Mev of energy, of which the antineutrino and the recoiling proton take an unpredictable share, is the simplest weak interaction for experimental study.

### Optics of Neutrons

The optics of neutrons is a much less geometrical-optics affair than that of electrons. They cannot be focused by electric and magnetic fields, or made to do Newtonian-particle tricks. On the other hand, their Compton or de Broglie wavelength  $\lambda = h/mv$  can be altered by moderating their speed, and beams of a homogeneous velocity (monochromatic neutrons) can be obtained by reflecting them at nearly grazing incidence from a crystal. The analogue of the X-ray 'Bragg angle' depends on  $v$  (or on  $\lambda$ ), so that those coming off in a given direction are monochromatic. Collimation is done, as with X-rays, by using a long thin tube; and, indeed, the whole job is much more like X-ray optics than electron optics.

With this difference, that the neutron's magnetic moment is a major significant property. X-rays are undeviated by a magnetic field, and electrons go round in circles; but neutrons tend to set with their magnetic axes in line with the field (either parallel or antiparallel), and so can be polarized by it.

### Study of Weak Interactions

In the classical Lorentz electron theory of optical refraction and dispersion, the electron is considered as an oscillator with a natural frequency which responds as a sort of forced oscillation to the electromagnetic waves; and the refractive index for electromagnetic waves of a given frequency is worked out in terms of the

number of electrons per unit volume and the coupling between the oscillators and the waves. For 'waves' read 'neutrons', of wavelength  $\lambda = h/mv$  if you like; and for 'forced oscillation' read 'weak interaction between neutrons and electrons'. The picture is then translated into neutron-optics terms. Neutrons passing from a vacuum to a medium should thus be refracted; the refractive index will depend on the extent of the interaction between the neutrons and the electrons in the medium, and on the number of electrons per unit volume. If we know the latter and can measure the refractive index, then the magnitude of the neutron-electron interaction can be calculated.

Things are not so simple really, because the nuclei of the atoms in the medium have their say in things,

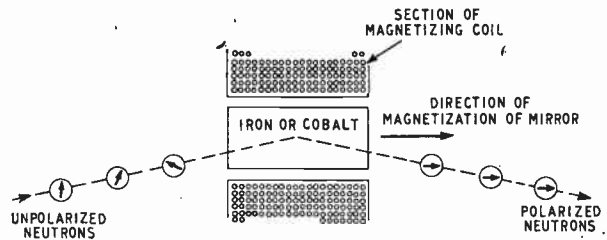


Fig. 2. Production of polarized neutron beam. The diagram is in a sort of semi-perspective, and the mirror is surrounded by a magnetizing solenoid, and also attached to a yoke (not shown) completing the magnetic circuit. The direction of magnetization is from left to right. Unpolarized neutrons striking the surface at a suitable angle are reflected with their magnetic axes parallel to the direction of magnetization of the mirror

and scatter the neutron beam. So the refractive index is, in fact, measured by determining the critical angle at a boundary between two solids which have approximately the same scattering effect but widely different electron densities, such as bismuth ( $Z = 83$ , density 8.9 gm/cc) and solid oxygen ( $Z = 8$ , density of the order 1.1 gm/cc). The critical angle then gives the relative refractive index between the two media. The apparatus is shown in Fig. 1. It should be noted that this experiment measures the strength of the action between a neutron and an electron, not that of the action of  $\beta$ -decay.

### Polarization of Neutrons

You remember all about Malus and reflection at a dielectric or transparent surface, and the Brewster angle in the production of polarized light. Something rather similar in appearance is done to obtain a polarized beam of neutrons (Fig. 2) by reflection at the surface of a smooth sheet of magnetized iron or cobalt. The magnetic axes of the neutrons are aligned either parallel or antiparallel to the direction of magnetization of the mirror, and we have the same situation as in optics, where we never really get one beam of polarized light, but always two which often conveniently separate themselves. Here it appears that the mirror acts not only like a Malus reflector, but also like a calcite crystal, as the refractive index is different for the two directions of polarization. Total reflection can occur at the surface, but the critical angle is different for the two directions of polarization, and a beam in which one polarization

predominates can be obtained by arranging the direction suitably.

With a beam of polarized neutrons undergoing  $\beta$ -decay as they travel, it was possible to see whether this orientation of their axes conferred any preferential direction on their decay products.

### Symmetry Properties in the Decay of Polarized Neutrons

This series of experiments was performed by M. T. Burgy and his collaborators at the Argonne National Laboratory, and V. L. Telegdi of the University of Chicago, and published in the *Physical Review*, Vol. 110, p. 1214 (1958). A very narrow vertical-strip beam of slow ('thermal') neutrons with their spins setting horizontally in one direction (or about 87% of them doing so) was obtained by scattering a collimated beam, that had been previously moderated and rendered monochromatic, at a very small grazing angle from a vertical mirror of magnetized cobalt, about 12 cm high by 120 cm long. While the half-life of a neutron is about a quarter of an hour, sufficient individuals decay while traversing a 15-cm length of the evacuated detector chamber (Fig. 3) for the event to be recorded, first by a pulse in the electron detector due to the  $\beta$ -particle, and then after the proper short interval by a pulse in the proton detector. The two together check that this is indeed a genuine  $\beta$ -decay event. With the mirror magnetized one way, the neutron spins were

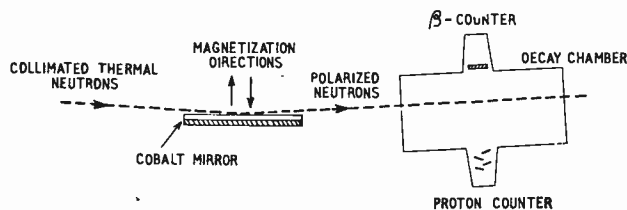


Fig. 3. Scheme of apparatus for testing symmetry in  $\beta$ -decay, viewed in plan. The cobalt mirror, set vertically, could be magnetized horizontally in either of the directions shown by the arrows, so that the beam of neutrons entering the decay chamber was a thin vertical wafer with the neutron spins setting horizontally in the appropriate arrow direction, pointing either towards or away from the  $\beta$ -counter. The  $\beta$ -counter used a scintillator in conjunction with a photomultiplier, and the proton counter a system of dynodes

polarized towards the electron detector, while with its magnetization reversed, they were polarized with the spin-axes pointing away from it. It was found that 20% more electrons were emitted in a direction opposite to the spin direction than along the spin direction. In order to check that this was attributable solely to differences in the neutron polarization, each observation was repeated with the neutron beam depolarized by passing it through a very thin steel sheet at the entrance to the chamber.

The foregoing account may be a little misleading, in that it seems to suggest that the electrons had to go one way or the other. The point is, that a symmetrical distribution *might* have been expected, but that there was instead an emission in all directions, but with that against the spin favoured. There is an analogy in the events of the cricket field. You might think that some-

body like Lock or Laker would get people dismissed from catches in any part of the field in equal proportions; actually a high proportion of them fall to catches on one particular side due to playing against the spin. Do not think, by the way, that I am implying that cricket is nothing but a form of weak interaction nowadays. It is a noble instrument of instruction, without which no schoolboy would ever believe in Newton's laws of motion, and no true Briton ever be reconciled to the principle of glorious Uncertainty; if it did not exist, it would be necessary to invent it in the interests of physics.

But this analogy runs away with me, and could be pursued to the point of infinite tedium. As compared with football, which is a highly-energetic strong interaction of short half-life (45 min), cricket is indeed a low-energy interaction of long half-life. The various decay modes can usually take anything up to three days, and 'strange' encounters which take an unconscionable long time dying have been observed by many reporters in various Commonwealth centres. Footballers are symmetrical in their play—like Wodehouse's man with two left feet most of the time, and craftily ambidextrous when the referee isn't looking; the cricketer is consistently either left-handed or right-handed. In football, time and space treat both sides more or less impartially; not so in cricket, where one side or the other is usually trying to beat the clock and there is no precedent for any spatial symmetry involving both sides batting at once. And, of course, there is this odd two-component business in cricket; the ball may be accompanied by an anti-particle, the no-ball—which cannot exist until it is detected. The impatient among you may be fidgeting, and murmuring about bats that get stored in belfrys; but I am plodding through the drowsy sun-drenched summer afternoon to the stage at which I intend to declare.

This is the point. Put yourself in the position of an intelligent footballer seeing a cricket match for the first time and trying to interpret it in familiar terms, and you are somewhere near the problem that the theoretical physicist found in weak interactions. The most difficult part is really in absorbing the vast array of apparently unco-ordinated events, and in finding out what the pattern really is. So far as I can understand things, this side is pretty well under control now. Next, to try and find out why it all happens, the sensible footballer would probably seek to isolate the simplest type of interaction, that of a single bowler and batsman at the nets. Once he understood what each was trying to do, he would then have some hope of sorting out the many-body interactions of a full-dress match. And this, of course, is where the neutron experiments come in; they are, to end this analogy for good, a study of weak interactions practising at the nets.

To return to business. In the action  $n \rightarrow e + p + \bar{\nu}$ , the antineutrino flies off in one direction and the proton recoils in the other. The antineutrino itself cannot be detected, but the recoil proton can and is. Going through the experiment again, but this time noting the relative numbers of protons for the two orientations of the neutron spin, it was found that there is a strong preferential emission of antineutrinos *in* the neutron-spin direction.



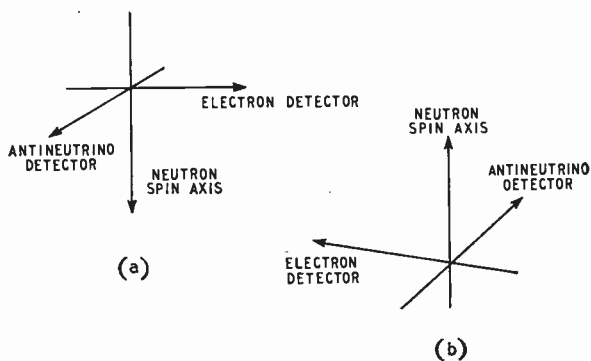


Fig. 4. Time-reversal simplified: (a) the relative directions of antineutrino (or proton) detector and electron detector as we would see them, (b) as the same situation would appear to an observer for whom time was running backwards and who sees all the timeable things—the momenta of electron and proton, and the neutron spin, reversed. As can be seen by rotating (b), this differs only from (a) in that the direction of the neutron spin relative to the other two arrows is reversed. In this experiment, to see whether reversal of the neutron spin affected the counts in the two detectors, they were shifted from the positions of Fig. 3 to those shown here

What symmetry really means in this connection is that a process involving certain spatial directions, and the process obtained by imagining the whole thing reflected in a mirror, should, if symmetry obtained, have the same relations between the relative directions. That is, the same result should be obtained in equations in which  $x$ ,  $y$ , and  $z$  are replaced by  $-x$ ,  $-y$ , and  $-z$ . The experiments, in showing that symmetry of this kind breaks down in  $\beta$ -decay, help to discriminate between types of equation which might be used to describe the process.

### An Experiment with Time

So much for  $x$ ,  $y$ , and  $z$ . But what about the fourth co-ordinate,  $t$ ? Well, there is no question of making time run backwards, but it is possible to forecast the result of putting  $-t$  for  $t$  in the equations by taking up the view-point of an imaginary observer for whom time was running in reverse. Fig. 4 (a) shows the directions of emission of antineutrino and electron (the proton is omitted) with respect to the neutron spin. A time-inverting observer would meet this as it is, but would record this same event with the direction of the spin and of the momenta of the electron and antineutrino reversed. Now, this second point of view is related to the first like the Fleming left-hand motor rule, and the right-hand dynamo rule.

In Fig. 4(a), with your left hand say to yourself, "forefinger electron, second finger neutron-spin, thumb antineutrinos". And apply the same incantation to Fig. 4(b) with your right hand. If you now superpose the forefingers and thumbs of the two hands, you see that this amounts *only to the direction of the neutron spin being reversed*.

Reading, of course, recoil-proton detector for antineutrino detector, it is only necessary to preserve the two directions of these fixed, and to note their respective particle counts for the two opposite orientations of the neutron spin in order to check whether time is operating symmetrically. These experiments showed that it did.

The significance of these results is rather harder to explain. I can only say, as the Burgy-Telegdi paper

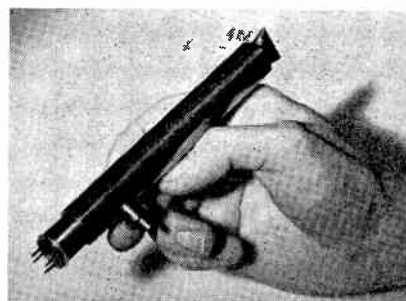
does, that they help to discriminate between some four possible processes that might account for  $\beta$ -decay. Until the experts can get round to putting things a little more simply, that is about the best that I can do. Meanwhile, it is interesting to reflect that after about twenty years of serving nuclear physics as a piece of furniture rather like your own trusty electron, and after a rather shorter career in nuclear power as (in the words of O. R. Frisch) an industrial commodity to be consumed by the ton, the neutron has been promoted to a post of special responsibility in the attack on the mysteries of weak interactions.

### THE OPHITRON

A compact microwave generator embodying a new focusing principle has been developed by the General Electric Co. Ltd.

This valve is an electrostatically focused backward-wave oscillator which has been named the 'Ophitron'. The name is derived from a Greek word meaning a serpent and is suggested by the undulating path of the electron stream flowing along the structure. The main advantages of this oscillator are: small size (6 in. long by  $\frac{3}{4}$  in. diameter), low weight (7 oz.) and its simple construction.

A single stamped-out periodic structure and two flat focusing plates form the propagating path for the r.f. wave, and set up the periodic electrostatic field which focuses the electron beam. The system has the fundamental advantage that the crests of the undulating electron beam are brought into the region of the maximum r.f. field. This feature gives good coupling between beam and wave and gives a large bandwidth. The present Ophitron tunes electronically over at least a 40% band in the 10,000-Mc/s region.



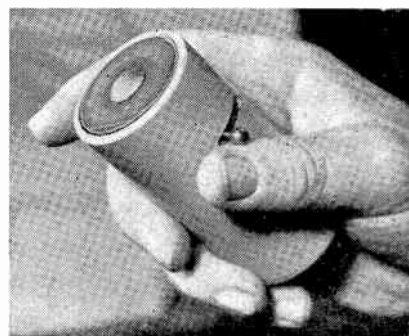
G.E.C. electrostatically-focused backward-wave oscillator

### TRANSISTORIZED ARTIFICIAL LARYNX

A new artificial larynx, for persons who have lost their voices through surgical removal (laryngectomy) or paralysis of their vocal cords, has been developed by Bell Telephone of America.

Still in the experimental stage, it is completely self-contained in a unit  $3\frac{1}{4}$  in. long by  $1\frac{1}{4}$  in. diameter. The underlying principle is a vibrating driver (transducer) which is held against the throat. By means of a finger-operated combination push-to-talk switch and inflection control, the user can control the frequency of the driver and, therefore, the pitch of his artificial voice. Users of this 'larynx' can, with practice, achieve a sentence intelligibility of 97%.

In this unit, two transistors are used in a relaxation oscillator of variable frequency and pulse width. The frequency is variable between 100 to 200 c/s for men and 200 to 400 c/s for women.



The complete artificial larynx showing the combined on/off switch and inflection control

# Electromagnetic Wave Problems

A SYNTHETIC APPROACH

By J. D. Lawson\*

**SUMMARY.** A number of wave problems encountered in physics and electrical engineering are related in ways which may not be immediately apparent. In this article a number of such problems are discussed in such a way as to bring out their common features. First, the plane electromagnetic wave in a loss-free medium is described in some detail; the physical distinction between the normal uniform plane waves and slow or 'inhomogeneous' waves, in which the amplitude varies exponentially in one direction, is emphasized. This is followed by a discussion of some diffraction problems in which the fields may be readily synthesized as a spectrum of plane waves. Cylindrical systems are then introduced by the imaginary operation of 'rolling up' planar systems; thus a corrugated surface guide supporting a slow wave becomes a linear accelerator or a magnetron according to whether it is rolled up in a direction perpendicular or parallel to the corrugations. Radiation from an electron moving in a straight line (Čerenkov radiation) and in a circle (synchrotron radiation) are studied by considering the electron as a  $\delta$ -function of current which can be resolved by Fourier analysis into a spectrum of sinusoidal currents, each associated with a travelling electromagnetic wave. In this case analogies are drawn with surface waves on wires and with corrugated surfaces rolled up in such a way that the corrugations are on the outside. Also discussed are the properties and limitations of 'super-gain' aerials, and their relation to phenomena associated with the wave-mechanical description of neutron scattering.

The solution of the time-independent wave equation  $\nabla^2 + (2\pi/\lambda)^2 = 0$  has a wide variety of forms, each with its appropriate mathematical description. Sometimes this mathematical description tends to obscure the essential simplicity of the physical situation, and does not reveal features common to a number of systems. A physical description of the field distribution often depends essentially on the topology and scale (the ratio of a characteristic dimension of the system to  $\lambda$ ), whereas a mathematical description is very sensitive to the actual geometry. Thus, the difference between the

wave propagation in a circular waveguide and a hexagonal waveguide is physically trivial, but a mathematical description of the fields looks very different in the two cases. In this article some common features of topologically similar problems are discussed in terms of physical ideas obtained from the study of the two forms of the simple electromagnetic plane wave in a loss-free medium.

The method is descriptive rather than deductive, and the object is merely to show a few underlying physical features common to a number of phenomena which may not appear at first sight to be closely related.

Simplifications are made, and intuitive reasoning is sometimes used; it is felt that this is justifiable in an article designed to present familiar ideas in a slightly unorthodox way, rather than to obtain new results. Adequate treatments of the subjects under consideration will be found in the references, which are to articles which are readily available rather than to original sources.

## Two Forms of Plane-Wave Solution

The plane-wave solution of Maxwell's equations in a lossless medium will now be described. Co-ordinates are chosen such that the magnetic field is in the  $z$  direction, then if the direction of propagation of the wave makes

\* Atomic Energy Research Establishment, Harwell.

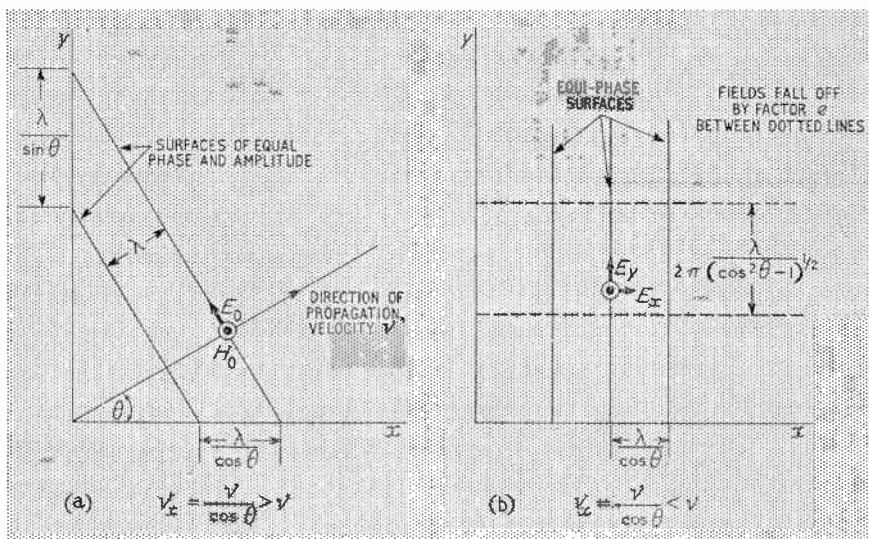


Fig. 1. Two forms of plane wave in a lossless medium

an angle  $\theta$  with the  $x$  axis the field components are given by the real part of the expression :

$$\left. \begin{aligned} H_z &= H_0 \exp \{2\pi i(ft - x \cos \theta/\lambda - y \sin \theta/\lambda)\} \\ E_x &= -Z_0 H_z \sin \theta \\ E_y &= Z_0 H_z \cos \theta \end{aligned} \right\} \dots (1a)$$

$Z_0$  is the intrinsic impedance of the medium, and the wavelength and frequency are related to the velocity of propagation  $v$  by the equation :

$$v = f\lambda \dots \dots \dots (2)$$

A diagrammatical representation of such a plane wave is given in Fig. 1(a). It will be seen that the apparent wavelengths measured along the  $x$  and  $y$  axes are  $\lambda/\cos \theta$  and  $\lambda/\sin \theta$  respectively. The phase velocity of the disturbance is therefore  $v \sec \theta$  along the  $x$  axis and  $v \operatorname{cosec} \theta$  along the  $y$  axis. These velocities vary between  $v$  and  $\infty$  as  $\theta$  varies, so that in such a wave they are always greater than  $v$ . This result is quite familiar in the theory of rectangular waveguides in which the simplest mode in a guide of width  $a$  consists essentially of two interfering plane waves at angles  $\pm \sin^{-1}(\lambda/2a)$  to the direction of propagation.

It is of interest also to consider the impedance of the wave system defined by Equ. (1a). In a wave system referred to cartesian co-ordinates the impedance  $Z_x$  measured in the  $x$  direction is given by  $Z_x = E_y/H_z$ , provided that there are no other components of field in the  $yz$  plane<sup>1,2</sup>. The significance of this quantity is that it is continuous across boundaries parallel to the  $yz$  plane. For the plane wave under consideration, Fig. 1(a),  $Z_x = E_y/H_z = Z_0 \cos \theta$ . Similarly  $Z_y = -E_x/H_z = Z_0 \sin \theta$ .

In deriving the solution of the wave equation given in Equ. (1), the only restriction placed on  $\cos \theta$  and  $\sin \theta$  is that  $\cos^2 \theta + \sin^2 \theta = 1$ . It is therefore necessary to investigate solutions in which  $\cos \theta$  is greater than unity and  $\sin \theta = \pm i(\cos^2 \theta - 1)^{1/2}$  is pure imaginary. Writing the solution in terms of  $\cos \theta$  and choosing the negative imaginary value of  $\sin \theta$  yields

$$\left. \begin{aligned} H_z &= H_0 \exp \{-2\pi y(\cos^2 \theta - 1)^{1/2}/\lambda\} \times \\ &\quad \exp \{2\pi i(ft - x \cos \theta/\lambda)\} \\ E_x &= iZ_0 H_z (\cos^2 \theta - 1)^{1/2} \\ E_y &= Z_0 H_z \cos \theta. \end{aligned} \right\} (1b)$$

In such a wave the fields decrease exponentially away from the  $x$  axis, and since  $\cos \theta > 1$ , the phase velocity

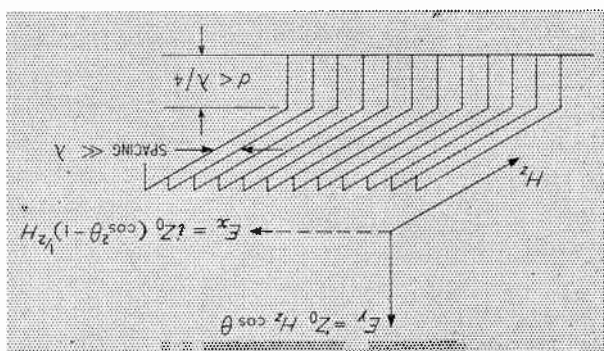


Fig. 3. Inductive corrugated surface

along the  $x$  axis is less than  $v$ . The  $x$  component of electric field is pure imaginary, this means that it is  $\pi/2$  out-of-phase with the other fields. Consequently the impedance  $Z_y$  is also imaginary,  $Z_y = -iZ_0(\cos^2 \theta - 1)^{1/2}$ . A negative imaginary value denotes that the magnetic field 'leads' the electric field, and hence that the impedance is capacitive. Such a wave is shown diagrammatically in Fig. 1(b).

Waves of this type are known as surface waves, or sometimes as slow waves or inhomogeneous plane waves. They occur, for example, at the surface of a slab of optically-dense material at which total internal reflection is occurring; under these circumstances Snell's law gives a value greater than unity for  $\cos \theta$ , the angle between the 'refracted' ray in the less dense medium and the surface. Evidently the phase velocity along the interface is less than the velocity of light in the less dense medium (Fig. 2).

Such surface waves may also be produced on corrugated surfaces. A surface structure such as that shown in Fig. 3 is purely inductive, since it appears as a system of short-circuited transmission lines of length less than  $\lambda/4$ . Provided that the fine structure of the surface can be neglected, its impedance may be matched to that of a capacitive surface wave. The impedance  $Z_{(-y)}$  looking into the surface is  $iZ_0 \tan 2\pi d/\lambda$  where  $d$  is the depth of the slot, and the impedance looking away from the surface into the surface wave  $Z_y$  is  $-iZ_0(\cos^2 \theta - 1)^{1/2}$ . Now the condition for a match is that these should be equal numerically but opposite in sign, so that

$$Z_0 \tan 2\pi d/\lambda = Z_0(\cos^2 \theta - 1)^{1/2} \dots \dots (3)$$

whence

$$\cos \theta = v/v_x = \sec 2\pi d/\lambda \dots \dots (4)$$

As  $d$  increases from 0 to  $\lambda/4$ , the phase velocity drops from  $v$  to zero.

### A Spectrum of Plane Waves

So far, only single waves have been considered; some problems however can be very conveniently treated by considering an angular spectrum of plane waves, in which  $\cos \theta$  takes all values between  $-\infty$  and  $+\infty$ . As an example, a somewhat idealized solution of the problem of two-dimensional diffraction through an aperture in a screen will be outlined. A more complete and rigorous treatment of this method may be found elsewhere<sup>3,4</sup>.

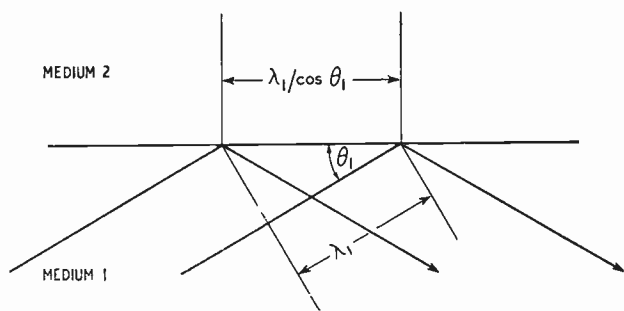


Fig. 2. Reflection at an interface; the wave in medium 2 is a slow wave if  $\lambda_1 \cos \theta_1 < \lambda_2$

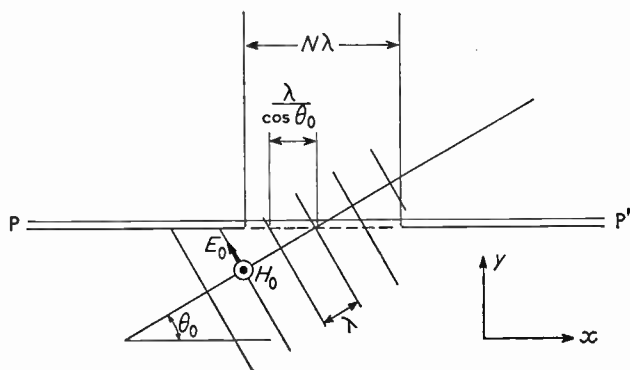


Fig. 4. Diffraction by aperture

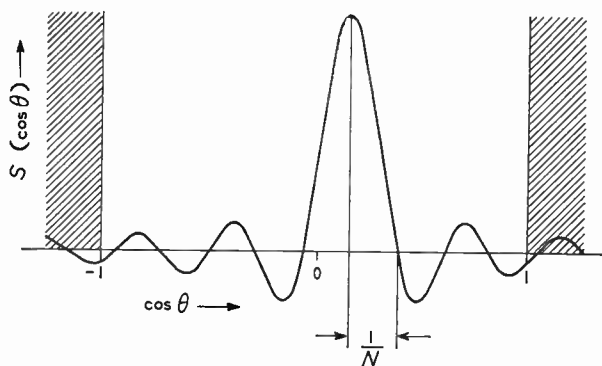


Fig. 5. Spectrum of plane waves through the aperture plane in Fig. 4. The values of  $\cos \theta$  in the shaded region correspond to slow waves

The situation to be analysed is shown in Fig. 4. A plane wave in which  $H$  is perpendicular to the paper falls on a screen at an angle  $\theta_0$ ; there is an aperture of width  $N\lambda$  in the screen, and it is required to find the distribution of fields in the space beyond the screen.

Before doing this, the concept of an aperture plane  $PP'$  will be introduced. This plane is just beyond the screen (Fig. 4), and divides the space into two halves, one of which contains the source of radiation and the screen, whereas the other is empty. These will be referred to as the 'source region' and 'free region' respectively. The screen will be assumed to be conducting, and edge effects will be neglected. By this we mean that the distribution of electric field in the aperture plane is assumed to be uniform with a phase gradient of  $2\pi \cos \theta_0$  radians/wavelength opposite the aperture ( $N\lambda/2 > x > -N\lambda/2$ ), and zero elsewhere ( $x > |N\lambda/2|$ ).

By means of the Fourier integral this field may be analysed into a spectrum of fields in the aperture plane each extending from  $-\infty$  to  $+\infty$ , each component of the spectrum being characterized by a particular value of  $\cos \theta$ . This procedure is formally similar to the resolution of a single rectangular pulse into a frequency spectrum. Furthermore each of these component fields may be consistently regarded as belonging to a plane wave travelling into the free half of space at an angle  $\theta$  from the aperture.

Omitting the term  $\exp(-2\pi if t)$  expressing variation

with time (since this is a constant factor throughout) the aperture field may be written:

$$E_x = E_0 \sin \theta_0 \exp(-2\pi i x \cos \theta_0 / \lambda),$$

where  $N\lambda/2 > x > -N\lambda/2$ .

Denoting the spectrum of fields by  $S(\cos \theta)$

$$E_x = \int_{-\infty}^{\infty} S(\cos \theta) \exp(-2\pi i x \cos \theta / \lambda) d(\cos \theta)$$

whence by the Fourier inversion theorem

$$S(\cos \theta) = \int_{-N\lambda/2}^{N\lambda/2} E_x \exp(2\pi i x \cos \theta / \lambda) dx / \lambda$$

$$= E_0 \sin \theta_0 \sin\{N\pi(\cos \theta - \cos \theta_0)\} \div \pi(\cos \theta - \cos \theta_0) \dots \dots \dots (6)$$

Fig. 5 shows the shape of the spectrum; values of  $|\cos \theta|$  greater than unity correspond to slow waves travelling along the aperture plane, with amplitude decreasing in a direction measured perpendicular to the plane. It is interesting to note that changing  $\cos \theta_0$  merely changes the origin in the figure. It is possible to show that the angular spectrum of waves is identical to the distant 'polar diagram' of the aperture considered as an aerial<sup>3,4</sup>. This might be expected from the form of Equ. (6), which is that of the well-known polar diagram of a continuous linear array of length  $N\lambda$  and phase gradient  $2\pi \cos \theta_0$  radians per wavelength<sup>5</sup>.

It is possible to set up a field in which  $\cos \theta_0$  is greater than unity in the aperture plane by placing a material of high optical density behind the screen, and making the angle of incidence in this medium (measured to the surface) less than the critical angle. If this is done the 'main beam' at  $\theta = \theta_0$  disappears, and only radiation corresponding to the secondary maxima occurs. The importance of this apparently trivial example will be apparent later.

### Some Applications to Particle Accelerators

Some characteristics of particle accelerators will now be discussed in the light of concepts so far developed.

Since surface waves have a phase velocity less than that of light, and a field component in the direction of propagation, they are clearly suitable for accelerating particles. For example, the corrugated surface of Fig. 3 could be rolled into a tube about a horizontal line (Fig. 6), and the phase velocity of the wave varied by varying the depth of the corrugations. This is essentially what is done in the travelling-wave electron accelerator<sup>6</sup>. The mathematical representation of the fields looks different, exponentials are replaced by Bessel functions, but the essential physical situation is the same.

Another system worthy of consideration in this

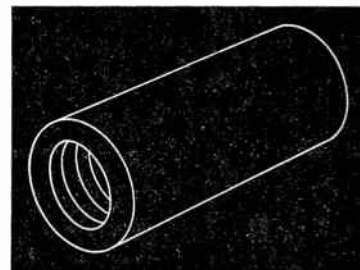


Fig. 6. Corrugated waveguide formed by rolling up the surface of Fig. 3

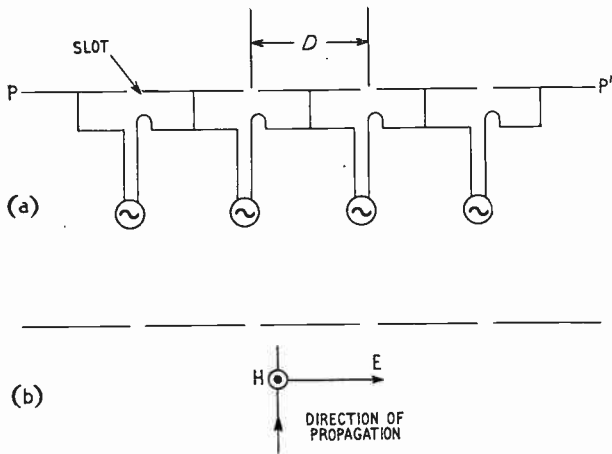


Fig. 7. Array of slots in a conducting metal sheet fed by (a) resonators; (b) a plane wave

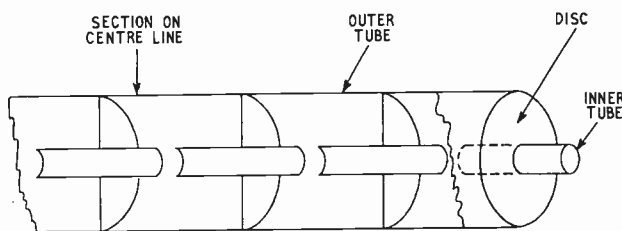


Fig. 8. The slot system of Fig. 9 (a) rolled up to form a standing-wave linear accelerator

connection is that of an infinite array of slots in a metal sheet, fed either by resonators which are in turn fed by generators all in phase, Fig. 7(a), or alternatively by an incident plane wave normal to the sheet, Fig. 7(b). The polar diagram of the radiation from the slots can be found in a manner similar to that used to calculate diffraction through a single aperture. Since, however, the function  $E_x$  in the aperture plane is periodic and infinite in extent, the form of the function  $S(\cos \theta)$  is that of a 'line spectrum'. Lines will occur at values of  $\cos \theta$  given by  $\cos \theta = n \lambda / D$ , where  $D$  is the slot spacing and  $n$  may be any integer positive or negative. The envelope of the lines will depend on the slot width, and will be broad if the slots are narrow. There will only be a finite number of lines for which  $n \lambda / D$  is less than unity; these will correspond to plane waves travelling away from the aperture at angles  $\cos^{-1}(n \lambda / D)$ , as in a diffraction grating. For  $n \lambda / D$  greater than unity however, there is an infinite set of slow waves travelling in both directions along the aperture plane. (A detailed study of a very similar problem, the reflection of a wave at a grid of wires, has been made by Macfarlane<sup>7</sup>).

If now, as before, the system of Fig. 7(a) is rolled up about a horizontal axis into a small enough tube the radiated waves may be suppressed while the slow waves are retained. The system then becomes virtually a resonant type linear accelerator (Fig. 8). The amplitude of the very slow waves ( $n$  large) falls off rapidly with inward radial distance from the walls, so that these

waves do not interact strongly with the particles. An alternative way of interpreting this effect is to say that particles moving at these slow speeds ( $vD/n\lambda$ ) spend many cycles in the field of each gap, and thus do not receive a large net acceleration. In the notation of klystron theory this is expressed by saying that the gap factor,  $\beta$ , is small.

If the accelerator of Fig. 8 is split into separate resonator units, and the whole rotated about a vertical axis, the type of accelerating system used in synchrotrons is obtained (Fig. 9).

### Cylindrical Waves Moving Axially

In the discussion on accelerators, cylindrical waves were introduced. Another form of cylindrical wave which has been studied both theoretically and experimentally may be obtained by effectively turning the corrugated waveguide inside out, and replacing the corrugations (if desired) by a dielectric, so that the system consists of a metal tube or wire surrounded by a cylindrical shell of dielectric<sup>8</sup>. The radial dependence of the field for such a system can be expressed in terms of the Hankel function<sup>9</sup>. At large distances from the wire however the field is indistinguishable from that of a plane wave if observed over small ranges of  $r$  and  $\phi$  where  $r$  is the distance from the wire and  $\phi$  the angle measured in a plane perpendicular to the wire with the wire at the origin. Furthermore the value of  $\cos \theta_0$  (which is greater than unity) associated with the wave is just that given by the velocity of light divided by the velocity of

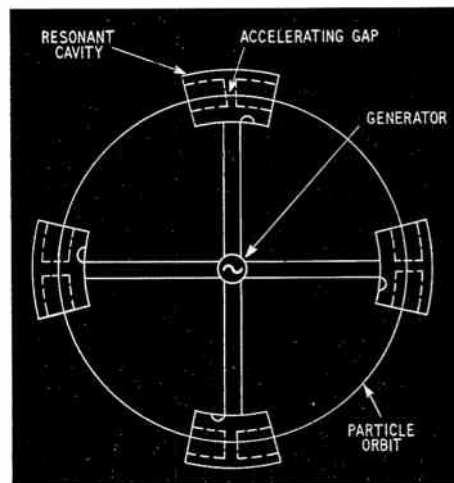


Fig. 9. R.F. system for synchrotron

the wave along the wire, as in the case of the plane wave. This can be verified quite simply by writing down the asymptotic expression for the Hankel function solution, as given for example in reference 9.

In such a guided wave the power flux is of course entirely in a direction parallel to the wire. An alternative way of supporting such a wave would be to use an infinite array of Hertzian dipoles placed end to end, each fed in such a way that the phase gradient along the array is  $2\pi \cos \theta_0$  per wavelength. If such a system is used there is no reason why  $\cos \theta_0$  should not be less

than unity. If this is so, the Hankel function changes its character, and the solution remote from the dipoles becomes a travelling wave, moving outwards at an angle  $\theta_0$  to the axis.

The radiation from an array of finite length can be found in an analogous way to the radiation through a finite aperture, by Fourier analysis of the current distribution along the array into a spectrum of current waves each extending all the way along the axis. Analogous to Equ. (6), for an array of length  $N\lambda$ ,

$$S(\cos \theta) = I_0 \sin \{N\pi (\cos \theta - \cos \theta_0)\} / \pi (\cos \theta - \cos \theta_0) \quad \dots \quad (7)$$

The angular distribution of radiation,  $P(\cos \theta)$ , is not, however, given by Equ. 7. It is nevertheless related to it by the expression

$$P(\cos \theta) \propto \sin \theta \cdot S(\cos \theta) \quad \dots \quad (8)$$

Even if  $|\cos \theta| > 1$  some radiation occurs when the array is of finite length; this may be compared with diffraction through a finite aperture when  $|\cos \theta| > 1$  discussed in the section on 'A Spectrum of Plane Waves'. Of particular interest is the case when  $\cos \theta = 1 + 1/2N$ .<sup>10</sup>

### Radiation from an Electron Moving in a Straight Line

The main interest of the previous section is the insight it gives into the problem of radiation from an electron. Fourier analysis has already been used to analyse the current function into components with different spatial periodicities  $\cos \theta/\lambda$ , but a single temporal periodicity  $f$  has always been assumed. In the radiation problem, however, use is made of Fourier analysis in time also.

An electron or assemblage of electrons moving in a straight line with velocity  $u$  may be considered as a current,  $I = g(ut - x)$ . This may now be Fourier analysed into frequency components of the form  $\exp\{2\pi i(ft - fx/u)\}$ , so that if  $h(f)$  is the distribution of frequencies

$$I(x, t) = \int h(f) \exp\{2\pi i(ft - x \cos \theta_0/\lambda)\} df \quad \dots \quad (9)$$

$$\text{where } \cos \theta_0 = f\lambda/u = v/u \quad \dots \quad (10)$$

In free space  $\cos \theta_0$  is always greater than unity, and no radiation occurs. In a dielectric medium, however,  $u$  can exceed  $v$ , and in this case radiation occurs at an angle  $\cos^{-1}v/u$ . This is Čerenkov radiation<sup>11</sup>. If wavelengths large compared with the linear dimensions of the electron bunch only are considered, then  $g(ut - x)$  is proportional to  $\sigma(ut - x)$ ,  $h(f)$  then becomes independent of  $f$ , and it is readily seen from Equ. (9) that the spectral distribution varies as  $1/f$ . It was stated above that in free space  $|\cos \theta_0|$  is always greater than unity, and that no radiation occurs. If, however, the track is of finite length, by analogy with the finite aperture in the section on 'A Spectrum of Plane Waves'  $\cos \theta_0$  has to be replaced by a spectrum in which all values of  $\cos \theta$  are present, and some radiation does therefore take place. This radiation is normally associated with the acceleration of the charge at the beginning and end of the track. The angular distribution of a single frequency component of the radiation from an ideal point electron in free space which moves with uniform velocity over a finite track of length  $L$  is given by Eqs. (7) and (8), with  $N = L/\lambda$  ( $\lambda$  being the free-space wavelength of the frequency component under

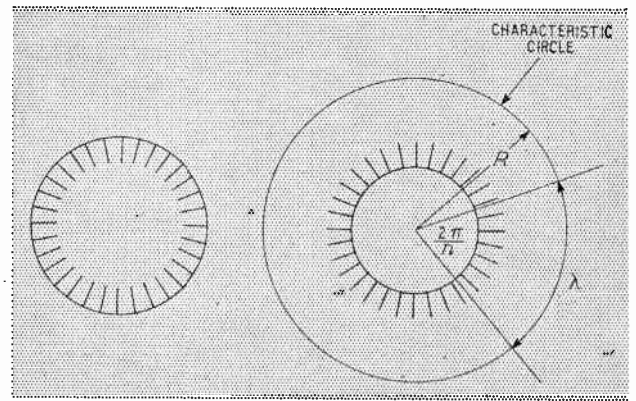


Fig. 10. The corrugated surface of Fig. 3 rolled up about an axis perpendicular to the paper

consideration). If the track of the particle is many wavelengths long, an overall picture of the radiation polar diagram can be obtained by replacing the oscillatory term in the numerator of Equ. (7) by its envelope, Equ. (8) then becomes,

$$P(\cos \theta) \propto \sin \theta / \pi (\cos \theta - \cos \theta_0) \quad \dots \quad (11)$$

The divergence at  $\theta = \theta_0$  is in the region where  $\cos \theta > 1$ , and is therefore not important.

For a relativistic electron travelling at nearly the speed of light an interesting substitution can be made. If  $\gamma$  is the ratio of the total energy of the electron to its rest energy then for  $u \approx c$

$$u/c = (1 - 1/\gamma^2)^{1/2} \approx 1 - 1/2\gamma^2 \quad \dots \quad (12)$$

whence for  $\theta$  small equation (11) becomes

$$P(\cos \theta) = p(\theta) \propto 2\theta/\pi (\theta^2 + 1/\gamma^2) \quad \dots \quad (13)$$

It is seen that the radiation is directed more strongly forward as the electron energy increases. The angle at which the maximum emission occurs can readily be shown to be  $\theta = 1/\gamma$ .

This method of calculating the radiation from an accelerated electron is not, in general, the most useful or convenient; it is, however, sometimes useful for discussing the behaviour of low-frequency components<sup>12</sup>.

### Cylindrical Waves Moving Circumferentially

In Fig. 3 a plane guiding surface is shown. It is of interest to consider what happens when the surface is curved into a cylinder with its axis perpendicular to the paper. If the surface is rolled up with the corrugations on the inside, a magnetron structure is obtained. The magnetron operates when the magnetic field and applied voltage are adjusted so that the electron cloud moves with an angular velocity equal to that of the slow waves, Fig. 10.

When the corrugations are on the outside, the situation is rather more interesting. If the phase velocity of the wave is  $u$  at the surface of the corrugations, it will be equal to  $v$  the velocity of light at a radius equal to  $v/u$  times the radius of the cylinder. This radius and the associated circle will be called the characteristic radius  $R$  and the characteristic circle respectively. If the total change of phase round the cylinder is  $2\pi n$ , then it may

easily be verified that  $R = n\lambda/2\pi$ . The solution of the wave equation for this case can be expressed in terms of a Hankel function of the second kind of order  $n$ .<sup>13</sup> Fig. 11 shows the variation of the circumferential component of  $E$  for the special case where  $n = 4$ . An examination of the form of the solution shows that the wave changes character at the characteristic circle; it varies monotonically outwards to the circle, and is oscillatory outside it. Well inside the characteristic circle the components of  $E$  and  $H$  are nearly  $\pi/2$  out-of-phase, at large distances outside they are in phase. The whole solution is rather like that of a plane wave in which  $\cos \theta$  varies with radius  $r$  according to the relation  $\cos \theta = R/r$ . Inside the circle the wave is predominantly an evanescent wave, and outside it is a predominantly travelling wave, so that power gradually leaks away from the corrugated surface into the radiation field. For small values of  $u$  or of the surface curvature the characteristic circle is a long way from the surface, and the power leaks out very slowly.

### Analogy with Wave Mechanics

The region between the circle and the surface is analogous to a potential barrier in wave mechanics. In the scattering of neutrons by a nucleus for example, partial waves associated with an angular momentum  $\{l(l+1)\}^{1/2}$  only interact weakly with a nucleus of radius less than  $l\lambda/2\pi$ . The reason for this is that such a nucleus lies inside the characteristic sphere and a potential barrier (the centrifugal barrier) has to be crossed in order to reach it. Under these circumstances, the wave function decreases monotonically inwards from the characteristic sphere.

### 'Super-Gain' Aerials

If two waves of equal amplitude and rotating in opposite directions are present on a cylindrical guiding surface, the angular dependence of the components of the field becomes proportional to  $\exp. i(2\pi ft - n\phi) + \exp. i(2\pi ft + n\phi) = 2 \cos n\phi \exp. (2\pi if t)$ . If the system is considered as an aerial, the distant radiation pattern then has the form  $p(\phi) \propto \cos n\phi$ . A more practical aerial could be made from a slotted cylinder fed by generators; c.f., the system shown in Fig. 7 rolled up about an axis perpendicular to the paper. If the slots are sufficiently close, any arbitrary field distribution round the circumference can ideally be obtained by suitable adjustment of the amplitude and phase of the generators. This field distribution can be written as a Fourier series

$$E_\phi = \sum E_n \cos n\phi \quad \dots \quad (14)$$

The distant radiation field can similarly be written

$$E'_\phi = \sum E'_n \cos n\phi \quad \dots \quad (15)$$

where  $E'_n/E_n$  is a function of the radius  $r$  of the aerial. From Equ. (15) it is clear that from an aerial of given size, an angular distribution of any arbitrary shape can be obtained by taking enough terms of Equ. (15) and adjusting the values of  $E_n$  accordingly. However, as  $n$  is increased beyond a value such that the characteristic circle has a larger radius than that of the aerial ( $n > 2\pi R/\lambda$ ) the value of  $E'_n/E_n$  drops very rapidly indeed, due to the presence of the 'potential barrier'<sup>14</sup>. In order that an

appreciable amount of power can leak out, therefore, the fields  $E_n$  (when  $n$  is greater than  $2\pi R/\lambda$ ) must be extremely large at the radius  $r$ . These fields are predominantly reactive and represent a considerable amount of stored energy in the neighbourhood of the slots. Thus it is difficult to produce a beam narrower (between zeros) than  $\pi/n$ , where  $n = 2\pi R/\lambda$ ; that is, narrower than  $\lambda/2r$ . This may be compared with the angle between zeros from a uniformly illuminated aperture of width  $2r$  of  $\sin^{-1}\lambda/2r$ , or  $\lambda/2r$  when  $r \gg \lambda$ . The difficulty of producing a beam substantially narrower than that from a uniformly illuminated plane aperture is well known<sup>3</sup>.

### Radiation from Electrons Moving in a Circle

When electrons move in a circle, power is radiated. This fact is well known to designers of particle accelerators, and is important in the design of large electron synchrotrons. That such radiation will occur can easily be seen by Fourier analysis of the current pulse (due to the electron) as a spectrum of sinusoidal current distributions running round the circle with a phase velocity equal to the electron velocity  $u$ . Since  $u$  is less than  $v$  (the velocity of light), the field due to a component with

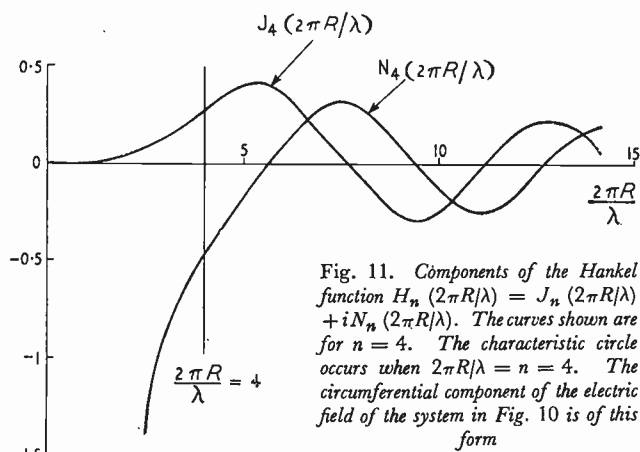


Fig. 11. Components of the Hankel function  $H_n(2\pi R/\lambda) = J_n(2\pi R/\lambda) + iN_n(2\pi R/\lambda)$ . The curves shown are for  $n = 4$ . The characteristic circle occurs when  $2\pi R/\lambda = n = 4$ . The circumferential component of the electric field of the system in Fig. 10 is of this form

wavelength  $\lambda$  will fall off in a direction away from the orbit, being substantially reduced in a distance  $\lambda/2\pi(\cos^2\theta - 1)^{1/2}$  where  $\cos \theta = v/u > 1$ ; c.f., the plane wave in Fig. 1 (b). If then the characteristic circle is nearer to the circle on which the electron moves than this, radiation will occur freely, if it is further away, little radiation will occur. A 'cut-off' therefore occurs at a wavelength given by

$$\lambda = \Delta R/2\pi(\cos^2\theta - 1)^{1/2} \quad \dots \quad (16)$$

where  $\Delta R$  is the radial distance between the two circles; this argument is only valid when the electron velocity is nearly equal to  $v$ , so that  $\Delta R \ll R$ . From geometrical considerations

$$\lambda/2\pi(\cos^2\theta - 1)^{1/2} = \Delta R = R(1 - u/v) \quad \dots \quad (17)$$

Now from Equ. (12),

$$u/v = \sec \theta \approx 1 - 1/2\gamma^2$$

whence Equ. (17) becomes

$$\lambda = \pi R/\gamma^3 \quad \dots \quad (18)$$

This is, therefore, the critical wavelength below which little radiation occurs. A full mathematical treatment of

this problem has been given by Schwinger<sup>15</sup>. Because of this cut-off, classical theory is a good approximation unless the circle is so small that its radius is of the same order as the de Broglie wavelength of the electron. Under these conditions, quantum mechanics must be used.

### Conclusion

The aim of this article has been to show how a physical understanding of the two forms of plane electromagnetic wave can give insight into a number of wave and radiation phenomena. Although it may appear trivial to some readers, it is hoped that it may be of value to those who think visually rather than in terms of formal relationships.

### Acknowledgement

I should like to thank Professor A. L. Cullen for several helpful suggestions and criticisms.

### REFERENCES

- <sup>1</sup> S. A. Schelkunoff, "The Impedance Concept", *Bell Syst. tech. J.*, 1938, Vol. 17, p. 17. Also "Electromagnetic Waves", Van Nostrand, 1943, Ch. 8.
- <sup>2</sup> H. G. Booker, "The Elements of Wave Propagation using the Impedance Concept", *J. Instn. elect. Engrs*, 1947, Vol. 94, Part 3, p. 181.
- <sup>3</sup> P. M. Woodward and J. D. Lawson, "The Theoretical Precision with which an Arbitrary Radiation-Pattern may be obtained from a Source of Finite Size", *J. Instn. elect. Engrs*, 1948, Vol. 95, Part 3, p. 363.
- <sup>4</sup> H. G. Booker and P. C. Clemmow, "The Concept of an Angular Spectrum of Plane Waves and its Relation to that of a Polar Diagram and Aperture Distribution", *Proc. Instn. elect. Engrs*, 1950, Vol. 97, Part 3, p. 11.
- <sup>5</sup> J. A. Stratton, "Electromagnetic Theory", 1941, McGraw-Hill, p. 450.
- <sup>6</sup> D. W. Fry and W. Walkinshaw, "Linear Accelerators", 1948, Reports in the Progress of Physics, No. 12, p. 102.
- <sup>7</sup> G. G. Macfarlane, "Surface Impedance of an Infinite Parallel Wire Grid at Oblique Angles of Incidence", *J. Instn. elect. Engrs*, 1946, Vol. 93, Part 3A, p. 1523.
- <sup>8</sup> G. Goubau, "Surface Waves and their Application to Transmission Lines", *J. appl. Phys.*, 1950, Vol. 21, p. 1119.
- <sup>9</sup> J. A. Stratton, "Electromagnetic Theory", 1941, McGraw-Hill, p. 359.
- <sup>10</sup> F. K. Goward, "An Improvement in End Fire Arrays", *J. Instn. elect. Engrs*, 1947, Vol. 94, Part 3, p. 415.
- <sup>11</sup> W. K. H. Panofsky and M. Phillips, "Classical Electricity and Magnetism", 1955, Addison-Wesley, p. 309.
- <sup>12</sup> J. D. Lawson, "On the Relation between Cherenkov Radiation and Bremsstrahlung", *Phil. Mag.*, 1954, Vol. 45, p. 748.
- <sup>13</sup> H. M. Barlow and A. L. Cullen, "Surface Waves", *Proc. Instn. elect. Engrs*, 1953, Part 3, p. 329.
- <sup>14</sup> L. J. Chu, "Physical Limitations of Omni-Directional Antennas", *J. appl. Phys.*, 1948, Vol. 19, p. 1163.
- <sup>15</sup> J. Schwinger, "On the Classical Radiation of Accelerated Electrons", *Phys. Rev.*, 1949, Vol. 75, p. 1912.

# Super-Gain Aerial Beam

## DERIVATION OF A CYLINDRICAL APERTURE DISTRIBUTION

By R. F. Kyle\*

SUMMARY. This article describes a method of deducing the distribution of field on a cylinder of any prescribed radius from a given distribution on a cylinder of infinite radius.

It has been the dream of designers for some years to produce an aerial with more gain than that obtained from an aperture with uniform illumination and constant phase. It has been demonstrated theoretically that aperture distributions to produce such super-gain aerials exist, but it has also been shown that the difficulties of feeding such an array are great and that the value of  $Q$  becomes very large. For apertures which are a fraction of a wavelength long, some degree of super gain is certainly practicable, as shown in the case of certain television aerials; however, this has not been demonstrated in the case where the aperture length is considerably in excess of one wavelength.

This article develops a method by which the amplitude and phase distribution around a cylinder of arbitrarily small diameter can be deduced from a radiation pattern of given shape. It was suggested by the late Dr. O. Bohm that the simplest theoretical approach to the problem of working back from the radiation pattern to the distribution over an aperture, is to consider the conditions around a closed surface. This eliminates the diffraction methods which are necessary when a line source is considered. A circular cylindrical surface is the simplest case to analyse and an expression for the field on any

radius can be deduced for the required radiation pattern at infinity.

### Theory

The horizontal radiation pattern of a circular cylinder whose axis coincides with the  $z$ -axis of the co-ordinate system is given by an expression of the form  $F(\theta)$ . The case considered in this note is where  $F(\theta) = \cos^2 m \theta$  and  $F(\theta)$  is taken as zero outside the range  $\theta = \pm \pi/2m$ . This represents a beam with no side-lobes and the voltage beam width is given by  $\phi = \pi/2m$ . The pattern is assumed to be uniphase.

The above expression can be expanded in the form of a Fourier series.

$$F(\theta) = \sum A_n \cos n \theta \quad \dots \quad \dots \quad \dots \quad \dots \quad (1)$$

$$\text{where } A_n = \frac{\phi \sin n \phi}{\pi n \phi} \frac{1}{1 - \left(\frac{n \phi}{\pi}\right)^2} \text{ and } \phi = \frac{\pi}{2m}$$

Any electromagnetic wave can be represented in cylindrical co-ordinates by

$$\psi = \sum a_n \exp(in\theta) H^{(1)}_n(r \sqrt{k^2 - h^2}) \exp(\pm ihz - i\omega t) \quad \dots \quad \dots \quad (2)$$

\* Admiralty Signal and Radar Establishment, Portsmouth. Hants.



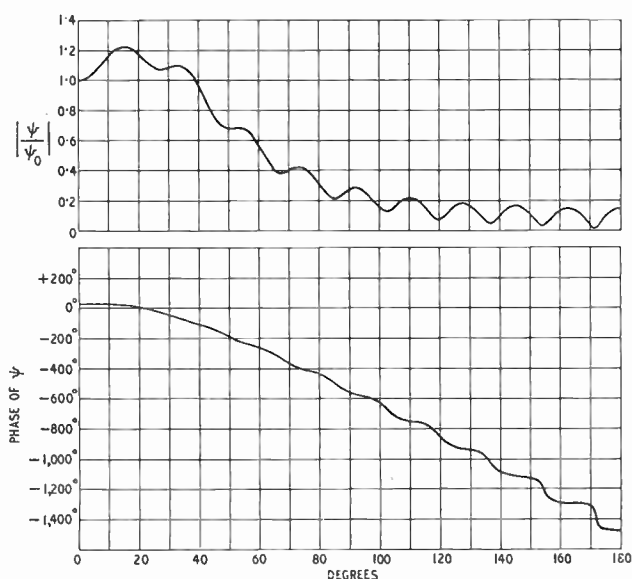


Fig. 1. Variation of amplitude and phase around cylinder of radius  $\frac{10\lambda}{2\pi}$

This represents a wave travelling outwards<sup>1</sup>. If it is assumed that  $h = 0$ , then the problem becomes a two-dimensional one and the radiation is purely radial. If it is further assumed that the distribution is symmetrical about  $\theta = 0$  and the term  $\exp(-i\omega t)$  is neglected then expression (2) reduces to

$$\psi = \sum a_n \cos n\theta H_n^{(1)}(kr) \quad \dots \quad (3)$$

where  $k = \frac{2\pi}{\lambda}$

It now remains to determine the coefficients  $a_n$  by identifying the expression (3) for large values of  $r$  with the assumed radiation pattern.

The asymptotic expression for  $H_n^{(1)}(kr)$  is

$$H_n^{(1)}(kr) = \sqrt{\frac{2}{\pi kr}} \exp(ikr) \exp\left[-\frac{2n+1}{4} \frac{\pi i}{2}\right]$$

As it is only the variation with  $\theta$  which is considered in the expression for the radiation pattern the terms in  $r$  and the constants which do not vary with the terms of the series can be neglected.

$$\therefore H_n^{(1)}(kr) = \left[ \sqrt{\frac{2}{\pi kr}} \exp(ikr) \exp\left(-\frac{\pi i}{4}\right) \right] \exp\left(-\frac{n\pi i}{2}\right)$$

From this we get  $a_n \exp\left(-\frac{n\pi i}{2}\right) = A_n \therefore a_n = i^n A_n$

Therefore for any value of  $r$ ,  $\psi = \sum i^n A_n \cos n\theta H_n^{(1)}(kr)$

### Particular Case

If the particular case of  $m = 5$  is taken in the above expressions the half-voltage beam width is  $18^\circ$ . The Fourier series is an infinite one but if it is terminated at the 11th term it is found that, instead of a main beam with no sidelobes, there are sidelobes approximately 19 dB down from the main beam and that the main beam is widened by about  $5^\circ$ .

It is obvious by considering this Fourier series that, in general, small changes of a few per cent in the amplitude

of one mode on the finite cylindrical surface will change the radiation pattern by a negligible amount.

The expression for the field amplitude and phase derived above have been computed around cylinders of circumference  $10\lambda$  and  $5\lambda$ , for the particular case  $m = 5$  and  $n = 0$  to 10; these are shown in Figs. 1 and 2. It is clear from these curves that the variations of amplitude which have to be set up around the smaller cylinder are extremely rapid and violent. The phase variation is steeper on the smaller cylinder.

### Impedance Considerations

If the case of a transverse magnetic field is considered and, as before, only the purely two-dimensional problem is taken, then there are two impedances in the directions of the transverse axes which can be defined.

$$Z_r = -\frac{E_z}{H_\theta} \text{ and } Z_\theta = \frac{E_z}{H_r}$$

where  $E_z = k^2 \psi$ ;  $H_r = -\frac{ik^2}{\omega\mu} \frac{1}{r} \frac{\delta\psi}{\delta\theta}$ ; and  $H_\theta = \frac{ik^2}{\omega\mu} \delta\psi$

$$\begin{aligned} \text{Hence } Z_\theta &= \frac{\omega\mu}{n} r, \quad Z_r = \frac{i\omega\mu}{k} H_n^{(1)}(\rho) \bigg/ \frac{\delta}{\delta\rho} H_n^{(1)}(\rho) \\ &= iZ_0 H_n^{(1)}(\rho) \bigg/ \frac{\delta}{\delta\rho} H_n^{(1)}(\rho) \end{aligned}$$

It is the radial impedance  $Z_r$  which is of practical significance and when

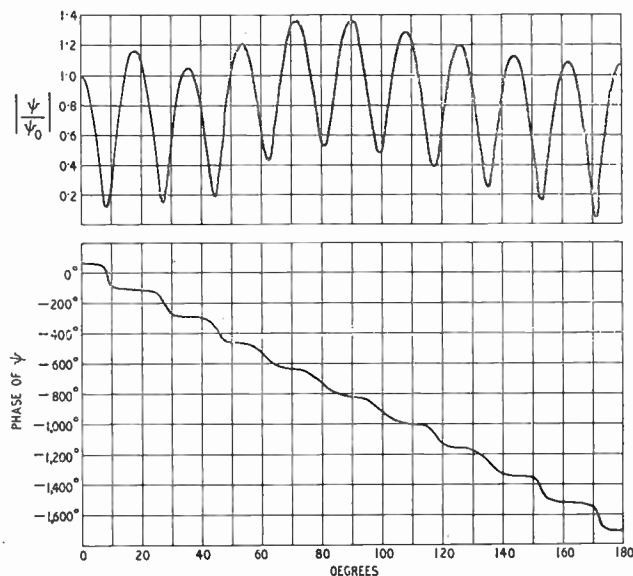
$$r \rightarrow \infty, H_n^{(1)}(\rho) \bigg/ \frac{\delta}{\delta\rho} H_n^{(1)}(\rho) \rightarrow \frac{1}{i}$$

Hence  $Z_r \rightarrow Z_0$

The values of  $Z_r$  for the separate modes on cylinders of circumference  $10\lambda$  and  $5\lambda$  are shown in Fig. 3. The most significant aspect of these graphs is that the resistive component drops to very low values for the higher modes on the smaller cylinder.

An estimate of the frequency sensitivity of the

Fig. 2. Variation of amplitude and phase around cylinder of radius  $\frac{5\lambda}{2\pi}$



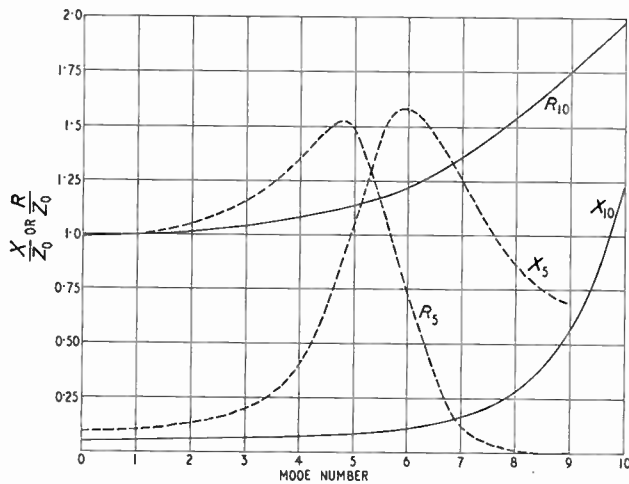


Fig. 3. Resistance and reactance of cylindrical modes

impedance has been calculated as being an alternative to the calculation of the  $Q$  and, as is to be expected, the variation is most for the higher modes. The percentage changes of resistance and reactance for a 1% change of frequency are given in Table 1.

TABLE 1

Percentage Change of Resistance and Reactance of the Individual Modes for a 1% Frequency Variation.

(A) Cylinder of Radius  $\frac{10\lambda}{2\pi}$

	$\frac{\Delta R}{R} \times 100$ %	$\frac{\Delta X}{X} \times 100$ %
$Z_0$	Zero	-1.0
$Z_1$	-0.0003	-1.01
$Z_2$	-0.03	-1.12
$Z_3$	-0.083	-1.33
$Z_4$	-0.16	-1.65
$Z_5$	-0.28	-2.12
$Z_6$	-0.46	-2.82
$Z_7$	-0.70	-3.80
$Z_8$	-1.02	-5.17
$Z_9$	-1.13	-6.78
$Z_{10}$	+0.77	-7.01

(B) Cylinder of Radius  $\frac{5\lambda}{2\pi}$

	$\frac{\Delta R}{R} \times 100$ %	$\frac{\Delta X}{X} \times 100$ %
$Z_0$	Zero	-0.9
$Z_1$	-0.008	-1.3
$Z_2$	-0.1	-1.5
$Z_3$	-0.29	-2.4
$Z_4$	-0.45	-3.6
$Z_5$	-0.9	-4.0
$Z_6$	8.0	0.44
$Z_7$	13.2	2.5
$Z_8$	15.5	2
$Z_9$	17.9	1.6
$Z_{10}$	20.3	1.4

### Conclusions—Further Problems

The problem of relating the properties of the individual dipoles or sources to the overall field round the cylinder has not been resolved. It is considered that any system of sources will be backed by a metal cylinder and the modifications which this produces in the field remain to be calculated, as does also the effect of considering a finite source system in place of the field independent of the  $z$  direction.

### Acknowledgement

The article is published by kind permission of the Admiralty.

### REFERENCE

<sup>1</sup> "Electromagnetic Theory" by J. A. Stratton. (McGraw-Hill Book Co.)

### STEPPING TRANSISTOR

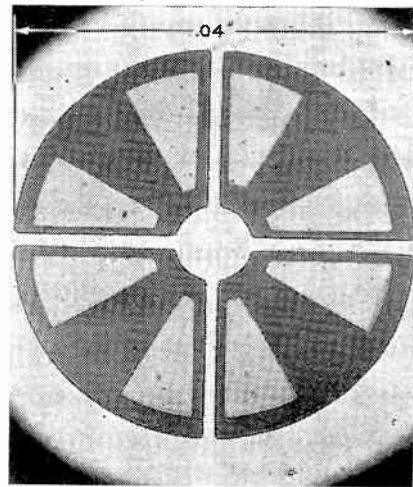
The development of a p-n-p-n semiconductor element that can serve as the basic building block of a silicon stepping transistor was recently announced by Bell Telephone Laboratories, U.S.A.

The four-terminal device acts as a pulse-controlled on/off switch and may be used as a basic stage in building certain logic circuits in digital computers. By using one element to drive two others, versatile decoders can be made.

A more complex device, which is fabricated from a single piece of silicon, can also perform the logic functions. An experimental prototype stepping transistor with four stages has been made.

The original object of the development was to produce a semiconductor device that would function in a similar way to a gas stepping tube (such as a Dekatron). The gas stepping tube utilizes the bistable voltage-current characteristic of a gas discharge for its operation. Unidirectional transfer of voltage between one anode and several cathodes is obtained by the non-symmetrical geometry of its construction.

The stepping transistor uses a p-n-p-n transistor as the bistable element. The design of the structure results in a bistable voltage-



A four-stage stepping transistor fabricated on a single piece of silicon.

current characteristic between a single common electrode and a set of multiple electrodes. Non-symmetrical geometry is employed to obtain a uni-directional transfer of voltage. Also, unlike the gas stepping tube, close proximity is not basically required in the stepping transistor.

The current level at which these devices are operated can be designed within the range 1 to 100 mA with supply voltages of 10 to 100 V.

Experimental models have been operated at speeds up to  $10^6$  pulses per second and it is expected that, with improved designs, they will operate even faster.

# Transistor High-Frequency Parameter $f_1$

ITS MEASUREMENT AND IMPLICATIONS

By L. G. Cripps, B.A.\*

**SUMMARY.** *The frequency at which the earthed-emitter short-circuit current gain has fallen to unity is a parameter of use in defining high-frequency characteristics of transistors. In this article the idea is discussed and the significance of the parameter explained. A method of measurement of use up to frequencies of the order of 200 Mc/s is also given. It is concluded that the parameter is sufficiently important for it to replace, at least partially, the alpha cut-off frequency, as a means of specifying the frequency performance of a transistor.*

A parameter which gives a qualitative idea of the high-frequency performance of a junction transistor (Fig. 1) is the frequency at which  $|\alpha'| = 1$ . It has not been widely used in the past since its connection with equivalent circuit parameters and other characteristics has not been well understood. The purpose of the present article is to discuss its more precise use as a means for obtaining quantitative results, in the way that the alpha cut-off frequency has been used in the past. The relations between the new parameter and quantities such as the alpha cut-off frequency are first considered, and a brief explanation is given of the effects of emitter depletion-layer capacitance. A method of measurement, alternative to one discussed by Pritchard<sup>1</sup> is also described. Certain of the results are shown to be virtually independent of any (constant) drift field which may be present in the base region of the transistor. Two papers have appeared recently which are related to the present article. Thomas and Moll<sup>2</sup> have given a general discussion of transistor current gain, and certain of their results are in accord with the ideas presented below. Appendix II of the paper by Thornton and Angell<sup>3</sup> compares a quantity  $f_T$  (almost identical with  $f_1$ ) with the alpha cut-off frequency.

Before proceeding with the main discussion it is convenient to prove a basic theorem, remarkable for its simplicity and for the fact that it does not seem to be very widely known. If we assume the internal alpha of a transistor to be represented by

$$\alpha = a - jb, \quad \dots \dots \dots (1)$$

where  $a$  and  $b$  are both real, then the quantity  $\alpha'$  ( $= \alpha/(1 - \alpha)$ ) will be given by

$$\alpha' = \frac{a - jb}{(1 - a) + jb}$$

If we then consider the particular condition

$$a = 1/2 \quad \dots \dots \dots (2)$$

we see that

$$\alpha' = \frac{1/2 - jb}{1/2 + jb} \text{ so that } |\alpha'| = 1. \quad \dots \dots (3)$$

Thus (2) and (3) are equivalent conditions, and we

may assert the theorem: the frequency at which  $|\alpha'| = 1$  is identical with the frequency at which  $\text{Re}(\alpha) = 1/2$ .

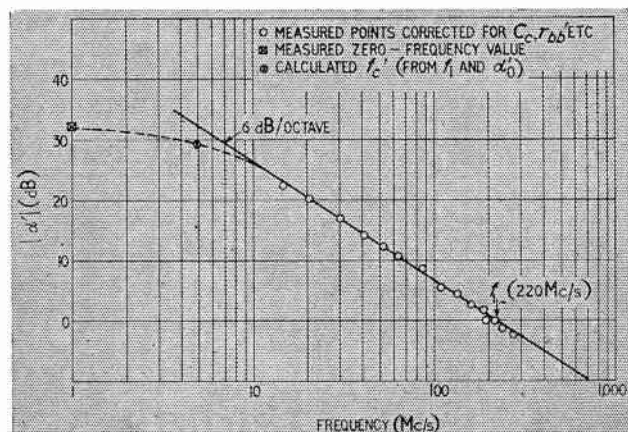
It should be noted that this result is quite general, and will apply to any device for which the quantities  $\alpha$  and  $\alpha'$  may be defined. It is independent of the form of the functions representing the behaviour of  $a$  and  $b$  with frequency, and is also independent of the low-frequency value of alpha ( $\alpha_0$ ). It will thus hold for the alpha of a transistor with a 'built-in' drift field, whatever the characteristics of that field.

## The Parameter $f_1$

We define  $f_1$  ( $= \omega_1/2\pi$ ) to be the frequency at which the real part of the internal alpha of the transistor has fallen to 6 dB below its low-frequency value:  $\text{Re}(\alpha)/\alpha_0 = 1/2$ . By the theorem just proved,  $f_1$  is almost, but not quite, the frequency at which  $|\alpha'| = 1$  (since  $\alpha_0$  is normally close to unity) and, for many practical purposes, the two frequencies may be taken to be the same; a discussion of the relation between them is given in the section describing the measurement of  $f_1$ .

It should be noted that by 'internal alpha' in the above definition is meant the alpha for the base trans-

Fig. 1. Measured curve of  $|\alpha'|$  against frequency for an experimental transistor



\* Mullard Research Laboratories.

mission process, after the effects of parasitic elements such as collector capacitance and series resistance, base resistance, etc., have been removed.

In the following, we shall consider the relation between  $f_1$  and the earthed-base and earthed-emitter cut-off frequencies, and the capacitance  $C_{b'e}$  in

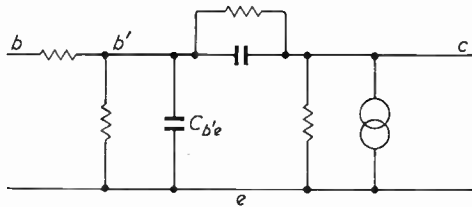


Fig. 2. Earthed-emitter hybrid- $\pi$  equivalent circuit for alloy junction transistors

the earthed-emitter hybrid- $\pi$  equivalent circuit (Fig. 2). Stephenson<sup>4</sup> has related  $f_1$  to physical rather than electrical quantities in a paper concerned with the effect of d.c. collector voltage. Winkel<sup>5</sup> has given a more complete discussion of the equivalent circuit of a drift transistor using  $f_1$ .

It has been shown<sup>6</sup> that the following expression is a good approximation for the alpha of a transistor with no drift field:

$$\alpha = \frac{\alpha_0 \exp(-j\Phi f/f_c)}{1 + jf/f_c} \quad \dots \quad (4)$$

Here  $\Phi$  is the phase angle (in radians) at the cut-off frequency  $f = f_c$ , referred to the radius  $\theta = -\pi/4$  (Fig. 3). It has a value  $\Phi = 0.22$ .

Winkel<sup>5</sup> has shown that Equ. (4) is also a good approximation if a uniform drift field is present, provided an appropriate value of  $\Phi$  is employed [see his equation (25) loc. cit.]. The range of validity of the equation is approximately  $0 \leq f \leq 2f_1$ , and  $\Phi$  takes values  $0.22 \leq \Phi \leq 1$ .

From Equ. (4) it is possible to obtain the relation between  $f_1$  and  $f_c$ , for various values of  $\Phi$ . If this is done it is found that, to a good approximation,

$$f_1 = f_c (1 + \Phi) \quad \dots \quad (5)$$

Equation (5) can also be inferred from Winkel's<sup>5</sup>

analysis, and the degree of approximation estimated.

Calculation of the behaviour of  $\alpha'$  from expression (4) for alpha gives

$$\alpha' = \frac{\alpha_0'}{1 + j\frac{f}{f_c} \cdot (1 + \Phi) (1 + \alpha_0')} \quad \dots \quad (6)$$

where

$$\alpha_0' = \frac{\alpha_0}{1 - \alpha_0}$$

The derivation of this equation has been given by Winkel, together with an indication of its range of validity. Crudely, it breaks down at frequencies of the order of  $f_1$ .

Two important results emerge. First,  $\alpha'$  follows the simple law, implying that  $|\alpha'|$  falls with increasing frequency at a rate asymptotically approaching 6 dB per octave, whatever the value of drift field. Experimental confirmation of this fact is given in Fig. 1. Secondly, the 3-dB down point is seen from Equ. (6) to occur when  $f/f_c (1 + \Phi) (1 + \alpha_0') = 1$ , so that, with  $f = f_c'$  at this point, we have, firstly

$$f_c' = \frac{f_c}{1 + \alpha_0'} \cdot \frac{1}{1 + \Phi} \quad \dots \quad (7)$$

and secondly, using (5),

$$f_c' = \frac{f_1}{1 + \alpha_0'} \quad \dots \quad (8)$$

in which the unpleasant quantity  $(1 + \Phi)$  has been removed. The value of  $f_c'$  calculated according to Equ. (8) is shown on the experimental curve of Fig. 1.

For alloy transistors it is well known that neglecting emitter depletion-layer capacitance, the capacitance  $C_{b'e}$  (see Fig. 2) is given by

$$C_{b'e} = 1.21/\omega_c r_e \quad \dots \quad (9)$$

If a uniform drift field is present, this expression becomes

$$C_{b'e} = (1 + \Phi)/\omega_c r_e \quad \dots \quad (10)$$

so that, using (5) we may write

$$C_{b'e} = 1/\omega_1 r_e \quad \dots \quad (11)$$

and again the quantity  $(1 + \Phi)$  has been removed. If there is appreciable emitter depletion-layer capacitance, this expression must be modified to

$$C_{b'e} = C_{ed} + 1/\omega_1 r_e \quad \dots \quad (12)$$

where  $\omega_1$  is an 'internal' quantity which differs from the measured value due to the presence of  $C_{ed}$ . An indication of the effect of  $C_{ed}$  on the measured  $f_1$  may be obtained by the following heuristic argument. We may equate the actual  $C_{b'e}$  to that which would be calculated from a measurement:

$$1/\omega_1 m r_e = C_{ed} + 1/\omega_1 r_e \quad \dots \quad (13)$$

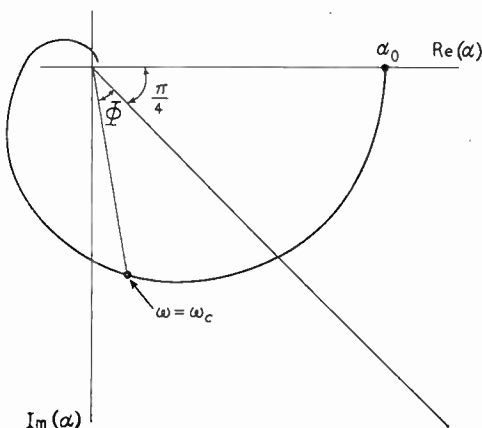
Writing  $r_e = kT/qI_e$

we have

$$1/\omega_1 m = 1/\omega_1 + (C_{ed} kT/q) (1/I_e) \quad \dots \quad (14)$$

Thus a graph of  $1/\omega_1 m$  against  $1/I_e$  should be a straight line of intercept  $1/\omega_1$  and slope  $C_{ed} kT/q$ . An experimental curve is shown in Fig. 4, which indicates that Equ. (14) is at least of the correct form. From the curve, values of  $f_1$  and  $C_{ed}$  were deduced.

Fig. 3. The angle  $\Phi$



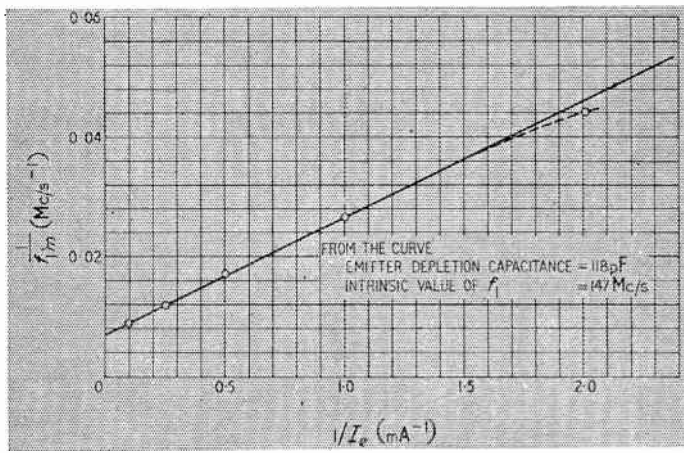
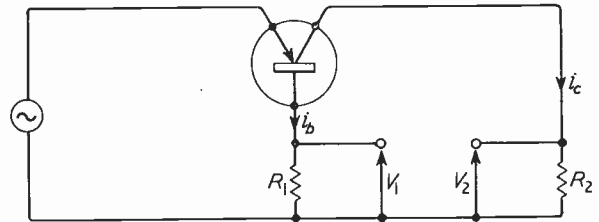


Fig. 4. Measured curve of  $1/f_{1m}$  against  $1/I_e$  for an experimental transistor

Fig. 5. Basic method of measuring  $f_1$



### Measurement of $f_1$

The quantity actually measured by the apparatus to be described is the frequency at which the modulus of the earthed-emitter current gain falls to unity. Correction for the effects of collector capacitance, base resistance and the external measuring circuit must be applied to the result to obtain the corresponding quantity for the 'intrinsic' transistor; that is, for the base transmission process. The corrected quantity then corresponds to the true value for  $|\alpha'| = 1$ , and therefore, for  $\text{Re}(\alpha) = 1/2$ , by the basic theorem proved earlier. To obtain  $f_1$ , for which by definition  $\text{Re}(\alpha) = \alpha_0/2$ , a second correction is necessary. The two corrections are discussed in detail in the Appendix. They correspond to similar corrections when measuring  $f_c$  by methods which yield the frequency at which  $|\alpha| = 1/\sqrt{2}$  rather than  $|\alpha| = \alpha_0/\sqrt{2}$ .

The basis of the method is shown in Fig. 5. A signal is fed to the emitter, and the voltages  $V_1$  and  $V_2$  developed across two small and equal resistors  $R_1$  and  $R_2$  included in series with the base and collector are observed by a single voltmeter which is connected alternately across the two resistors. The frequency of the generator is adjusted until the voltages  $V_1$  and  $V_2$  are equal in magnitude. Since  $R_1 = R_2$ , the generator setting corresponds to the frequency at which  $|i_c| = |i_b|$ . This measured frequency will be called  $f_{1m}$ .

The method has the advantage of being independent of the calibration accuracy of the voltmeter and is, in principle, capable of operation up to very high frequencies, provided the reactive parts of the impedance of  $R_1$  and  $R_2$  are balanced and are not too large. An amplitude-modulated signal generator may be employed, so that a wide-band voltmeter can be obtained by using a diode detector followed by amplification at the modulation frequency. Non-linearity of the detector at low levels is unimportant.

It should be noted that the equipment easily lends itself to the measurement of  $|\alpha'|$  at frequencies other than  $f_1$ , so that a curve of  $|\alpha'|$  against frequency may be obtained. The procedure is as follows. The detector is connected across  $R_1$  and the voltage  $V_1$  observed. The detector is then transferred to  $R_2$  and the input signal attenuated until the observed voltage  $V_2$  is the same as the voltage  $V_1$  observed in the first

position. The change of attenuator reading is then  $|\alpha'|$ . The curve of Fig. 1 was obtained by this technique.

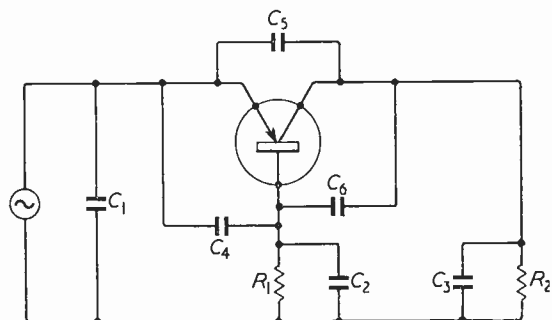
Before considering the detailed circuit, a number of factors affecting accuracy will be considered.

The requirements for the generator are twofold. First, its frequency calibration must clearly be accurate or should be checked against a standard. Secondly, the output waveform should be pure. This factor may be easily overlooked in this type of measurement, but results can be nullified if harmonics or audio frequency are presented, since the transistor will behave differently for these frequencies and for the fundamental.

As in all measurements of this type, the signal level employed must be small enough for transistor non-linear effects to be negligible. This condition can be achieved by reducing the signal level until no change of answer is obtained.

Ultimate accuracy depends upon the ease with which a small difference between the two signals  $V_1$  and  $V_2$  (Fig. 5) can be detected. Thus the detector used for these voltages must have good noise performance or the difference will be lost. Since the resistors  $R_1$  and  $R_2$  are only of the order of  $10 \Omega$  and therefore develop only small voltages, high sensitivity is also important. A receiver would be an obvious choice for the detector, but has the severe disadvantage of requiring retuning each time the generator frequency is adjusted. However, sufficiently good performance can normally be combined with the advantage of wide-band detection, by using

Fig. 6. Stray capacitances



a modulated signal, as described above, provided the amplifier following the detector is narrow-band.

The behaviour of the two measuring resistors  $R_1$  and  $R_2$  is of importance. It is easy to satisfy the condition  $R_1 = R_2$  at low frequencies (to an accuracy of 1 part in 1000, say), and the use of high-stability resistors ensures a reasonable permanence of the equality (occasional checking of the resistors is, of course, desirable). However, stray components become important at high frequencies and, since the resistances are low, series inductance becomes important at a much lower frequency than shunt capacitance. By using similar and similarly-arranged resistors the inductive effects of the loops associated with the resistors may be approximately balanced. Minor adjustment at high frequencies to the loops then allows a more accurate balance to be obtained. This may be done, with no transistor in circuit, by connecting a suitable impedance alternately between emitter and base terminals, and then emitter and collector terminals, and adjusting for equality of  $V_1$  and  $V_2$ .

The stray capacitances in the circuit are shown in Fig. 6.  $C_1$  may be neglected completely since it will not normally be high enough to limit the generator output. As explained above,  $C_2$  and  $C_3$  only become important at frequencies outside the range of the apparatus since the series inductance of  $R_1$  and  $R_2$  predominates.  $C_4$ ,  $C_5$  and  $C_6$  must be made small by screening the circuits associated with the three transistor terminals from each other.

Finally, there are the corrections which must be applied to the measured frequency to allow for the effects of resistors, and for the fact that  $\alpha_0 \neq 1$ . The derivation of the correction formula is given in the Appendix, the result being

$$f_1 = f_{1m} \left[ 1 + \omega C_e (r_{bb'} + R_1 + R_2) + \frac{2}{\alpha_0} \right] \quad \dots (15)$$

This correction formula is based on a simple equivalent circuit and the assumption that the correction is small. It may be necessary under some circumstances to use a more exact expression.

### Complete Measuring Circuit

The complete circuit is shown in Fig. 7 and will operate over the range 5–200 Mc/s. The signal is fed to the emitter via a d.c. blocking capacitor (1000 pF) and the emitter supply is connected via a decoupling circuit (1.5 k $\Omega$ , 1000 pF, 1.5 k $\Omega$ ). A path for the base direct current is provided by a 1.5-k $\Omega$  resistor, across which the 10  $\Omega$  measuring resistor is connected by a 1000-pF capacitor; a.c. coupling is used to avoid applying d.c. to the detector. A similar arrangement is used for the measuring circuit (1000 pF and 10  $\Omega$ ) at the collector, and the collector d.c. supply is connected through a decoupling network (1.5 k $\Omega$ , 1000 pF, 1.5 k $\Omega$ ) similar to that at the emitter. The 1.5-k $\Omega$  resistor in the base, and the 1.5-k $\Omega$  resistor in the collector decoupling network shunt the measuring resistors, but the shunting is small (less than 1%) and in any case the two effects almost cancel. The coupling capacities (1000 pF) to the 10  $\Omega$  measuring resistors are almost certainly inductive at the high-frequency

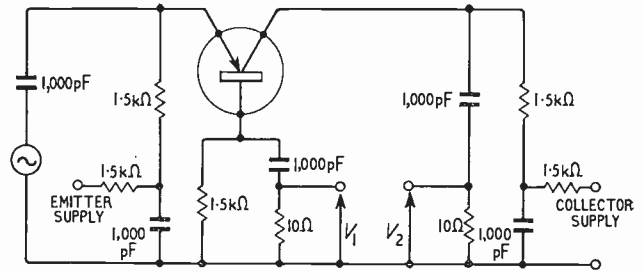


Fig. 7. Complete circuit of apparatus for measuring  $f_1$  over the range 5–200 Mc/s

end of the range, but their impedance will still be low and the effect small. Accuracy of measurement is probably better than 2% over most of the range [provided the correction formula (15) is applied] but the errors may rise slightly above, say, 180 Mc/s. The inductances associated with the two measuring resistors are balanced at 220 Mc/s and the balance then holds over the entire range of the apparatus. The curve of Fig. 1 was obtained using the apparatus described. It should be noted that the application of the correction formula (15) changed the observed value of  $f_1$  for the particular transistor used by about 10%, and altered the slope of the curve from 6.4 dB/octave to 6.0 dB/octave.

### Conclusions

The two conditions  $|\alpha'| = 1$  and  $\text{Re}(\alpha) = 1/2$  are equivalent, and the equivalence is independent of the behaviour of alpha. The result is thus independent of any drift field which may be present. The frequency at which these conditions are satisfied may be called  $f_{1m}$ .

A more convenient parameter for analysis is  $f_1$ , which is the frequency for  $\text{Re}(\alpha) = \alpha_0/2$ . It may easily be obtained from  $f_{1m}$  [for which  $\text{Re}(\alpha) = 1/2$ ] by applying a small correction.  $f_1$  is related to well-known parameters by the expressions

$$\begin{aligned} f_1 &= f_c / (1 + \Phi) \\ f_1 &= f_c' (1 + \alpha_0') \\ C_{b'e} &= 1 / \omega_1 r_e \end{aligned}$$

Emitter depletion capacitance may be related to  $C_{b'e}$  and  $\omega_1$  by the expression

$$C_{b'e} = C_{ed} + 1 / \omega_1 r_e,$$

which leads to a simple means of measuring  $C_{ed}$ .

Measurement of  $f_1$  may be easily carried out, to an accuracy of about 2%, up to frequencies of the order of 200 Mc/s.

The conclusion from the work described here is that  $f_1$  is a more attractive parameter than  $f_c$  for many purposes, in that it is convenient to measure, and has more direct application to equivalent circuits. It is therefore desirable that  $f_1$  should replace, or at least supplement,  $f_c$  wherever possible.

### Acknowledgements

The author is indebted to several of his colleagues for suggestions and assistance. In particular, Mr.

L. P. Morgan first suggested the basic method of measuring  $f_1$ ; Mr. J. B. Rodgers designed, constructed and checked the measuring equipment; Mr. M. J. Gay carried out the original calculations of errors introduced by  $C_c$ ,  $r_{bb'}$ , and external resistors; and Mr. W. L. Stephenson pointed out the method of estimating  $\omega_1$  and  $C_{ed}$  from measurements at various currents. The author also wishes to thank the Directors of Mullard Ltd., and the Director of the Mullard Research Laboratories for permission to publish this paper.

### APPENDIX

Calculation of a Correction Formula for the Effects of  $C_c$ ,  $r_{bb'}$ , Measuring Resistors, and  $\alpha_0$ .

The analysis will be carried out in two parts, the effect of  $\alpha_0$  being treated separately from the remaining effects.

Assuming the equivalent circuit of Fig. 8, in which the section enclosed by a dotted line represents the transistor and writing  $1/j\omega C_c = -jX_c$ , then we have

$$I_b [r_{bb'} + R_1] = [I_c (1 - \alpha) - \alpha I_b] [-jX_c] + I_c R_2$$

If suffix  $m$  is used to denote a measured quantity we thus have, after rearrangement,

$$|\alpha'|_m = \left| \frac{I_c}{I_b} \right| = \left| \frac{r_{bb'} + R_1 - j\alpha X_c}{R_2 - jX_c(1 - \alpha)} \right| \dots \dots \dots (16)$$

With  $\alpha = a - jb$ , this becomes

$$|\alpha'|_m = \frac{|\omega C_c (r_{bb'} + R_1) - ja - b|}{|\omega C_c R_2 - j(1 - a) + b|}$$

$$= \sqrt{\frac{\omega^2 C_c^2 (r_{bb'} + R_1)^2 + b^2 - 2b\omega C_c (r_{bb'} + R_1) + a^2}{\omega^2 C_c^2 R_2^2 + b^2 + 2b\omega C_c R_2 + (1 - a)^2}}$$

The true value is given by

$$|\alpha'| = \left| \frac{\alpha}{1 - \alpha} \right| = \left| \frac{a - jb}{1 - a + jb} \right| = \sqrt{\frac{a^2 + b^2}{(1 - a)^2 + b^2}}$$

Hence

$$\left| \frac{\alpha'|_m}{\alpha'} \right| = \sqrt{1 - \frac{2b}{a^2 + b^2} \cdot \omega C_c (r_{bb'} + R_1) + \frac{\omega^2 C_c^2 (r_{bb'} + R_1)^2}{a^2 + b^2}}$$

$$\sqrt{1 + \frac{2b}{(1 - a)^2 + b^2} \cdot \omega C_c R_2 + \frac{\omega^2 C_c^2 R_2^2}{(1 - a)^2 + b^2}}$$

We now assume that the effect of  $C_c$  etc. is small so that

$$\frac{\omega C_c (r_{bb'} + R_1)}{\omega C_c R_2} \ll 1$$

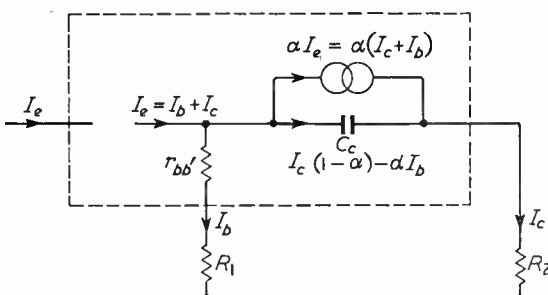
Expanding by the binomial theorem and neglecting second-order terms we have

$$\left| \frac{\alpha'|_m}{\alpha'} \right| \approx \left[ 1 - \frac{b}{a^2 + b^2} \cdot \omega C_c (r_{bb'} + R_1) \right] \left[ 1 - \frac{b}{(1 - a)^2 + b^2} \omega C_c R_2 \right]$$

$$\approx 1 - b\omega C_c \left[ \frac{r_{bb'} + R_1}{a^2 + b^2} + \frac{R_2}{(1 - a)^2 + b^2} \right]$$

To obtain a true correction factor it is necessary to know the values of both  $a$  and  $b$ . We know  $a$  is of the order of 0.5 and it is a reasonable approximation to take the same value for  $b$ . Thus we assume  $a = b = 0.5$

Fig. 8. Circuit for analysis of effect of  $C_c$ ,  $r_{bb'}$  and external resistors



so that

$$\left| \frac{\alpha'|_m}{\alpha'} \right| \approx 1 - \omega C_c (r_{bb'} + R_1 + R_2)$$

or  $|\alpha'| \approx |\alpha'|_m [1 + \omega C_c (r_{bb'} + R_1 + R_2)]$

$$= 1 + \omega C_c (r_{bb'} + R_1 + R_2) \dots \dots \dots (17)$$

if  $|\alpha'|_m = 1$

Taking the approximation

$$\alpha' = \frac{\alpha_0'}{1 + jff_c'}$$

then  $|\alpha'| = \frac{\alpha_0'}{\sqrt{1 + (ff_c')^2}}$

At frequencies of the order of  $f_1$ , we have  $ff_c' \gg 1$ . Hence,

$$|\alpha'| \approx \alpha_0' f_c' / f$$

so that

$$\frac{d|\alpha'|}{df} = -\alpha_0' f_c' / f^2 = -|\alpha'| / f.$$

Thus, since

$$\Delta |\alpha'| = \frac{d|\alpha'|}{df} \Delta f$$

we have

$$\frac{\Delta |\alpha'|}{|\alpha'|} = -\frac{\Delta f}{f}$$

Thus if  $|\alpha'|$  is measured to be  $x\%$  too high, the frequency is  $x\%$  too low. Hence, using Equ. (17), the correction formula is

$$f_1 = f_{1m} [1 + \omega C_c (r_{bb'} + R_1 + R_2)] \dots \dots \dots (18)$$

A more accurate result requires a knowledge of  $a$  and  $b$  so that a bridge or other method of measurement is necessary enabling the real and imaginary parts of  $\alpha$  to be found.

The effect of  $\alpha_0$  may be calculated as follows. Provided  $\alpha_0$  is not too different from unity, only a small correction is necessary to obtain the true value of  $f_1$ . Thus, an approximate expression for  $\alpha$  is justified:

$$\alpha = \frac{\alpha_0}{1 + jff_c} \dots \dots \dots (19)$$

Then  $\text{Re}(\alpha) = \frac{\alpha_0}{1 + (ff_c)^2}$

Hence

$$\frac{d\text{Re}(\alpha)}{df} = -\frac{\alpha_0}{[1 + (ff_c)^2]^2} \cdot 2f$$

$$= -\frac{\text{Re}(\alpha)}{1 + (ff_c)^2} \cdot \frac{2f}{f_c^2}$$

Now

$$\Delta \text{Re}(\alpha) = \frac{d\text{Re}(\alpha)}{df} \cdot \Delta f$$

Thus

$$\frac{\Delta \text{Re}(\alpha)}{\text{Re}(\alpha)} = -\frac{\Delta f}{f} \cdot \frac{2(ff_c)^2}{1 + (ff_c)^2}$$

$$= -\frac{\Delta f}{f} \cdot \frac{2 \left[ \frac{f}{f_1(1 + \Phi)} \right]^2}{1 + \left[ \frac{f}{f_1(1 + \Phi)} \right]^2}$$

Thus, at  $f = f_1$

$$\frac{\Delta \text{Re}(\alpha)}{\text{Re}(\alpha)} = -\frac{\Delta f}{f} \cdot \frac{2 \left[ \frac{1}{1 + \Phi} \right]^2}{1 + \left[ \frac{1}{1 + \Phi} \right]^2}$$

If  $\Phi = 0.2$ ,

$$\frac{\Delta \text{Re}(\alpha)}{\text{Re}(\alpha)} = -\frac{\Delta f}{f} \cdot 0.82$$

If  $\Delta = 1.0$

$$\frac{\Delta \text{Re}(\alpha)}{\text{Re}(\alpha)} = -\frac{\Delta f}{f} \cdot 0.40$$

Thus a reasonable compromise, approximately valid for all values of  $\Phi$ , would appear to be

$$\frac{\Delta \text{Re}(\alpha)}{\text{Re}(\alpha)} = -\frac{\Delta f}{f} \cdot \frac{1}{2} \dots \dots \dots (20)$$

[Of course, if the value of  $\Phi$  is known, a more accurate figure can be taken, but there would be little point in doing this since the initial equation (19) is not accurate in any case.]

Equ. (20) means that a small change  $x\%$  in  $\text{Re}(\alpha)$  corresponds to a change  $(-2x)\%$  in frequency. The percentage change in  $\text{Re}(\alpha)$  in passing from the measured point  $\text{Re}(\alpha) = 1/2$  to the required point  $\text{Re}(\alpha) = \alpha_0/2$  is a decrease of  $(1 - \alpha_0) \times 100\%$ . Thus the change in frequency, by Equ. (20), is an increase of  $2(1 - \alpha_0) \times 100\%$ . Thus the correction formula is

$$f_1 = f_{1m} [1 + 2(1 - \alpha_0)]$$

$$\approx f_{1m} \left[ 1 + \frac{2}{\alpha_0} \right] \dots \dots \dots (21)$$

The approximation breaks down at high values of  $\Phi$  since Equ. (19) is then no longer valid. However, since the correction

is small, Equ. (21) may be sufficiently accurate for most purposes. Combining Equs (18) and (21), neglecting second-order corrections, gives

$$f_1 = f_{1m} \left[ 1 + \omega C_c (\tau_{bb'} + R_1 + R_2) + \frac{2}{\alpha_0} \right] \dots \dots (22)$$

### REFERENCES

- <sup>1</sup> R. L. Pritchard, "Transistor Tests Predict High Frequency Performance", *Electronic Ind. Tele-Tech.*, March 1957, Vol. 16, No. 3, p. 62.
- <sup>2</sup> D. E. Thomas and J. L. Moll, "Junction Transistor Short-Circuit Current Gain and Phase Determination", *Proc. Inst. Radio Engrs.*, June 1958, Vol. 46, p. 1177.
- <sup>3</sup> C. G. Thornton and J. B. Angell, "Technology of Micro-Alloy Diffused Transistors", *Proc. Inst. Radio Engrs.*, June 1958, Vol. 46, p. 1166.
- <sup>4</sup> W. L. Stephenson, "Transistor Cut-off Frequency", *Electronic & Radio Engr.*, February 1958, Vol. 35, No. 2, p. 69.
- <sup>5</sup> J. te Winkel, "Drift Transistor", *Electronic & Radio Engineer.* August 1959, p. 280.
- <sup>6</sup> R. L. Pritchard, "Electric-Network Representation of Transistors—A Survey", *Trans. Inst. Radio Engrs (Circuit Theory)*, March 1956, Vol. CT-3, No. 1.

## Hydrogen-Oxygen Fuel Cell

For over one hundred years, engineers and scientists have been endeavouring to produce a practical fuel cell. First envisaged in the early part of the nineteenth century by Sir William Grove, a form of fuel cell was produced by the end of that century, but lack of materials and technology prevented its further development.

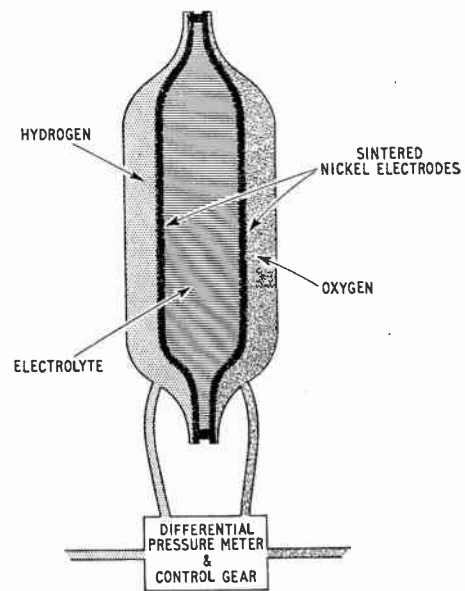
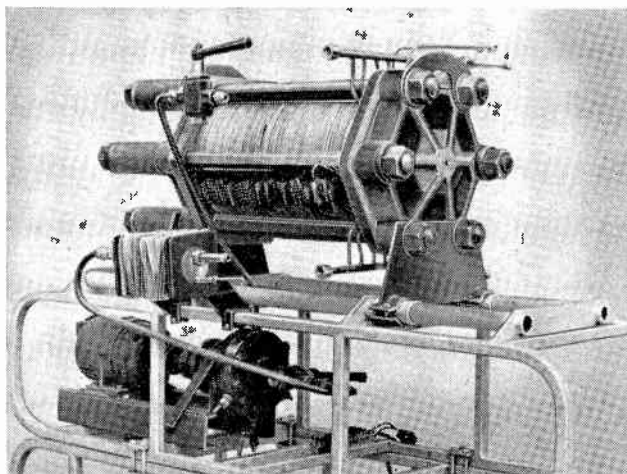
Now, a team working in Cambridge under the sponsorship of the National Research and Development Corporation and led by F. T. Bacon, M.A., A.M.I.Mech.E., has produced a cell capable of delivering an output of 5 kW at 24 V.

A 'Fuel Cell' is an electro-chemical device in which the free energy of combustion of a fuel is converted directly into electrical energy. It operates by a simple reversal of the process of electrolysis of water.

The one now produced consists of 40 cells, 10 in. diameter and approximately 30 in. long; each cell consists of two porous sintered-nickel electrodes, one for hydrogen and the other for oxygen, separated by an electrolyte. The oxygen electrode is treated with lithium and pre-oxidized to prevent corrosion. The electrolyte is a strong caustic potash and working conditions are around 200° C and 400 p.s.i. The electrolyte soaks into the porous electrodes but, on the application of gas under pressure from the back of the plate, is expelled from the larger pores; the gas cannot bubble through the smaller-pored surface due to the surface tension of the liquid. Thus, there is a very large surface of wetted metal in contact with gas in each electrode (about forty square metres).

Oxygen molecules on the oxygen electrode combine with water to form negatively charged hydroxyl ions, each of which removes an electron from the oxygen electrode. The hydroxyl ions migrate through the electrolyte to the hydrogen electrode where they combine with the hydrogen to form water, depositing an electron in the process. Thus the hydrogen electrode becomes negative with respect

*A forty-cell battery with the hydrogen circulator and condenser for water removal mounted underneath*



*Simplified schematic diagram of fuel cell*

to the oxygen electrode and, if a load is connected, current flows in the external circuit.

In order to remove the water formed, the hydrogen is circulated past the back of the hydrogen electrodes and the mixture of hydrogen and steam is cooled externally, so that the condensate can be released as required.

The pressure of the two gases in the cell must be very evenly balanced; to ensure this, a control system is incorporated to keep the oxygen pressure constant and to control the hydrogen pressure against it by a very accurate differential pressure meter which actuates a power-operated inlet valve controlled by a servo-mechanism.

In its present form, the hydrogen-oxygen fuel cell has reached the second stage of development and is now approaching the commercial proposition of a completely automatic source of power. Before this can be accomplished there are several problems to be solved, including the reduction in size of the control gear and the pre-heating of the cell.

When operating, the cell generates heat that can be used to keep the cell at its optimum operating temperature but, for starting, it is necessary to supply heat from an external source.

In its commercial form the cell will have to be provided with some means of pre-heating. This could be supplied by a secondary source of power, such as an accumulator or, alternatively, on off-load condition the cell could be made to 'tick over' by supplying current to a pre-heating element. Up to the present time this problem has not been solved.



## Cancel with Care

**F**ig. 1 shows an equivalent circuit for a transformer which has unity ratio, at frequencies sufficiently high for the shunting effect of the primary and secondary inductances to be negligible. Leakage inductance is represented by  $L$  and the primary and secondary capacitances by  $C_1$  and  $C_2$ ; these represent internal as well as external capacitances. The resistances  $R_1$  and  $R_2$  are mainly the source and load resistances, but can be taken to include also shunt losses in the transformer.

A constant current  $I$  is supplied, and the resulting secondary voltage  $V_0$  is easily obtained in the form

$$\frac{IR}{V_0} = 1 - \omega^2 T_1^2 (1+b)d + j\omega T_1 \left( \frac{1+ab}{1+a} + d - \omega^2 T_1^2 bd \right) \quad \dots (1)$$

where

$$\left. \begin{aligned} R &= \frac{R_1 R_2}{R_1 + R_2}, \quad T_1 = C_1 R_1, \quad a = R_1 / R_2 \\ b &= C_2 R_2 / C_1 R_1, \quad d = L / C_1 R_1 (R_1 + R_2) \end{aligned} \right\} \dots (2)$$

The magnitude of  $IR/V_0$ , say  $1/G$ , is therefore given by

$$\frac{1}{G^2} = 1 + \omega^2 T_1^2 \{ (x+d)^2 - 2d(1+b) \} + \omega^4 T_1^4 \{ d^2(1+b)^2 - 2bd(x+d) \} + \omega^6 T_1^6 b^2 d^2 \quad \dots (3)$$

$$\text{where } x = \frac{1+ab}{1+a} \quad \dots (4)$$

For maximal flatness we require the coefficients of  $\omega^2 T_1^2$  and  $\omega^4 T_1^4$  to be zero, so that

$$(x+d)^2 = 2d(1+b) \quad \dots (5)$$

$$d^2(1+b)^2 = 2bd(x+d) \quad \dots (6)$$

Now if  $b = d = x = 1$  it is easily verified that Eqs. (5) and (6) are both true, but when  $b = 1$ , Equ. (4) tells

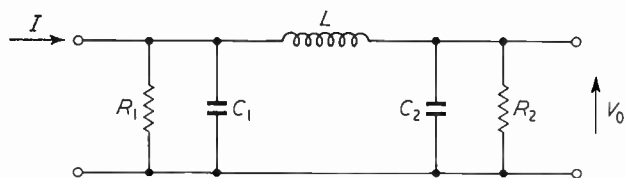


Fig. 1. An equivalent circuit for a unity-ratio transformer at high frequencies

us that  $x$  must be 1 whatever the value of  $a$  may be. Physically,  $b = 1$  means that the time constants  $C_1 R_1$  and  $C_2 R_2$  are equal. In a practical case we might have  $R_1 = 20 \text{ k}\Omega$ ,  $R_2 = 5 \text{ k}\Omega$ ,  $C_1 = 100 \text{ pF}$ ,  $C_2 = 400 \text{ pF}$  and  $L = 50 \text{ mH}$ ;  $a$  then has the value 4 and  $b = d = 1$ , the time constants  $C_1 R_1$  and  $C_2 R_2$  being  $2 \mu\text{sec}$ .

Now let us consider the general case. In Eqs. (5)

$$a = \frac{(1+b)^3 - 4b(1+b^2)}{4b(1+b^2) - b(1+b)^3} = \frac{1-b+3b^2-3b^3}{b\{3-3b+b^2-b^3\}} = \frac{(1-b)(1+3b^2)}{b(1-b)(3+b^2)} \quad (13)$$

and (6) the quantities  $b$ ,  $d$  and  $x$  are all real, positive and finite. The obvious way to proceed is to eliminate  $x$  [or rather  $(x+d)$ ] by squaring both sides of Equ. (6) and substituting from Equ. (5); this gives

$$(1+b)^4 d^4 = 4b^2 d^2 \cdot 2d(1+b) \quad \dots (7)$$

At this point we must note carefully that Equ. (7) could not only be obtained from Eqs. (5) and (6) as they stand, but would also be obtained if Equ. (6) had been

$$d^2(1+b)^2 = -2bd(x+d) \quad \dots (8)$$

Equ. (8) is fortunately irrelevant to our present investigation, because  $b$ ,  $d$  and  $x$  are positive, but when squaring has to be done in order to solve equations, it is most important that all solutions obtained are checked in the original equations, because a solution of Equ. (7) could have been a solution of Eqs. (5) and (8) instead of a wanted solution of Eqs. (5) and (6).

Returning to Equ. (7), we can be quite sure that  $(1+b)$  and  $d^3$  are different from zero, and therefore may be cancelled to give

$$d = \frac{8b^2}{(1+b)^3} \quad \dots (9)$$

Substituting from Equ. (8) to Equ. (5), we may also safely cancel a  $d$  and divide through by  $b$  to obtain

$$x = \frac{(1+b)^2 d}{2b} - d = \frac{4b(1+b^2)}{(1+b)^3} \quad \dots (10)$$

and we can easily verify that these values of  $x$  and  $d$  satisfy the original Eqs. (5) and (6), whatever the value of  $b$  may be. We have, however, already seen that although Equ. (4) is apparently a relation between  $x$  and  $a$ , it reduces to  $x = 1$  (which is independent of  $a$ ) when  $b = 1$ . Let us therefore try and express  $a$  in terms of  $x$  from Equ. (4) and see how the result is affected by putting  $b = 1$ .

Multiplying through Equ. (4) by the safely positive quantity  $(1+a)$ , we have

$$\begin{aligned} (1+a)x &= 1+ab \\ \therefore a(x-b) &= 1-x \quad \dots (11) \end{aligned}$$

Now provided that  $x$  is not equal to  $b$ , we can deduce from Equ. (11)

$$a = \frac{1-x}{x-b} \quad \dots (12)$$

Substituting from Equ. (10) for  $x$ , we can safely multiply numerator and denominator by  $(1+b)^3$  to clear cumbersome fractions, and we thus obtain

Provided that  $b$  is not equal to 1, Equ. (13) yields

$$a = \frac{1 + 3b^2}{b(3 + b^2)} \quad \dots \quad (14)$$

by cancelling the factor  $(1 - b)$ . If, however,  $b$  is equal to 1, we have already seen that  $x$  has the required value 1 whatever the value of  $a$  may be.

We have also noted that Equ. (12) is not valid when  $x = b$ ; Equ. (11) in this special case tells us that  $x = 1$ . There is thus only one special case, when both  $x$  and  $b$  are equal to 1.

In order to understand the peculiarities of the special case, let us consider first what happens for a general value of  $b$  if we are content to allow a small tolerance in the value of  $x$ , so that we accept  $x_1$  as sufficiently near the required value of  $x$  given by Equ. (10), where

$$x_1 = \frac{4b(1 + b^2)}{(1 + b)^3} (1 + \lambda) \quad \dots \quad (15)$$

If we think of  $\lambda$  as 0.01, this means that we are prepared to tolerate a 1% excess in  $x$ ; if  $\lambda$  is -0.01, we are prepared to tolerate a 1% deficiency. When we allow  $x$  to be replaced by  $x_1$ , we must correspondingly replace  $a$  by  $a_1$  where

$$x_1 = \frac{1 + a_1 b}{1 + a_1} \quad \dots \quad (16)$$

Multiplying through Equ. (16) by  $(1 + a_1)$  [which is positive in cases of practical interest] and rearranging, we have

$$a_1 (x_1 - b) = 1 - x_1 \quad \dots \quad (17)$$

In order to obtain a usable value of  $a_1$  from Equ. (17), we must adjust  $\lambda$  so that  $x_1$  is between  $b$  and 1 [if  $b = 1$ , Equ. (17) simply tells us that  $x_1 = 1$  since  $a_1$  cannot usefully be  $-1$ , and Equ. (15) then tells us that  $\lambda$  is necessarily zero. No tolerance is thus required, and  $a_1$  reduces to  $a$ , which, as we have already seen, can have any value in this case]. If  $b$  exceeds 1,  $(1 - x_1)$  and  $(x_1 - b)$  will both be negative, so that a useful, positive value of  $a_1$  is obtained; if  $b$  is less than 1,  $x_1 - b$  and  $(1 - x_1)$  will both be positive, so that again a useful value of  $a_1$  is obtained. In either case we can find an explicit formula for  $a_1$  from Equ. (17) by dividing through by  $(x_1 - b)$ . If we then substitute for  $x_1$  from Equ. (15), we have

$$a_1 = \frac{1 - x_1}{x_1 - b} = \frac{(1 - b)(1 + 3b^2) - 4\lambda b(1 + b^2)}{b(1 - b)(3 + b^2) + 4\lambda b(1 + b^2)} \quad \dots \quad (18)$$

The position we have now reached is that if we require exact maximal flatness in the general case ( $b \neq 1$ ) we must make  $R_1/R_2$  have the value  $a$  given by Equ. (14). Nevertheless, if we are prepared to tolerate a slight departure from maximal flatness (measured by the quantity  $\lambda$  defined in Equ. (15)) we can allow  $R_1/R_2$  to have instead the value  $a_1$  given by Equ. (18).  $\lambda$  must necessarily be small, or the variation of  $G$  with frequency [Equ. (3)] will be excessive. If therefore  $(1 - b)$  is not small, whether it is positive or negative,  $a_1$  will not be very different from  $a$ . On the other hand, if  $(1 - b)$  is comparable with  $\lambda$ ,  $a_1$  can be very different from  $a$ . Suppose, for example, that  $b = 0.99$ . Then Equ. (18) reduces to

$$a_1 = \frac{0.0394 - 7.8412\lambda}{0.0394 + 7.8412\lambda} \quad \dots \quad (19)$$

and therefore if  $\lambda$  is just below +0.005,  $a_1$  is small and positive, while if  $\lambda$  is just above (i.e. nearer zero than) -0.005,  $a_1$  is very large. Hence although the value of  $a$  for maximal flatness is in this case very close to unity [from Equ. (14) with  $b = 0.99$  or Equ. (19) with  $\lambda = 0$ ]  $\lambda$  will not numerically exceed 0.005 for any value of  $R_1/R_2$ , so that the error in  $x$  will not exceed  $\frac{1}{2}\%$  and there will be very little change of  $G_1$  with frequency whatever the value of  $R_1/R_2$  may be. Correspondingly, if we put  $(1 - \epsilon)$  for  $b$  in Equ. (18) and neglect  $\epsilon^2$  and  $\epsilon\lambda$ , Equ. (18) reduces to

$$a_1 = \frac{\epsilon - 2\lambda}{\epsilon + 2\lambda} \quad \dots \quad (20)$$

and, therefore, although the correct value for maximal flatness is found from Equ. (14) to be unity,  $\lambda$  will only lie between  $+\frac{1}{2}\epsilon$  [ $R_1 \ll R_2$ ,  $a_1$  small] and  $-\frac{1}{2}\epsilon$  [ $R_1 \gg R_2$ ,  $a_1$  large] whatever the value of  $a_1$  may be.

If  $\frac{1}{2}\epsilon$  numerically exceeds the greatest value of  $|\lambda|$  that can be tolerated, say  $\lambda_0$ , then Equ. (20) shows that  $a_1$  can only be varied between finite limits which include the value given by Equ. (14); in fact

$$\frac{|\epsilon| - 2\lambda_0}{|\epsilon| + 2\lambda_0} < a_1 < \frac{|\epsilon| + 2\lambda_0}{|\epsilon| - 2\lambda_0} \quad \dots \quad (21)$$

and, as we have already noted, if  $|\epsilon|$  is large compared to  $\lambda_0$  [though still sufficiently small to justify the neglect of  $\epsilon^2$  and  $\epsilon\lambda$  in deriving Equ. (20)]  $a_1$  differs little from the value unity obtained for  $a$  in Equ. (14) neglecting  $\epsilon^2$ . If  $\epsilon^2$  cannot be neglected, we must, of course, use Equ. (18) instead of Equ. (20), but the result is still essentially the same— $a_1$  does not differ appreciably from  $a$  if the error in  $x$  is to be kept within the prescribed tolerance.

Thus the apparently anomalous case when  $b = 1$  is now seen in its proper perspective as a limiting case. The value  $a_0$  of  $a$  obtained from Equ. (14) after the factor  $(1 - b)$  is cancelled always gives maximal flatness, and if  $(1 - b)$  is not small (whether positive or negative) we cannot vary  $a$  appreciably from  $a_0$  without seriously disturbing the constancy of  $G_1$  with respect to frequency. If  $(1 - b)$  is small, but of the same order of magnitude as the maximum relative discrepancy in  $x$  that can be tolerated,  $a_0$  is still the correct value of  $a$  for maximal flatness, but considerable variation of  $a$  can be permitted without seriously disturbing the constancy of  $G$ . When  $(1 - b)$  is very small, even the variation of  $a$  from 0 to  $\infty$  will have so little effect on the value of  $x$ , that the maximal flatness is virtually independent of  $a$ . When  $b$  is actually 1, we simply proceed to the limit so that the maximal flatness is completely independent of the value of  $a$ , and no tolerance in the value of  $x$  is required.

## U.S. ELECTRONICS

The 6th National Symposium on Reliability and Quality Control in Electronics will be held at the Statler Hilton Hotel, Washington, D.C. from 11th to 13th January 1960. Information regarding the submission of papers and attendance at the Symposium may be obtained from Mr. R. Brewer of the Research Laboratories, The General Electric Co. Ltd., Wembley, Middlesex. (Arnold 1262).

# Coaxial-Cable Performance

## DETERMINATION OF SINE-SQUARED PULSE RESPONSE

By W. A. Cameron, B.Sc., A.M.I.E.E.\*

The British Post Office has recently included in its specification for repeater sections of 0.375-in. coaxial cable, pulse measurements of impedance regularity, and has followed the C.C.I.T.T.† recommendations<sup>1</sup> governing the overall testing of television links, that the test pulse should be sine squared in shape. This specification is for a three-mile and six-mile repeater spacing and requires a test pulse of width at half height of 0.1 μsec.

The transmission of a transient waveform through a cable causes a decrease in amplitude of the waveform and an increase in its effective width. Thus the measurement of impedance regularity of a cable by pulse reflection requires a knowledge of the response of the cable to the impulse used. This can be measured experimentally using multiple reflections in a short length of cable, or calculated from a knowledge of the pulse shape.

### Measurement of the Pulse Response of Coaxial Cable

Equipment essential for the pulse measurement of cable impedance regularity consists of a pulse generator and a high-speed oscilloscope with a fairly high sensitivity<sup>2</sup>.

In order to measure the pulse response of the cable, the pulse generator, which is normally of low output impedance, is connected to a short length  $l$  of the cable under test through a series resistor of value  $R$ , and the output from the cable is connected to the oscilloscope input (which is of impedance  $R_0$ ) through a similar resistor (as shown in Fig. 1). Due to the presence of the second resistor, a discontinuity will exist and, at this point, the input pulse will be reflected and an echo pulse will travel along the cable towards the pulse generator where it will again be reflected. At each point of discontinuity there will be a reflection factor of

$$\rho = \frac{R - R_0}{R + R_0} \quad \dots \quad (1)$$

and a voltage transmission factor of

$$k = \frac{2 R_0}{R + R_0} \quad \dots \quad (2)$$

where  $R_0$  is the characteristic impedance of the cable. Thus, if  $R$  is chosen to be much larger than  $R_0$  and the oscilloscope is of a sufficiently high gain to compensate for the factor  $k$  then, for each input pulse, a train of impulses will be displayed on the oscilloscope and the  $n$ th impulse of the train will be distorted due to trans-

mission along a length  $(2n - 1)l$  of cable. Since the maximum value of  $R$  will be limited by the available gain of the oscilloscope amplifier, a correction to each pulse height will have to be made for the additional attenuation due to the factor  $\rho^{2(n-1)}$ . Fig. 2 shows a typical echo train and Fig. 3 the decrease of the pulse height with the length of cable traversed, as measured in the laboratory on 750 yards drum length of 0.375 in. coaxial cable using this technique. These results have been corrected for the additional attenuation due to the factor  $\rho^{2(n-1)}$ .

### Calculation of the Response of 0.375 in. Trunk Coaxial Cable to a Sine-Squared Pulse

If a linear system is driven by a transient signal and if the transient is of sufficiently short duration then the output waveform from the system may be approximated by the impulse response of the system. The pulse response of a system is its response to a Dirac impulse  $\delta(t)$  which has a Laplace Transform given by

$$\int_0^{\infty} e^{-st} \delta(t) dt = 1 \quad \dots \quad (5)$$

As is well known<sup>3</sup>, if  $i(t)$  is the system impulse response and  $f(t)$  the input waveform then, assuming zero initial values, the output will be given by the convolution integral

$$V_0(t) = \int_0^t i(\tau) f(t - \tau) d\tau \quad \dots \quad (6)$$

and by use of this integral one may compute the response

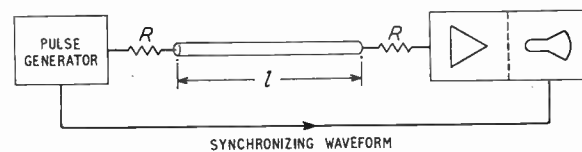
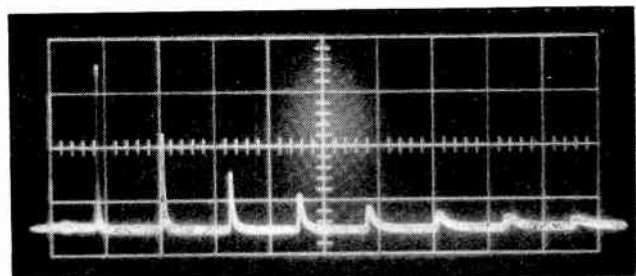


Fig. 1. Measurement of cable pulse response by multiple reflections

Fig. 2. Typical echo train



\* Research Laboratories, General Electric Co. Ltd., Wembley.  
† International Telegraph and Telephone Consultative Committee.

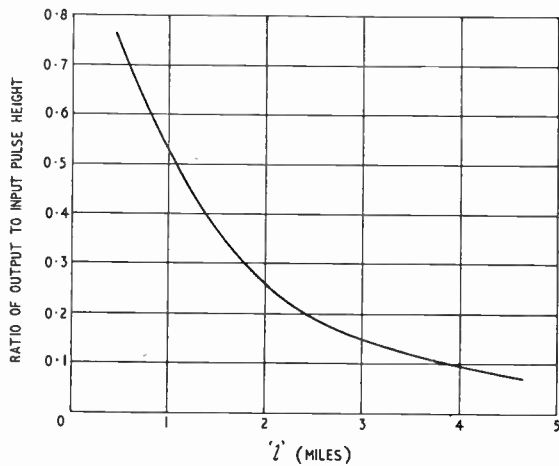


Fig. 3. Measured decrement in pulse height v. length of cable

of a linear system to any waveform from a knowledge of the system impulse response.

The transmission of a voltage wave along a correctly terminated transmission line is given by

$$V(x) = V(0) e^{-Px} \quad \dots \quad (7)$$

where  $P$  is the propagation constant for the line and  $x$  is the distance along the direction of propagation. For a coaxial cable with low dielectric loss

$$P = jHf + (1 + j)K\sqrt{f}$$

where  $H$  and  $K$  are constants depending on the cable dimensions. Putting  $s = j\omega = 2\pi jf$

$$Px = \frac{HXs}{2\pi} + \frac{Kx}{\sqrt{\pi}}\sqrt{s} \quad \dots \quad (8)$$

where, for 0.375-in. trunk coaxial cable,

$$K = 4.375 \times 10^{-4}$$

In a transient analysis we may neglect the basic time delay due to  $\exp(-HXs/2\pi)$  and consider the response

of a network having the transfer characteristic

$$V_0(s, x) = V_t(s, 0) \exp\left(\frac{-Kx}{\sqrt{\pi}}\sqrt{s}\right) \quad \dots \quad (9)$$

The impulse response of the cable is given by the inverse transform of

$$\exp\left(\frac{-Kx}{\sqrt{\pi}}\sqrt{s}\right)$$

which is given by Carslaw and Jaeger<sup>3</sup> as

$$i(t) = \frac{Kx}{2\pi t} 3/2 \exp\left(\frac{-K^2x^2}{4\pi t}\right) \quad \dots \quad (10)$$

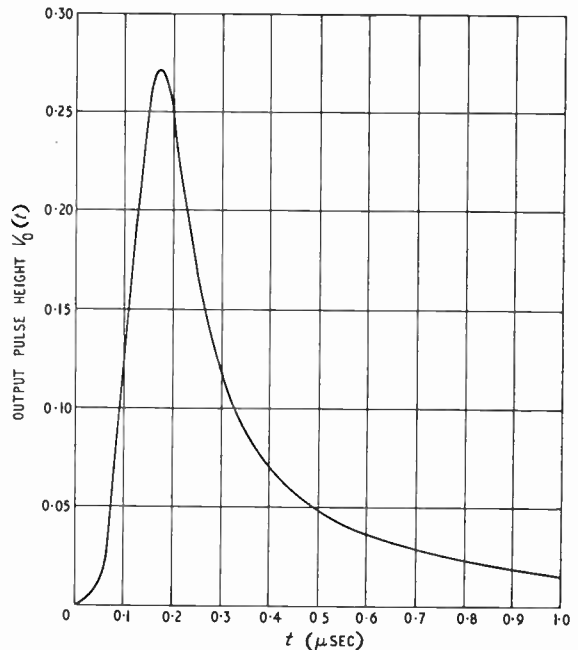
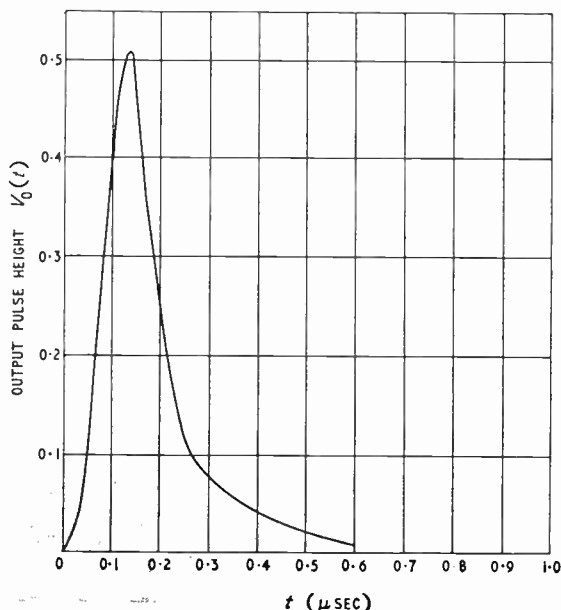


Fig. 5. Sine-squared pulse response of two miles of cable

Fig. 4. Sine-squared pulse response of one mile of cable



Substituting Equ. (10) into the integral (6) and taking

$$f(t) = \begin{cases} \sin^2(\pi t/2T), & 0 \leq t \leq 2T \\ 0, & t < 0 \text{ and } t > 2T \end{cases} \quad \dots \quad (11)$$

we see that the output waveform from the cable is given by

$$V_0(t) = \frac{Kx}{2\pi} \int_0^t \frac{1}{\tau} 3/2 \exp\left(\frac{-K^2x^2}{4\pi\tau}\right) \sin^2 \frac{\pi}{2T}(t-\tau) d\tau \quad \dots \quad (12)$$

This integral has been evaluated over the relevant range of  $t$  for  $x = 1, 2, 3,$  and  $4$  miles using a Hollerith HEC 2M digital computer. Graphs of the output waveform for these lengths of cable are given in Figs. 4-7. Fig. 8 shows how the calculated height of the output pulse varies with cable length, and is in good agreement with the measured curve given in Fig. 3. Fig. 9 gives the pulse height attenuation in dB plotted against the cable length in yards. This is the curve which would normally be used in correcting a cable echo response to allow for pulse-height attenuation.

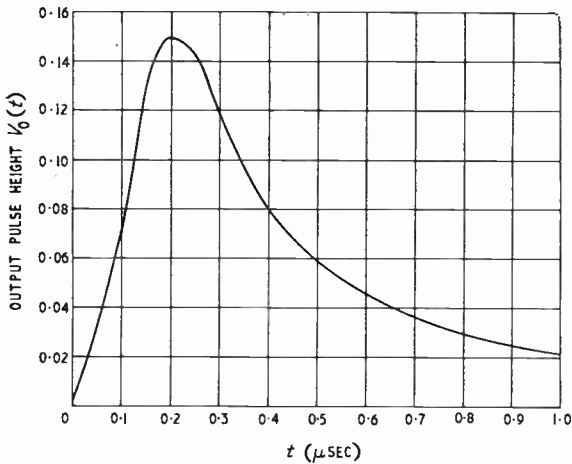


Fig. 6. Sine-squared pulse response of three miles of cable

**Validity of the Impulse Approximation**

It is of interest to know the minimum length of cable for which it is valid to consider the pulse as an impulse in computing the attenuation of the pulse amplitude and this question will now be considered.

The Laplace Transform of the sine-squared pulse is given by

$$V_i(s) = \int_0^\infty e^{-st} \sin^2 \frac{\pi t}{2T} dt$$

$$= \left\{ \frac{1 - e^{-2st}}{2} \right\} \left\{ \frac{1}{s} - \frac{sT^2}{s^2T^2 + \pi^2} \right\} \dots (13)$$

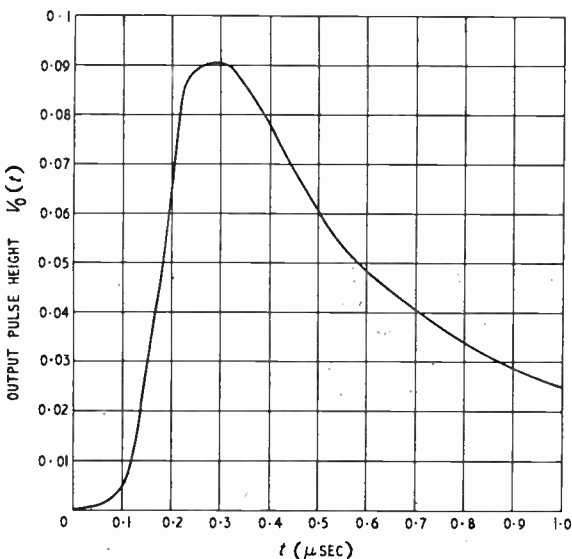
We may expand this in ascending powers of  $T$  as

$$V_i(s) = T - sT^2 + s^2T^3 \left\{ \frac{2}{3} - \frac{1}{\pi^2} \right\} - s^3T^4 \left\{ \frac{1}{3} - \frac{1}{\pi^2} \right\} \dots (14)$$

Now,  $V_0(s) = V_i(s) Z(s)$ , where  $Z(s)$  is the system function.

Thus from Equ. (14) we see that since, assuming

Fig. 7. Sine-squared pulse response of four miles of cable



zero initial conditions, multiplication of the system function by  $s^n$  implies the  $n$ th differentiation of the system impulse response we may, by performing the requisite differentiations, expand  $V_0(t)$  in ascending powers of  $T$  as

$$V_0(t) = T i(t) - T^2 \frac{di(t)}{dt} + T^3 \left\{ \frac{2}{3} - \frac{1}{\pi^2} \right\} \frac{d^2i(t)}{dt^2} - T^4 \left\{ \frac{1}{3} - \frac{1}{\pi^2} \right\} \frac{d^3i(t)}{dt^3} \dots (15)$$

where  $i(t) = \frac{Kx}{2\pi t} 3/2 \exp \left\{ -\frac{K^2x^2}{4\pi t} \right\}$

$$= \frac{b}{t} 3/2 \exp \left( -\frac{a}{t} \right)$$

$$\frac{di(t)}{dt} = \left\{ \frac{a}{t^2} - \frac{3}{2t} \right\} i(t)$$

$$\frac{d^2i(t)}{dt^2} = \left\{ \frac{a}{t^2} - \frac{3}{2t} \right\} \frac{di(t)}{dt} + \left\{ \frac{3}{2t^2} - \frac{2a}{t^3} \right\} i(t)$$

Since we are interested in the peak response we shall

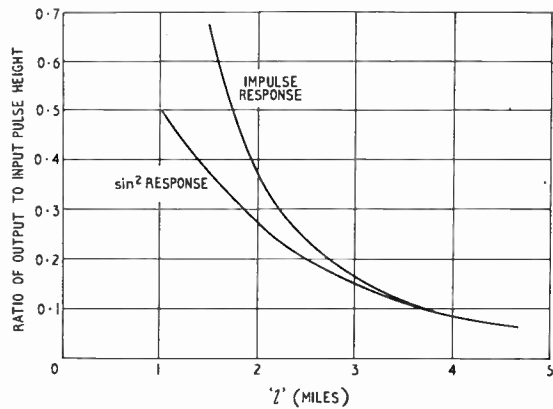


Fig. 8. Peak height of output wave

consider the validity of the approximation at the time when  $di(t)/dt = 0$ , that is when

$$t = \frac{2a}{3} \dots (16)$$

Thus neglecting powers of  $T$  greater than the third we require that

$$\left| T^3 \left\{ \frac{2}{3} - \frac{1}{\pi^2} \right\} \frac{d^2i}{dt^2} \right| \ll \left| T i(t) \right|$$

or

$$\left| T^2 \left\{ \frac{2}{3} - \frac{1}{\pi^2} \right\} \left\{ \frac{3}{2t^2} - \frac{2a}{t^3} \right\} \right| \ll 1$$

or substituting from Equ. (16)  $1.89/a^2 \ll 1$ . For an 0.1-μsec pulse on 0.375-in. trunk coaxial cable

$$a = 0.153 \times 10^{-7} x^2$$

$$T = 10^{-7} \text{ sec}$$

and our requirement becomes

$$x^4 \geq 80.7$$

or  $x > 3 \text{ miles} \dots (17)$

Substituting Equ. (16) into Equ. (12) we obtain

$$i(x)_{\text{peak}} = \frac{T 3\sqrt{6\pi}}{K^2} \frac{\exp(-1.5)}{x^2} = \frac{1.518}{x^2} \dots (18)$$

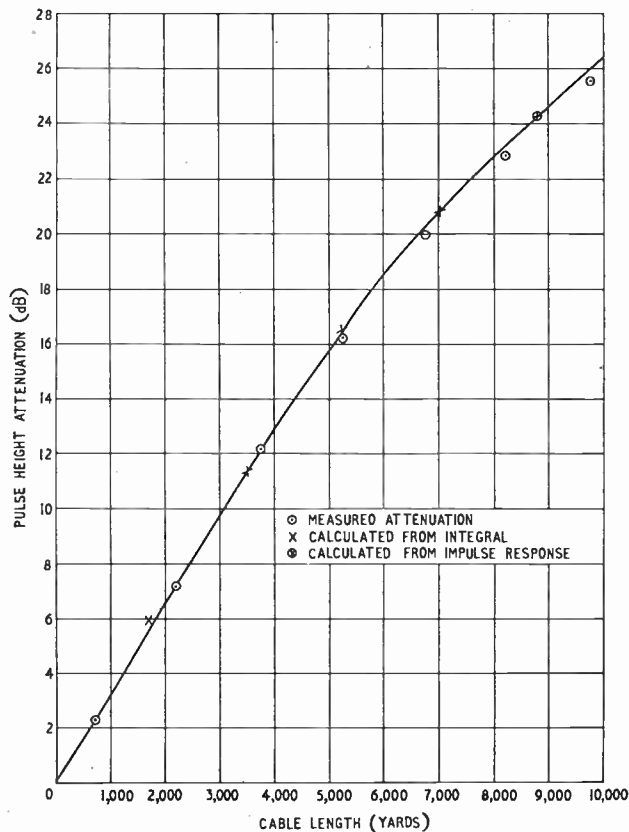


Fig. 9. Height attenuation of 0.1 μsec sine-squared pulse

where  $x$  is in miles and for 0.375-in. trunk coaxial cable  $K = 4.375 \times 10^{-4}$  and  $T = 10^{-7}$ .

Thus we see that for cable lengths of greater than three miles the pulse height is decaying according to the inverse square of the cable length. That is, doubling the length of cable traversed will produce an additional attenuation of 12 dB.

This function is shown in Fig. 8 where it is compared with the peak height of the response of the cable to an 0.1-μsec sine-squared pulse.

**Conclusion**

Methods have been described for the calculation and measurement of the response of a length of cable to a transient waveform of given shape. In particular, a curve has been derived for the attenuation of the peak amplitude of an 0.1-μsec sine-squared pulse propagating through 0.375 in. diameter coaxial cable of the type used for trunk telephony.

**REFERENCES**

<sup>1</sup> Volume I of the Red Book of the C.C.I.T.T., Geneva, 1956, p. 229.  
<sup>2</sup> F. F. Roberts, "A Pulse Test Set for the Measurement of Small Impedance Irregularities in High Frequency Cables", *Proc. Instn elect. Engrs*, Part III, January 1949, Vol. 96, p. 17.  
<sup>3</sup> H. S. Carslaw and J. C. Jaeger, "Operational Methods in Applied Mathematics" Oxford University Press, 1948.

# Correspondence

*Letters to the Editor on technical subjects are always welcome. In publishing such communications the Editors do not necessarily endorse any technical or general statements which they may contain.*

**Comparison of Four Television Standards**

SIR,—Dr. Haantjes and Mr. Breimer of Philips' Research Laboratories, have pointed out the existence of an error in the Appendix of my article, "Comparison of Four Television Standards", which appeared in *Electronic & Radio Engineer*, November 1957. The formula for the group delay,  $\tau(x)$ , given in the caption of Fig. 6, is too small by a factor  $n$  and this means that the scale of group-delay ordinates in Fig. 6 requires multiplication by 40 for the U.K., U.S. and West European television systems, whilst the French system requires a multiplication by 15. The same remarks apply to the ordinate scale of Fig. 7, whilst in Fig. 8 each ordinate corresponding

to a given abscissa,  $n$ , must be multiplied by that value of  $n$ . Also, the formula for  $\phi(x)$  must be multiplied by  $n$ .

The result of this correction is to make the group-delay errors caused by the Nyquist slope in the receiver no longer negligible, as was suggested in the original article.

The last column of the attached table gives a measure of the group-delay error as a proportion of the duration of a picture element. It will be seen from this that the U.K. system suffers very little degradation, but that the West European 625-line system, employing negative modulation, gives rise to an error across the video band of nearly three picture elements. It is, of course, true

Television system	Parameter, $n$ determining steepness of Nyquist slope in receiver	Picture Element duration $\tau_0$ ( $\mu$ sec)	Group delay at vision carrier f., $\tau(\omega_0)$ ( $\mu$ sec)	Group delay at cut-off frequency of main sideband $\tau(\omega_0 + \omega_c)$ ( $\mu$ sec)	Difference: $\tau(\omega_0) - \tau(\omega_0 + \omega_c)$ ( $\mu$ sec)	$\frac{\tau(\omega_0) - \tau(\omega_0 + \omega_c)}{\tau_0}$
U.K. .. ..	40	0.167	0.52	0.36	0.16	0.96
U.S. .. ..	40	0.125	0.52	0.30	0.22	1.76
West European neg. mod. 5-Mc/s video	40	0.100	0.52	0.24	0.28	2.80
French .. ..	15	0.048	0.142	0.073	0.069	1.44

that much greater errors than these may arise in practice and, furthermore, the modulation depth has an effect upon the way in which these group-delay errors are translated into distortion of the response of a receiver to transient excitations.

B.B.C. Research Department,  
Kingswood Warren,  
Surrey.  
9th September 1959.

D. MAURICE.

### Echo-Distortion in Frequency Modulation

SIR.—Mr. Medhurst's article in the July issue, p. 253, is a valuable contribution to the study of multichannel radio systems, and has been read with interest. Some of the results given have been compared with measurements made in this Laboratory, and good agreement has been found.

It may be of interest to mention a further approximate result

when  $\theta_0$  is large, derived from a consideration of the f.m. noise-power spectrum. This approximation neglects the effect of the carrier phase and therefore gives only the mean distortion power ratio; it is,

$$\frac{1}{r^2} \frac{D}{S} = \frac{1}{2\sqrt{\pi}A^3 \left(1 - \frac{\sin \theta_0}{\theta_0}\right)^{\frac{1}{2}}} \exp - \frac{1}{4A^2 \left(1 - \frac{\sin \theta_0}{\theta_0}\right)}$$

where Mr. Medhurst's symbols are used. The result is valid only for large values of  $A$ ; it closely follows the mean-power curves derived from Figs. 1 and 2 for  $A \theta_0 > 2$  and  $A > 1$ .

It may also be noted that the mean-power curves lie 3 dB below the corresponding curves in Fig. 1 over the region where Equation (7) is valid (approximately  $A \theta_0 < \frac{1}{2}$ ).

Post Office Engineering Dept.,  
Cardiff.

R. HAMER

18th September 1959.

## New Books

### Synthesis of Linear Communication Networks

By WILHELM CAUER. Pp. 866 + xxxvi. McGraw-Hill Publishing Co. Ltd., 95 Farringdon Street, London, E.C.4. Price £7.17s.

This is not a 'new' book. The first edition of this classic of German and international circuit theory was completed in 1940 and published in Germany in 1941 (under the title "Die Theorie der linearen Wechselstromschaltungen"). A new, much enlarged, edition was originally planned and prepared by Cauer himself. After his tragic and early death in 1945 a second edition was prepared by Klein and Pelz and published (again in German) in 1954. This edition contains some additions based on various Cauer manuscripts and a number of explanatory comments and notes by the editors. Now an English (or rather American) translation, based on the second German edition, has been prepared by Knausenberger and Warfield. Some of the material has been re-arranged, and some notes and comments by the translators and "a commentary of latest developments in network theory together with a bibliography of pertinent English-American literature" have been added.

Cauer is one of the pioneers and architects of modern network theory. One of his first important contributions was the generalization of Foster's reactance theorem, on the one hand by means of continued fraction expansions leading to ladder structures, and on the other hand by extending it to  $RC$  and  $RL$  two-terminal networks. This was followed by the application of elliptic function theory to approximation ('interpolation') problems in network design (combined with a modern treatment of lattice filters). He continued to contribute to all problems of modern network synthesis, always with originality and mathematical rigour, his fundamental aim being the creation of 'exact mathematical' synthesis methods.

Modern synthesis methods are characterized by three stages.

1. General types and structures of 'physically possible' networks are studied and corresponding classes of network performance characteristics are determined.
2. The performance characteristics required in a particular design or synthesis problem (which originally do not exactly correspond to those of a physically possible network) are approximated by suitably chosen characteristics which do correspond to such a network.
3. A network is realized which corresponds to the chosen approximating characteristics.

Until less than two years ago there were no text books in English dealing in a comprehensive way with such modern synthesis methods. Today the situation is different, and this is chiefly due to the publication of Guillemin's latest book "Synthesis of Passive Networks" (which has to be considered together with his well-known previous books).

Thus the question arises:—What purpose is served by the publication of another book which deals basically with the same subject and which in its essential parts is now nearly 19 years old? To this reviewer the answer seems clear:—Quite apart from the historical interest with which many research workers in this field will greet

the publication of this translation, there are at least three eminently practical aspects which ought to be stated. First, this book is widely quoted in publications, but access to it was difficult until now. Secondly, even after nearly two decades this is an invaluable reference book for the serious research worker in this field; as an example it may be mentioned that some derivations of important formulae, given without proof in Darlington's famous publication on insertion-parameter filters, will be found in Cauer's book. Thirdly, the treatment and style in Cauer's book are quite different from those in Guillemin's book. Where Guillemin always seems to remain the teacher, passionately interested in making matters easy for the reader—without in any way lowering the standard—Cauer's main interest seems to lie in mathematical rigour and in the generality of results. This difference in the two authors' styles and methods of approach increases by their very contrast the attraction and value of the appearance of Cauer's book in an English edition.

The book begins with four prefaces of various kinds, a short biographical note by his widow and an extract from an obituary, written by K. W. Wagner. After a list of Cauer's publications and patents and a detailed list of contents there is an Introductory Chapter which has been added in the second edition and is based on an original monograph by Cauer. Its value appears doubtful, as it is in many parts difficult to understand unless the reader is already familiar with the book or at least with the subject matter. On page 28 the characteristics function  $\psi$  (where  $\psi$  is defined by the expression  $A = \log_e \sqrt{1 + |\psi|^2}$  for the 'operating loss'  $A$ ) is discussed. Here the statement "... if the operating loss is prescribed,  $\psi$  can be found except for its sign" is wrong (the corresponding statement on p. 27 in the second German edition "if the operating loss is prescribed,  $\psi$  can generally be chosen in various different ways, even apart from its sign" is correct). The following chapters are: 1. Statement of the Problems and Examples; 2. Circuit Analysis; 3. Two-Terminal-pair Networks; 4. Positive-real Functions and Positive Matrices; 5. Reactance Theorems; 6. Image Parameter Theory of the Low-pass Reactance Filter; 7. Generalized Image-parameter Theory. Then there are two appendices (1. Two-terminal-pair-network Formula Collection, and 2. Practical Filter-design Techniques Based on the Image-parameter Theory) which complete the first part of this book. In the English edition there are two parts (designated as 'volumes 1 and 2'), though the book is published like its two German predecessors in one single volume, and though the German editions do not show any division into two parts. This sub-division of the English edition, involving a re-arrangement of appendices, is regrettable as it may cause confusion, particularly as Dr. Glowatzki, a pupil of Cauer, is preparing a 'second volume' for the German edition, containing so far unpublished Cauer manuscripts (announced in the second German, but not in the English edition).

The chapter headings of part II of the English edition are: 8. Reactance Two-terminal-pair Networks with Prescribed Operating Conditions; 9. Frequency Band-separating Networks; 10. Equival-

ence of Reactance Networks. They are followed by five appendices (1. Aids in Linear Algebra; 2. Elements of the Theory of Analytic Functions; 3. Solution of Some Chebyshev Extremal Problems; 4. Practical Filter Design Techniques Based on the Operating-parameter Theory; 5. Recent Advances; Supplementary References) and by an Index. Appendix 5 represents an attempt to bring the book up, to date.

Summarizing, it may be said that the editors and translators of this book had a very difficult task and the result can be criticized, and could probably be improved, in many details. However, this is rather unimportant. It should also be said that this is emphatically not a book for a first study of the subject, and even for a specialist it would not serve as the only book on synthesis. However, "Cauer" should be studied and consulted by, and be accessible to, everybody working in the field of modern network synthesis and design. The publication of this translation will make the attainment of this aim very much easier.

W.S.

### Noise in Electron Devices

Edited by LOUIS D. SMULLIN and HERMANN A. HAUS. Pp. 413 + xvi. Chapman & Hall Ltd. (for John Wiley), 37 Essex Street, London, W.C.2. Price 96s.

The 'electron devices' with which this book is concerned might be summarized as active network devices, since they are grid-controlled thermionic valves, electron-beam tubes and transistors. This is further emphasized by decorating the cover with a pattern of " $2eI_0\Delta f$ ", and the impression on the reader is almost that pains have been taken to seclude mention of  $4RkTAf$  from the book as far as possible. This is unfortunate, because the minimum noise of most thermionic devices is proportional to cathode temperature.

Of the authors contributing to this book, Haus, Quate and Peter are known to all who are interested in electron-beam tubes, and Van der Ziel is known as an authority on flicker noise and semi-conductors. Noise in multi-electrode valves is covered by Talpey (who has published work on elastically-reflected electrons in relation to induced grid noise), and noise in practical transistors and transistor amplifiers by Fonger of R.C.A. Laboratories, Princeton. The book contains a great deal of information which hitherto has been scattered in the literature and thus will be a valuable introduction for anyone intending to specialize in one of the three fields which it covers. It claims to its credit thorough mathematical analyses, but at times one feels a lack of that physical interpretation which would assist in transferring the theory to new applications.

The book is based on a vacation course given at M.I.T. in 1955, and unfortunately for the authors the intervening years have been exceptionally fruitful in the development of amplifying devices. The maser and the (variable-capacitance) parametric amplifier appear only by way of apology in the preface, and the book includes neither the most recent work on low-noise guns for conventional travelling-wave tubes nor the recent work on 'fast-wave' low-noise beam amplifiers.

The reader who has followed this book will have no difficulty in following the subsequent literature on electron-beam amplifiers, but he may feel the lack of guidance in approaching the noise properties of the maser.

D.A.B.

### Television Servicing

By ALEX LEVY and MURRAY FRANKEL. Pp. 534 + vii. McGraw-Hill Publishing Co. Ltd., 95 Farringdon Street, London, E.C.4. Price 43s.

This should be a useful book to anyone concerned with American television receivers. Its application to British receivers, however, is limited by the difference between the two television systems, for these have led to big differences in receiver circuitry.

W.T.C.

### Basic Electricity

By VAN VALKENBURGH, NOOGER & NEVILLE Inc. Pp. 596 in 5 parts. The Technical Press Ltd., 1 Justice Walk, Chelsea, London, S.W.3. Price 55s.

These books form a course of training developed for the U.S. Navy and adapted to British and Commonwealth usage by a special electronics training investigation team of R.E.M.E. They are of a very elementary nature, starting with the electron and frictional electricity and ending with circuit breakers.

Anyone examining these books is apt to be misled by the form of the illustrations. Many are of a pictorial character, which will

undoubtedly help the real beginner, but most are far too big, creating an impression almost of a child's picture book. The text, however, is clearly written and the material is, in the main, well presented.

The books form a first course of an unusual character and one which is worth studying by anyone interested in elementary training.

W.T.C.

### Radio Circuits (4th Edition)

By W. E. MILLER, M.A.(Cantab.), M.Brit.I.R.E. Revised by E. A. W. SPREADBURY, M.Brit.I.R.E. Pp. 172 + ix. Published for *Wireless & Electrical Trader* by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1. Price 15s.

### BRITISH STANDARDS

#### Fixed Electrolytic Capacitors (Aluminium Electrodes)

Pp. 10. B.S. 2134, Part 2: 1959. Price 5s.

#### Year Book 1959

Pp. 543. Contains information about the Institution and the services it offers. It lists the British Standards current at 1st January 1959. Price 15s.

*These publications can be obtained from British Standards Institution, 2 Park Street, London, W.1.*

### NATIONAL BUREAU OF STANDARDS

#### On the Theory of Fading Properties of a Fluctuating Signal imposed on a Constant Signal

By H. BREMMER. Pp. 32. Price 32 cents.

#### Standards Materials issued by the National Bureau of Standards

Pp. 27. Price 44 cents.

#### Tables of Osculatory Interpolation Coefficients

By H. E. SALZER. Price 38 cents.

#### Tables of the Exponential Integral for Complex Arguments

Applied Mathematics Series 51. Price \$5.65.

#### Fractional Factorial Experiment Designs for Factors at Three Levels

Pp. 37. Price 38 cents.

#### Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and Water for Occupational Exposure

Pp. 95. N.B.S. Handbook 69. Price 44 cents.

*These publications can be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., U.S.A.*

### MANUFACTURERS' LITERATURE

**Brimar Valve and Teletube Manual No. 8.** A 374-page catalogue including details of recent additions to the ranges of products available, as well as comprehensive information on many current equipment valves. The catalogue also includes: new rating charts for rectifiers, data on "Replacement and Obsolete" types and a revised circuits section. Price 6s.

*Standard Telephones & Cables Ltd., Valve Division, Footscray, Sidcup, Kent.*

**Advance Components Catalogue.** This revised edition includes comprehensive details of all current products: a.f. and r.f. generators, v.h.f. and f.m./a.m. generators, 'Q' meters, standard inductors, crystal calibrator, a.c. valve voltmeter, attenuator casting and switch, attenuators and coaxial switches.

*Advance Components Ltd., Roebuck Road, Hainault, Ilford, Essex.*

**How to use Araldite Epoxy Resin Adhesives.** A booklet produced as a guide to the materials which can be successfully bonded by Araldite.

*CIBA (A.R.L.) Ltd., Duxford, Cambridge.*

**Electrical Insulation.** A 24-page booklet describing electrical insulating materials produced by Langley London Ltd. Includes



information on mica and mica products and the range of Lantex laminates of paper-fabric and glass with bonds of phenolic, polyester, ethoxylene, silicone and other resins.  
*Langley London Ltd., Kelvin Way, Crawley, Sussex.*

**Permanent Magnets Summarized.** This 48-page booklet was written by F. G. Tyack, A.M.I.E.E., of James Neill & Co. (Sheffield) Ltd., and gives practical information on design and application of permanent magnets.  
*James Neill & Co. (Sheffield) Ltd., Magnet Department, Napier Street, Sheffield 11, Yorks.*

**Regalox Alumina Ceramics.** Booklet containing information on high-grade sintered alumina ceramic materials produced by *Royal Worcester Ceramics Ltd., Tonyrefail, Glamorgan.*

**Beryllium Products.** Illustrated technical brochures available on beryllium copper wrought alloys and beryllium metal.  
*Beryllium Smelting Co. Ltd., 36-38 Southampton Street, London, W.C.2.*

**Mullard Photomultiplier Tubes.** A 6-page folder giving characteristics, constructional details, etc., of photomultiplier tubes for scintillation counting.  
*Mullard Ltd., Torrington Place, London, W.C.1.*

**Copper Cables.** Pp. 62. Contains chapters on the properties of copper and some of its alloys, the manufacturers of copper wire, power, transmission and other types of insulated cables. An appendix, bibliography and list of applicable British Standards, together with numerous diagrams and illustrations, are also included.  
*Copper Development Association, 55 South Audley Street, London, W.1.*

## MEETINGS

### I.E.E.

27th October. "Future Trends in Memory Stores for High-Speed Digital Computers", discussion to be opened by W. Renwick, M.A., B.Sc.

28th October. "Development of Eurovision", by M. J. L. Pulling, C.B.E., M.A.

2nd November. "Some Comments on the Classification of Waveguide Modes", by A. E. Karbowski, B.Sc.(Eng.), Ph.D., and "Some Comments on Quasi-Optical Methods at Millimetre Wavelengths", by L. Lewin.

3rd November. "An Analogue Electronic Multiplier using Transistors as Square-Wave Modulators", by P. Gleghorn, B.Sc.(Eng.).

6th November. Medical Electronics Discussion Group. Subject not announced, to commence at 6 o'clock.

9th November. "Theory of the Travelling-Wave Parametric Amplifier", by Prof. A. L. Cullen, Ph.D., B.Sc.(Eng.); "The Gain of Travelling-Wave Ferromagnetic Amplifiers", by P. J. B. Clarricoats, B.Sc.(Eng.), Ph.D.; "Some Properties of Travelling-Wave Resonance", by J. R. G. Twisleton, B.Sc., and "Saturation Effects in a Travelling-Wave Parametric Amplifier", by A. Jurkus, B.Sc., and P. N. Robson, B.A.

*These meetings will be held at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, and will commence at 5.30, except where otherwise stated.*

### The Television Society

22nd October. "New Television Standards: Their Effect on British Television". Discussion.

6th November. "Deflection Techniques for 110° Picture Tubes", by B. Eastwood, B.Sc.

*These meetings will commence at 7 p.m. at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, London, W.C.2.*

### The Society of Instrument Technology

14th October. "An Automatic Analogue Computer for Missile Homing Investigations", by J. G. Thomason, B.Sc., to be held at Manson House, 26 Portland Place, London, W.1, at 7 o'clock.

### Brit. I.R.E.

28th October. "Radio—Its Impact on Shipping", by Captain J. D. F. Elvish, C.B.E., and "A Historical Survey of Radar and

Radio Aids to Aircraft Navigation", by Air Marshal Sir Raymund G. Hart, K.B.E., C.B., M.C.

4th November. "Input/Output Devices", half-day symposium; meetings commencing at 3 and 6 p.m.

11th November. "Physiological and Acoustical Aspects of Hearing" by R. P. Gannon, B.Sc., M.B., Ch.B.

*These meetings will be held at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, and will commence at 6.30, except where otherwise stated.*

## NEW DIRECTOR FOR S.I.M.A.

The Scientific Instrument Manufacturers' Association of Great Britain have recently announced the inauguration of S.I.M.A.'s new Director—Captain Robert Alexander Villiers, C.B.E., A.M.I.E.E., R.N. (Retired).

## OBITUARY

It is with regret that we learn of the sudden death of a well-known personality in the radio industry, Thomas Edward Goldup, C.B.E., M.I.E.E., aged 65.

Mr. Goldup joined Mullard Valve Co. in 1923, and in 1928 was responsible for the formation of their Technical Service Department. In 1938 he was made a director of Radio Transmission Equipment Ltd., now Mullard Equipment Ltd. and, in 1951, he was appointed a director on the main Mullard board.

In addition to his work for Mullard Ltd., Mr. Goldup was known throughout the industry for his active participation in matters relating to technical education. He was a member of many committees, including the British Standards Institution and Radio Industry Council, and he was Chairman of the Ministry of Supply at Malvern.

Mr. Goldup was appointed C.B.E. in 1954 and elected President of the Institution of Electrical Engineers for the year 1957/58.

## STANDARD-FREQUENCY TRANSMISSIONS

(Communication from the National Physical Laboratory)

*Deviations from nominal frequency\* for July 1959*

Date 1959 July	MSF 60 kc/s 1500 G.M.T. Parts in 10 <sup>9</sup>	Droitwich 200 kc/s 1030 G.M.T. Parts in 10 <sup>9</sup>
1	NM	— 7
2	— 18.3	— 7
3	— 18.4	— 8
4	— 18.3	NM
5	— 18.0	NM
6	NM	— 10
7	— 18.0	— 11
8	— 18.5	— 12
9	— 18.5	— 12
10	— 18.2	— 13
11	— 18.1	NM
12	— 18.3	NM
13	— 18.1	— 11
14	— 18.0	— 9
15	— 18.2	— 9
16	— 18.4	— 9
17	— 18.6	— 9
18	NM	NM
19	— 18.7	NM
20	— 18.3	— 9
21	— 18.3	— 10
22	— 18.1	— 11
23	— 17.6	— 12
24	— 16.8	— 12
25	— 16.8	NM
26	— 16.4	NM
27	— 16.3	NM
28	— 16.0	NM
29	NM	NM
30	— 16.1	— 13
†31	NM	— 13

\* Nominal frequency is defined to be that frequency corresponding to a value of 9 192 631 770 c/s for the N.P.L. caesium resonator.

† At 2400 G.M.T. on this day the phase of the seconds pulses was advanced by 20 milliseconds. NM = Not Measured.

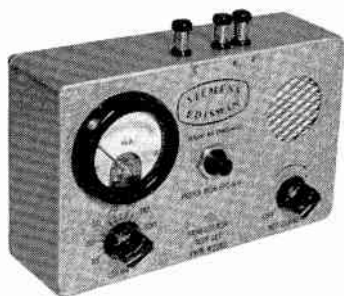
# New Products

## Transistor Beta Tester

Siemens Edison Swan have announced a new low-priced battery-operated transistor tester.

Its purpose is to provide a quick run-of-the-mill test on all p-n-p transistors; current gain and collector leakage being measured under common-emitter conditions.

Current gain ( $\beta$  or  $\alpha'$ ) within a range 10-150 can be read directly on a dial by adjusting the control until an audible note just ceases. This measurement can be



carried out at a collector current of 0.5-4 mA, the set collector current being read on a meter.

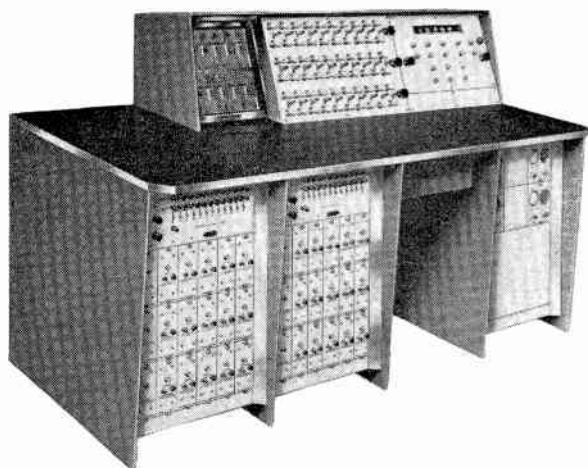
Leakage current is measured on the meter at a fixed voltage of 9 V. Accuracy of measurement  $\pm 5\%$  or  $\pm 5$ , whichever is the greater.

Siemens Edison Swan Ltd.,  
155 Charing Cross Road, London, W.C.2.

## Space '30' Analogue Computer

Solartron Electronic Group have announced the introduction of a new general-purpose analogue computer designed for the solution of linear and non-linear simultaneous or single differential equations.

It includes 30 operational amplifiers (with computing components), 60 coefficient potentiometers, 4 diode bridges, 4 relay amplifiers, 2 diode function generators, 4 servo multipliers,  $\pm 100$ -V 200-mA reference supply, a digital voltmeter (5



digit), 816-way detachable patch panel, control and monitoring panel with automatic timer, a.c. mains stabilizer and all the necessary power supplies.

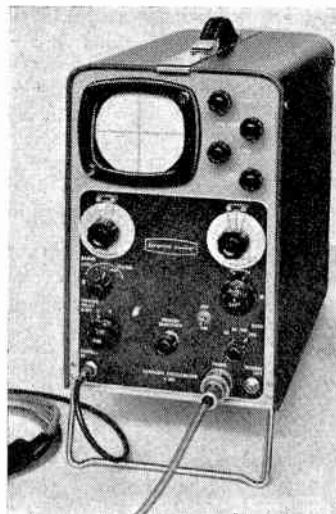
All the computing passive elements incorporated are of 0.1% accuracy.

Solartron Electronic Group Ltd.,  
Thames Ditton, Surrey.

## Pulse Monitoring Oscilloscope

Mullard Equipment Ltd. have introduced a new pulse monitoring oscilloscope with the exceptionally fast rise-time of 2  $\mu$ sec, equivalent to a bandwidth of d.c. to 220 Mc/s.

The Instrument, type L362, has been designed for the display or measurement of



pulses between 3- $\mu$ sec and 3- $\mu$ sec duration.

It has been developed from a design of the Atomic Energy Research Establishment, Harwell, and makes use of the sampling principle; the complete c.r.t. trace is built-up, as a low-frequency replica of the input, from a series of dots, each of which corresponds to a sample taken from successive

repetitions of the input. A charge storage circuit maintains the position of a dot until the succeeding sample is taken.

Details from the makers' specification include:

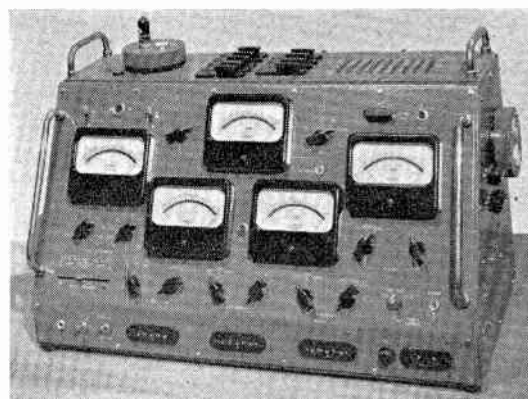
<i>Y System</i>	
Sensitivity	150 mV/cm.
Voltage measurement range	1.5-0-1.5 V.
Input impedance	1 k $\Omega$ , 2 pF approx.
Noise level	10 mV peak-to-peak at probe input.
<i>X System</i>	
Time-base ranges	0.03, 0.1, 0.3, 1 and 3 $\mu$ sec.
Calibration	By calibrated potentiometer scaled 0-1 and 0-3.
Trigger pulse delay	0.02-0.3 $\mu$ sec and 0.3-2 sec.
Number of samples	25, 50, 100 or 200 approx.
P.r.f. limits	Approx. 50 c/s-10 kc/s.

The L362 is distributed in the U.K. by  
Research & Control Instruments Ltd.,  
207 King's Cross Road, London, W.C.1.

## Valve Analyser and Bridge

The Metrix valve analyser type U-61B is designed for the accurate and detailed analysis of static characteristics of receiving and low-power transmitting valves. In addition, it can be used to obtain neon-tube regulation curves and thyatron control characteristics. Positive-grid characteristics may also be obtained.

Five meters indicate simultaneously: heater voltage, anode voltage, screen voltage, grid voltage and anode or screen current. Four separate stabilized voltage sources provide the necessary electrode voltages, all of which are variable and available for external use by means of sockets on the front panel. A series of adaptors each carrying one or two valve bases is supplied, these adaptors fit into nine jacks on the valve panel and are available fitted with any valve base. Between the voltage and pin selectors and the adaptor jacks, there are sockets and jumpers which



allow circuit elements to be interposed in the electrode circuits.

The instrument is fitted with a system of overload cut-outs which protect the d.c. sources of h.t. and the milliammeters in the event of an overload caused by faulty setting-up or a defective valve.

The valve bridge type 661 is designed for the measurement of the dynamic characteristics of valves; amplification factor, internal resistance and slope.

It is almost identical in appearance to the analyser U-61B, and the two instruments can be connected together by means of a cable provided to form a completely self-contained assembly for the measurement of all static and dynamic characteristics. With this arrangement, the d.c. supplies from the U-61B are used to obtain the accurate static operating conditions when taking dynamic measurements on the bridge.

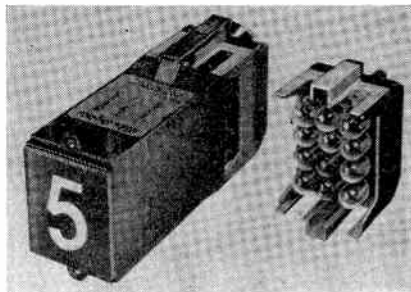
Possible measurements include: amplification factor ranging from 0.01 to 1,000, internal resistance from 100  $\Omega$  to 10 M $\Omega$  and slope from 0.001 to 100 mA/V. The minimum accuracy is 5% for the resistance range and 2.5% for other characteristics.

Manufactured by Compagnie Générale de Métrologie, France, these instruments are distributed in the U.K. by

*Metrix Instruments Ltd.,*  
54 Victoria Road, Surbiton, Surrey.

#### Projection Type Indicator

Known as the Aldis Digilite Type A100, this new unit provides display facilities for



figures 0 to 9 plus two decimal points, one left, one right.

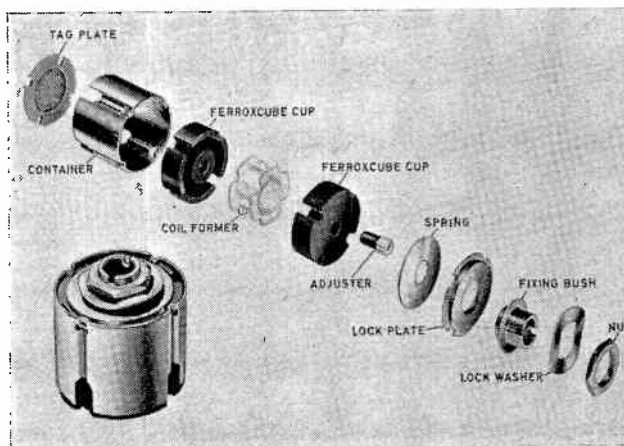
It comprises 12 lamps in a quick-release lamp housing and an optical lens system for projecting illuminated figures on to the front-viewing screen. Flush panel mounting gives an angle of view of 75° off axis in all directions. The height of the figures is 1.2 in.

*R. B. Pullin & Co. Ltd.,*  
Phoenix Works, Great West Road,  
Brentford, Middx.

#### Adjustable Ferrite Pot-Core Assemblies

Mullard has introduced a new range of adjustable ferrite pot-core assemblies known as 'Vinkors'.

They are made from a new grade of Ferroxcube material and incorporate an adjustable magnetic shunt which can vary



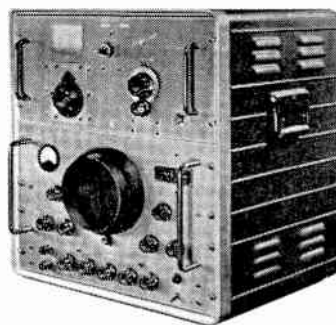
the inductance of an assembled coil  $\pm 7\%$  with an accuracy of better than 2%.

The present range of 'Vinkors' comprises five types for use at frequencies up to 200 kc/s, with outside core diameters of 18, 21, 25, 30 and 35 mm respectively. Each size of core is available with an effective permeability of 160, 100 or 63.

*Mullard Ltd.,*  
Torrington Place, London, W.C.1.

#### Spectrum Analysers

The new Polytechnic Series 860 spectrum analysers have been designed for precise spectrum measurements—evaluation of high v.s.w.r., leakage and loss; and analysis of radar, radio relay and other signals. Four



models are available, each with an accuracy of  $\pm 0.8\%$  or  $\pm 1$  Mc/s, to cover the frequency ranges 2,400 to 3,400 Mc/s, 3,000 to 3,700 Mc/s, 5,100 to 5,900 Mc/s and 8,500 to 9,600 Mc/s.

The Polytechnic analyser is essentially a sensitive, continuously-scanning microwave receiver which resolves the spectrum of an r.f. signal and presents it on a 5-in. c.r.t. screen. A complete analyser consists of one or more r.f. heads, with an indicator unit which contains a narrow-band i.f. amplifier, video amplifier, sweep circuits, cathode-ray tube, metering circuits and power supplies.

The radio-frequency range is determined by the r.f. head, each of which contains a calibrated input attenuator with 100-dB range, a swept microwave local oscillator, a calibrated frequency meter and a crystal mixer. The local oscillator is swept in synchronism with the horizontal trace of the c.r.t. so that the spectrum amplitude is

displayed as a function of frequency; the sweep speed is variable from 5 to 30 c/s. The sensitivity of each r.f. head is better than -80 dBm and the maximum resolution between two adjacent signals is 40 kc/s.

These instruments are manufactured by Polytechnic Research & Development Co., Inc., U.S.A. and are distributed in the U.K. through

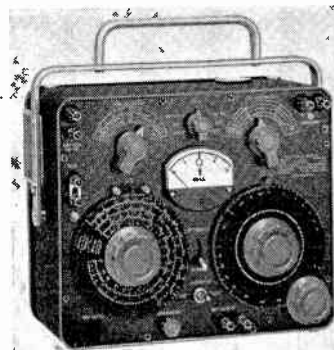
*Leland Instruments Ltd.,*  
Abbey House, Victoria Street, London, S.W.1.

#### Impedance Bridge

Claude Lyons Ltd., U.K. distributors for General Radio Company, U.S.A., have announced the introduction of a new impedance bridge type 1650-A.

It is a general-purpose instrument designed for  $R$ ,  $C$ ,  $L$  and  $Q$  or  $D$  measurements. The bridge is complete with built-in transistorized 1-kc/s oscillator and selective detector and it incorporates the 'Orthonull' mechanism, which is a device to speed bridge-balance convergence when high-loss components are measured. The basic 'Orthonull' mechanism is a friction clutch that drives exponential variable-resistance arms making the normally electrically-interdependent  $RCL$  and  $QD$  adjustments independent by non-reciprocally ganging them.

When used with an external d.c. supply, the resistance range will measure a.c. and d.c. resistance values from 0.001  $\Omega$  to 10 M $\Omega$  with an accuracy of  $\pm 1\% \pm 0.001 \Omega$ . The capacitance range covers 1 pF to 1,000  $\mu F$  ( $\pm 1\% \pm 1$  pF) and the inductance range 1  $\mu H$  to 1,000 H ( $\pm 1\%$



$\pm 1\mu\text{H}$ ). The  $Q$  and  $D$  ranges measure a maximum of 1,000 and 50 respectively.

The carrying handle and protective face-plate cover combine to provide an adjustable-angle prop-stand for the bridge.

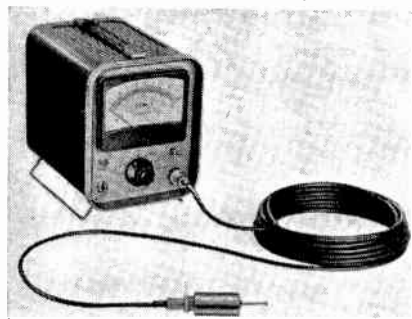
Distributed in U.K. by  
*Claude Lyons Ltd.,*  
*Valley Works,*  
*4-10 Ware Road, Hoddesdon, Herts.*

### Capacitance-Sensing Tachometer

Designed for the measurement of speed of rotating objects, this instrument can also be used for such applications as proximity measurement, timing and control of automatic processes and synchronization of fast-moving machinery.

Known as type CTM-1, it utilizes a capacitance probe which can be supplied with detachable end-pieces of various shapes, lengths and diameters.

In operation, the end-piece of the probe



is mounted near to, but not in contact with, any irregularity on the rotating part moving at the speed to be measured. The irregularity may be an indentation or a projection but must not be less than  $\frac{1}{16}$  in. diameter  $\times$   $\frac{1}{16}$  in. deep. Each time the irregularity passes the end-piece of the probe, a capacitance change is produced. This develops a voltage pulse which is fed via a cable to the counting instrument, which may be as much as several hundred yards away from the probe.

Details from the makers' specification include:

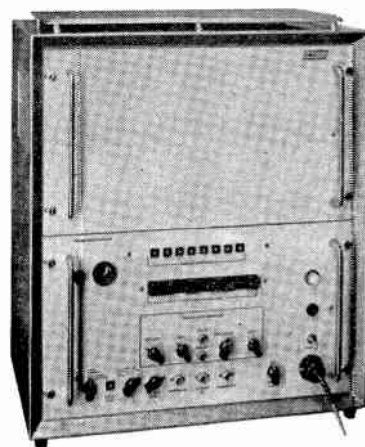
Range	..	0 to 200,000 r.p.m. (6 ranges)
Accuracy	..	better than 2%.
Drift	..	less than 1% in any hour.
Stability	..	better than $\pm 0.5\%$ for $\pm 10$ V mains fluctuation.
Power supply	..	200/250 V, 50 c/s.

*Grunther Instruments Ltd.,*  
*14 Oriental Street, London, E.14.*

### Time Calibrator Unit

A new version of their time calibrator unit has been announced by Cawkell Research & Electronics Ltd.

Known as type CU3A, it provides eight basic time-interval pulses which range from  $0.5\mu\text{sec}$  to 1 msec. Selection of the output is made by press-button switches and arrangements are made so that one, or any combination of the eight time intervals is available, in positive- or negative-going form, at one of the common output sockets.



The eight basic time interval pulses are also available from individual sockets mounted on the front panel of the instrument.

The markers are calibrated against an internal 2-Mc/s crystal-controlled oscillator and may be free-running or keyed from an external source.

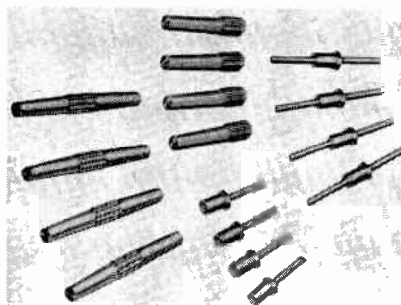
Details from the makers' data includes:

Accuracy	$\pm 0.05\%$ (when set against internal crystal)
Amplitude	$\pm 50$ V
Pulse width	0.5 and 1 $\mu\text{sec}$
Rise time	0.1 $\mu\text{sec}$ .
Output loading	100 pF max.
Internal gate amplitude	- 50 V peak max.
Synchronizing signal	1 V peak min.

*Cawkell Research & Electronics Ltd.,*  
*Scotts Road, Southall, Middx.*

### Solder Pins

Two new ranges of solder pins have been introduced by Harwin Engineers Ltd. to meet the 0.052-in. hole recommended in B.S.S. 3081/1959 and Defence Guide 5007. They are available for rivet or force-fit



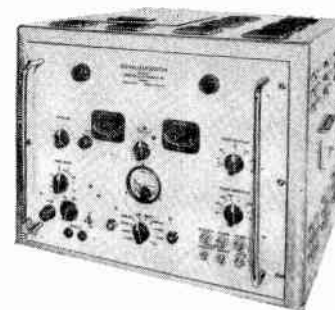
assembly for either single- or double-ended connections.

The pins are turned from solid brass and are flow-tinned.

*Harwin Engineers Ltd.,*  
*Rodney Road, Portsmouth, Hants.*

### 'L'-Band Signal Generator

Winston Electronics has recently announced a new generator which provides a source of c.w. or pulse-amplitude-



modulated power over the frequency range 800-2,100 Mc/s.

Known as type 957, it utilizes a single continuously-variable control which is directly calibrated to an accuracy of  $\pm 1\%$ . Frequency drift is less than 0.2% during the 'warm-up' period, after which it is approximately 0.003%/°C. The output power can be varied over the range 0 to -100 dB (relative to 1mW), by a directly-calibrated control. The output is taken via an 'N'-type connector which has an output impedance of 50  $\Omega$  at a v.s.w.r. not worse than 0.5. Modulation may be provided by: external pulses, the internal pulse generator or the internal generator synchronized by an external pulse or sine-wave generator at a rate of 40 to 4,000 c/s.

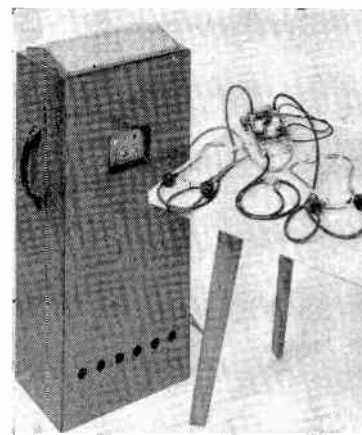
Other facilities include three calibrated controls for pulse width, pulse delay, pulse rate and two outputs for synchronization, one undelayed and the other delayed.

*Winston Electronics Ltd.,*  
*Govett Avenue, Shepperton, Middx.*

### Electronic Stethoscope

The Soniscope is an electronic stethoscope giving high gain in the audio range. It incorporates treble- and bass-frequency attenuators for the selection of required groups of frequencies in the sonic range.

The stethoscope consists of a miniature battery-operated valve amplifier, crystal



contact microphone and two sets of conventional earpieces. A special extension speaker is also available for use with the Soniscope.

*Faraday Electronic Instruments Ltd.,*  
*65 Fairview Road, London, S.W.16.*

# Abstracts and References

COMPILED BY THE RADIO RESEARCH ORGANIZATION OF THE DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH AND PUBLISHED BY ARRANGEMENT WITH THAT DEPARTMENT

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses. Copies of articles or journals referred to are not available from Electronic & Radio Engineer. Application must be made to the individual publishers concerned.

	Page A		Page A
Acoustics and Audio Frequencies .. .. .	137	Measurements and Test Gear .. .. .	148
Aerials and Transmission Lines .. .. .	138	Other Applications of Radio and Electronics .. .. .	149
Automatic Computers .. .. .	139	Propagation of Waves .. .. .	149
Circuits and Circuit Elements .. .. .	139	Reception .. .. .	150
General Physics .. .. .	141	Stations and Communication Systems .. .. .	150
Geophysical and Extraterrestrial Phenomena .. .. .	142	Subsidiary Apparatus .. .. .	150
Location and Aids to Navigation .. .. .	145	Television and Phototelegraphy .. .. .	151
Materials and Subsidiary Techniques .. .. .	145	Transmission .. .. .	152
Mathematics .. .. .	148	Valves and Thermionics .. .. .	152
Miscellaneous .. .. .	.. .. .	.. .. .	.. .. .
		.. .. .	A 154

## ACOUSTICS AND AUDIO FREQUENCIES

- 534.001.5(51) **2808**  
**Acoustics in China.**—Ma Da-Yu. (*Akust. Zh.*, Oct./Dec. 1958, Vol. 4, No. 4, pp. 373-375.) Outline of the development of research in China since 1949, in the fields of ultrasonics, architectural acoustics, electro-acoustics, speech, musical acoustics and hearing.
- 534.213.4 **2809**  
**Attenuation of Plane Sound Waves of Finite Amplitude in Gases.**—B. F. Podoshevnikov & B. D. Tartakovskii. (*Akust. Zh.*, Oct./Dec. 1958, Vol. 4, No. 4, pp. 369-371.) Investigation of the dependence of attenuation on sound intensity. A graph shows the distribution of sound pressure in a resonant aluminium tube at a frequency of 13 kc/s.
- 534.22-8-14 **2810**  
**The Propagation of Sound in Seawater.**—A. V. J. Martin. (*Ann. Géophys.*, Oct.-Dec. 1957, Vol. 13, No. 4, pp. 307-309.) A brief description of laboratory experiments using an ultrasonic pulse technique to determine the velocity of sound in pure and salt water. See 1 of January.
- 534.22-8-14 **2811**  
**The Velocity of Ultrasound in Water near the Freezing Point.**—N. F. Otpushchennikov. (*Akust. Zh.*, Oct./Dec. 1958, Vol. 4, No. 4, pp. 367-369.) Brief description of measurements made in distilled water at a frequency of 0.7 Mc/s in the temperature range +20° to 0°C. Results indicate a velocity minimum at 0.7°C and a maximum adiabatic compression at +2°C.
- 534.232-8-14 : 537.228.2 **2812**  
**Electrostrictive Generation of Ultrasonics in Liquids.**—E. Gerdes. (*Naturwissenschaften*, June 1958, Vol. 45, No. 12, pp. 280-281.) Preliminary report on measurements to determine the magnitude of electrode deformation due to Coulomb attraction. See e.g. 310 of 1956 (Goetz).
- 534.26 **2813**  
**Diffraction of Sound Waves in Converging Beams.**—B. D. Tartakovskii. (*Akust. Zh.*, Oct./Dec. 1958, Vol. 4, No. 4, pp. 355-360.) Approximate formulae are derived for the sound field near the focal point of a converging beam, characterized by a nonuniform amplitude distribution over the wave front and spherical aberration.
- 534.522.1 **2814**  
**Measurements of Finite Amplitude Distortion of Progressive Ultrasonic Waves at Moderate Intensities.**—K. L. Zankel & E. A. Hiedemann. (*Naturwissenschaften*, July 1958, Vol. 45, No. 14, pp. 329-330. In English.) Low-amplitude waves were investigated by measurements in water at 2 and 4 Mc/s, and in carbon tetrachloride at 2 and 3 Mc/s over a range of pressures and at various distances from the transducer.
- 534.614-8 **2815**  
**Measurement of Ultrasonic Wave Velocities and Elastic Moduli for Small Solid Specimens at High Temperatures.**—H. J. McSkimin. (*J. acoust. Soc. Amer.*, March 1959, Vol. 31, No. 3, pp. 287-295.) Data for fused silica and single-crystal Ge are listed for temperatures up to 300°C in illustration of the measurement methods described.
- 534.614-8-14 **2816**  
**Modification of Ultrasonic Interferometer Design.**—A. A. Isaev, I. G. Mikhallov & A. S. Khimunin. (*Akust. Zh.*, Oct./Dec. 1958, Vol. 4, No. 4, pp. 363-364.) Note on the design of an improved quartz oscillator for use in interferometric measurements of sound velocity in liquids.
- 534.75 **2817**  
**Unpleasantness of Distorted Sounds: a Criterion derived from the Distortion Spectrum.**—E. R. Wigan. (*Nature, Lond.*, 9th May, 1959, Vol. 183, No. 4671, p. 1320.) An objective criterion of 'unpleasantness' has been computed. Methods for checking it's validity are briefly discussed.
- 534.76 : 534.85 **2818**  
**Moving-Magnetic Stereo.**—H. Horowitz. (*Audio*, May 1959, Vol. 43, No. 5, pp. 19-21..47.) A description of a pickup in which the stylus lever is attached to a magnet pivoted between the pole faces of two pairs of pickup coils. Characteristics are discussed.
- 534.78 : 621.39 **2819**  
**Intelligibility Evaluation of Voice Communications.**—H. Schwarzlander.

(*Electronics*, 29th May 1959, Vol. 32, No. 22, pp. 88-91.) The integral of a difference voltage due to the pure speech signal and that passed through the system under test is used as a measure of intelligibility.

534.781 : 621.374.33 **2820**  
**An Electronic Speech Sampler for Studying the Effect of Sample Duration on Articulation.**—R. Fatechand & R. Ahmed. (*J. Instn Telecommun. Engrs, India*, March 1959, Vol. 5, No. 2, pp. 86-88.) The start of any word is signalled by a pulse which itself operates the subsequent electronic delay and gate.

534.845 **2821**  
**Panel Absorbents for Low-Frequency Sound Absorption.**—N. K. D. Choudhury & M. V. S. S. K. Rao. (*J. Instn Telecommun. Engrs, India*, March 1959, Vol. 5, No. 2, pp. 103-108.) Resonant plywood panels show effective absorption in the range 75-300 c/s.

534.861 : 534.84 **2822**  
**The Acoustic Design of Talks Studios and Listening Rooms.**—C. L. S. Gilford. (*Proc. Instn elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 245-256. Discussion, pp. 256-258.)

621.395.623.7.001.4 **2823**  
**The Impedance and Phase Angle of Loudspeaker Loads.**—R. E. Cooke. (*Muirhead Technique*, April 1959, Vol. 13, No. 2, pp. 11-16.) A description of the basic measurement circuit and a discussion of the impedance and phase-angle characteristics obtained for moving-coil and e.s. loudspeaker systems.

621.395.623.8 **2824**  
**Column Loudspeakers for Public-Address Systems.**—M. L. Gayford. (*Electronics*, 12th June 1959, Vol. 32, No. 24, pp. 64-65.) The principles of design are briefly described, with particular reference to polar response.

621.395.625.3 **2825**  
**A Regulator of Speed and Pitch for Sound Recordings.**—A. M. Springer. (*Elektronische Rundschau*, Aug. 1958, Vol. 12, No. 8, pp. 275-276.) An adaptor unit for magnetic-tape recorders is described. This has a rotating assembly of four magnetic heads to provide independent changes of speed and pitch in recordings.

## AERIALS AND TRANSMISSION LINES

621.372.8 **2826**  
**The Design and Testing of Integrally Constructed Waveguide Assemblies.**—G. Craven & V. H. Knight. (*Proc. Instn elect. Engrs*, Part B, Vol. 106, No. 27, pp. 321-334.) A microwave-link repeater is described as an example of an assembly. Testing facilities include a plug-in reflectometer and a frequency-sweep reflection display.

621.372.8 : 537.226 **2827**  
**Dielectric Image Lines.**—S. P. Schlesinger & D. D. King. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 291-299. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)

621.372.821 **2828**  
**Measurement of the Properties of a Strip Line and its Transition Junction.**—F. Norman. (*Proc. Instn Radio Engrs, Aust.*, Dec. 1958, Vol. 19, No. 12, pp. 788-795.) Measurements made in the range 8-11 cmλ indicate that a single modified TEM mode could be excited efficiently by means of a simple transition junction.

621.372.823 **2829**  
**The Waveguide for Low-Loss Transmission.**—K. Noda, A. Konose, T. Fujii & K. Miyauchi. (*Rep. elect. Commun. Lab., Japan*, Oct. 1958, Vol. 6, No. 10, pp. 394-400.) A report of measurements of attenuation in straight circular waveguides, and in serpentine and uniform bends propagating the H<sub>01</sub> mode in circular and elliptic waveguides.

621.372.826 **2830**  
**Launching Efficiency of Wires and Slots for a Dielectric Rod Waveguide.**—R. H. DuHamel & J. W. Duncan. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 277-284. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)

621.372.832.43 **2831**  
**Centre-Excited TE<sub>10</sub>-TE<sub>01</sub> Mode Transducer.**—B. Oguchi & K. Yamaguchi. (*Rep. elect. Commun. Lab., Japan*, Oct. 1958, Vol. 6, No. 10, pp. 389-393.) Experimental data are given on the design and performance of a new type of mode transducer for use in the 24-kMc/s band.

621.372.832.8 **2832**  
**X Circulator.**—S. Yoshida. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, p. 1150.) A new four-port waveguide circulator; experimental results are given.

621.372.837.2 **2833**  
**A New Form of High-Power Microwave Duplexer.**—P. D. Lomer & R. M. O'Brien. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 264-267. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1776.)

621.372.837.3 : 621.318.134 **2834**  
**A Fast Ferrite Switch for Use at 70 kMc/s.**—E. H. Turner. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 300-303. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)

621.372.837.3 : 621.396.65 **2835**  
**A Faraday-Rotation Switch for the TH System.**—J. A. Weiss. (*Bell Lab. Rec.*, April 1959, Vol. 37, No. 4, pp. 139-143.) Description of a rapid-acting microwave switch based on the Faraday effect, designed for switching stand-by oscillators into service.

621.372.852.22 **2836**  
**A Perturbation Method for Circular Waveguides containing Ferrites.**—P. J. B. Clarricoats. (*Proc. Instn elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 335-340.) The propagation coefficient of a guide containing a longitudinally magnetized ferrite is derived. Good agreement is obtained with experimental data.

621.372.852.22 **2837**  
**A Phenomenological Theory of the Reggia-Spencer Phase Shifter.**—J. A. Weiss. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1130-1137.) Explains the essential properties of the device by means of a simplified model. See 387 of 1958 (Reggia & Spencer).

621.372.852.22 **2838**  
**Theory of the Mode Spectra of Cylindrical Waveguides containing Gyromagnetic Media.**—R. A. Waldron. (*J. Brit. Instn Radio Engrs*, June 1959, Vol. 19, No. 6, pp. 347-356.) The cut-off equations are derived and solved for the dielectric-centred case and the normal modes are studied. The relations between this case and that of the ferrite-centred case studied previously (341 of February) are pointed out.

621.372.852.323 : 621.318.134 **2839**  
**Theoretical Analysis of the Operation of the Field-Displacement Ferrite Isolator.**—K. J. Button. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 303-308. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)

621.396.67.095 **2840**  
**Four-Dimensional Electromagnetic Radiators.**—H. E. Shanks & R. W. Bickmore. (*Canad. J. Phys.*, March 1959, Vol. 37, No. 3, pp. 263-275.) The effect of modulating one or more parameters of an aerial or aerial array, such as aperture dimensions, frequency or phase distribution, is discussed, and applications to multi-pattern operation, simultaneous scanning and sidelobe suppression are considered.

621.396.67.095 : 537.311.5 **2841**  
**Determination of a Current Distribution over a Cone Surface which will Produce a Prescribed Radiation Pattern.**—H. Unz. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 182-186. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.674.31 **2842**  
**The Effects of the Physical Parameters on the Bandwidth of a Folded Dipole.**—J. F. German & F. E. Brooks, Jr. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 186-190. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.674.33 **2843**  
**The Characteristic Impedance of Two Infinite Cones of Arbitrary Cross-Section.**—R. L. Carrel. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 197-201. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.677 : 523.164 : 621.318.57 **2844**  
**A Compact Antenna Switch for Scintillation Measurements.**—W. D. Ryan. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, p. 1159.) This switch introduces a phase shift of 90° successively into the lines from each of two aeri-als.

621.396.677.029.63 **2845**  
**The Performance of Directive Aerials in Complex U.H.F. Fields.**—J. A. Saxton & B. N. Harden. (*Proc. Instn elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 315–317.) Apparent gains of directive aerials, relative to a half-wave dipole, were measured at 580 and 904 Mc/s on a number of urban and rural sites. The median gains were similar to the calculated plane-wave gains, but the apparent gain was low, owing to the complexity of the field, on a significant number of sites.

621.396.677.3 : 523.164.32 **2846**  
**A New High-Resolution Interferometer for Solar Studies.**—Kundu. (See 2936.)

621.396.677.3 : 621.396.965 **2847**  
**A Note on the Effective Aperture of Electrically Scanned Arrays.**—R. W. Bickmore. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 194–196. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.677.32 **2848**  
**The Radiation Characteristics of a Zig-Zag Antenna.**—D.L. Sengupta. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 191–194. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.677.71 **2849**  
**Design Data for Small Annular Slot Antennas.**—W. A. Cumming & M. Cormier. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 210–211. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.677.75 **2850**  
**Hemi-isotropic Radiators for the S or X Band.**—E. G. A. Goodall. (*Proc. Instn elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 318–320.) “An aerial having approximate hemi-isotropic properties has been constructed on the principle that a dielectric rod will act as a guiding medium for electromagnetic energy. Using this principle, a broad-band, shaped dielectric element has been developed, which, when placed at the aperture of an open-ended circular waveguide, radiates with hemi-isotropic cover over a 20% frequency band.”

621.396.677.81 : 621.397.7 **2851**  
**The Passive TV Relay and its Practical Possibilities.**—R. Aschen. (*TSF et TV*, Nov. 1957, Vol. 33, No. 349, pp. 329–330.) Field strength and aerial gain calculations for typical passive relay systems comprising a coupled receiving and transmitting aerial are given. See also 2852 below.

621.396.677.83 **2852**  
**Passive Relay by Microwave Mirror.**—R. Aschen. (*TSF et TV*, Jan. 1958, Vol. 33, No. 351, pp. 5–7.) Formulae are given for calculating the mirror area and reflection losses for a typical relay circuit based on a received field strength of 2 mV/m at a frequency of 200 Mc/s.

621.396.677.83 **2853**  
**A Log-Periodic Reflector Feed.**—D. E. Isbell. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1152–1153.) An aerial of the log-periodic reflector type has been constructed which has been used over the range 105–430 Mc/s. Its effective aperture is fairly constant below 325 Mc/s.

621.396.677.85 **2854**  
**Microwave Stepped-Index Luneberg Lenses.**—G. D. M. Peeler & H. P. Coleman. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 202–297. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

## AUTOMATIC COMPUTERS

681.142 **2855**  
**The Design of a Standard Block for a Digital Computing System.**—R. J. Miles. (*Mullard tech. Commun.*, April 1959, Vol. 4, No. 38, pp. 222–248.) Logical theory, design considerations and practical circuit of a block based on alloy-junction transistors operating at frequencies up to 1 Mc/s.

681.142 **2856**  
**Binary Multiplication in Digital Computers.**—A. Green. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1159–1160.) Shows how many steps can be eliminated from the usual process of multiplication by computer.

681.142 **2857**  
**Computation of Sin N, Cos N and m√N using an Electronic Computer.**—E. G. Kogbetliantz. (*IBM J. Res. Developm.*, April 1959, Vol. 3, No. 2, pp. 147–152.)

681.142 **2858**  
**Rotating-Disk Function Generator for Analogue Computers.**—M. E. Young, W. M. Alexander & H. D. Schwetman. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 318–322.) A variable-radius revolving lamina modulates the light incident upon the cathode of a photomultiplier tube to produce a required voltage/time function.

681.142 : 518.4 **2859**  
**A Design for an Automatic Graph Plotter.**—M. P. Atkinson, W. T. Bane & D. L. A. Barber. (*Proc. Instn elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 299–306.) Transistors and printed circuits are used in equipment based on digital techniques. Points may be plotted at a rate of three per second, with an accuracy within 0.01 in.

681.142 : 621.318.042 **2860**  
**Magnetic-Core Matrices for Logical Functions.**—A. L. Freedman. (*Electronic Engng*, June 1959, Vol. 31, No. 376, pp. 358–361.) Some applications of cores having a square hysteresis loop.

681.142 : 621.318.57 **2861**  
**The Design of Biased-Diode Function Generators.**—C. C. Ritchie & R. W. Young. (*Electronic Engng*, June 1959, Vol. 31, No. 376, pp. 347–351.) Relations between the number and spacing of diode sections to give minimum error are derived.

## CIRCUITS AND CIRCUIT ELEMENTS

621.3.049.7 **2862**  
**Recent Advances in Potted and Printed Circuits.**—H. G. Manfield (*J. Brit. Instn Radio Engrs*, May 1959, Vol. 19, No. 5, pp. 289–302.) “The various potting resins are described in relation to the variation of properties with different proportions of hardener and the effects on the parameters of the potted components. The causes of failure of potted circuits are discussed. Design problems in the use of printed circuits are examined with particular reference to questions of conductor thickness and spacing. A method of sealing printed circuits by a thin polysulphide rubber layer which is sprayed or brushed on is described.”

621.3.049.7 : 621.385.1 **2863**  
**Thermionic Integrated-Micro-modules.**—J. E. Beggs, W. Grattidge, P. J. Molenda, A. P. Haase & A. F. Dickerson. (*Electronics*, 15th May 1959, Vol. 32, No. 20, pp. 80–83.) The construction and application of microminiature heaterless valves, resistors and capacitors using titanium and ceramic materials are described.

621.318.57 : 537.227 **2864**  
**The Transpolarizer: an Electrostatically Controlled Circuit Impedance with Stored Setting.**—C. F. Pulvari. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1117–1123.) The device operates by the controlled transfer of polarization through two or more ferroelectric dielectric sections in series.

621.318.57 : 621.52 **2865**  
**An Electronic Timer with Voltage Control of Setting.**—R. Gladstone. (*Electronic Engng*, June 1959, Vol. 31, No. 376, pp. 362–363.) A new grid-controlled ‘bootstrap’ circuit with common-cathode trigger provides accurately controlled time delays up to about 100 seconds.

621.318.57 : 621.314.63 **2866**  
**Microwave Switching by Crystal Diodes.**—M. R. Millet. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 284–290. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)

- 621.319.4 : 621.3.049.75 **2867**  
**Tantalum Printed Capacitors.**—R. W. Berry & D. J. Sloan. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1070–1075.) Description of the structural features and characteristics of capacitors using sputtered Ta films as the base for the anodized oxide film, with evaporated metal counter-electrodes.
- 621.319.45 : 669.718.5 **2868**  
**The Surface Enlargement of Aluminium for Electrolytic Capacitors.**—P. Werner. (*Nachr. Tech.*, June 1958, Vol. 8, No. 6, pp. 269–277.) Various chemical and electrochemical methods are described and compared, and details are given of a method of measuring the increase in surface area achieved.
- 621.372.5 **2869**  
**General Solution of the Symmetric Iterative Analysis of Asymmetric Passive Linear Quadripoles.**—S. Mayr. (*Arch. Elektrotech.*, 8th Dec. 1958, Vol. 44, No. 2, pp. 120–129.) The asymmetric quadripole is divided into two symmetric quadripole sections which can be treated by iterative matrix methods.
- 621.372.57 : 621.3.087.4 : 551.594.6 **2870**  
**Investigation of an Apparatus for Recording Atmospherics.**—R. Benoit & J. Kernevez. (*Ann. Géophys.*, Oct./Dec. 1957, Vol. 13, No. 4, pp. 321–324.) An analysis of an integrating circuit with a long time-constant and its response to a series of pulses.
- 621.372.6 **2871**  
**A Topological Nonreciprocal Network Element.**—A. W. Keen. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1148–1150.) The element is a three-terminal device which may be used with physical elements (immittances) to model the more complex nonreciprocal devices.
- 621.372.6 **2872**  
**Traditors, a New Class of Non-energetic Nonlinear Network Elements.**—S. Duinker. (*Philips Res. Rep.*, Feb. 1959, Vol. 14, No. 1, pp. 29–51.) From an analysis based on the Lagrangian dynamical equations a class of nonlinear multiport elements is defined, which are characterized by the property of neither dissipating nor storing but only transferring energy.
- 621.372.632 : 621.314.63 **2873**  
**Transmitting Frequency Converter in which Gold- or Silver-Bonded Diode is Used.**—Kita, Sanpei & Okajima. (See 3145.)
- 621.372.632.029.6 **2874**  
**One Aspect of Minimum-Noise-Figure Microwave Mixer Design.**—S. M. Bergmann. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 324–326. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)
- 621.373 : 537.312.62 **2875**  
**A Cryogenic Oscillator.**—G. B. Rosenberger. (*IBM J. Res. Developm.*, April 1959, Vol. 3, No. 2, pp. 189–190.) A relaxation process based on the transition between the superconducting and conducting phases of a Pb film is described. Oscillations at frequencies around 100 kc/s have been obtained.
- 621.373.42.029.422 **2876**  
**A Sine-Wave Generator with Periods of Hours.**—G. Klein & J. M. den Hertog. (*Electronic Engng*, June 1959, Vol. 31, No. 376, pp. 320–325.) An 'inverse function generator' based on the difference amplifier [see e.g. 362 of 1956 (Klein)] is examined and examples of its use are considered, (a) in a logarithmic voltmeter, and (b) for sine-triangle waveform transformation. Triangle-sine transformation can be achieved by negative feed-back; a v.l.f. triangular waveform obtained from a CR circuit and relay is thus converted to an accurate sine wave without transients.
- 621.373.43 : 621.314.7 : 621.385.1 **2877**  
**Tube-Transistor Hybrids Provide Design Economy.**—G. A. Dunn & N. C. Hekimian. (*Electronics*, 5th June 1959, Vol. 32, No. 23, pp. 68–70.) A bistable cathode follower and four-stage ring counter are described. The transistors appear in the cathode circuits of the valves.
- 621.373.52 **2878**  
**Physical Principles of Avalanche-Transistor Pulse Circuits.**—D. J. Hamilton, J. F. Gibbons & W. Shockley. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1102–1108.) "A model for the transistor is defined in terms of charge variables and the physical parameters of the device. The transient performance of the model is calculated by focusing attention on the minority-carrier charge stored in the base region and the influence of base-width modulation upon this stored charge. In the charge formulation of the problem, the physical details of the avalanche multiplication process need not be considered; multiplication is accounted for by the boundary conditions which it imposes upon the stored charge. Good agreement has been obtained between calculated and experimentally observed data for a simple avalanche-transistor relaxation oscillator."
- 621.374.3 : 621.387.4 **2879**  
**Time to Pulse-Height Converter.**—J. V. Kane. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 374–375.) A circuit is described for deriving pulses the amplitudes of which decrease linearly with time.
- 621.374.3 : 621.387.4 **2880**  
**Linear Gate of 20- $\mu$ s Duration.**—E. L. Garwin. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 373–374.) Diodes with a 6  $\mu$ s recovery time are used in a coincidence circuit.
- 621.374.5 : 538.652 **2881**  
**A Torsional Magnetostrictive Delay Line.**—A. Rothbart. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1153–1154.) An application of the Wiedemann effect, using toroidal coil transducers.
- 621.375.018.75 : 537.311.33 **2882**  
**Pulse Amplification using Impact Ionization in Germanium.**—M. C. Steele, L. Pensak & R. D. Gold. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1109–1117.) Some aspects of the phenomena of impact ionization in an impurity-doped semiconductor at 4.2°K are described. Control of the breakdown process is used to obtain pulse amplification in the millimicrosecond range, using two- and three-terminal devices.
- 621.375.2.029.3 **2883**  
**Reducing Distortion in Class-B Amplifiers.**—B. Sklar. (*Electronics*, 22nd May 1959, Vol. 32, No. 21, pp. 54–56.) Linearization is accomplished by a non-linear compensation network containing diodes. The calculations for an a.f. amplifier with 2.6% distortion are described.
- 621.375.232.4 **2884**  
**Grounded-Grid Power Amplifier Design.**—J. L. Dautremont, Jr. (*Electronic Equipm. Engng*, Dec. 1958, Vol. 6, No. 12, pp. 33–36.) A graphical design procedure is described, using a disk-seal valve Type 2C39-A as an example.
- 621.375.4.029.3 **2885**  
**Single-Ended Amplifiers for Class-B Operation.**—H. C. Lin & B. H. White. (*Electronics*, 29th May 1959, Vol. 32, No. 22, pp. 86–87.) A transistorized 10-W high-fidelity push-pull amplifier is described in detail.
- 621.375.4.029.3 **2886**  
**Designing High-Quality A.F. Transistor Amplifiers.**—R. Minton. (*Electronics*, 12th June 1959, Vol. 32, No. 24, pp. 60–61.) A seven-stage 25-W amplifier is described.
- 621.375.4.029.3 **2887**  
**One-Transistor 'Push-Pull'.**—J. A. Worcester. (*Electronics*, 12th June 1959, Vol. 32, No. 24, p. 74.) An a.f. output stage in which the biasing condition is controlled by the rectified output.
- 621.375.9 : 538.569.4 **2888**  
**Molecular Oscillators and Amplifiers.**—N. G. Basov & A. M. Prokhorov. (*Priroda, Mosk.*, July 1958, No. 7, pp. 24–32.) The principle and operation of molecular-beam oscillators and amplifiers are described with reference to the ammonia-beam maser. Molecular amplifiers based on paramagnetic crystals give a wider pass-band and a higher output power than the molecular-beam type. The frequency stability achieved is within one part in 10<sup>9</sup>.
- 621.375.9 : 538.569.4 **2889**  
**Zero-Field Masers.**—G. S. Bogle & H. F. Symmons. (*Aust. J. Phys.*, March 1959, Vol. 12, No. 1, pp. 1–20.) "Solid state three-level masers operating with zero magnetic field are shown to be feasible and to have advantages over magnetic-field masers in many applications. The requirements of the working substance are discussed and it is found that compounds of Cr<sup>2+</sup>, Fe<sup>3+</sup>, Ni<sup>2+</sup>, and Gd<sup>3+</sup> should



be suitable. Diagrams and tables of maser properties of selected compounds are given; on the basis of present knowledge a number of amplifying frequencies between 120 and 75 000 Mc/s should be available. The range of suitable compounds which has been studied is very small, and should be extended."

621.375.9 : 538.569.4 **2890**

**Role of Double-Quantum Transitions in Masers.**—S. Yatsiv. (*Phys. Rev.*, 15th March 1959, Vol. 113, No. 6, pp. 1538–1544.) Conditions are found in which the operation of a three-level maser is governed by the double-quantum process and does not require a true 'pumping' stage. Such a case, although realizable in practice, may be of doubtful technical applicability.

621.375.9 : 538.569.4 **2891**

**Travelling-Wave Solid-State Masers.**—A. E. Siegman, P. N. Butcher, J. C. Cromack & W. S. C. Chang. (*Proc. Instn. Engrs.*, Part B, 1958, Vol. 105, Supplement No. 11, pp. 711–712. Discussion.)

621.375.9 : 538.569.4 : 523.164 **2892**

**A Maser Amplifier for Radio Astronomy at X Band.**—J. A. Giordmaine, L. E. Alsop, C. H. Mayer & C. H. Townes. (*Proc. Inst. Radio Engrs.*, June 1959, Vol. 47, No. 6, pp. 1062–1069.) "The design and operating characteristics of a maser radiometer for use in radio astronomy at 3-cm wavelength are discussed. The operating system which is described has a bandwidth of 5.5 Mc/s and an input noise temperature, including background radiation into the antenna, of about 85° K. An r.m.s. fluctuation level of about 0.04° K is attained using an averaging time of 5 seconds. A discussion of the factors determining the sensitivity of such devices is presented."

621.375.9 : 538.22 : 538.569.4 **2893**

**Two-Level Maser Materials**—Hoskins. (See 3037.)

621.375.9 : 538.569.4 : 538.222 **2894**

**Theory of Three-Level Paramagnetic Masers.**—P. N. Butcher. (*Proc. Instn. Engrs.*, Part B, 1958, Vol. 105, Supplement No. 11, pp. 684–711.)

Part 1—Quantum Theory (pp. 684–690).

Part 2—Amplification and Oscillation (pp. 691–698).

Part 3—Output Noise Power Spectrum (pp. 699–704).

Part 4—Noise Figure (pp. 705–709). Discussion (pp. 709–711).

621.375.9 : 550.389.2 : 629.19 **2895**

**Parametric Amplifier Receives Space Signals.**—(*Electronics*, 5th June 1959, Vol. 32, No. 23, pp. 80–81.) Signal amplification was in L band and pump frequency in X band giving a noise factor of 1 dB and bandwidth 100 kc/s. Using a 32-dB paraboloid (diameter 18 feet) the fraction of a watt radiated by Pioneer IV was received at 410 000 miles.

621.375.9 : 621.3.011.23 **2896**

**Microwave Parametric Amplifiers and Convertors.**—G. Wade & H. Heffner. (*Proc. Instn. Engrs.*, Part B, 1958, Vol. 105, Supplement No. 11, pp. 677–679.) The inherent gain, noise and bandwidth characteristics of basic circuits are discussed and a brief description is given of a ladder-network converter in which the output frequency is higher than the pumping frequency.

621.375.9 : 621.3.011.23 **2897**

**Circuit Conditions for Parametric Amplification.**—J. E. Pallett. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 261–262.) Correction of an error in Valdes' paper (75 of January).

621.376.23 **2898**

**Simplified Product Detector Design.**—J. L. Ekstrom. (*QST*, May 1959, Vol. 43, No. 5, p. 43.) A circuit is described for a pentagrid converter which may be self-excited or separately excited and which has an inter-modulation balance adjustment to reduce rectification effects.

621.376.4 **2899**

**The Modulator as a Phase Detector.**—W. Frazer & R. E. Schemel. (*Electronic Engng.*, June 1959, Vol. 31, No. 376, pp. 345–346.) A note on the error due to a finite switching voltage applied to a shunt modulator.

**GENERAL PHYSICS**

535.13 **2900**

**Solution of Maxwell's Equations in Terms of a Spinor Notation: the Direct and Inverse Problem.**—H. E. Moses. (*Phys. Rev.*, 15th March 1959, Vol. 113, No. 6, pp. 1670–1679.) The use of spinor notation enables the solution to be obtained in more compact form than does vector notation.

537.226 **2901**

**The Quantum Mechanical Theory of the Dielectric Orientation Polarization of Gases: Part 1—The Static Orientation Polarization of a Dipole Gas consisting of Symmetric Spin Molecules.**—W. Maier & H. K. Wimmel. (*Z. Phys.*, 5th Dec. 1958, Vol. 153, No. 3, pp. 297–313.)

537.311.1 : 621.396.822 **2902**

**Noise Theory for Hot Electrons.**—P. J. Price. (*IBM, J. Res. Developm.*, April 1959, Vol. 3, No. 2, pp. 191–193.) Nyquist's theorem is extended to the case in which the distribution of electrons is disturbed by a steady electric field.

537.311.4 **2903**

**Transient Behaviour of the Ohmic Contact.**—M. A. Lampert & A. Rose. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1236–1239.) The behaviour of

ohmic injecting contacts is analysed for transient currents at a fixed voltage. These occur when the free-carrier density in the solid is changed by some exciting agent as in photoconductivity or bombardment-induced conductivity.

537.311.5 : 538.566 **2904**

**The Calculation of the Field in a Homogeneous Conductor with a Wavy Interface.**—J. R. Wait. (*Proc. Inst. Radio Engrs.*, June 1959, Vol. 47, No. 6, pp. 1155–1156.) Analysis showing that the perturbation of an e.m. field in the conductor due to the ripples is proportional to their amplitude.

537.311.5 : 621.3.015.3 **2905**

**Penetration of Transient Electromagnetic Fields into a Conductor.**—A. Grumet. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 682–686.) Theory for a uniform electric field abruptly applied to a plane boundary.

537.322.1 **2906**

**On the Theory of the Peltier Heat Pump.**—E. S. Rittner. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 702–707.) The figure of merit for a single-stage pump is optimized in the region of partial Fermi degeneracy.

537.527 : 537.56 **2907**

**The Space-Charge Field-Emission Hypothesis applied to Hayashi Data on Discharges through Gases.**—H. Ritow. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 236–245.)

537.533 **2908**

**Concerning the Nature of the Aberrations in Electron Sheet Beams.**—W. E. Waters. (*J. opt. Soc. Amer.*, March 1959, Vol. 49, No. 3, pp. 304–307.) A power-series expansion is used to derive expressions for the aberrations up to the third order in electron sheet beams subject to purely electrostatic focusing. Four purely geometric aberrations and four aberrations due to chromatic effects are found.

537.542 **2909**

**New Hollow-Cathode Glow Discharge.**—A. D. White. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 711–719.) Current densities of 0.5 A/cm<sup>2</sup> can be obtained with a cathode consisting of a refractory metal with a spherical cavity. In neon, stable characteristics at a few milliamperes are obtained.

537.56 : 538.56 **2910**

**New Experimental Results for Plasma Electron Oscillations.**—D. W. Mahaffey. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 193–203.) Study of oscillations in low-pressure mercury vapour discharges with plane oxide-coated cathodes.

537.56 : 538.56 **2911**

**A Lagrangian Formulation of the Boltzmann-Vlasov Equation for Plasmas.**—F. E. Low. (*Proc. roy. Soc. A*, 11th Nov. 1958, Vol. 248, No. 1253, pp. 282–287.) A variational principle is found

which leads to a new formulation of the problem of small oscillations about equilibrium.

537.581 **2912**  
**Wave-Mechanical Correction of the Richardson-Dushman Emission Formula.**—F. Ollendorff. (*Arch. Elektrotech.*, 12th Feb. 1959, Vol. 44, No. 3, pp. 177–188.) An attempt is made to overcome the discrepancies between the spin-corrected theory of thermionic electron emission and empirical results.

538.1 **2913**  
**Bose-Einstein Lattice Gases equivalent to the Heisenberg Model of Ferro-, Antiferro- and Ferri-Magnetism.**—T. Morita. (*Progr. theor. Phys.*, Nov. 1958, Vol. 20, No. 5, pp. 614–624.) A Hamiltonian is presented that has the form of a finite series of Bose operators and is equivalent to the Heisenberg model. See also *ibid.*, pp. 728–736.

538.3 : 535.13 **2914**  
**Formation of Discontinuities in Classical Nonlinear Electrodynamics.**—M. Lutzky & J. S. Toll. (*Phys. Rev.*, 15th March 1959, Vol. 113, No. 6, pp. 1649–1652.)

538.566 **2915**  
**Polarization and Angle Dependence of the Reflection Factor of Absorbers for Centimetre Electromagnetic Waves.**—K. Walther. (*Z. angew. Phys.*, June 1958, Vol. 10, No. 6, pp. 285–295.) The dependence of the reflection factor on the angle of incidence and plane of polarization of e.m. waves is investigated for various types of absorbers and results are confirmed experimentally.

538.566 **2916**  
**Transients in Conducting Media.**—P. I. Richards. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 178–182. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

538.566 : 535.42] + 534.26 **2917**  
**The Effect of Incident Wave Fluctuations on the Mean Intensity Distribution near the Focal Point of a Lens.**—M. N. Krom & L. A. Chernov. (*Akust. Zh.*, Oct./Dec. 1958, Vol. 4, No. 4, pp. 341–347.) An extension of Chernov's analysis (3772 of 1958) to the case of fluctuations of arbitrary amplitude.

538.566 : 535.42 **2918**  
**The Kirchhoff-Young Theory of the Diffraction of Electromagnetic Waves.**—O. Laporte & J. Meixner. (*Z. Phys.*, 14th Nov. 1958, Vol. 153, No. 2, pp. 129–148.) A transformation is discussed which facilitates the evaluation of Kirchhoff's double integrals.

538.566 : 535.43] + 534.26 **2919**  
**On Propagation of Waves in Slightly Rough Ducts.**—J. C. Samuels. (*J. acoust. Soc. Amer.*, March 1959, Vol. 31, No. 3, pp. 319–325.) Mathematical treatment of acoustic and e.m. wave propagation assum-

ing that the heights of the roughness peaks are small compared to the average separation of the duct walls.

538.566.2 **2920**  
**The Propagation of a Variable Electromagnetic Field in a Stratified Anisotropic Medium.**—A. N. Tikhonov. (*Dokl. Ak. Nauk S.S.S.R.*, 11th June 1959, Vol. 126, No. 5, pp. 967–970.) Computation of the field on the surface of an anisotropic conducting medium due to a dipole lying in the surface. See also 3036 of 1956 (Tikhonov & Shakhsvarov).

538.566.2 : 548 **2921**  
**On the Propagation of Electromagnetic Waves in a Medium with Appreciable Spatial Dispersion.**—V. M. Agranovich & A. A. Rukhadze. (*Zh. eksp. teor. Fiz.*, Oct. 1958, Vol. 35, No. 4(10), pp. 982–984.) Brief description of a method more detailed than that of Ginzburg (1169 of April), in which expansions are obtained for 'direct' and 'inverse' dispersion. It is shown that in cubic crystals inclusion of the spatial dispersion leads to a weak anisotropy of the index of refraction.

538.569.4 **2922**  
**A General Theory of Magnetic Double Resonance.**—K. Tomita. (*Progr. theor. Phys.*, Nov. 1958, Vol. 20, No. 5, pp. 743–773.) The theory describes a system consisting of two interacting different species of spin, one being saturated by a strong resonant radiation field and the other being detected by a weak field. See also 95 of January.

538.569.4 **2923**  
**Multiple-Quantum Transitions in Nuclear Magnetic Resonance.**—S. Yatsiv. (*Phys. Rev.*, 15th March 1959, Vol. 113, No. 6, pp. 1522–1537.)

538.569.4 **2924**  
**The Application of Magnetic Resonance to Solid-State Electronics.**—D. J. E. Ingram. (*J. Brit. Instn Radio Engrs*, June 1959, Vol. 19, No. 6, pp. 357–367.) A description of the basic principles and techniques and an outline of some recent applications.

538.569.4 **2925**  
**Excitation of Spin Waves in an Antiferromagnet by a Uniform R.F. Field.**—R. Orbach & P. Pincus. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1213–1215.) It is possible to excite spin waves in an antiferromagnet by a uniform r.f. field provided that spins on the surface of the specimen experience anisotropy interactions different from those acting on spins in the interior.

538.569.4 **2926**  
**Exchange Effects in Ferromagnetic Resonance.**—M. A. Gintsburg. (*Zh. eksp. teor. Fiz.*, Oct. 1958, Vol. 35, No. 4(10), pp. 1047–1049.) A single dispersion law for transverse e.m. waves and for spin waves is derived which takes account of both relativistic and exchange interactions.

538.569.4 : 538.222 **2927**  
**Paramagnetic Electron-Resonance Induction.**—E. Lutze & D. Bösnecker. (*Naturwissenschaften*, July 1958, Vol. 45, No. 14, p. 332.) Preliminary note on investi-

gations of induced emission at paramagnetic resonance.  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  was used at room temperature and a wavelength of 3.33 cm.

538.569.4 : 621.318.132 **2928**  
**Ferrimagnetic Resonance Modes in Spheres.**—P. C. Fletcher & R. O. Bell. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 687–698.) The magnetostatic solutions of ferrimagnetic resonance in ferrite spheres are briefly derived. Some experimental results are compared with the theory.

538.569.4 : 621.375.9 **2929**  
**Role of Double-Quantum Transitions in Masers.**—Yatsiv. (See 2890.)

538.652 **2930**  
**Form Effect in Linear Magnetostriction.**—H. E. Stauss. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 698–701.)

539.2 **2931**  
**Electron Interaction in Solids. Characteristic Energy Loss Spectrum.**—P. Nozières & D. Pines. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1254–1267.) The characteristic energy loss spectrum is analysed with the aid of the dielectric formulation of the many-body problem.

**GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA**

523.164 : 621.396.677.8 **2932**  
**Improved Measurements of the Positions of 17 Intense Radio Stars.**—B. Elsmore. (*Mon. Not. R. astr. Soc.*, 1958, Vol. 118, No. 6, pp. 603–608.) Observations have been made at 1.9 m $\lambda$ , using the Cambridge radio telescope as a crossed-axis interferometer. See also 103 of January (Edge et al.).

523.164.32 **2933**  
**The Extension of Solar Radio Spectroscopy to Decametre Wavelengths.**—K. V. Sheridan, G. H. Trent & J. P. Wild. (*Observatory*, April 1959, Vol. 79, No. 909, pp. 51–53.) Preliminary report on spectrographic investigations in the frequency range 24–40 Mc/s.

523.164.32 **2934**  
**On Short Periodic Variations in Solar Noise Storms on 200 Mc/s.**—Ø. Hauge. (*Astrophys. norveg.*, Jan. 1958, Vol. 6, No. 5, pp. 43–54.) 19 days of enhanced solar radiation on 200 Mc/s in June, July and August 1955 are investigated by an autocorrelation method in a search for short periodic variations with repetition times between 7.5 and 90 min. Results indicate that some noise storms are characterized by periodic variations with repetition times differing from day to day, while other noise storms exhibit no periodic variations. It is possible that a specific noise storm area retains its characteristics of short periodic variations in radio emission for a solar rotation or longer.

523.164.32

2935

**On the Fine Structure of Solar Bursts in the 200-Mc/s Range and their Drift in Frequency.**—Ø. Elgarøy. (*Astrophys. norveg.*, Jan. 1958, Vol. 6, No. 6, pp. 55-74.) High-speed records have been obtained simultaneously on 199 Mc/s and 200.5 Mc/s with a twin-channel receiver at the Harestua Solar Observatory during the period February-September 1957. An analysis of the records shows that 48 % of the bursts occur first on the lower frequency, 34 % first on the higher frequency and 18 % simultaneously. The results are discussed and the receiving equipment is described.

523.164.32 : 621.396.677.3

2936

**A New High-Resolution Interferometer for Solar Studies.**—M. R. Kundu. (*J. Instn Telecommun. Engrs, India.*, March 1959, Vol. 5, No. 2, pp. 77-85.) The device is essentially a two-element interferometer with the two aerials aligned equatorially which permits use far from the median plane and gives a resolving power of the order of 1'. See 2733 of 1957 (Alon et al.).

523.164.4

2937

**A High-Resolution Survey of the Andromeda Nebula at 408 Mc/s.**—M. I. Large, D. S. Mathewson & C. G. T. Haslam. (*Nature, Lond.*, 2nd May 1959, Vol. 183, No. 4670, pp. 1250-1251.) A report of observations made with the Jodrell Bank radio telescope.

523.164.4

2938

**A High-Resolution Survey of the Coma Cluster of Galaxies at 408 Mc/s.**—M. I. Large, D. S. Mathewson & C. G. T. Haslam. (*Nature, Lond.*, 13th June 1959, Vol. 183, No. 4676, pp. 1663-1664.)

523.164.4 : 621.396.11 : 523.755

2939

**The Scattering of Radio Waves in the Solar Corona.**—A. Hewish. (*Mon. Not. R. astr. Soc.*, 1958, Vol. 118, No. 6, pp. 534-546.) An account is given of measurements carried out each June during the period 1952-1958 of the radio emission from the Crab nebula at wavelengths of 7.9, 3.7 and 1.9 m. Results indicate a pronounced sunspot-cycle variation in certain regions of the corona, a scatter anisotropy, and the presence of refraction effects in addition to scattering. See also 2286 of 1955.

523.5 : 621.396.11

2940

**Theory of the Radio-Echo Meteor Height Distribution in a Non-isothermal Atmosphere.**—A. A. Weiss. (*Aust. J. Phys.*, March 1959, Vol. 12, No. 1, pp. 54-64.) The height distribution of echoing points of shower and sporadic meteors belonging to a homogeneous velocity group is calculated for a model atmosphere whose scale height is a linear function of height. Experimental cut-off and the theoretical approximations involved limit the accuracy with which actual scale height and density may be found from observed meteor trails.

523.5 : 621.396.11

2941

**Elevation, Height, and Electron Density of Echoing Points of Meteor Trails.**—A. A. Weiss. (*Aust. J. Phys.*, March 1959, Vol. 12, No. 1, pp. 65-76.)

These parameters may be evaluated by the continuous operation of c.w. equipment on 27 Mc/s. At least 60 % of all echoes are found to be distorted. The electron density distributions are in qualitative agreement with known meteor mass distributions and trail shapes.

523.745 : 523.165

2942

**Solar Activity and Transient Decreases in Cosmic-Ray Intensity.**—D. Venkatesan. (*J. geophys. Res.*, May 1959, Vol. 64, No. 5, pp. 505-520.)

523.755

2943

**A New Theory of the Solar Corona.** P. J. Kellogg & E. P. Ney. (*Nature, Lond.*, 9th May 1959, Vol. 183, No. 4671, pp. 1297-1301.) It is proposed that the solar corona consists of trapped charged particles moving in the magnetic fields of the sun. Experimental data are discussed in terms of this model.

550.385

2944

**Disturbances of the Earth's Magnetic Field considered as Relaxation Variations.**—P. Herrinck. (*Ann. Géophys.*, July-Sept. 1957, Vol. 13, No. 3, pp. 211-221.) Records of the horizontal magnetic component at Elisabethville and elsewhere show relaxation processes analogous to post-disturbances of magnetic storms and subject to the 27-day recurrence tendency.

550.385

2945

**Possible Causes of Geomagnetic Fluctuations having a 6-sec Period.**—H. J. Duffus, J. A. Shand & C. Wright. (*Nature, Lond.*, 23rd May 1959, Vol. 183, No. 4673, pp. 1479-1480.) Comment on 1532 of May (Daniels). Short- and long-period oscillations, sometimes preceding but more often accompanying a main train of magnetic activity are described. They are considered to be associated and of electromagnetic origin.

550.385.37

2946

**Geographical Variations in Geomagnetic Micropulsations.**—H. J. Duffus, J. A. Shand, C. S. Wright, P. W. Nasmyth & J. A. Jacobs. (*J. geophys. Res.*, May 1959, Vol. 64, No. 5, pp. 581-583.) Significant differences consistently occur in simultaneous data obtained at stations 25 miles apart.

550.385.37 : 551.594.5

2947

**On a Possible Auroral Origin of Certain Geomagnetic Pulsations.**—J. Coulomb. (*Ann. Géophys.*, April-June 1957, Vol. 13, No. 2, pp. 91-102.)

550.385.4 : 523.745

2948

**The Relation between the Sudden Disappearance of Filaments and Magnetic Storms.**—M. Dizer. (*Ann. Géophys.*, Oct.-Dec. 1957, Vol. 13, No. 4, p. 325.) An analysis of records shows a correlation between the sudden disappearance of filaments close to the sun's central meridian and magnetic disturbances.

550.386 : 523.755

2949

**Green Coronal Line Intensity and Geomagnetism.**—C. Warwick. (*J. geophys. Res.*, May 1959, Vol. 64, No. 5, pp. 527-

531.) Statistical analysis indicates a minimum in geomagnetic activity following the central meridian passage of regions of high green-line intensity.

550.389.2 : 629.19

2950

**Laws of Motion of an Earth Satellite.**—Yu. A. Pobedonostev. (*Priroda, Mosk.*, Jan. 1958, No. 1, pp. 19-25.) The principles of multistage rocket flight are considered and formulae for rocket velocity are derived. Tables give the satellite velocity and duration of flight for heights up to 6000 km.

550.389.2 : 629.19

2951

**A Discussion on Observations of the Russian Artificial Earth Satellites and their Analysis.**—(*Proc. roy. Soc. A*, 28th Oct. 1958, Vol. 248, No. 1252, pp. 1-87.) The text is given of fifteen papers discussed at a meeting in London, 29th November 1957. These include results obtained using radio telescopes and interferometers, Doppler recorders and direction-finding and field-strength measuring equipment. Applications are made to the computation of orbit parameters. See also 1720 of 1958 for a similar discussion.

550.389.2 : 629.19

2952

**Observations on the U.S.S.R. Earth Satellites and the Study of Radio-Wave Propagation.**—W. C. Bain & E. D. R. Shearman. (*Proc. Instn elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 259-263.) Measurements of bearing, angle of elevation and Doppler frequency shift were made at 20 and 40 Mc/s. The observed phenomena could be explained in terms of existing knowledge of ionospheric propagation. The derivation of orbital parameters from the observations is discussed.

550.389.2 : 629.19

2953

**A Type of Variation of the Signal Strength from 1958 82 (Sputnik 3).**—L. Liszka. (*Nature, Lond.*, 16th May 1959, Vol. 183, No. 4672, pp. 1383-1384.) Fluctuations of signal strength relative to the satellite position in orbit indicate that the satellite produces heavily ionized tracks of very long lifetime. Observations have been made to test this hypothesis and results are given.

550.389.2 : 629.19

2954

**Diurnal Lapse of Signals from Sputnik III.**—G. H. Munro. (*Nature, Lond.*, 30th May 1959, Vol. 183, No. 4674, p. 1549.) A brief note, dated 28th April 1959, states that systematic observations have established that pulse modulation is present only when the satellite 19588 2 is in sunlight. On very close transits the c.w. signal can be detected with sufficient strength to record the Doppler shift.

550.389.2 : 629.19

2955

**Density of the Atmosphere at Heights between 200 km and 400 km from Analysis of Artificial-Satellite Orbits.**—D. G. King-Hele. (*Nature, Lond.*, 2nd May 1959, Vol. 183, No. 4670, pp. 1224-1227.)

550.389.2 : 629.19

2956

**Fluctuations in the Brightness of the Second Artificial Earth Satellite.**—V. P.

Tsevech. (*Priroda, Mosk.*, April 1958, No. 4, pp. 78-79.) These brightness fluctuations are explained by the rotation of the satellite on its axis, its maximum brightness corresponding to its greatest cross-section as seen by the observer. A graph shows these brightness variations as recorded by the Odessa Observatory.

550.389.2 : 629.19 **2957**  
**The Antipodal Reception of Sputnik III.**—E. Woyk (Chvojková). (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, p. 1144.) The mechanism of the propagation of waves around the earth within the ionospheric layers is discussed and the best conditions for antipodal reception are deduced. It is concluded that at Stanford, Calif., the best conditions for frequent reception occur from the south-east during summer afternoons. This is in agreement with observations.

550.389.2 : 629.19 **2958**  
**Satellite-Measured Radiation.**—G. W. Stuart. (*Phys. Rev. Lett.*, 15th May 1959, Vol. 2, No. 10, pp. 417-418.) The relevance of atomic change-exchange processes to the nature of the radiation belt is noted.

550.389.2 : 629.19 **2959**  
**Some Results of Investigations on Cosmic Rays using Artificial Earth Satellites.**—L. V. Kurnosova. (*Priroda, Mosk.*, June 1958, No. 6, pp. 85-86.) The intensity variations of cosmic rays as recorded during the flight of the second sputnik are shown. There were no appreciable corresponding variations at ground level.

550.389.2 : 629.19 **2960**  
**Corpuscular Radiation and the Acceleration of Artificial Satellites.**—L. G. Jacchia. (*Nature, Lond.*, 13th June 1959, Vol. 183, No. 4676, pp. 1662-1663.) Observations of satellites 1958  $\beta 2$  and  $\delta 1$  have been re-examined and more accurate values of acceleration have been calculated at twice the original resolution (see 2564 of August). Correlation with 10.7-cm solar radiation is higher for  $\beta 2$  than  $\delta 1$ , probably due to greater observational accuracy. An increased acceleration of  $\delta 1$  at the time of two major geomagnetic disturbances following flares indicates the effect of corpuscular radiation on atmospheric density at the 200-km level.

550.389.2 : 629.19 : 551.510.535 **2961**  
**On the Existence of a Strong Magneto-ionic Effect Topside of the F Maximum of the Kennelly-Heaviside Layer.**—P. R. Arendt. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 793-795.) Observations of the Faraday effect in 108-Mc/s signals from artificial satellites showed noticeable magneto-ionic effects at altitudes up to 2 000 km.

550.389.2 : 629.19 : 621.375.9 **2962**  
**Parametric Amplifier Receives Space Signals.**—(See 2895.)

550.389.2 : 629.19 : 621.396.11 **2963**  
**Radio Reflections from Satellite-Produced Ionization.**—C. R. Roberts, P. H. Kirchner & D. W. Bray. (*Proc. Inst.*

*Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1156-1157.) Observations have been made on frequencies of 5, 10, 15 and 20 Mc/s and two very different effects obtained on both 10 and 15 Mc/s are described.

550.389.2 : 629.19 : 621.398 **2964**  
**Cosmic-Ray Instrumentation in the First U.S. Earth Satellite.**—G. H. Ludwig. (*Rev. sci. Instrum.*, April 1959, Vol. 30, No. 4, pp. 223-229.) The instrumentation was designed for conservation of electrical power and for stable and reliable operation over a wide range of temperatures.

551.510.535 **2965**  
**Some Results of Investigations of the Upper Atmosphere.**—V. V. Mikhnevich. (*Priroda, Mosk.*, May 1958, No. 5, pp. 71-72.) Vertical rocket investigations carried out in U.S.S.R. between 1949 and 1958 showed that, contrary to established opinion, above the E-layer there is only a very shallow minimum in electron density. The electron density increases up to 250-300 km with a maximum at 300 km and then slowly decreases so that at 470 km the density is  $10^6$  electrons/cm<sup>3</sup>.

551.510.535 **2966**  
**A Theoretical Study of the Dynamical Structure of the Ionosphere.**—T. Shimazaki. (*J. Radio Res. Labs, Japan*, March 1959, Vol. 6, No. 24, pp. 109-241.) A comprehensive survey of the modifications to Chapman theory which are necessary to explain the actual behaviour of the ionosphere. Both the large F<sub>2</sub>-layer anomalies and the smaller ones for the E and F<sub>1</sub> layers are discussed. Over 100 references.

551.510.535 **2967**  
**Conditions in the Outer Ionosphere.**—Ya. L. Al'pert. (*Priroda, Mosk.*, June 1958, No. 6, pp. 86-87.) It is found that the electron concentration in the outer ionosphere decreases with the height considerably less rapidly than it increases at lower levels. The values obtained show that at 2 000-3 000 km the concentrations of electrons and neutral particles are of the order of  $10^3$ - $10^2$  and 1 per cm<sup>3</sup> respectively.

551.510.535 **2968**  
**Investigation of the Equatorial Electrojet by Rocket Magnetometer.**—L. J. Cahill, Jr. (*J. geophys. Res.*, May 1959, Vol. 64, No. 5, pp. 489-503.) Two layers of electrical current were detected, one existing near an altitude of 100 km and the other about 20-25 km higher.

551.510.535 **2969**  
**Geophysical Effects of High-Altitude Nuclear Explosions.**—T. Obayashi, S. C. Coroniti & E. T. Pierce. (*Nature, Lond.*, 23rd May 1959, Vol. 183, No. 4673, pp. 1476-1478.) A report of observations made at Hiraio Observatory on 1st and 12th August 1958. Fade-outs on frequencies between 10 and 20 Mc/s and an enhancement of atmospheric noise at 28 Kc/s have been recorded. These effects are

attributed to an increase in D-layer ionization extending over much greater distances than had previously been envisaged.

551.510.535 **2970**  
**Sporadic E-Region Ionization, 'Spread F', and the Twinkling of Radio Stars.**—D. F. Martyn. (*Nature, Lond.*, 16th May 1959, Vol. 183, No. 4672, pp. 1382-1383.) Kinematic instability in the ionization gradient of a medium drifting across a magnetic field is considered to be responsible for the three phenomena.

551.510.535 **2971**  
**The Effect of Sudden Ionospheric Disturbances (S.I.D.'s) on 2.28 Mc/s Pulse Reflections from the Lower Ionosphere.**—F. F. Gardner. (*Aust. J. Phys.*, March 1959, Vol. 12, No. 1, pp. 42-53.) During a typical large S.I.D., associated with a class 2 or class 3 flare, the increase in ionization might vary from 20/1 at 65 km through 3/1 at 90 km to unity at 110 km. The amplitude recovery of the E-layer echo lagged about 4 min behind the recovery of the lower echoes around 85 km. At all heights below 85 km, echo recovery occurred simultaneously.

551.510.535 : 621.396.11 **2972**  
**Rocket Measurements of Absorption in the Lower Ionosphere.**—H. Mende, K. Rawer & E. Vassy. (*Ann. Geophys.*, July-Sept. 1957, Vol. 13, No. 3, pp. 231-233.) Results are given of measurements of the field strength of one long-wave and two medium-wave transmitters. The D-layer minimum height is about 70 km and medium-wave observations indicate maximum absorption at 80 km, the attenuation being 1.2 dB/km for normal incidence.

551.510.535 : 621.396.11 : 523.164 **2973**  
**Refraction of Extraterrestrial Radio Waves in the Ionosphere.**—M. M. Komesaroff & C. A. Shain. (*Nature, Lond.*, 6th June 1959, Vol. 183, No. 4675, pp. 1584-1585.) Expressions are derived for estimating ionospheric refraction at low frequencies. Horizontal gradients of electron density are considered. Positions of a discrete source obtained from observation at 19.7 Mc/s after applying corrections for refraction are within a few minutes of arc of the observed position at 85.5 Mc/s.

551.594 **2974**  
**Simultaneous Occurrence of Subvisual Aurorae and Radio Noise Bursts on 4.6 kc/s.**—R. A. Duncan & G. R. Ellis. (*Nature, Lond.*, 6th June 1959, Vol. 183, No. 4675, pp. 1618-1619.) Records show that there is a correlation between aurorae and noise bursts but anomalies exist which cannot be explained satisfactorily.

551.594.5 **2975**  
**Auroral Isochasms.**—B. Hultqvist. (*Nature, Lond.*, 23rd May 1959, Vol. 183, No. 4673, pp. 1478-1479.) Observed isochasms and projections of circles in the equatorial plane along the geomagnetic lines of force are compared.

551.594.6 : 621.3.087.4 : 621.372.57 2976  
**Investigation of an Apparatus for Recording Atmospheric.**—Benoit & Kernevez. (See 2870.)

551.594.6 : 621.396.11.029.45/.51 2977  
: 551.510.535

**An Experimental Proof of the Mode Theory of V.L.F. Ionospheric Propagation.**—Obayashi, Fujii & Kidokoro. (See 3094.)

## LOCATION AND AIDS TO NAVIGATION

621.396.93 2978  
**Radio Aids to Navigation.**—(*Engineering, Lond.*, 5th Sept. 1958, Vol. 186, No. 4826, pp. 313–323.) Three papers presented at the British Association meeting in Glasgow, September 1958.

(a) Position Finding by Radio.—R. L. Smith-Rose (pp. 313–315).

(b) Marine Radio Navigational Aids.—B. G. Pressey (pp. 316–318).

(c) Radio Aids and Aeronautical Navigation.—C. Williams (pp. 318–323).

621.396.96 2979  
**Doppler Radar Navigation.**—F. B. Berger. (*Electronics*, 8th May 1959, Vol. 32, No. 19, pp. 62–63.) A table of characteristics of existing airborne systems.

621.396.96 : 621.314.63 2980  
**Using Silicon Diodes in Radar Modulators.**—Gray. (See 3110.)

621.396.963 : 621.374.32 2981  
**Digital-Counter Techniques increase Doppler Uses.**—B. E. Keiser. (*Electronics*, 22nd May 1959, Vol. 32, No. 21, pp. 46–50.) The frequency of an oscillator is adjusted automatically to the Doppler frequency of the returned signal and is measured using a circuit which counts 100 pulses per 360° cycle.

621.396.969.3 2982  
**'Ring Angels' over South-East England.**—E. Eastwood, J. D. Bell & N. R. Phelp. (*Nature, Lond.*, 20th June 1959, Vol. 183, No. 4677, pp. 1759–1760.) The unexplained phenomena described have been observed on high-power L-band radar equipment during the sunrise period at heights up to 2 000 ft. The rings expand as ripples at a velocity of 25–55 m.p.h., the maximum diameter recorded being 30 miles.

621.396.969.33 2983  
**'Escort'—a Marine Radar with Unusual Features.**—(*Beama J.*, May 1959, Vol. 66, No. 2, pp. 57–59.) Four types of p.p.i. display can be selected and provision is made for automatic resetting of the ship's own position on the display and for automatic alignment correction.

621.396.969.34 + 621.396.934 2984  
**Anti-aircraft Radiolocation Techniques.**—K. Trofimov. (*Radio, Mosk.*, Feb. 1958, No. 2, pp. 27–31.) A description of radar techniques for the location of enemy aircraft and their destruction by guided missiles.

## MATERIALS AND SUBSIDIARY TECHNIQUES

533.5 : 621.385.032.22 2985  
**Measurements of Gas Evolution or Sorption of Anode Materials under Simulated Life Conditions.**—C. H. Rehkopf. (*Sylvania Technologist*, Oct. 1958, Vol. 11, No. 4, pp. 114–116.) A brief description of techniques and results of measurements.

533.58 2986  
**Electrical Absorption of Gases in the High-Vacuum Pressure Range.**—G. Strotzer. (*Z. angew. Phys.*, May 1958, Vol. 10, No. 5, pp. 207–216.) Various hypotheses for the 'clean-up' effect in low-pressure gases are investigated.

535.215 : 538.6 : 546.682.86 2987  
**Indium Antimonide Photoelectromagnetic Infrared Detector.**—P. W. Kruse. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 770–778.) The theory of operation, construction, and performance data are presented.

535.215 : 539.2 2988  
**Photoconductor Performance, Space-Charge Currents, and the Steady-State Fermi Level.**—A. Rose & M. A. Lampert. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1227–1235.) "The performance of a photoconductor is analysed, via the concept of the steady-state Fermi level, and shown to be limited by the injection of space charge. Using the gain-bandwidth product  $G/\tau_0$  as a measure of performance, it is found that  $G/\tau_0 = M/\tau_r$  where  $\tau_r$  is the dielectric relaxation time under operating conditions, and  $M = \mathfrak{N}_A/\mathfrak{N}_T$ , with  $e\mathfrak{N}_A$  the total charge on the anode and  $e\mathfrak{N}_T$  the total volume charge, free plus trapped, effectively in thermal contact with the free charge."

535.215 : 546.472.21 2989  
**Anomalous Photovoltaic Effect in ZnS Single Crystals.**—A. Lempicki. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1204–1209.) Photovoltages larger than the band gap have been observed in both cubic and hexagonal crystals with stacking faults but not in hexagonal crystals free of such faults.

535.215 : 546.482.21 2990  
**Lattice Scattering Mobility of Electrons in Cadmium Sulphide.**—H. Miyazawa, H. Maeda & H. Tomishima. (*J. phys. Soc. Japan*, Jan. 1959, Vol. 14, No. 1, pp. 41–47.) The temperature variation of the lattice scattering mobility is found to be given by the expression  $\mu_L = A \{ \exp(\Theta/T) - 1 \}$  with  $A = 92.5 \pm 15 \text{ cm}^2/\text{V}\cdot\text{sec}$  and  $\Theta = 370 \pm 30^\circ\text{K}$ . The Conwell-Weisskopf formula is used to correct for impurity scattering.

535.215 : 546.482.21 2991  
**Polarization of Photoconductivity Excitation Bands in CdS Single Crystals.**—R. L. Kelly & W. J. Fredericks. (*Phys.*

*Rev. Lett.*, 1st May 1959, Vol. 2, No. 9, pp. 389–390.) The wavelength of incident light exciting maximum photoconductivity was measured as a function of its angle of polarization with respect to crystal orientation. Results are interpreted with an energy-level model.

535.215 : 546.482.21 : 538.63 2992  
**Relaxation-Time Anisotropy in Cadmium Sulphide Studied with Electrical Resistivity and Magnetoresistance Effect.**—T. Mazumi. (*J. phys. Soc. Japan*, Jan. 1959, Vol. 14, No. 1, pp. 47–56.) Experimental results indicate unusual anisotropic temperature dependence of the galvanomagnetic effects in hexagonal CdS single crystals.

535.215 : 546.482.21 : 539.23 2993  
**Electric Breakdown of Vapour-Deposited CdS Films.**—K. W. Böer, U. Kümmel & W. Misselwitz. (*Naturwissenschaften*, July 1958, Vol. 45, No. 14, p. 331.) Breakdown field-strength is plotted as a function of film thickness for both polarities of the applied voltage.

535.215 : 546.817.221 : 539.23 2994  
**Effect of Thickness of Thin Films of Lead Sulphide on the Spectral Response of Photoconductivity.**—H. E. Spencer. (*Phys. Rev.*, 15th March 1959, Vol. 113, No. 6, pp. 1417–1420.)

535.215 : 548.73 2995  
**Crystal Structure of Sodium-Potassium Antimonide (Na<sub>2</sub>KSb).**—J. J. Scheer & P. Zalm. (*Philips Res. Rep.*, April 1959, Vol. 14, No. 2, pp. 143–150.) The structure of Na<sub>2</sub>KSb, a photoconductive material, has been determined by X-ray analysis. It closely resembles that of Cs<sub>3</sub>Sb.

535.37 2996  
**Two-Stage Optical Excitation in Sulphide Phosphors.**—R. E. Halsted, E. F. Apple & J. S. Prener. (*Phys. Rev. Lett.*, 15th May 1959, Vol. 2, No. 10, pp. 420–421.) Optical evidence shows that the same impurities give rise to electron transitions involving energy levels near or in the valence band as well as the conduction band.

535.37 : 061.3 2997  
**Transactions of the 5th Conference on Luminescence (Crystal Phosphors).**—(*Izv. Ak. Nauk S.S.S.R., Ser. fiz.*, April & May 1957, Vol. 21, Nos. 4 & 5, pp. 475–784.) The text is given of 98 papers presented at the conference held in Tartu, Estonia, 25th–30th June 1956. For a list of titles in English, see *Translated Contents Lists of Russian Periodicals*, Feb. & May 1958, Nos. 107 & 110, pp. 43–45 & 47–50.

535.37 : 539.2 2998  
**Energy-Level Positions of Silver Luminescent Centres in Sulphides.**—C. C. Klick. (*Phys. Rev. Lett.*, 15th May 1959, Vol. 2, No. 10, pp. 418–420.)

535.37 : 546.472.21 2999  
**Excitation Spectra and Temperature Dependence of the Luminescence of ZnS Single Crystals.**—A. Halperin & H. Arbell. (*Phys. Rev.*, 1st March 1959,

- Vol. 113, No. 5, pp. 1216-1221.) "The luminescence of ZnS:Cl and ZnS:Cu:Cl crystals was measured for the temperature region 80-500° K and for different wavelengths of exciting light. The behaviour of the luminescence versus temperature curves differed from similar curves for powders reported in literature."
- 535.376 3000  
**A.C.-D.C. Electroluminescence.**—W. A. Thornton. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1187-1191.) The addition of a direct voltage to an alternating voltage exciting visible electroluminescence in certain ZnS powders increases the emission by as much as 250 times under conditions where the d.c. luminescence alone is about equal to the initial a.c. luminescence.
- 535.376 3001  
**Rise and Decay of Intensity of Luminescence of Short-Persistence Phosphors.**—R. Feinberg. (*Nature, Lond.*, 30th May 1959, Vol. 183, No. 4674, pp. 1546-1547.) Results of measurements made on three c.r. tube phosphors are discussed in relation to theory.
- 535.376:537.533.2 3002  
**Investigations of Exo-electron Emission and Luminescence of Inorganic Crystals.**—G. Gourgé. (*Z. Phys.*, 14th Nov. 1958, Vol. 153, No. 2, pp. 186-206.) The investigations discussed were carried out to determine the relation between exo-electron emission and luminescence; measurements were made at temperatures down to -165° C.
- 535.376:546.281.26 3003  
**Electroluminescence of Silicon Carbide.**—D. Rücker. (*Z. angew. Phys.*, June 1958, Vol. 10, No. 6, pp. 254-263.) The external and internal light emission observed on d.c.-excited SiC junctions [see e.g. 3890 of 1957 (Patrick)], is investigated on blue and green single crystals, and an interpretation of the various effects is given.
- 535.376:546.482.21 3004  
**On the Mechanism for Carrier Excitation in CdS.**—D. D. Snyder & C. E. Bleil. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 736-739.) The production and absorption of X-rays in the experimental crystals have been calculated and some confirmatory data presented.
- 535.376:546.561.31 3005  
**Electroluminescence in Cuprous Oxide.**—R. Frerichs & R. Handy. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1191-1198.) The electroluminescent properties of Cu<sub>2</sub>O are not directly analogous to those of a semiconductor such as Ge or an insulating phosphor such as ZnS. A detail study has been made of current creep effects occurring in Cu<sub>2</sub>O plate rectifiers with d.c. excitation.
- 537.226/228.1 3006  
**Studies on (Ba-Pb)(Ti-Zr)O<sub>3</sub> System.**—T. Ikeda. (*J. phys. Soc. Japan.*) Feb. 1959, Vol. 14, No. 2, pp. 168-174.)
- 537.226/227:546.431.824-31 3007  
**Polarization Reversal in Barium Titanate.**—(*Bell Lab. Rec.*, April 1959, Vol. 37, No. 4, p. 144.) A note on the polarization reversal in single crystals which occurs by extensive sideways motion of domain walls. See 155 of January (Miller).
- 537.227:547.476.3 3008  
**Ferroelectric Hysteresis and After-Effect Phenomena in Rochelle Salt.**—H. E. Müser. (*Z. angew. Phys.*, June 1958, Vol. 10, No. 6, pp. 249-254.) Investigation of the constriction of ferroelectric hysteresis loops observed in Rochelle salt. For a similar anomaly in BaTiO<sub>3</sub> see e.g. 2757 of 1958 (Hegenbarth).
- 537.228.1:549.514.51 3009  
 **$\beta$ -Quartz as High-Temperature Piezoelectric Material.**—D. L. White. (*J. acoust. Soc. Amer.*, March 1959, Vol. 31, No. 3, pp. 311-314.) Lengthwise extensional, face shear and thickness shear modes can be excited piezoelectrically by suitable rotation of the crystal plate.
- 537.311.33 3010  
**On a Simple Model for Impurity-Band Conduction.**—K. Helmers. (*Philips Res. Rep.*, Feb. 1959, Vol. 14, No. 1, pp. 1-10.) A study of the influence of impurity-centre distribution on the resistance of the sample using a stochastic resistance network.
- 537.311.33 3011  
**Some Optical Characteristics of Semiconductors.**—O. Simpson. (*Research, Lond.*, April 1959, Vol. 12, No. 4, pp. 127-132.) A number of optical phenomena are described and related to the electronic structure of semiconductors.
- 537.311.33 3012  
**Space Charge in Semiconductors resulting from Low-Level Injection.**—M. Green. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 744-747.) A solution of the continuity equations is obtained for the space-charge distribution by assuming that (a) deviations from neutrality are small, and (b) the space-charge fields give rise to pure diffusion and pure 'drift-wave' terms with time-dependent coefficients.
- 537.311.33 3013  
**Role of Single Phonon Emission in Low-Field Breakdown of Semiconductors at Low Temperatures.**—M. A. Lampert, F. Herman & M. C. Steele. (*Phys. Rev. Lett.*, 1st May 1959, Vol. 2, No. 9, pp. 394-397.) Observations of low-field breakdown are correlated with the known energy-band structure and phonon spectra of Ge and Si. A simple, necessary condition for breakdown is suggested.
- 537.311.33:535.34-15 3014  
**Effect of Pressure on the Infrared Absorption of Semiconductors.**—L. J. Neuringer. (*Phys. Rev.*, 15th March 1959, Vol. 113, No. 6, pp. 1495-1503.) Measurements were made on Ge, Si, and Te in the pressure range 1-2 000 atm. The pressure coefficients were used to calculate the thermal dilation term in the equation for
- the change of the energy gap with temperature and hence the magnitude of the electron-lattice interaction.
- 537.311.33:537.32 3015  
**On the Theory of the Thermoelectricity in Two-Band Semiconductors.**—E. Haga. (*J. phys. Soc. Japan.*, Jan. 1959, Vol. 14, No. 1, pp. 35-38.) A theory is developed taking account of the temperature dependence of the energy gap. The Thomson relations are shown to be satisfied.
- 537.311.33:537.533 3016  
**Field Emission from Semiconductors.**—G. Busch & T. Fischer. (*Brown Boveri Rev.*, Nov./Dec. 1958, Vol. 45, Nos. 11/12, pp. 532-539.) Theoretical and experimental work on field emission is reviewed. Results are discussed of an investigation carried out on SiC point electrodes, which confirm the exponential relation between current and field which is characteristic of field emission.
- 537.311.33:538.214 3017  
**The Effect of Concentration on the Magnetic Susceptibility of Trapped Electrons and Holes in Semiconductors.**—F. T. Hedgcock. (*Canad. J. Phys.*, March 1959, Vol. 37, No. 3, pp. 381-383.) A model proposed to explain the anomalous magnetic susceptibility of certain impurity semiconductors at low temperatures [see 2800 of 1957 and 3513 of 1958 (Sonder & Stevens)] is found to be attractive qualitatively but quite inadequate quantitatively.
- 537.311.33:538.614 3018  
**The Faraday Effect in Anisotropic Semiconductors.**—I. G. Austin. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 271-274.) "The theory of the Faraday effect in semiconductors is extended to uniaxial crystals with spheroidal energy surfaces, using the classical Drude-Zener theory. Expressions applicable at infrared frequencies are given and used to discuss preliminary measurements on Bi<sub>2</sub>Te<sub>3</sub>."
- 537.311.33:[546.28 + 546.289] 3019  
**Semiconductor Surface Phenomena.**—A. Many. (*Sylvania Technologist*, Oct. 1958, Vol. 11, No. 4, pp. 117-124.) 'Slow' and 'fast' surface states have been established for Ge and Si; their characteristics are summarized and discussed.
- 537.311.33:[546.28 + 546.289] 3020  
**Metallurgy of Semiconductors, in Particular Germanium and Silicon.**—A. J. Goss. (*Marconi Rev.*, 1st Quarter 1959, Vol. 22, No. 132, pp. 3-17.) 54 references.
- 537.311.33:546.28 3021  
**The Effects of Seed Rotation on Silicon Crystals.**—A. J. Goss & R. E. Adlington. (*Marconi Rev.*, 1st Quarter 1959, Vol. 22, No. 132, pp. 18-36.) Single crystals pulled in an argon atmosphere at rotation rates up to 200 r.p.m. have been examined. The effect of rotation on crystal pulling, the growth interface, dislocations, etching, resistivity,  $9\mu$  absorption data and heat treatment of the crystal are given. Results are discussed in relation to a mechanical model of stirring in the melt.

- 537.311.33 : 546.281.26 **3022**  
**Some Surface Properties of Silicon Carbide Crystals.**—J. A. Dillon, Jr, R. E. Schlier & H. E. Farnsworth. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 675-679.) Both work-function and electron-diffraction studies indicated that SiC surfaces obtained by ion bombardment and annealing were nonstoichiometric.
- 537.311.33 : 546.289 **3023**  
**High-Electric-Field Effects in Germanium  $p$ - $n$  Junction.**—J. Yamaguchi & Y. Hamakawa. (*J. phys. Soc. Japan.*, Jan. 1959, Vol. 14, No. 1, pp. 15-21.) Increase of ambient temperature caused the critical voltage for avalanche breakdown to increase and the voltage for the onset of negative resistance to decrease. The barrier temperature was independent of the ambient temperature.
- 537.311.33 : 546.289 **3024**  
**Barrier Temperature at Turnover in Germanium  $p$ - $n$  Junction.**—J. Yamaguchi & Y. Hamakawa. (*J. phys. Soc. Japan.*, Feb. 1959, Vol. 14, No. 2, pp. 232-233.)
- 537.311.33 : 546.289 **3025**  
**Injection and Extraction of Minority Carriers at the Surface of a Germanium Electrode as a Result of Electrochemical Processes.**—Yu. V. Pleskov. (*Dokl. Ak. Nauk S.S.S.R.*, 1st May 1959, Vol. 126, No. 1, pp. 111-114.)
- 537.311.33 : 546.289 **3026**  
**Sb Distribution in Quenched Ge-Sb Alloys.**—G. Pröpstl & G. Zielasek. (*Z. angew. Phys.*, May 1958, Vol. 10, No. 5, pp. 201-204.) The distribution of Sb in alloys prepared for doping Ge single crystals is investigated using a radioactive isotope. A considerable degree of inhomogeneity is observed in spite of rapid quenching. This difficulty can be overcome by zone melting.
- 537.311.33 : 546.289 : 535.215 **3027**  
**The Photoconduction of Germanium after Bombardment with Fast Electrons.**—F. Stöckmann, E. E. Klontz, J. MacKay, H. Y. Fan & K. Lark-Horovitz. (*Z. Phys.*, 5th Dec. 1958, Vol. 153, No. 3, pp. 331-337.) The spectral distribution of photoconduction was measured on differently doped specimens of single-crystal Ge after bombardment with 4.5-MeV electrons.
- 537.311.33 : 546.289 : 548.4 **3028**  
**The Generation of Dislocations by Thermal Stresses.**—P. Penning. (*Philips tech. Rev.*, 22nd Aug. 1958, Vol. 19, No. 12, pp. 357-364.) A study is made of etch-pit distribution over the cross-section of a Ge rod to assess the influence of the cooling rate on its internal perfection. The theoretical dislocation distribution is calculated assuming that stresses are only partially relieved by plastic flow. Results are in good agreement with observations. See also 2459 of 1958.
- 537.311.33 : 546.289 : 548.5 **3029**  
**The Pulling of Germanium Single Crystals from 'Floating Crucibles'.**—J. Goorissen & F. Karstensen. (*Z. Metallkde*, Jan. 1959, Vol. 50, No. 1, pp. 46-50.) The floating-crucible technique is described and its theoretical yield is compared with that of the Czochralski and zone-refining methods.
- 537.311.33 : 546.623.86 **3030**  
**The Formation of Barrier Layers in Aluminium Antimonide by the Alloying Method.**—H. J. Henkel. (*Z. Metallkde*, Jan. 1959, Vol. 50, No. 1, pp. 51-53.) A  $p$ - $n$  function is produced by alloying  $n$ -type AlSb with Zn-doped aluminium foil.
- 537.311.33 : 546.681.241 **3031**  
**The Changes in the Crystal Structure of Gallium Telluride ( $\text{Ga}_2\text{Te}_3$ ) Doped with Copper.**—G. Harbecke & G. Lautz. (*Naturwissenschaften*, June 1958, Vol. 45, No. 12, pp. 283-284.)
- 537.311.33 : 546.682.19 **3032**  
**Effect of Heat Treatment upon the Electrical Properties of Indium Arsenide.**—J. R. Dixon & D. P. Enright. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, pp. 753-759.) Large reversible variations in carrier concentration, Hall Mobility, and carrier lifetime have been produced in InAs by heat treatment. The observed phenomena are consistent with a model involving the segregation and dispersion of donor impurities to and from dislocations.
- 537.311.33 : 546.682.86 **3033**  
**Properties of the Semiconductor InSb.**—M. Rodot. (*J. Phys. Radium*, Feb. 1958, Vol. 19, No. 2, pp. 140-150.) Properties are reviewed with special reference to the value of the effective mass of the electrons and the scattering mechanism. The theory of thermoelectric and thermomagnetic effects is given and experimental results are presented. See 2469 of 1958.
- 537.311.33 : 546.824-31 **3034**  
**Infrared Absorption of Reduced Rutile  $\text{TiO}_2$  Single Crystals.**—D. C. Cronemeyer. (*Phys. Rev.*, 1st March 1959, Vol. 113, No. 5, pp. 1222-1226.)
- 538 : 061.3 **3035**  
**Transactions of the 3rd Conference on the Physics of Magnetic Phenomena.**—(*Izv. Ak. Nauk S.S.S.R., Ser. fiz.*, June, Aug. & Sept. 1957, Vol. 61, Nos. 6, 8 & 9, pp. 787-904, 1038-1212 & 1215-1336.) The text is given of 74 papers presented at the conference held in Moscow, 23rd-31st May 1956. For a list of titles in English, see *Translated Contents Lists of Russian Periodicals*, May & June 1958, Nos. 110 & 111, pp. 50-51 & 32-34.
- 538.22 : 538.569.4 **3036**  
**Indirect Coupling of Nuclear Spins in Antiferromagnet with Particular Reference to  $\text{MnF}_2$  at Very Low Temperatures.**—T. Nakamura. (*Progr. theor. Phys.*, Oct. 1958, Vol. 20, No. 4, pp. 542-552.) The line width ( $\approx 14$  oersteds) of the  $F^{19}$  nuclear magnetic resonance in  $\text{MnF}_2$  at 1.4° K observed by Jaccarino & Shulman (527 of 1958) is shown to come mainly from indirect coupling of nuclear spins through hyperfine interaction with spin waves. The line width of the  $\text{Mn}^{55}$  resonance is about 600 oersteds.
- 538.22 : 538.569.4 : 621.375.9 **3037**  
**Two-Level Maser Materials.**—R. H. Hoskins. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, p. 797.) Comment on some advantages of paramagnetic ions in ionic crystals as materials for two-level solid-state masers.
- 538.221 **3038**  
**Distribution of Magnetic Domains between the Two Phases in a Single-Crystal Flat Disk of Iron.**—K. F. Niessen. (*Philips Res. Rep.*, April 1959, Vol. 14, No. 2, pp. 101-110.)
- 538.221 : 539.23 **3039**  
**Magnetic Properties of Very Thin Films of Nickel.**—G. Goureaux & A. Colombani. (*C. R. Acad. Sci., Paris*, 26th Jan. 1959, Vol. 248, No. 4, pp. 543-546.)
- 538.221 : 539.234 : 538.63 **3040**  
**Determination of the Distribution of Orientation of the Magnetization Vectors in Nickel and Iron Vapour-Deposited Films using the Magneto-resistance Effect.**—W. Hellenthal. (*Z. Phys.*, 5th Dec. 1958, Vol. 153, No. 3, pp. 359-371.)
- 538.221 : 621.318.134 **3041**  
**Temperature Dependence of the Paramagnetic Susceptibility of Nickel-Zinc Ferrites.**—V. I. Chechernikov & Yu. D. Volkov. (*Zh. eksp. teor. Fiz.*, Oct. 1958, Vol. 35, No. 4, (10), pp. 875-879.) The reciprocal of molar susceptibility for a range of Ni-Zn ferrites is plotted as a function of temperature in the range 300°-1500° K. Near the ferromagnetic Curie point the dependence of specific magnetization  $\sigma$  on magnetic field strength  $H$  is expressed in the form  $H = a\sigma + b\sigma^3$ , where the coefficients  $a$  and  $b$  depend on temperature and pressure.
- 538.221 : 621.318.134 : 538.569.4 **3042**  
**Magnetic Resonance Studies in the Reaction of Nickel Cobalt Ferrite.**—S. L. Blum & M. H. Sirvetz. (*J. appl. Phys.*, May 1959, Vol. 30, No. 5, p. 795.) Use is made of the analysis of ferromagnetic-resonance line shapes to obtain indications of the course of the reaction as a function of the reaction conditions.
- 538.221 : 621.318.134 : 538.569.4 : 029.64 **3043**  
**Microwave Resonance in Gadolinium-Iron Garnet Crystals.**—W. V. Smith, J. Overmeyer & B. A. Calhoun. (*IBM J. Res. Developm.*, April 1959, Vol. 3, No. 2, pp. 153-162.) Ferrimagnetic resonance at 9479 and 23 725 Mc/s is described in terms of a two-sublattice model.
- 538.221 : 621.318.134 : 621.318.57 **3044**  
**Reciprocity Relationships for Gyrotropic Media.**—R. F. Harrington & A. T. Villeneuve. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 308-310. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)
- 538.221 : 621.318.134 : 621.375.9 **3045**  
**Power-Flow Relations in Lossless Nonlinear Media.**—H. A. Haus. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6,

No. 3, pp. 317-324. Abstract, *Proc. Inst. Radio Engrs*, Oct. 1958, Vol. 46, No. 10, p. 1777.)

621.315.3 (083.7) **3046**  
**Wire in the Electronic Industry.**—(Electronic Ind., Dec. 1958, Vol. 17, No. 12, pp. 89-97.) U.S. specifications, wire codes and general information are tabulated.

621.793:621.3.049.75 **3047**  
**Electroless Copper Plating in Printed Circuitry.**—E. B. Saubestre. (*Sylvania Technologist*, Jan. 1959, Vol. 12, No. 1, pp. 6-11.) The deposition of copper films on plastic printed-circuit boards by chemical reduction is discussed, and a procedure for producing 'plated-through' holes is described. An extension of the plating process for unclad laminates is noted.

## MATHEMATICS

512:621.318.57:681.142 **3048**  
**Classification and Minimization of Switching Functions: Part 1.**—N. C. de Troye. (*Philips Res. Rep.*, April 1959, Vol. 14, No. 2, pp. 151-193.) An attempt to find from a given Boolean function either the minimal sum of products or the minimal product of sums.

516.7:621.3 **3049**  
**Geometric-Analytic Theory of Transition in Electrical Engineering.**—E. F. Bolinder. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1124-1129.)

517.942.9:517.949.8 **3050**  
**Numerical Solution of Laplace's Equation, given Cauchy Conditions.**—I. Sugai. (*IBM J. Res. Developm.*, April 1959, Vol. 3, No. 2, pp. 187-188.) An expression giving the order of magnitude of the propagated errors is obtained for numerical analysis by methods of finite differences. For the practical aspect in the design of electron guns with curved electron trajectories see *Proc. Inst. Radio Engrs*, Jan. 1959, Vol. 47, No. 1, pp. 87-88.

## MEASUREMENTS AND TEST GEAR

621.3.011.4 (083.74) **3051**  
**The Cylindrical Cross-Capacitor as a Calculable Standard.**—A. M. Thompson. (*Proc. Instn. elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 307-310.) The capacitor consists of a hollow conducting cylinder divided into four insulated sections by gaps parallel to the axis. A practical form described consists of four parallel bars of circular cross-section. The capacitance can be computed with precision.

621.3.018.41 (083.74) **3052**  
**A Portable Frequency Standard.**—L. F. Koerner. (*Bell Lab. Rec.*, May 1959, Vol. 37, No. 5, pp. 173-176.) Description of a unit, the size of a miniature camera, which operates at about 15 Mc/s with an accuracy within 1 part in 10<sup>6</sup>.

621.3.018.41 (083.74) **3053**  
**Construction of a Mobile Caesium Frequency Standard.**—A. H. W. Beck & J. Lytollis. (*Proc. Instn. elect. Engrs*, Part B, 1958, Vol. 105, Supplement No. 11, pp. 712-715. Discussion.) Practical details of the construction of a sealed-off version are given.

621.3.018.41 (083.74):538.569.4 **3054**  
**Construction and Application of a Frequency Standard for Microwave Spectrometers.**—H. G. Fitzky. (*Z. angew. Phys.*, July 1958, Vol. 10, No. 7, pp. 297-303.) A 10-Mc/s crystal oscillator and frequency multiplication to 1080 Mc/s are used in the equipment described for measurements of frequency up to 25 kMc/s with an accuracy better than 1 part in 10<sup>7</sup>.

621.317.3:621.396.822 **3055**  
**Measurement of Equivalent Noise Resistance of a Noise-Thermometer Amplifier.**—H. Pursey & E. C. Pyatt. (*J. sci. Instrum.*, June 1959, Vol. 36, No. 6, pp. 260-264.) Amplifier noise is compared with that of a wire-wound resistance at a standard temperature, using a vibrating switch to connect the sources alternately to a single channel. An accuracy within 1% is obtained.

621.317.4:538.569.4 **3056**  
**Measurement of Magnetic Flux Density by Paramagnetic Resonance.**—C. P. Allen & M. Sherry. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 264-270.) The method is based on measurement of the frequency of paramagnetic resonance in an organic compound. It uses a simple coaxial-line probe unit and enables flux densities in the range of a few hundreds up to some thousands of gauss to be measured to an absolute accuracy of  $\pm 0.06\%$ .

621.317.4:621.3.042.1:621.397.62 **3057**  
**Magnetic Measurements on Ferrite U-Cores for Horizontal-Deflection Output Transformers.**—R. Falker & E. E. Hücking. (*Elektronische Rundschau*, Aug. 1958, Vol. 12, No. 8, pp. 270-274.) Methods of measurement are reviewed and a specially designed core tester is described.

621.317.42:550.385 **3058**  
**The Influence of the Self-Inductance of Magnetic-Core Windings used for the Recording of Rapid Variations of the Earth's Magnetic Field.**—G. Grenet. (*Ann. Géophys.*, July-Sept. 1957, Vol. 13, No. 3, pp. 249-251.)

621.317.61:621.385.1 **3059**  
**A Method for the Accurate Measurement of Mutual Conductance of Thermionic Valves.**—M. R. Child & D. J. Sargent. (*Proc. Instn. elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 311-314.) Absolute errors are estimated to be less than

0.25%, and comparative error less than 0.1%. Adaptations for measurement of anode conductance and screen-grid amplification factor are described.

621.317.7:621.314.7 **3060**  
**A Transistor Characteristic Curve Tracer.**—J. F. Young. (*Electronic Engng*, June 1959, Vol. 31, No. 376, pp. 330-336.) "A Dekatron is used to develop a stepped voltage controlling the base current of the transistor under test. At each step a half sinusoidal voltage is applied to the transistor and the resulting collector current is plotted against voltage on an external oscilloscope. A series resistor provides the current signal and limits the transistor dissipation. The unit can also be used to plot the characteristics of normal or of Zener diodes."

621.317.733:621.375.2.024 **3061**  
**Use of a Direct-Current Amplifier and Recorder to Balance a Mueller Resistance Bridge.**—G. T. Armstrong, P. K. Wong & L. A. Krieger. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 339-343.) Methods of reducing system noise to give improved sensitivity.

621.317.733.011.4:621.372.54 **3062**  
**The Balanced Unsymmetrical Parallel-T Network as a Three-Terminal Frequency-Dependent Bridge for the Measurement of Capacitance and Dissipation Factor.**—K. Posel. (*Trans. S. Afr. Inst. elect. Engrs*, Aug. 1958, Vol. 49, Part 8, pp. 287-298.) The theory of operation of the bridge and its design are detailed. See also 2656 of 1958.

621.317.733.029.62 **3063**  
**Coaxial Displacement Dielectric Cell for Liquids Usable to 250 Mc/s.**—S. E. Lovell & R. H. Cole. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 361-362.) Construction details of a bridge element useful in the determination of capacitance, dielectric loss, or conductivity.

621.317.74:534.2-8:621.373.52 **3064**  
**Zero-Crossing Technique syncs Wave-Train Outputs.**—J. A. Werek, Jr. (*Electronics*, 8th May 1959, Vol. 32, No. 19, pp. 64-65.) A technique for producing a sinusoidal wave-train starting from the zero-crossing point of another sine wave. The generator is used in testing ultrasonic equipment.

621.317.75.087.6 **3065**  
**Homodyne Detector for Reproduction of Periodic Waveforms.**—C. Lagercrantz. (*J. sci. Instrum.*, June 1959, Vol. 36, No. 6, pp. 257-259.) An a.f. signal is scanned using 20- $\mu$ s gating impulses whose phase is shifted slowly and linearly. The gated output is recorded on a pen recorder. The circuit and performance tests are described.

621.317.763.029.64:621.372.413 **3066**  
**The Design of Broad-Band Circular Wavemeters.**—P. Andrews. (*Brit. Commun. Electronics*, May 1959, Vol. 6, No. 5, pp. 354-357.) The design is considered mainly with cylindrical cavities in the TE<sub>11</sub> mode. Mode suppression and the temperature coefficient of wavemeters are treated.



531.721 : 621.397.9 3067

**The Video Differential Planimeter.**—M. Tobin. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 323–327.) Description of an instrument for measuring variations in the projected area of a remote object by means of a television camera system or flying-spot scanner.

538.566.029.6 : 541.126 3068

**Observations of Detonation in Solid Explosives by Microwave Interferometry.**—G. F. Cawsey, J. L. Farrands & S. Thomas (*Proc. roy. Soc. A*, 9th Dec. 1958, Vol. 248, No. 1255, pp. 499–521.) Confined detonation processes have been studied by a method noted earlier [1833 of 1956 (Farrands & Cawsey)], using apparatus developed from that described by Froome (3532 of 1952).

550.340 : 621.3.087.6 3069

**An Electronic Seismic Transducer for Visual Recording.**—P. Gouin. (*Ann. Géophys.*, July–Sept. 1957, Vol. 13, No. 3, pp. 234–241. In English.) A detailed description of the capacitance-type transducer, amplifier and recorder.

551.508.71 : 621.372.413 3070

**Recording Microwave Hygrometer.** J. Sargent. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 348–355.) A description is given of a microwave refractometer designed at the National Bureau of Standards for measurement of low water-vapour pressures in a moving air stream.

621.384.6 : 621.319.3 3071

**Electrostatic-Transformer-Type Particle Accelerator using Ceramic BaTiO<sub>3</sub>—Ferrostac.**—T. Shibata, A. Toi & T. Suita. (*J. Phys. Soc. Japan*, Feb. 1959, Vol. 14, No. 2, p. 227.) A note on the construction of a 150-kV accelerator in which the h.v. generator has rotating ferroelectric disks which carry electric charges.

621.384.8 : 621.318.381 : 621.316.7.078.3 3072

**Current and Field Stabilization of the 9-kW Electromagnet of the A.E.I. Magnetic Spectrograph.**—R. Bailey & E. C. Fellows. (*J. Brit. Instn Radio Engrs*, May 1959, Vol. 19, No. 5, pp. 309–321.) Signals obtained from nuclear resonance are used to control the strength of a magnetic field to within  $\pm 0.01\%$ .

621.385.833 3073

**Numerical Computation of Electrostatic Immersion Objectives.**—E. Hahn. (*Optik, Stuttgart*, Aug. 1958, Vol. 15, No. 8, pp. 500–515.)

621.385.833 3074

**Space-Charge Aberration and Resolving Power in Electron Microscopes.**—W. E. Meyer. (*Optik, Stuttgart*, July 1958, Vol. 15, No. 7, pp. 398–406.)

Space-charge effects may limit the resolving power more than spherical aberration. Methods of reducing the influence of space charge are indicated.

621.385.833 3075

**Stigmatic Image in Rotationally Asymmetric Electron Lenses.**—F. Lenz. (*Optik, Stuttgart*, July 1958, Vol. 15, No. 7, pp. 393–397.)

621.385.833 : 535.317.3 3076

**Compensation of the Chromatic Dependence of Magnification in the Electrostatic Electron Microscope.**—W. Weitsch. (*Optik, Stuttgart*, Aug. 1958, Vol. 15, No. 8, pp. 492–499.)

621.385.833 : 621.3.032.21 3077

**Some Electron-Optical Properties of Point Cathodes.**—S. Maruse & Y. Sakaki. (*Optik, Stuttgart*, Aug. 1958, Vol. 15, No. 8, pp. 485–491.) Experimental results show that electron emission of the point cathode is mainly determined by the Schottky effect. The use of the point cathode as a cold cathode in electron microscopes is discussed. See also 245 of 1957 (Sakaki & Möllenstedt).

621.385.833 : 621.3.032.213.6 3078

**Oxide-Cored Cathode.**—K. Ando, O. Kamigaito, Y. Kamiya, S. Takahashi & R. Uyeda. (*J. Phys. Soc. Japan*, Feb. 1959, Vol. 14, No. 2, pp. 180–185.) Description of a cathode for electron microscopy consisting of a drawn platinum wire filled with oxide powder. The method of preparation and performance tests are described.

621.387.424 3079

**Improved Design for Halogen-Quenched End-Window Geiger Counters.**—K. van Duuren & J. Hermsen. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 367–368.)

621.387.464 3080

**Modern Development of Scintillation Counters.**—W. Hanle & H. Schneider. (*Z. angew. Phys.*, May 1958, Vol. 10, No. 5, pp. 228–248.) Detailed review of design, construction and applications. 242 references.

621.387.464 : 621.383.27 3081

**The Resolving Power of Scintillation Multipliers and the Influence on it of Various Parameters.**—P. Görlich, A. Krohs, H. J. Pohl, R. Reichel & L. Schmidt. (*Z. angew. Phys.*, July 1958, Vol. 10, No. 7, pp. 303–309.) Results of measurements on a photomultiplier for scintillation counting are discussed.

621.397.9 : 522.2 3082

**Using TV Techniques in Astronomy.**—J. Borgman. (*Electronics*, 8th May 1959, Vol. 32, No. 19, pp. 66–68.) A variable star is detected by a differential photographic method which eliminates constant features. Television techniques are used to display the difference signals.

621.397.9 : 522.2 3083

**Television Techniques in Astronomy.**—N. F. Kuprevich. (*Priroda, Mosk.*, March 1958, No. 3, pp. 50–54.) Two systems are

described based on: (a) a two-stage electron-optical converter consisting of a photocathode emitting electrons which form an image on a 35-mm luminous screen with a possible increase of brightness up to 100–130 times; (b) the use of an orthicon-type 625-line television screen on which an image is obtained with magnification up to 6.5 times.

621.398 3084

**Radio Telemetry: Part 1—Systems.**—A. J. Shimmins. (*Proc. Instn Radio Engrs, Aust.*, Dec. 1958, Vol. 19, No. 12, pp. 775–787.) Factors which determine system performance are analysed, taking as an example the R.A.E. subminiature f.m./a.m. system.

621.398 : 616.831-073.97 3085

**A Miniature Electroencephalograph Telemeter System.**—D. C. Gold & W. J. Perkins. (*Electronic Engng*, June 1959, Vol. 31, No. 376, pp. 337–339.) Transmits the electrical activity of the brain of an unrestrained cat on a 6.8-Mc/s a.m. carrier.

681.61 : 621.319 3086

**High-Speed Read-Out for Data Processing.**—R. E. West. (*Electronics*, 29th May 1959, Vol. 32, No. 22, pp. 83–85.) Description of an e.s. teletypewriter which can print more than 3000 words/min. Input pulses to the print heads charge the surface of paper to which powdered ink adheres.

PROPAGATION OF WAVES

621.396.11 : 550.389.2 : 629.19 3087

**Radio Reflections from Satellite-Produced Ionization.**—Roberts, Kirchner & Bray. (See 2963.)

621.396.11 : 551.510.52 3088

**The Role of Turbulent Mixing in Scatter Propagation.**—R. Belgiano, Jr. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 161–168. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1438.)

621.396.11 : 551.510.52 3089

**The Influence of Moisture in the Ground, Temperature and Terrain on Ground Wave Propagation in the V.H.F. Band.**—B. Josephson & Å. Blomquist. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 169–172. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.11 : 551.510.52 3090

**Distance Dependence, Fading Characteristics and Pulse Distortion of 3000-Mc/s Transhorizon Signals.**—B. Josephson & G. Carlson. (*Trans Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 173–175. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.11 : 551.510.52 3091

**Some Microwave Propagation Experiences from a 'Just-Below-Horizon' Path.**

—B. Josephson & F. Eklund. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 176-178. Abstract, *Proc. Inst. Radio Engrs*, July 1958, Vol. 46, No. 7, p. 1439.)

621.396.11 : 551.510.52 3092

**The Diffraction of Electromagnetic Waves by the Earth's Curvature—a Theory of Tropospheric Propagation Near and Beyond the Radio Horizon.**—O. Tukizi. (*Rep. elect. Commun. Lab., Japan*, Nov. 1958, Vol. 6, No. 11, pp. 421-425.) Classical diffraction theory is modified to account for the slow rate of decrease of field-strength well beyond the horizon. A saddle-point method is used to take into account the contribution of all the terms of the residue series.

621.396.11 : 551.510.535 : 523.164 3093

**Refraction of Extraterrestrial Radio Waves in the Ionosphere.**—Komesaroff & Shain. (See 2973.)

621.396.11.029.45/.51 : 551.510.535 : 551.594.6 3094

**An Experimental Proof of the Mode Theory of V.L.F. Ionospheric Propagation.**—T. Obayashi, S. Fujii & T. Kidokoro. (*J. Geomag. Geoelect.*, 1959, Vol. 10, No. 2, pp. 47-55.) V.l.f. atmospherics are received on a receiver which continuously sweeps over the frequency band 5-70 kc/s. The output is displayed on an intensity-modulated c.r. tube which is photographed on continuously moving film. There is an intensity maximum near 10 kc/s and selective absorption bands which vary with time of day and may be associated with the cut-off frequencies of the earth-ionosphere waveguide. The effects of solar flares are also discussed.

621.396.11.029.63 3095

**A Contribution to the Knowledge of Propagation Conditions at 1.3 Gc/s based on Measurements over a Transmission Path within Optical Range.**—U. Kühn. (*Tech. Mitt. BRF, Berlin*, Oct. 1957, Vol. 1, No. 1, pp. 4-10.) Statistical analysis of field-strength recordings taken in one year over an 82-km path, and comparison with meteorological data for the same period.

621.396.11.029.63 3096

**Measurements of 1250-Mc/s Scatter Propagation as Function of Meteorology.**—D. L. Ringwalt, W. S. Ament & F. C. MacDonald. (*Trans. Inst. Radio Engrs*, April 1958, Vol. AP-6, No. 2, pp. 208-209.) Short detailed report and discussion of the results of measurements made over a 262-mile over-water path between Florida and the Bahamas in December 1956. Ground and airborne field-strength measurements, refractometer soundings, radiosonde data and visual observations were recorded.

621.396.11.029.63 3097

**Apparent Correlation between Tropopause Height and Long-Distance Transmission Loss at 490 Mc/s.**—D. R. Hay. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1144-1145.) For a 640-mile path in June-July 1957 signals were low and

steady when the tropopause was low, but were higher and fluctuated more when the tropopause was high.

621.396.812 3098

**Prolonged Signal Fade-Out on a Short Microwave Path.**—D. R. Hay & G. E. Poaps. (*Canad. J. Phys.*, March 1959, Vol. 37, No. 3, pp. 313-321.) During a period of one year, the incidence of signal fade-out has been observed in 2-kMc/s transmissions over a 21-mile path near Ottawa. Fade-out durations varied from a few minutes to several hours, with the most frequent occurrence in the summer and during the night. An analysis of the refractivity of the air at the middle of the radio path indicates that fade-out is associated with a shallow horizontal transition zone in vapour pressure at a level near the aerial heights.

## RECEPTION

621.376 3099

**Correlation Devices Detect Weak Signals.**—H. R. Raemer & A. B. Reich. (*Electronics*, 22nd May 1959, Vol. 32, No. 21, pp. 58-60.) Operating principles of auto-correlators, cross-correlators, and radiometers are described.

621.396.621 : 621.314.7 3100

**How to Design Reflexed Transistor Receivers.**—J. Waring. (*Electronics*, 8th May 1959, Vol. 32, No. 19, pp. 70-72.) Methods for obtaining i.f. and a.f. gain in the same stage without motorboating.

621.396.66 : 621.396.828 3101

**Negative-Supply Outboard Codan.**—R. L. Ives. (*Audio*, May 1959, Vol. 43, No. 5, pp. 22-23..73.) Details are given of a circuit which silences the a.f. stages of a receiver when the carrier amplitude falls below a predetermined level. The circuit does not alter the characteristics of the receiver to which it is connected.

621.396.812.3 : 621.396.666 3102

**Linear Diversity Combining Techniques.**—D. G. Brennan. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1075-1102.) An analysis and results of measurements of the relative performance are given for three types of diversity combining techniques: (a) selection diversity, (b) maximal-ratio diversity, and (c) equal-gain diversity systems. The effects of various departures from the ideal conditions are considered and the relative merits of predetection and post-detection combining and of long-term distributions are discussed.

## STATIONS AND COMMUNICATION SYSTEMS

621.391 3103

**On Asymmetric Information Channels.**—R. B. Banerji. (*J. Brit. Instn Radio*

*Engrs*, May 1959, Vol. 19, No. 5, pp. 305-308.) A study of channel capacity in terms of the probability of possible errors, and application to p.c.m. with amplitude keying.

621.396.3 : 621.391 3104

**Some Operational Considerations Affecting the Use of Automatic Error Correcting Equipment on H.F. Telegraph Networks.**—E. G. Copper. (*Point to Point Telecommun.*, Feb. 1959, Vol. 3, No. 2, pp. 21-34.) A discussion of some of the problems associated with the radio error-correcting multiplex (REM) system.

621.396.5 : 534.76 3105

**Compatible Stereo Radio using A.M./F.M. Multiplex.**—H. E. Sweeney. (*Electronics*, 8th May 1959, Vol. 32, No. 19, pp. 56-58.) Transmission of two channels by amplitude and frequency modulation of the same carrier. A circuit is given for the addition of a f.m. channel to an a.m. receiver.

621.396.65 3106

**The TJ Radio System.**—S. D. Hathaway & H. H. Haas. (*Bell Lab. Rec.*, April 1959, Vol. 37, No. 4, pp. 129-133.) Description of a 6-channel 11-kMc/s relay system using dual frequency-diversity transmission, giving details of arrangement of subcarriers in the spectrum and examples of use for telephony, television and data transmission.

621.396.65 : 621.396.41 3107

**F.M. Multiplexing for Studio-Transmitter Links.**—D. Harkins. (*Electronics*, 22nd May 1959, Vol. 32, No. 21, pp. 44-45.) Three program signals modulate subcarriers at 26, 65 and 175 kc/s, which are combined to modulate a 946 Mc/s carrier for transmission to the transmitter site 16 miles away.

## SUBSIDIARY APPARATUS

621.3.087.45 : 621.395.625.3 3108

**A Multiple-Channel D.C. Recording System.**—H. D. Scott. (*Electronic Engng*, June 1959, Vol. 31, No. 376, pp. 340-344.) Describes an a.m. system with tape-noise cancellation enabling up to twelve 0-10-c/s channels to be recorded on a conventional single-track recorder together with speech and timing signals.

621.314.63 : 546.289 3109

**The Thermal Behaviour of Semiconductor Rectifiers.**—O. Jakits. (*Brown Boveri Rev.*, Nov./Dec. 1958, Vol. 45, Nos. 11/12, pp. 540-544.) Measurements are described which were made on heavy-current Ge diodes to determine the thermal inertia. The effect of cooling on the overload characteristic is discussed.

621.314.63 : 621.396.96 3110

**Using Silicon Diodes in Radar Modulators.**—M. G. Gray. (*Electronics*, 12th June 1959, Vol. 32, No. 24, pp. 70-72.) A peak power of 250 kW is developed using

Si diodes for charging the artificial line and for clipping reverse voltage swings. The diodes dissipate instantaneous powers up to 300 kW.

621.314.634 **3111**  
**Selenium Rectifiers with Artificial Layers of Selenides of Cadmium, Tin, Bismuth and Lead.**—Y. Moriguchi. (*J. Phys. Soc. Japan*, Feb. 1959, Vol. 14, No. 2, pp. 152–167.) The action of various selenides as barrier layers has been investigated by measurement of the rectifier d.c. and a.c. characteristics. CdSe and SnSe layers play an important role in rectification but the selenides of Bi and Pb seem to be unsuitable. In general, the layer material should have a resistivity  $< 10^4 \Omega \text{ cm}$ .

621.314.64 **3112**  
**Current/Time Relationship in the Forward Direction of Electrolytic Rectifiers.**—W. C. van Geel & C. A. Pistorius. (*Philips Res. Rep.*, April 1959, Vol. 14, No. 2, pp. 123–131.) Qualitative explanation of the effects observed on applying alternating rectangular and sinusoidal voltages.

621.316.721.078 : 621.375.2.024 **3113**  
**Use of Operational Amplifiers in Precision Current Regulators.**—K. Eklund. (*Rev. sci. Instrum.*, May 1959, Vol. 30, No. 5, pp. 328–331.) Low-drift high-gain d.c. amplifiers in a control loop can reduce steady-state error.

**TELEVISION  
AND PHOTOTELEGRAPHY**

621.397.24 **3114**  
**Carrier Transmission for Closed-Circuit Television.**—L. G. Schimpf. (*Electronics*, 12th June 1959, Vol. 32, No. 24, pp. 66–68.) A simple and inexpensive coaxial-cable transmission system, using transistors in the terminal and repeater circuits is described. D.c. supplies to the repeaters are applied via the signal cable.

621.397.611.2 **3115**  
**Measurement of the Transmission Characteristics of Television-Camera Preamplifiers.**—W. Eckardt. (*Tech. Mitt. BRF, Berlin*, Dec. 1957, Vol. 1, No. 2, pp. 27–32.)

621.397.62 **3116**  
**Two Realizations of the New Synchronphase.**—L. Chrétien & R. Aschen. (*TSF et TV*, March–May 1957, Vol. 33, Nos. 341–343, pp. 71–76, 152–157 & 167–168.) A rejector circuit and a variable video-frequency gain control compensate for phase distortion by altering the shape of the video-frequency response curve. Detailed descriptions are given of a medium-range and a long-range television receiver, with a note on the adjustment of the phase-correction circuit.

621.397.62 **3117**  
**Television I.F. Amplifiers with Linear Phase Response.**—A. N. Thiele. (*Proc.*

*Instn Radio Engrs, Aust.*, Nov. 1958, Vol. 19, No. 11, pp. 652–668.) This type of response is discussed in relation to ease of tuning and alignment and to phase equalization at the transmitter.

621.397.62 : 535.623 **3118**  
**Automatic Controls for Colour Television.**—Z. Wienczek. (*Electronics*, 15th May 1959, Vol. 32, No. 20, pp. 58–59.) A method of control of the phase (hue) and amplitude (chroma) of the colour signal using a low-frequency diode gate.

621.397.62 : 535.623 : 535.88 **3119**  
**The Projection of Colour-Television Pictures.**—T. Poorter & F. W. de Vrijer. (*Philips tech. Rev.*, 22nd Aug. 1958, Vol. 19, No. 12, pp. 338–355.) Three projection-type c.r. tubes are used respectively with red, green and blue fluorescing phosphors. Each is mounted in a Schmidt optical system the superposition of the three images being effected either by dichroic mirrors [1701 of May (van Alphen)] or by mounting the three tubes side by side. Projectors using these systems are described.

621.397.621.2 **3120**  
**Noise-Immune Synchronizing Circuits for Television Timebase Circuits.**—D. J. Howlett & L. Buduls. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1958, Vol. 19, No. 11, pp. 680–689.) Noise limiting and a.g.c. circuits are discussed and details are given of an improved form of the heptode sync separator described by Marks (252 of 1953).

621.397.621.2 **3121**  
**Some Aspects of Synchronization in Television Receivers.**—J. van der Goot. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1958, Vol. 19, No. 11, pp. 690–706.) A discussion of scanning oscillators and a.f.c. systems.

621.397.621.2 **3122**  
**The Synchronization Separator—an Unexpected Observation.**—J. Goldthorp. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1958, Vol. 19, No. 11, pp. 706–707.) A note describing the improved performance obtained using a remote-cut-off pentode as composite sync separator in place of a valve with sharp cut-off.

621.397.621.2 **3123**  
**Improvements in Television Receivers: Part 5—Stabilization of Line and Frame Output Circuits.**—B. G. Dammers, A. G. W. Uitjens, A. Boekhorst & H. Heyligers. (*Electronic Applic.*, Nov. 1958, Vol. 18, No. 4, pp. 129–142.) Detailed descriptions are given of circuits suitable for a  $110^\circ$  c.r. tube. Line output stages with flyback ratios of 16, 18 or 21% have been stabilized by voltage-dependent resistors (see Part 4: 989 of March). The frame output stage derives its charging voltage from the stabilized boost voltage. A protective circuit to limit beam current is described.

621.397.621.2 **3124**  
**Improvements in Television Receivers: Part 6—Design Considerations for Stabilized Line Output Circuits.**—B. G. Dammers, A. Boekhorst & D. Hoogmoed.

(*Electronic Applic.*, Nov. 1958, Vol. 18, No. 4, pp. 143–157.) Essential formulae and graphs are given for a quantitative investigation of circuits in which the line output valve operates above the knee of the  $I_a/V_a$  characteristic. For practical circuits see 3123 above.

621.397.621.2 : 535.623 : 621.385.832 **3125**  
**Errors of Magnetic Deflection: Part 2.**—J. Haantjes & G. J. Lubben. (*Philips Res. Rep.*, Feb. 1959, Vol. 14, No. 1, pp. 65–97.) Approximate formulae for the design of deflection coils have been developed from a theoretical study [Part 1: 2990 of 1957]. Convergence errors in the shadow-mask tube and in an experimental tube with three guns vertically in line are discussed. For the latter tube a deflection coil can be designed which makes dynamic convergence unnecessary.

621.397.621.2 : 621.373.444.1 **3126**  
: 621.314.7

**Transistor Line Deflection Circuits for Television.**—P. B. Helsdon. (*Marconi Rev.*, 1st Quarter 1959, Vol. 22, No. 132, pp. 38–70.) The shunt diode circuit and the retrace-driven circuit due to Gugli (2382 of 1957) are analysed and their limitations discussed. A flyback-driven circuit is described with automatic phase control, and reverse base current drive to the shunt diode circuit. The output is sufficient for scanning a  $70^\circ$  picture tube.

621.397.621.2 : 621.385.832 **3127**  
**A New Approach to Short Picture-Tube Design.**—G. A. Burdick. (*Sylvania Technologist*, Jan. 1959, Vol. 12, No. 1, pp. 2–5.) A brief description of the construction and principle of operation of the tripotential focus (TPF) gun which can be focused by varying the potential to any one of the three elements.

621.397.621.2 : 621.385.832.032.269.1 **3128**  
**A New Electron Gun for Picture Display with Low Drive Signals.**—K. Schlesinger. (*J. Telev. Soc.*, Jan.–March 1959, Vol. 9, No. 1, pp. 15–25.) High control sensitivity required for transistor drive is achieved by a new electron-optical approach. Beam focusing and modulation are effected in a cylindrical cavity by two separate e.s. fields: one of circular symmetry for focusing, and one of transverse-plane geometry for modulation.

621.397.7 **3129**  
**ABN Television Transmitter.**—F. M. Shepherd. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1958, Vol. 19, No. 11, pp. 609–614.) A brief description of main and standby equipment at Gore Hill.

621.397.7 **3130**  
**The ATN Television Centre.**—M. H. Stevenson. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1958, Vol. 19, No. 11, pp. 614–621.) A general description of the Centre which is near Sydney. Factors which influenced its design and the provisions made for expansion are discussed.

621.397.7 : 535.623 **3131**  
**Holding Video Level while Switching Studios.**—J. O. Schroeder. (*Electronics*,

29th May 1959, Vol. 32, No. 22, pp. 96-98.) An automatic circuit designed to compensate for wide variations in colour or monochrome input signal levels and to maintain a constant output level.

621.397.7 : 621.396.65 **3132**  
**Equalization of Aural and Visual Delay.**—I. Kerney & W. D. Mischler. (*Bell Lab. Rec.*, May 1959, Vol. 37, No. 5, pp. 182-186.) The delay of audio signals relayed by coaxial cable relative to video signals relayed by microwave link is reduced by bypassing demodulating equipment at coaxial relay points.

621.397.7 : 621.396.677.81 **3133**  
**The Passive TV Relay and its Practical Possibilities.**—Aschen. (See 2851.)

621.397.8 **3134**  
**Echo Phenomena in Television Images.**—J. Polonsky, L. Amster & G. Melchior. (*J. Telev. Soc.*, Jan.-March 1959, Vol. 9, No. 1, pp. 2-14.) English version of 283 of 1957.

621.397.8 **3135**  
**Results of Investigations on the Recognizability of Small Details on a Television Screen.**—F. Below, W. Kroebe & H. Springer. (*Z. angew. Phys.*, June 1958, Vol. 10, No. 6, pp. 277-285.) An objective method of measuring detail recognition is described based on the use of Landoltring test pictures (see 3321 of 1957). The effects of bandwidth limitation and contrast are investigated.

621.397.8 **3136**  
**The Perceptibility of Image Details in Television Images.**—W. Kroebe, F. Arp & H. Baurmeister. (*Z. angew. Phys.*, July 1958, Vol. 10, No. 7, pp. 320-327.) The test described in 3136 below is applied to television images. Results are closely related to those obtained with optically projected images.

621.397.8 **3137**  
**Phase-Shift Considerations in Television Broadcasting and Reception.**—M. W. Davies. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1958, Vol. 19, No. 11, pp. 642-651.) A general description of phase distortion and of the effects this distortion can have on the received signal of a vestigial-sideband system. Methods available for compensation are discussed; see e.g. 3117 above.

621.397.8 : 535.7 **3138**  
**The Visual Properties of the Human Eye as a Contribution to the Problem of Assessing the Quality of Projection and Television Images.**—W. Kroebe, F. Arp & H. Baurmeister. (*Z. angew. Phys.*, July 1958, Vol. 10, No. 7, pp. 309-317.) A test is described for the quantitative assessment of the perception of small objects by the eye and a mathematical expression is derived relating perception to contrast and object size. For the underlying statistical considerations see *ibid.*, pp. 317-320 (Arp).

621.397.8 : 621.396.822 **3139**  
**Effects of Noise in Television Transmission.**—T. Kilvington. (*J. Telev. Soc.*,

Jan.-March 1959, Vol. 9, No. 1, pp. 26-31.) The nature of random noise and its effect on sound and vision reception are reviewed. The subjective effects on the picture of both random and periodic noise are described and methods of minimizing them are considered.

621.397.8 : 621.396.822 **3140**  
**Theoretical and Experimental Characteristics of Random Noise in Television.**—R. Fatchchand. (*J. Brit. Instn Radio Engrs*, June 1959, Vol. 19, No. 6, pp. 335-344.) The characteristics of noise distributed uniformly over the frequency band and that concentrated at the high frequency end of the pass-band are compared. The effects of a nonlinear transfer characteristic on noise alone and on noise plus signal are studied and the relation between these effects and noise visibility on a picture tube is examined.

## TRANSMISSION

621.396.61 : 629.19 **3141**  
**Minimum Transmitter System Weight for Space Communications.**—R. S. Davies & C. S. Weaver. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, pp. 1151-1152.) A method is given for calculating optimum transmitter weight and aerial size.

621.396.71 **3142**  
**New Radio Transmitters at Ongar.**—(*Engineer, Lond.*, 27th Feb. 1959, Vol. 207, No. 5379, p. 339.) Operational data are given on the seven new radiotelegraphy transmitters of the British Post Office.

## VALVES AND THERMIONICS

621.314.63 **3143**  
**The D.C. and A.C. Characteristics of Point-Contact Diodes.**—H. Beneking. (*Z. angew. Phys.*, May 1958, Vol. 10, No. 5, pp. 216-225.) A *p-n* diode of spherical symmetry [see e.g. 2411 of July (Hofmeister & Groschwitz)] is investigated by analogy with calculations for the plane configuration (1398 of April). An interpretation of the injection mechanism of point contacts is obtained. Good agreement between measured and theoretical diode characteristics is found.

621.314.63 : 621.318.57 **3144**  
**Millimicrosecond Switching Diodes.**—J. Halpern & R. H. Rediker. (*Electronics*, 5th June 1959, Vol. 32, No. 23, pp. 66-67.) Describes briefly the construction of Ge-In-Sb diffusion diodes for switching speeds of 2-3  $\mu$ s (see 2909 of 1958). A method of measuring the reverse recovery time is outlined.

621.314.63 : 621.372.632 **3145**  
**Transmitting Frequency Converter in which Gold- or Silver-Bonded Diode is Used.**—S. Kita, H. Sanpei & T. Okajima. (*Rep. elect. Commun. Lab., Japan*, Nov. 1958, Vol. 6, No. 11, pp. 415-420.) More than 8 dB conversion gain with output frequency 4130 Mc/s has been obtained using nonlinear-capacitance Ge diodes [see *Proc. Inst. Radio Engrs*, June 1958, Vol. 46, No. 6, p. 1307 (Kita)].

621.314.63 + 621.314.7]-71 (083.57) **3146**  
**Taking the Heat off Semiconductor Devices.**—W. Luft. (*Electronics*, 12th June 1959, Vol. 32, No. 24, pp. 53-56.) Charts and nomograms are given for the design of cooling fins.

621.314.7 + 621.314.63 **3147**  
**Transistors and Associated Semiconductor Devices.**—R. G. Hibberd. (*Proc. Instn elect. Engrs*, Part B, May 1959, Vol. 106, No. 27, pp. 264-278.) Progress in the manufacture and application of these devices is reviewed. Characteristics of many available types are tabulated.

621.314.7 **3148**  
**Diffusion Capacitance in Transistors.**—K. Böke, J. B. M. Spaapen & N. B. Speyer. (*Philips Res. Rep.*, April 1959, Vol. 14, No. 2, pp. 111-122.) Calculations taking into account the influence of the second junction are in agreement with the results of capacitance measurements at different temperatures, voltages and frequencies.

621.314.7 **3149**  
**A Particular Problem of Temperature Distribution concerning the Theory of Junction Transistors.**—A. Pignedoli. (*R.C. Accad. naz. Lincei*, Nov. 1957, Vol. 23, No. 5, pp. 257-262.) The temperature distribution as a function of position and time is analysed for a cylinder of circular or elliptical cross-section; the solution is applicable to the investigation of temperature distribution in a transistor whose junction temperature is raised.

621.314.7 : 546.28 : 621.317.3 **3150**  
**The Measurement of the Temperature Dependence of the Mobility and Effective Lifetime of Minority Carriers in the Base Region of Silicon Transistors.**—D. M. Evans. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 204-208.) The mobility of holes in the base of a fusion-alloy *p-n-p* transistor was found to vary with the absolute temperature *T* as *T*<sup>-2.1</sup>; the corresponding result for electrons in the base of a grown-junction *n-p-n* transistor was *T*<sup>-2.5</sup>. Results for the effective lifetime of minority carriers in the base are also given.

621.314.7 : 621.317.7 **3151**  
**A Transistor Characteristic Curve Tracer.**—Young. (See 3060.)

621.314.7 : 621.385.4 **3152**  
**Theory and Use of Field-Effect Tetrodes.**—H. A. Stone, Jr. (*Electronics*, 15th May 1959, Vol. 32, No. 20, pp. 66-68.) Characteristics and circuit applications of the device are discussed and a description is given of a technique by which laboratory models have been constructed.

- 621.314.7.012.8 **3153**  
**Transmission-Line Analogue of a Drift Transistor.**—J. te Winkel. (*Philips Res. Rep.*, Feb. 1959, Vol. 14, No. 1, pp. 52-64.) A method is described based on a constant drift field, for deriving base transport parameters and the small-signal equivalent circuit without solving the differential equations explicitly.
- 621.314.7.012.8 **3154**  
**Three-Dimensional Electric-Circuit Model of the High-Frequency Phenomena in a Junction Transistor.**—G. Brouwer. (*Philips Res. Rep.*, April 1959, Vol. 14, No. 2, pp. 132-142.) The linearized problem, corresponding to small-signal operation of a transistor, is solved with the aid of a model.
- 621.383.27 **3155**  
**New Photoelectron Multipliers.**—N. S. Khlebnikov. (*Izv. Ak. Nauk S.S.S.R., Ser. fiz.*, Jan. 1958, Vol. 22, No. 1, pp. 70-77.) Five types of photomultiplier are briefly described. Typical field distributions and electron paths are illustrated and operating characteristics are tabulated.
- 621.383.27 **3156**  
**Manufacture of Photoelectron Multipliers and Their Basic Parameters.**—A. E. Melamid. (*Izv. Ak. Nauk S.S.S.R., Ser. fiz.*, Jan. 1958, Vol. 22, No. 1, pp. 78-82.)
- 621.383.42 **3157**  
**The Open-Circuit Electromotive Force of a Selenium Photocell at Low Temperatures.**—G. Blet. (*J. Phys. Radium*, Feb. 1958, Vol. 19, No. 2, pp. 166-169.) Assumptions concerning the internal mechanism of photocells are checked and a general expression, independent of photocell size, is given.
- 621.383.5 **3158**  
**Photovoltaic Effect in Se Photocells having Artificial Intermediate Layers of CdSe, CdTe, ZnSe and ZnTe.**—H. Tubota & H. Suzuki. (*J. phys. Soc. Japan.*, Jan. 1959, Vol. 14, No. 1, pp. 38-40.)
- 621.385.029.6 **3159**  
**International Convention on Microwave Valves.**—(*Proc. Instn elect. Engrs*, Part B, 1958, Vol. 105, Supplement No. 11, pp. 609-812.) The text is given of the following papers which were included among those read at the I.E.E. Convention held in London 19th-23rd May 1958. Others are abstracted separately. For titles of papers included in Supplement No. 10 see 2788 and 2800 of August Technology:  
 (a) A new Ceramic Waveguide Window for Use on X-Band Valves.—W. F. Gibbons & A. V. Whale (pp. 609-613).  
 (b) Photo-etching Molybdenum Foil.—H. A. C. Hogg (pp. 614-616).  
 (c) High-Power Windows at Microwave Frequencies.—J. V. Lebacqz, J. Jasberg, H. J. Shaw and S. Sonkin (pp. 617-622).  
 (d) Study of the Lives of Dispenser-Type Barium-Tungsten Cathodes.—T. Hashimoto (p. 622).  
 (e) Application of Discharge Machining to Millimetre-Wave Magnetrons.—M. Nishimaki & T. Asaba (p. 623).  
 Space-Charge Waves:  
 (f) Large-Signal Linear-Beam Tube Theory.—C. C. Wang (pp. 624-632).  
 (g) A Variation Principle for Small-Amplitude Disturbances of Electron Beams.—P. A. Sturrock (pp. 632-634).  
 (h) Space-Charge Waves on Annular Beams in Drift Tubes.—A. H. W. Beck & P. E. Deering (pp. 635-641).  
 (i) Magnetic Oscillations in Electron Beams.—R. H. C. Newton (pp. 642-644).  
 (j) Microwave Amplification using an Unstable Electron Beam in Crossed Electric and Magnetic Fields.—D. J. Harris (pp. 645-648).  
 Semiconductors and New Methods of Generation:  
 (k) Parametric Amplification of Space-Charge Waves.—A. Ashkin, T. J. Bridges, W. H. Lousell & C. F. Quate (pp. 649-651). See 1025 of March.  
 (l) Some Proposals for Generating High-Frequency Electromagnetic Waves using the Doppler Effect.—R. B. R. Shersby-Harvie (pp. 652-655).  
 (m) Fast-Wave Interactions with an Electron Film at Cyclotron Resonance.—A. Karp (pp. 656-661).  
 (n) Junction Diodes in Microwave Circuits.—A. Uhlir (p. 661).  
 (o) Theory of the Microwave Crystal Mixer.—C. Baron (pp. 662-664).  
 (p) Microwave Amplification by means of Intrinsic Negative Resistances.—E. Rostas & F. Hülster (pp. 665-673).  
 Resonators and Slow-Wave Structures:  
 (q) Dielectric Loading for U.H.F. Valves.—G. B. Walker (pp. 717-718).  
 (r) A Structure, using Resonant Coupling Elements, suitable for a High-Power Travelling-Wave Tube.—A. F. Pearce (pp. 719-726).  
 (s) Results on Delay Lines for High-Power Travelling-Wave Tubes.—P. Palluel & J. Arnaud (pp. 727-729).  
 (t) Theoretical Investigation of some Closed Delay Structures for High-Power Travelling-Wave Tubes.—F. Sellberg (pp. 730-735).  
 Discussion (pp. 735-736).  
 (u) A New Type of Slow-Wave Structure for Millimetre Wavelengths.—E. A. Ash (pp. 737-745).  
 (v) Multiple Ladder Circuits for Millimetre-Wavelength Tubes.—R. M. White, C. K. Birdsall & R. W. Grow (p. 746).  
 Discussion (p. 746).  
 (w) Dispersion Curves for a Helix in a Glass Tube.—D. T. Swift-Hook (pp. 747-755).  
 (x) Some Aspects of the Design of a Helical Coupler for a Travelling-Wave Tube Operating in the 2-Gc/s Band.—P. A. Lindsay & K. D. Collins (pp. 756-761).  
 (y) Modified Transmission-Line Couplers for Helices.—E. A. Ash & J. D. Pattenden (pp. 762-768).  
 (z) The Coupling of Three Coaxial Helices.—B. Minakovic (pp. 769-778).  
 Discussion (pp. 778-779).  
 (aa) Characteristics of Interdigital Circuits and their Use for Amplifiers.—J. Hirano (pp. 780-785).  
 Noise:  
 (bb) Calculations concerning the Noisiness of a Drifting Stream of Electrons.—J. R. Pierce (pp. 786-789).  
 (cc) Progress in Low-Noise Microwave Tube Design.—W. R. Beam (pp. 790-795).  
 (dd) Frequency Noise in Travelling-Wave Tubes.—R. Liebscher & R. Müller (pp. 796-799).  
 (ee) Noise in Backward-Wave Oscillators.—N. W. W. Smith (pp. 800-804).  
 (ff) Oxide Cathodes for Low-Noise Travelling-Wave Tubes.—E. Windsor (pp. 805-809).
- 621.385.029.6 **3160**  
**Kinetic Theory of Space-Charge: Part 2—Electron Collisional Damping in the Magnetron (and Diode).**—L. Gold. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 209-235.) A detailed analysis of the part played by scattering in determining the field and charge distribution in a planar diode or magnetron. Various combinations of magnetic field, scattering frequency and transit time are considered. Part 1: 3696 of 1957.
- 621.385.029.6 **3161**  
**A.C. Operation of Continuous-Wave Magnetrons.**—W. Schmidt. (*Electronic Applic.*, Nov. 1958, Vol. 18, No. 4, pp. 158-162.) English version of 4013 of 1958.
- 621.385.029.6 **3162**  
**Current Limitation of A.C.-Operated Continuous-Wave Magnetrons by means of Inductance.**—E. G. Dorgelo. (*Electronic Applic.*, Nov. 1958, Vol. 18, No. 4, pp. 163-170.) Adjustment of the angle of flow, combined with high efficiency, can be achieved using a supply unit of low resistance incorporating an inductance of suitable value in the form of stray inductance or a choke.
- 621.385.029.6 **3163**  
**A Proposed Ferrite-Tuned Magnetron.**—A. Singh & R. A. Rao. (*J. Instn Telecommun. Engrs, India*, March 1959, Vol. 5, No. 2, pp. 72-76.) The frequency of an inverted interdigital magnetron can be controlled by varying a biasing magnetic field applied to a ferrite cylinder placed near the shorted end of a coaxial line which is coupled to the interdigital resonator. A tuning range of 5-10% may be expected as shown by a theoretically evaluated tuning curve.
- 621.385.029.6 : 621.372.8 **3164**  
**Backward-Wave Oscillations in an Unloaded Waveguide.**—R. H. Pantell. (*Proc. Inst. Radio Engrs*, June 1959, Vol. 47, No. 6, p. 1146.) Using a system in which electrons travel in a helical beam in ordinary S-band waveguide, oscillations have been observed in the range 2.5-4 kMc/s at a power level of 0.4 W.
- 621.385.029.6 : 621.396.822 **3165**  
**An Experimental Study of Interception Noise in Electron Streams at Microwave Frequencies.**—B. A. McIntosh. (*Canad. J. Phys.*, March 1959, Vol. 37, No. 3, pp. 285-299.) The frequency used was 3 kMc/s. An electron beam was produced in a demountable vacuum system by a parallel-flow Pierce gun in a confining

magnetic field. A series of circular apertures and mesh grids on a plate capable of being moved within the vacuum chamber intercepted various fractions of the beam current. The excess noise caused by interception was measured at the anode of the electron gun and at various points in a drift region. Interception noise caused by mesh grids was much greater than that caused by circular apertures.

621.385.032.213.13 : 538.632 **3166**  
**Hall Effect in Oxide Cathodes.**—T. Yabumoto. (*J. phys. Soc. Japan*, Feb. 1959, Vol. 14, No. 2, pp. 134–139.) The apparent electron mobility in the range 700° K–1 200° K was about  $10^8$ – $10^4$  cm<sup>2</sup>/V.sec which is very high as compared with the values obtained for single crystals. The pore conduction hypothesis is discussed.

621.385.1 : 621.3.049.7 **3167**  
**Thermionic Integrated-Micro-modules.**—Beggs, Grattidge, Molenda, Haase & Dickerson. (See 2863.)

621.385.1 : 621.314.7 : 621.373.43 **3168**  
**Tube-Transistor Hybrids Provide Design Economy.**—Dunn & Hekimian. (See 2877.)

621.385.1 : 621.317.61 **3169**  
**A Method for the Accurate Measurement of Mutual Conductance of Thermionic Valves.**—Child & Sargent. (See 3059.)

621.385.1.012.7 **3170**  
**The Mu of Ordinary Receiving Tubes.**—G. D. O'Neill. (*Sylvania Technologist*, Oct. 1958, Vol. 11, No. 4, pp. 125–132.) A distinction is made between the electronic mu and the electrostatic mu. A new formula is given for mu in terms of electrode dimensions; it is simple to evaluate and more accurate than others which are available.

621.385.832 : 621.397.62 **3171**  
**Design of a Flat Rectangular C. R. Tube.**—W. R. Aitken. (*Electronic Equipm. Engng*, Dec. 1958, Vol. 6, No. 12, pp. 24–28.) A qualitative description with a note on operating experience. See 977 of 1958 for detailed analysis.

621.385.832 : 621.397.621.2 : 535.623 **3172**  
**Errors of Magnetic Deflection: Part 2.**—Haantjes & Lubben. (See 3125.)

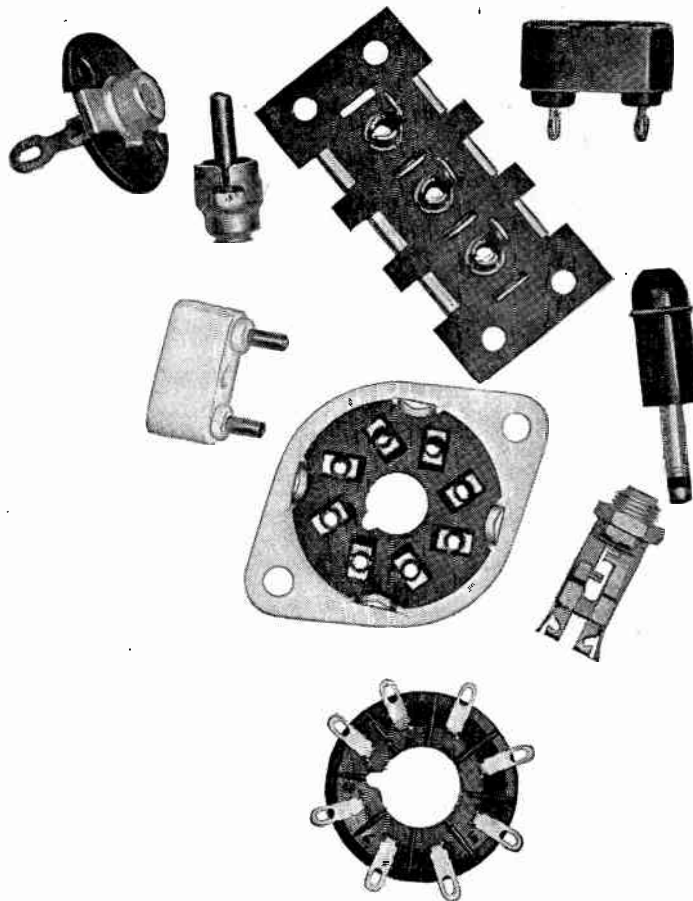
621.385.832.032.36 **3173**  
**Energy Losses of Cathode Rays at Binder Films of the Phosphor Screens of Cathode-Ray Tubes.**—G. Gergely & I. Hangos. (*Z. angew. Phys.*, May 1958, Vol. 10, No. 5, pp. 225–228.) Measurements of light emission were made on a number of phosphor screens with colloidal binder films of differing composition and thickness, to determine the dependence of losses on electron energy and film characteristics.

621.387 **3174**  
**The Effect of Trigger Pulse Polarity on the Anode Breakdown Time of the Cold-Cathode-Arc Conduction Tetrode.**—R. Feinberg. (*J. Electronics Control*, March 1959, Vol. 6, No. 3, pp. 246–257.) The breakdown time is found to depend on the trigger pulse duration if this pulse is positive, but not if it is negative. The explanation of this result is discussed.

**MISCELLANEOUS**

621.3.029.6 **3175**  
**Report of Advances in Microwave Theory and Techniques—1957.**—R. E. Beam. (*Trans. Inst. Radio Engrs*, July 1958, Vol. MTT-6, No. 3, pp. 251–263.) 320 references.

621.37/39(81) **3176**  
**Electronics and Communications in Brazil.**—J. I. Caicoya. (*Brit. Commun. Electronics*, May 1959, Vol. 6, No. 5, pp. 364–370.) Gives details of manufacturing and research organizations.



the  
component  
**YOU**  
are looking  
for could  
be here

We make thousands of components for radio, TV and electronics, and we believe they are generally better and, for their high quality, cheaper, than any on the market.

We can quote particularly favourable prices for the types of component illustrated—prices that could help you to get your production costs down to a new low level.

EIGHTAR CONNECTORS for the new 110° CRT's  
COAXIAL PLUGS AND SOCKETS, Single, 2, 3, 4 and 5-way  
MINIATURE JACK PLUGS AND SOCKETS  
INTERNATIONAL OCTAL VALVEHOLDERS  
CRYSTAL HOLDERS

*Manufacturers are invited to write for details of our complete range of components*



**ELECTRONIC COMPONENTS**

**SIEMENS EDISON SWAN LTD** *An A.E.I. Company*

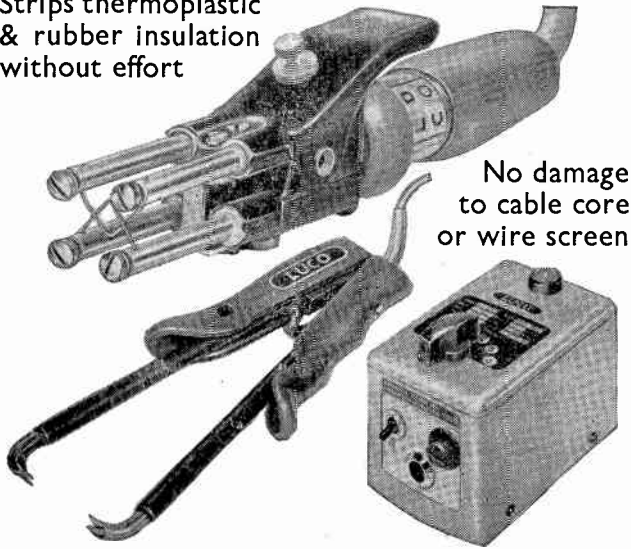
155 Charing Cross Road, London, WC2 and branches

Telephone: GERrard 8660 Grams: Sieswan Westcent London

CRC 17/22

## LUCO ELECTRICALLY HEATED Wire Strippers

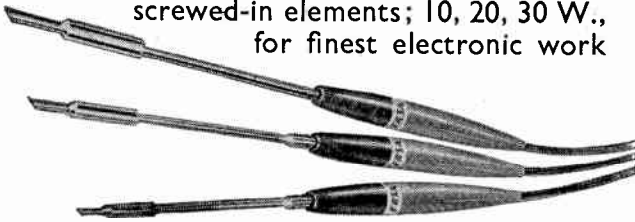
Strips thermoplastic & rubber insulation without effort



No damage to cable core or wire screen

## ERSA Soldering Appliances

Minitype **SOLDERING NEEDLES** with screwed-in elements; 10, 20, 30 W., for finest electronic work



**SOLDERING PENCILS** 20, 30, 50W., for the Assembly Line and the Service Engineer



Also available: **SOLDERING BATHS** for Printed Circuits and for the Tinning of Enamelled Wire

## WTC Comprehensive Tool Range for Electric, Electronic and Allied Industries

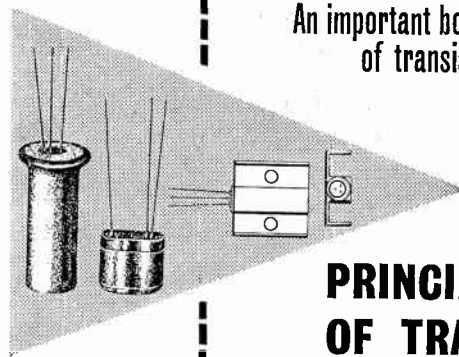
- Box Joint Wiring Pliers, Sidecutting and Frontcutting Nippers, 4½"-8".
- Special Pliers for tipcutting, securing circlips and thermo-shunting.
- Printed Circuit Pliers for crimping and cutting, bending and cutting.
- Wirestrippers, hand and bench type.
- Inner Core Ejectors for screened cables.
- Chrome-Vanadium Box Spanner and Screwdrivers, also with flexible shaft.
- Torque Wrenches and Torque Screwdrivers.
- Standard Piercing Punches, Ejector Pins, Locating Pins.
- Spring Tension Pins, Bushes, Sleeves, Bolts.
- Hard Needle Files, Diamond Files, Laps and Wheels.

Apply for Catalogues ERE1

## WELWYN TOOL Co. Ltd.

Stonehills House  
WELWYN GARDEN CITY · HERTS  
Phone: Welwyn Garden 5403-4

An important book on the design of transistorised circuits



## PRINCIPLES OF TRANSISTOR CIRCUITS

by S. W. Amos, B.Sc. (Hons.), A.M.I.E.E.

This book deals with the physical processes occurring in transistors, the main emphasis being on the application of these principles to practical problems of such quantities as input resistance, stage gain, optimum load, power output, values of coupling capacitors and transformer winding inductances. It provides an invaluable introduction to the design of transistorised equipment for professional designers, students and amateur constructors.

**21s net** by post 21s 11d. 167 pages *Illustrated*

from leading booksellers

Published for "Wireless World" by

Iliffe & Sons Ltd., Dorset House, Stamford St., London S.E.1

TAKE THE **PROBLEMS**  
OUT OF SOLDERING

**HENLEY  
SOLON**  
TRADE MARK

FOR 25 YEARS THE BEST  
ELECTRIC SOLDERING IRON

**RELIABLE  
SPEEDY  
LONG-LASTING**

Leaflets on request from:

**W. T. HENLEY'S  
TELEGRAPH  
WORKS Co. Ltd.**

Engineering  
Sales Department,  
59-62, High Holborn,  
London, W.C.1

Telephone: CHAncery 4361



25 watt instrument model (Illustrated)

'Electronic & Radio Engineer, September 1959



THE SMALLEST EVER

RECHARGEABLE CELL

# DEAC

PERMA-SEAL

For  
Radios  
Deaf-Aids  
Guided Weapons  
Tape Recorders  
Shavers, Etc.

A miracle of engineering precision. This 20 mAh capacity, hermetically sealed, gas tight accumulator provides the smallest rechargeable power source available in this country.

It is the latest addition to the famous DEAC range of patented rechargeable cells which can be permanently "wired in" to work with the utmost efficiency under all conditions without maintenance.

The range includes Disc, Rectangular and Cylindrical types. The Disc-type cells can be stacked to form up to 12 volt single batteries and combinations of stacks give even higher voltages and capacities.

- ★ No corrosion
- ★ No gassing
- ★ No maintenance
- ★ Unlimited shelf life
- ★ Robust and compact
- ★ From 20 mAh to 23 Ah

**G. A. STANLEY PALMER LIMITED**

Maxwell House, Arundel Street, London, W.C.2  
Telephone : Temple Bar 3721



# AUTOMAT

High-Stability RECTIFIERS · TRANSFORMERS · D.C. EQUIPMENT

PROTOTYPE RECTIFIERS  
**48hrs. SERVICE!**

*Specially designed to your requirements!*

Send now for your free copy of Technical Bulletin 58/1

AUTOMAT

MOORSIDE ROAD

SWINTON

MANCHESTER

TEL. SWINTON 4242/4

Issued by Northworks Ltd.

announcement

from



we have opened in one of our London factories a

# VIBRATION TEST LABORATORY

Manned by experienced Vibration Engineers, the laboratory can accept Vibration work for customers who are unable to carry out their own tests, due either to heavy commitments or equipment not being available.

### Range of Vibration Test Equipment.

1. 3,000 lbs. thrust vibrator (Type V1001) with 10 KW drive amplifier. (Type 10K) including automatic frequency sweep control. (Type SFO.1).
2. 800 lbs. thrust vibrator (Type V1000B) with 2 KW drive amplifier.
3. 550 lbs. thrust vibrator (Type V1000) with 1 KW drive amplifier.
4. 250 lbs. thrust vibrator (Type V999) with 500 watt. drive amplifier.

## W. BRYAN SAVAGE LTD

designers and manufacturers of amplifiers and vibrators for modern industry

17 Stratton Street, W.1. Phone: GROsvenor 1926



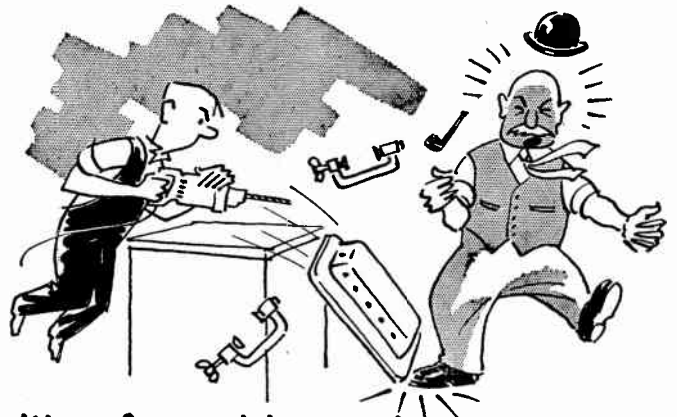
Da5959ERE

New edition just published

# EXPERIMENTAL RADIO ENGINEERING

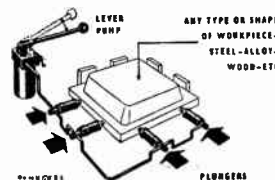
By E. T. A. RAPSON, M.Sc.(Eng.), A.C.G.I., D.I.C., M.I.E.E., etc. New and up-to-date 4th Edition. This book sets out a number of experiments and methods of measurement suitable for a three or four-year course in radio engineering at a technical college. In this new edition thirteen new experiments on transistors, discriminators and other topics are included and the chapter on radio receiver tests has been rewritten. From all booksellers, 12/6 net.

**PITMAN** TECHNICAL BOOKS  
Parker St., Kingsway, London, WC2



It's safer, quicker and more economical to use the

Cut work clamping costs with the Newton Hydraulic Clamp System. Plungers can be grouped in numbers to suit any particular job. Holding pressure of from 800 lbs. to 4 tons. Maximum pressure with smallest plungers. Easily adaptable to any fixture design.



Write for fully illustrated technical booklet. 243/32.



**POWER JACKS LIMITED**

VALETTA RD., ACTON, LONDON, W.3  
Tel: SHEpherd's Bush 3443 (4 Lines)  
Grams: Newsorber Ealux London

Volume I. *Fundamentals, Camera Tubes, Television Optics.*

Volume II. *Video-Frequency Amplification.*

Volume III. *Waveform Generation.*

Volume IV. *General Circuit Techniques.*

# Television Engineering

principles and practice By S. W. Amos, B.Sc. (Hons.), A.M.I.E.E., and D. C. Birkinshaw, M.B.E., M.A., M.I.E.E.

FROM

LEADING

BOOKSELLERS

This is a comprehensive work on the fundamentals of television theory and practice written primarily for the instruction of BBC Engineering Staff.

Volume I, written with the collaboration of J. L. Bliss, AMIEE, covers basic theory of the signal, modern camera tubes, theory of light, mirrors and lenses as applied to television, and electron optics. Volume II describes the fundamental principles of video-frequency amplifiers and examines the factors which limit their performance at the extremes of the passband. Volume III gives the application in television of sinusoidal, rectangular, sawtooth and parabolic waves and shows the mathematical relationship between them. The fourth and final volume covers such subjects as counter circuits, frequency dividers, principles and circuitry of d.c. restorer and d.c. clamping, gamma control amplifiers, delay lines, fixed and variable equalisers, electrical characteristics of scanning coils, field and line output stages, shunt-regulated amplifier.

Volume I. 35s. net. By post 36s. 2d.

Volume II. 35s. net. By post 36s. 2d.

Volume III. 30s. net. By post 31s.

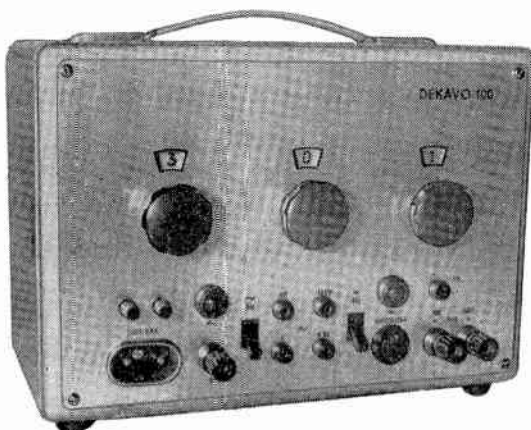
Volume IV. 35s. net. By post 36s. 2d.

Iiffe & Sons Ltd. • Dorset House • Stamford Street • London, S.E.1

*Every Laboratory, Test Room and Factory needs*

## DIRECT-READ-OFF HIGH STABILITY VARIABLE VOLTAGE SUPPLY

*With the new DEKAVO-100, setting and reading are absolute, on 3-decade calibrated "window-type" dials correct to  $\frac{1}{2}$  digit. 100-400 V. DC. 100mA.*



Operated direct from 220-250v. AC-supplies the unit compensates for mains fluctuations at the rate 0.02% output variation per 10% input-volts change. Overload- or short-circuit protection is afforded by built-in current limiter. Extra low-volt DC or high-volt output up to 800v by running 2 units in series. Power output multiplied by 2 or more units in parallel retaining full regulation. AC-outputs at 3A for 4, 6.3, and 12v.

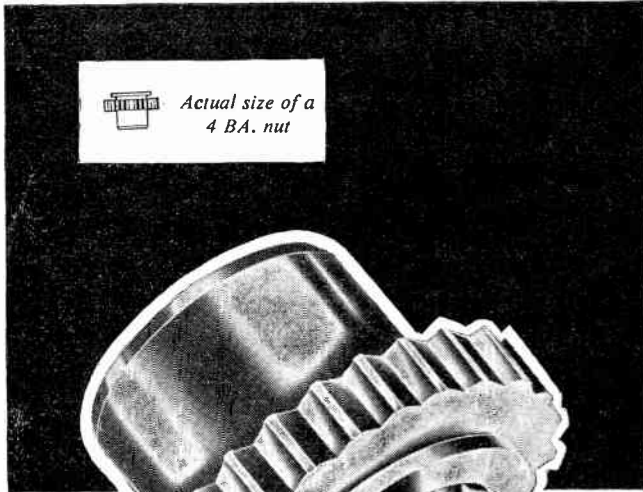
Ripple < 20  $\mu$ V/Volt • Accuracy =  $\pm 0.02\%$  for  $\pm 10\%$  input change

**KYNMORE ENGINEERING CO LTD** 19 BUCKINGHAM ST., LONDON, W.C.2

Telegrams and Cables KYNMORE LONDON Telephone TRAFalgar 2371 (3 lines)

# Quick & secure

## THE ROSAN PRESS NUT



Pat. App.  
No. 19826/57

The Rosan Press Nut provides a quick and secure deep tapped hole in metal sheet or plate. It is cheaper to buy than other methods and much quicker, easier and cheaper to fix. Improve your production and your product with the Rosan Press Nut. Write today for samples.

*Among the many firms which are household words using Rosan Press Nuts are:*

*Keith Blackman Ltd., Chubb & Sons, Lock & Safe Co. Ltd., Igranic Electric Co. Ltd., Pye Telecommunications Ltd., Vickers-Armstrong (Engineers) Ltd., Dynatron Radio Ltd., Claude Lyons Ltd., Elliott Brothers (London) Ltd., Electric & Musical Industries Ltd., Marconi's Wireless Telegraph Co. Ltd., Standard Telephones & Cables Ltd., Thorn Electrical Industries Ltd., Westinghouse Brake & Signal Co. Ltd., The Plessey Co. Ltd., The United Kingdom Atomic Energy Authority and many others.*

### **INSTRUMENT SCREW CO. LTD.**

Northolt Road, South Harrow, Middlesex. Tel: BRYON 1114  
TAS/15.12

## SHORT-WAVE RADIO & THE IONOSPHERE

By T. W. BENNINGTON, Engineering Division, BBC

Long-distance communication by means of short waves is dependent on the state of ionosphere, which changes during the day and at different seasons of the year. This book explains simply the reasons for these changes and shows how they influence the choice of wavelength for signalling between different points of the earth's surface. Published for the "Wireless World".

8½" x 5½" 138 pp. 2nd Edition 10s 6d net By post 11s 4d

Obtainable from leading booksellers or by post from  
The Publishing Dept., Iliffe & Sons Limited  
Dorset House, Stamford Street, London, SE1

### THE ENGLISH ELECTRIC COMPANY LIMITED NELSON RESEARCH LABORATORIES, STAFFORD

require urgently a

## **RADIO ENGINEER**

with experience of HIGH POWER R.F. GENERATORS to work on R.F. Equipment used in connection with Particle Accelerators and GAS DISCHARGE PHYSICS.

The post is permanent and pensionable after a probationary period.

Please write giving full details to Dept. C.P.S., Marconi House, 336/7 Strand, London, W.C.2, quoting reference RE 906L.

### THE WORLD'S GREATEST BOOKSHOP

# FOYLES

★ ★ FOR BOOKS ★ ★

FAMED CENTRE FOR

## **Technical Books**

☉ A bookshop such as booklovers [dream of. There is no other bookshop, anywhere, to compare with Foyles. ☽—A Customer's Letter.

119-125 CHARING CROSS ROAD, LONDON, WC2  
GERrard 5660 (20 lines) Open 9-6 (including Saturdays)  
Two minutes from Tottenham Court Road Station

A.I.D. **INDUCTA** Approved

<b>TRANSFORMERS</b>	of all types up to 25 KVA for Single or Three Phase operation, Phase conversion, etc.
<b>MAINS</b>	Output and Special Purpose Transformers for Radio Equipment, Chokes, etc.
<b>COILS</b>	for Contactors, E.M. Brakes, Air Valves, etc., and coil WINDINGS for all purposes.
<b>SOLENOIDS</b>	or A.C. and D.C. Operation.

**W. F. PARSONAGE & CO LTD**  
**INDUCTA WORKS**  
PARK RD BLOXWICH WALSALL  
TELEPHONE: BLOX. 76464

# ELECTRONIC & RADIO ENGINEER

## CLASSIFIED ADVERTISEMENTS

**Advertisement Rates.** 6d. per word, minimum charge 6/-, each paragraph charged separately. Remittances payable to Iliffe & Sons Ltd., Dorset House, Stamford St., S.E.1. Series discount of 15% is allowed for 12 consecutive insertions.

**Box Numbers** are available at an additional charge of 2/- to defray cost of registration and postage. Replies should be addressed Box No. 0000, c/o "Electronic & Radio Engineer", Dorset House, Stamford Street, London, S.E.1.

**Semi-Display advertisements with centralized lines** £1/15/- per single column inch—no additional charge for Box Numbers. The Publishers are not responsible for clerical or printers' errors although every care is taken to avoid mistakes.

### SITUATIONS VACANT

#### ELECTRONICS EXAMINERS REQUIRED BY MINISTRY OF SUPPLY

AT BROMLEY, WOOLWICH AND OTHER  
LOCATIONS IN S.E. ENGLAND

**DUTIES** cover inspection and testing of electronic equipment including radio and radar, accessories and components, and involve the use of meters, signal generators, oscilloscopes, bridges, etc. Applicants should be familiar with electrical and electronic specifications and be able to read circuit diagrams.

**RATE** of pay (London area): 242/4 rising to 257/4 for 44 hour five-day week. (Certain work carries a maximum of 267/4.) The provincial rate is 2s lower at all points.

**LEAVE:** Two weeks (88 hours) paid annual leave rising to three weeks (132 hours) after five years' service in the grade. Paid sick leave scheme.

**CANDIDATES** must have served a recognised apprenticeship (or have had equivalent experience) or have served in H.M. Forces in an appropriate skilled trade.

**PROSPECTS** of advancement.

**APPLY** giving documentary evidence of qualifications to

ADMINISTRATIVE OFFICER (L) (E.R.E.),  
E.I.D., MINISTRY OF SUPPLY, GOLF  
ROAD, BROMLEY, KENT. [1347

#### LOUGHBOROUGH COLLEGE OF TECHNOLOGY

**APPLICATIONS** are invited for the post of Senior Lecturer in Electrical Engineering. Candidates should be honours graduates in Electrical Engineering or in Physics, and should have had industrial or research experience in light-current work. Experience in Radio-frequency techniques would be an advantage.

**PREVIOUS** teaching experience is desirable, but not essential. Salary within the scale £1,417 10s x £52 10s—£1,627 10s, p.a. Further particulars and application forms may be obtained from the Registrar. (In reply please quote 15/AU). [1348

#### ELECTRO-ENCEPHALOGRAPHY RECORDIST, GRADE I

**APPLICATIONS** are invited from experienced technicians. The department also serves other hospitals in the district and a new research unit for neuro-surgery which opens shortly. Whitley Council salary scales and conditions apply. Apply, giving qualifications, experience, and quote two referees to Medical Superintendent, Parkside Hospital, Macclesfield. [1242

**EXAMINERS:** Air Ministry Aeronautical Inspection Service. About 20 pensionable posts for men and women at least 25 on July 1, 1959. Vacancies mostly at Henlow, Beds (where houses may be available shortly), and Sealand, near Chester, but some at Carlisle, Stafford and in the Gloucestershire area. Qualifications: (a) City and Guilds Inter. Certificate in Telecommunications Engineering and City and Guilds Certificate in Radio II, or equivalent qualification; (b) at least eight years' experience (including apprenticeship or similar period of training) in the manufacture, maintenance, or inspection of radio, radar, or other electronic equipment. Candidates trained in R.A.F. as fitters in radar or telecommunications who satisfy (b) but who do not satisfy (a) will be considered if they attained Class A standard at R.A.F. Cranwell or Locking. Starting salary (men) up to £750 (national rate). Maximum £875. Promotion prospects. Write Civil Service Commission, 17 North Audley Street, London, W.1, for application form quoting S5042/59. Closing date 19 November, 1959. [1349

### SITUATIONS VACANT

**ASSISTANT** Superintendent Engineer (Transmission) required by Sierra Leone Government Broadcasting Department on contract for two tours of 18/24 months each in first instance. Commencing gross salary according to experience in scale £1,210 rising to £1,528 a year. Gratuity at rate 15% of total salary drawn. Outfit allowance £60. Children's allowances £48/£288 a year. Free passages for officer, wife, and three children under 18 years. Liberal leave on full salary. Candidates should have received progressive theoretical training at a Technical College, Institute or Polytechnic up to a standard of City and Guilds Radio III, and hold the necessary certificates indicating success in examinations for each stage of training. They must be competent in the use of test equipment and hand tools normally employed in Radio and Instrument work and should have a keen interest and capacity for further study in specialised broadcasting techniques. Write to the Crown Agents, 4 Millbank, London, S.W.1. State age, name in block letters, full qualifications and experience and quote M2A/50783/EO. [1350

### AGENTS WANTED

**REPRESENTATIVES** wanted for correspondence abroad, high earnings, written instructions. Write Fortuna Publishing Co. Vienna 1/8, Postfach 49. [1324

### FINANCIAL

**HIRE** Purchase and Rental. Finance available for Radio and Electrical Equipment, Television, etc. D. Everard Ltd., 62 Oxford Street, London, W.1. Tel.: Museum 0811. [1346

### BOOKS, ETC.

**"ADVANCED** Theory of Waveguides." By L. Lewin. Sets out various methods of treating problems arising in work on this complex subject. The author has selected for discussion a number of topics as representative of the field in which the centimetre-wave engineer is engaged, many of the examples being concerned with the rectangular waveguide. 30s. net from all booksellers. By post 31s. from Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

**"SECOND** Thoughts on Radio Theory." By Cathode Ray of WIRELESS WORLD. Forty-four articles reprinted from popular WIRELESS WORLD series, in which the author examines various aspects of elementary radio science, explains them clearly, and shows that there may be more behind them than is apparent from the usual text-book. This volume deals with basic ideas; circuit elements and techniques; circuit calculations; and some matters in lighter mood. An entertaining and helpful text-book for the student, refresher course for the engineer, and reference book for all, combined. 25s. net from all booksellers. By post 26s. 4d. from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1.

**"RADIO** Designer's Handbook" (4th Edition). Editor: F. Langford-Smith, B.Sc., B.E., Senior Member I.R.E.(U.S.A.), A.M.I.E.(Aust.). A comprehensive reference book, the work of ten authors and twenty-three collaborating engineers, containing a vast amount of data in a readily accessible form. The book is intended especially for those interested in the design and application of radio receivers or audio amplifiers. Television, radio, transmission and industrial electronics have been excluded in order to limit the work to a reasonable size. 50s. net from all booksellers. By post 52s. 3d. from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1.

### BOOKS, ETC.

**"RADIO** Interference Suppression: As Applied to Radio and Television Reception." By G. L. Stephens, A.M.I.E.E. 2nd Ed. An up-to-date guide to the various methods of suppressing electrical interference with radio and television reception. Many practical applications are given, particular attention being paid to the problem of interference at television frequencies. Other chapters deal with the design and choice of suppressor components, methods of locating the source of interference, and suppression at the receiver itself. 10s. 6d. net from all booksellers. By post 11s. 2d. from Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

**"TELEVISION** Receiving Equipment." By W. I. Cocking, M.I.E.E. The fourth edition of one of the most important British books on television deals in a comprehensive manner with television receiver equipment and gives many practical details and much design data. The circuits of a television receiver are split into a number of sections and a separate chapter is devoted to each. Other chapters deal with general principles, the signal, superheterodyne interference problems, special circuits, the aerial, the complete receiver, faults and servicing. 30s. net from leading booksellers. By post 31s. 9d. from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1.

**"ABACS** or Nomograms." By A. Giet. Translated from the French by H. D. Phippen and J. W. Head. Most engineers have made use of nomograms at some time in their careers, and are fully alive to the fact that they are a very convenient tool when the same formula has to be solved repeatedly for several sets of variables. It is fair to say, however, that only a small proportion of even those who habitually employ nomograms know how to construct them for their own use. Most of the comparatively small literature on the subject is written for mathematicians and is extremely difficult for the practical engineer to comprehend. This book is essentially practical, and not only demonstrates the many and varied applications of the abac or nomogram, but shows how even those without highly specialised mathematical knowledge may construct their own charts. 35s. net from all booksellers. By post 36s. from the publishers: Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

**"WIRELESS** Servicing Manual" (9th Edition). By W. T. Cocking, M.I.E.E. A carefully revised edition of the handbook known since 1936 as an invaluable, comprehensive guide for radio servicemen and others. Completely up to date, it deals in a lucid practical way with the problems that arise in the repair, maintenance and adjustment of modern wireless receivers. All recent developments in receiving equipment have been incorporated and the servicing of frequency-modulated v.h.f. receivers—a development of great importance to all servicemen—is thoroughly covered in a completely new chapter. Here is a work of proven value to professional and amateur, written by a widely known authority on modern radio engineering. 17s. 6d. net from all booksellers. By post 18s. 8d. from The Publishing Dept., Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1.

**"BASIC** Mathematics for Radio and Electronics." By F. M. Colebrook, B.Sc., D.I.C.A.C.G.I. Revised and enlarged by J. M. Head, M.A. (Cantab.). Presents in readable form a complete course in basic mathematics for engineering students of all kinds and leads on to the more advanced branches of mathematics of increasing importance to radio engineers. In this edition the chapter covering the application of mathematics to radio has been revised and enlarged, while new subjects covered include Stability, Linear Differential Equations, Elementary Statistics, Short Cuts to Numerical Calculations and an Introduction to Matrices. Will be invaluable to those requiring a refresher course as well as to those without previous knowledge of the subject 17s. 6d. net from leading booksellers, by post 18s. 6d. from Iliffe & Sons, Ltd., Dorset House, Stamford Street, S.E.1.

A valuable book for  
Electrical and Electronics Engineers

# LAPLACE TRANSFORMS FOR ELECTRICAL ENGINEERS

By *B. J. Starkey, Dipl.Ing., A.M.I.E.E.* A presentation of the theory of Laplace transformation in which a physical vocabulary rather than a purely mathematical one is used as far as possible. This method of analysis has become

of increasing importance to electrical engineers in many fields, and the work is designed to provide a thorough treatment of the subject in a language with which they will be familiar. *Published for "Electronic & Radio Engineer."*

**30s. net** BY POST 31s. 2d.

*From leading booksellers, published by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1*

A.I.D., A.R.B., I.F.V. approved

**Anderton**

*Cyril Circlips' stock ranges from 1/16" to 15"*

Write for **DATA SHEETS** to Dept. A.3, **ANDERTON SPRINGS LTD., BINGLEY**

Telephone: 2388, 2351 & 2226  
Telegrams: Circlips, Bingley

**CIRCLIPS**

LONDON OFFICE: Tel.: Hol. 5151

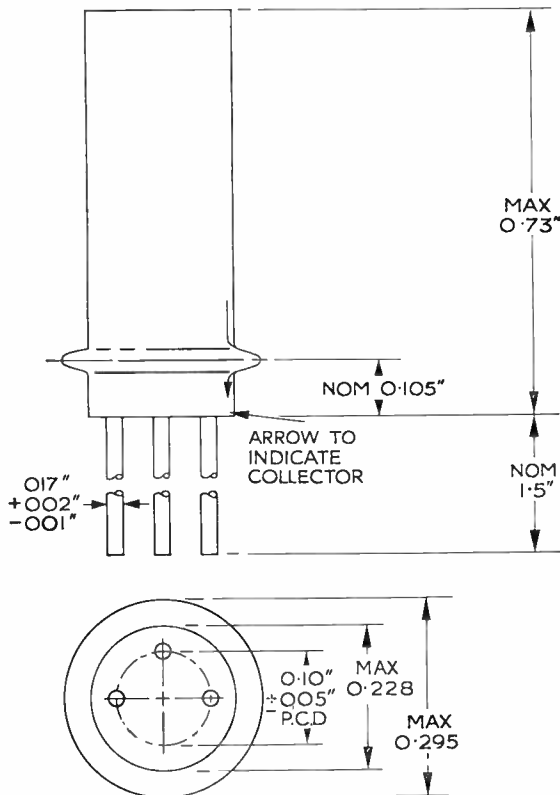
### Index to Advertisers

	PAGE		PAGE
Adcola Products Ltd. ....	14	Henley's, W. T., Co. Ltd. ....	28
Advance Components Ltd. ....	13	Iliffe & Sons Ltd. ....	28, 31, 32, 34
A.E.W. Ltd. ....	18	Imperial Chemical Industries Ltd. (B.I.) ....	17
Anderton Springs Ltd. ....	34	Instrument Screw Co. Ltd. ....	32
Appointments Vacant ....	32, 33	Kynmore Engineering Co. Ltd. ....	31
Automat ....	29	Leland Instruments Ltd. ....	Cover iv
Avo Ltd. ....	3	London Electric Wire Co. and Smiths Ltd. ....	15
British Insulated Callender's Cables Ltd. ....	Cover ii	Lyons. Claude, Ltd. ....	1
Ciba (A.R.L.) Ltd. ....	19	Marconi's Wireless Telegraph Co. Ltd. ....	9
Conder Engineering Co. Ltd. ....	11	McGrath Plastics Ltd. ....	14
Electronic Components ....	18	Mullard Ltd. ....	26
Electrothermal Engineering Ltd. ....	12	Murex Ltd. ....	16
English Electric Co. Ltd. ....	32	Nagard Ltd. ....	16
Ferranti Ltd. ....	5	Palmer. G. A. Stanley. Ltd. ....	29
Foyle, W. & G., Ltd. ....	32	Parsonage, W. F., & Co. Ltd. ....	32
Gardner's Radio Ltd. ....	6	Pitman, Sir Isaac, & Sons Ltd. ....	30
General Electric Co. Ltd. ....	7	Power Jacks Ltd. ....	30
		R.C.A. (Gt. Britain) Ltd. ....	20
		Rola Celestion Ltd. ....	22
		Savage, W. Bryan, Ltd. ....	30
		Siemens-Edison Swan Ltd. ....	10, 27, Cover iii
		Solartron Electronic Group Ltd. ....	4
		Standard Telephones & Cables Ltd. ....	2
		Steatite & Porcelain Products Ltd. ....	8
		Stratton & Co. Ltd. ....	23
		Sullivan, H. W., Ltd. ....	24
		Taylor Electrical Instruments Ltd. ....	15
		Texas Instruments Ltd. ....	21
		Vactite Wire Co. Ltd., The ....	15
		Welwyn Tool Co. Ltd. ....	28

Printed in Great Britain for the Publishers, Iliffe & Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. by Gibbs & Bamforth, Ltd., St. Albans. Distributed in U.S.A. by Eastern News Company, 306 West 11th Street, New York, 14.

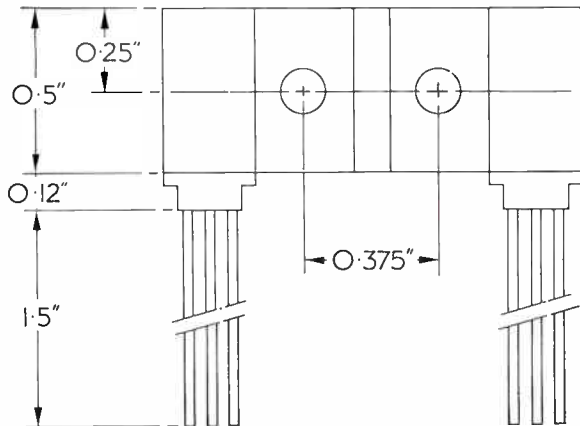
### NEW AUDIO OUTPUT TRANSISTORS

These new Ediswan Mazda transistors will be of special interest to designers and engineers concerned with audio output circuits of portable radios, amplifiers, and similar equipment. They offer low thermal resistance and high and level d.c.β. Full particulars of Ediswan Mazda Semiconductors will be sent gladly on request. If you wish to keep up to date with the latest developments in this field, please ask us to add your name to our semiconductor mailing list.



**GERMANIUM PNP JUNCTION TYPE XC 121**

Maximum Peak or Mean Collector/Emitter Voltage (Common Emitter Circuit)	(volts)	-16
Maximum Peak or Mean Collector/Base Voltage (Common Base Circuit)	(volts)	-35
Maximum Peak Collector/Emitter Voltage with Base driven to cut off (Common Emitter Circuit) or with $R_{b.e} < 500 \Omega$	(volts)	-35
Maximum Peak or Mean Emitter/Base Voltage	(volts)	-12
Minimum d.c. $\beta$ at $I_c = -200\text{mA}$ , $V_e = -1\text{v}$		40
Minimum d.c. $\beta$ at $I_c = -50\text{mA}$ , $V_e = -1\text{v}$		48
Maximum Junction Temperature	(°C)	75
Thermal Resistance in Free Air	(°C/mW)	0.2

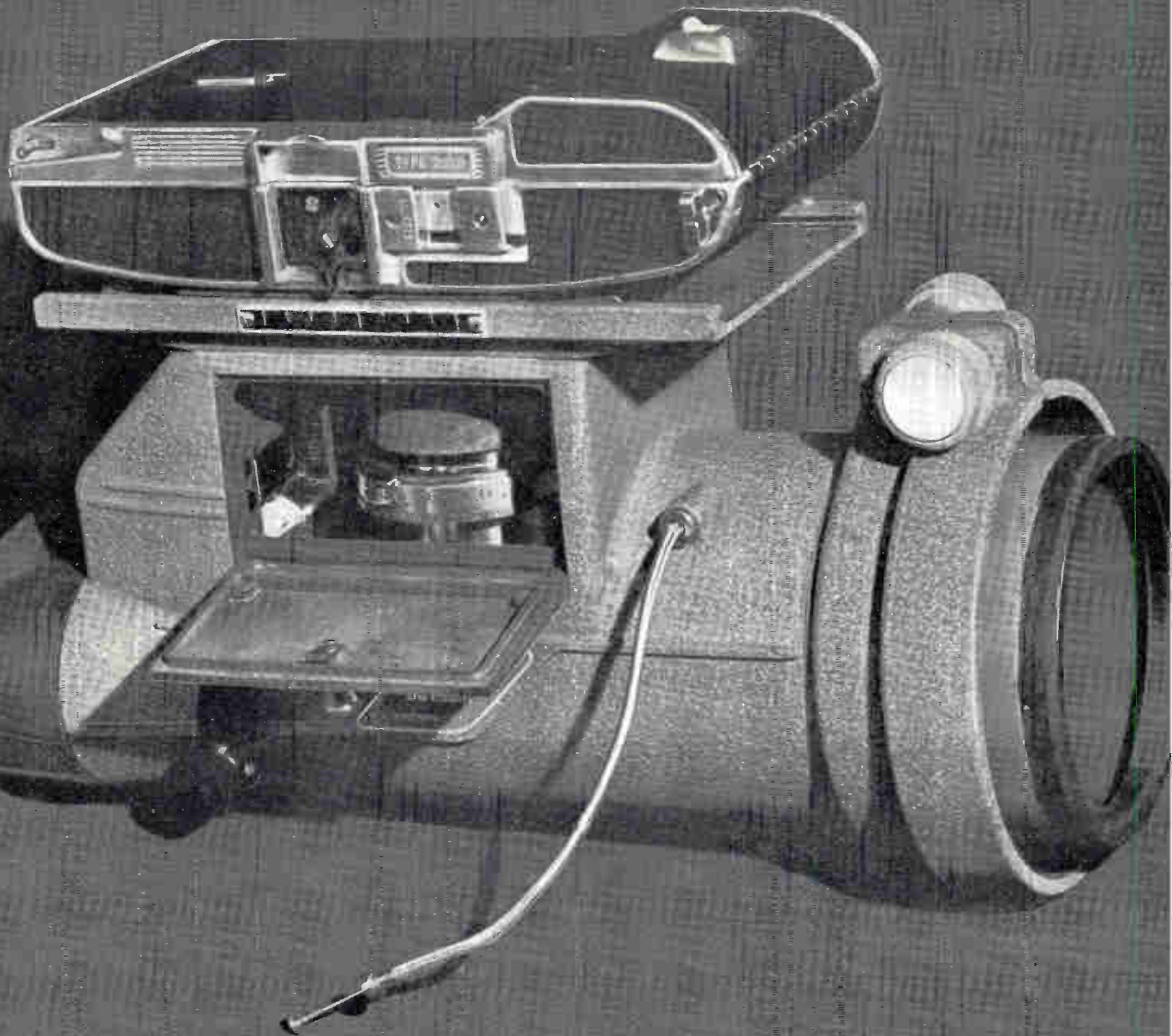


**GERMANIUM PNP JUNCTION TYPE XC 131**

(Matched pair of XC121's complete with heat sink for Class B Push-Pull Output Stage)

Maximum Peak or Mean Collector/Emitter Voltage (Common Emitter Circuit)	(volts)	-16
Maximum Peak or Mean Collector/Base Voltage (Common Base Circuit)	(volts)	-35
Maximum Peak Collector/Emitter Voltage with Base driven to cut-off (Common Emitter Circuit) or with $R_{b.e} < 500 \Omega$	(volts)	-35
Maximum Peak or Mean Emitter/Base voltage	(volts)	-12
Minimum d.c. $\beta$ at $I_c = -200\text{mA}$ , $V_e = -1\text{v}$		40
Minimum d.c. $\beta$ at $I_c = -50 \text{mA}$ , $V_e = -1\text{v}$		48
Maximum Junction Temperature	(°C)	75
Thermal Resistance with Heat Sink when clamped to aluminium plate of 12 sq. in. minimum area	(°C/mW)	0.1

**ELECTRONIC & RADIO ENGINEER**



**Allen B. DU MONT Laboratories Inc. OSCILLOSCOPE RECORD CAMERAS**

From the world's most comprehensive range of cameras for oscilloscope trace recording Leland Instruments Limited, sole distributors in the United Kingdom, present the Du MONT 302, supreme in the field for single frame recording of stationary patterns and single transients, where immediate prints are required. Other cameras provide continuous motion records on 35 m/m films as well as automatic series recording of individual trace phenomena at short time intervals on a wide range of film and paper based photographic material.

*Engineers are invited to write for details to*

- ★ Unequalled versatility permits use of standard 120 roll film or immediate paper record with "print-a-minute" Polaroid-Land back.
- ★ Writing speeds of up to 80 inches per microsecond (Model 299) are afforded by the various combinations of lens and sensitive recording materials.
- ★ Dichroic beam-splitting window filter permits viewing of oscilloscope trace whilst recording without danger of film fogging.
- ★ Multiple separated exposures on one frame are possible through the sliding back adaptors available on camera types 299 and 302.
- ★ Lens alternatives of  $f/1.9$  and  $f/2.8$  available on both the 299 and 302.

**LELAND  
INSTRUMENTS LTD.**  
*Electronic Engineers & Consultants*  
**TELEPHONE: ABBEY 3585 (FIVE LINES)**

**ABBAY HOUSE · VICTORIA STREET · LONDON S.W.1**



***ELECTRONIC & RADIO ENGINEER***

---

***Index  
to Abstracts and References  
1959***

***TWO SHILLINGS AND SIXPENCE***

With this index to Abstracts and References is included a title page for inclusion with the bound volume for 1959. When binding, it is suggested that the issues be broken down and assembled in the following order:— Title page; index to editorial (from December issue); all editorial pages together, in proper sequence; all abstracts pages together, in proper sequence; Index to Abstracts. This order has been found the most convenient.

# ***ELECTRONIC & RADIO ENGINEER***

---

*Volume 36 · 1959*

*Published by Iliffe and Sons Limited Dorset House Stamford Street London S.E.1*



# ELECTRONIC & RADIO ENGINEER

INDEX TO ABSTRACTS AND REFERENCES

Volume 36 • 1959

**CONTENTS**  
**Abbreviations I.1**  
**Author Index I.2**  
**Subject Index I.35**  
**Errata I.51**  
**List of Journals I.51**

## Symbols

Book Review **B**  
Note of Correction **C**  
Discussion **D**

## Author Index

A name followed by 'and' is that of the first author of a jointly written paper, while the word 'with' indicates that the name indexed is that of the second author

## Abbreviations used in the Abstracts and Index

a.c.	alternating current
d.c.	direct current
h.v.	high voltage
l.v.	low voltage
a.f.	audio frequency
i.f.	intermediate frequency
r.f.	radio frequency, including:—
v.l.f.	very low frequency, < 30 kc/s
l.f.	low frequency, 30–300 kc/s
m.f.	medium frequency, 300–3000 kc/s
h.f.	high frequency, 3–30 Mc/s
v.h.f.	very high frequency, 30–300 Mc/s
u.h.f.	ultra high frequency, > 300 Mc/s
a.m.	amplitude modulation
f.m.	frequency modulation
p.m.	pulse modulation, including:—
p.a.m.	pulse amplitude modulation
p.c.m.	pulse code modulation
p.f.m.	pulse frequency modulation
p.ph.m.	pulse phase modulation
p.p.m.	pulse position modulation
p.w.m.	pulse width modulation
ph.m.	phase modulation
v.m.	velocity modulation
c.w.	continuous wave
i.c.w.	} modulated c.w.
m.c.w.	
s.w.*	short wave
u.s.w.*	ultra short wave
λ	wavelength
c.r.	cathode ray
c.r.o.	cathode-ray oscilloscope
d.f.	direction finding
e.m.	electromagnetic, <i>but</i>
e.m.f.	electromotive force
e.s.	electrostatic
a.f.c.	automatic frequency control
a.g.c.	automatic gain control
a.ph.c.	automatic phase control
a.v.c.	automatic volume control
m.u.f.	maximum usable frequency
p.p.i.	plan position indicator
s.s.b.	single sideband
d.s.b.	double sideband
s.w.r.	standing-wave ratio
v.f.o.	variable-frequency oscillator
R/T	radiotelephony
W/T	wireless telegraphy
TV	television

\* No clearly defined limits

© Iliffe & Sons Ltd. 1960

Permission in writing from the Editor must first be obtained before letterpress is reproduced from this index. Brief abstracts or comments are allowed provided acknowledgement to the journal is given.

# AUTHOR INDEX

- Aaron, M. R., with J. A. Narud, transistor blocking oscillator, 2504
- Abbott, W. N., displacements of radiant point during auroral disturbance, 138; seasonal illumination of circumpolar earth satellite, 793
- Abdullaev, G. B., and A. A. Bashkhaliev, thermal conductivity of Se, 1606
- Abe, H., paramagnetic resonance in copper propionate monohydrate, 98
- Abel, J. L., with A. G. Chynoweth, polarization reversal in triglycine sulphate, 3742
- Abkevich, I. I., distribution of slow traps on surface of Ge and Si, 3768
- Abraham, M., M. A. H. McCoulland and F. N. H. Robinson, dynamic nuclear polarization, 3412
- Abrikosov, A. A., L. P. Gor'kov and I. M. Khalatnikov, superconductor in high-frequency field, 2195
- Abrikosov, N. Kh., with L. D. Dudkin, alloying of semiconductor compound CoSb<sub>2</sub>, 2667
- Acheson, M. A., interaction reliability, 1038
- Adams, E., with others, sendust flake, 894
- Adams, I., with others, electroluminescence of AlN, 4082
- Adams, J. A., miss-distance indicator, 2601
- Adcock, F., radio direction finding in three dimensions, 3314
- Addington, R. E., with A. J. Goss, effects of seed rotation on Si crystals, 3021
- Adirovich, E. I., and K. V. Temko, transition frequency and phase characteristics of transistor, 634
- Yu. S. Ryabinkin and K. V. Temko, field potential and charge carriers in fused-in junctions, 3787
- Adlam, J. H., and J. E. Allen, structure of collision-free hydromagnetic waves, 1162
- Adler, R., and G. Hrbek, low-noise electron-beam parametric amplifier, 321
- with G. Wade, method for pumping fast space-charge wave, 1412
- Agarwal, P. D., eddy current losses in Fe, 4130
- der Agobian, R., detection of non-ionizing shock waves, 3447
- and L. Lifschitz, propagation of non-ionizing shock waves, 4016
- Agostinelli, C., spherical vortices in magneto-hydrodynamics, 92
- Agranovich, V. M., and A. A. Rukhadze, propagation of e.m. waves in medium with spatial dispersion, 2921
- V. E. Pafomov and A. A. Rukhadze, Cherenkov radiation in medium with spatial dispersion, 3648
- Agranovskaya, A. I., with others, nonferroelectric phase transitions in solid solutions, 1912; effect of polarization on Pb<sub>2</sub>NiNb<sub>2</sub>O<sub>7</sub>-Pb<sub>3</sub>MgNb<sub>2</sub>O<sub>9</sub>, 2631; new ferroelectric, 2632
- Agrawal, D. B., with M. S. Sodha, low-field mobility of carriers in nondegenerate semiconductors, 164
- Agusta, B., sorting components by measuring waveforms, 1645
- Ahačić, A., reactance transformation of low-pass ladder networks, 2152
- Ahlstrom, E., W. G. Matthei and W. W. Gärtner, surface-barrier photodiodes as photocapacitors, 3885
- Ahmed, R., with R. Fatehchand, electronic speech sampler, 2820
- Aiken, W. R., flat rectangular c.r. tube, 3171
- Ainsworth, J., with F. H. Harris, single-line-scan television, 2033
- Aitchison, C. S., frequency synchronization of reflex klystron, 3524 y
- Aitchison, G. J., and K. Weekes, ionospheric information from observations of satellite 1957 α<sub>2</sub>, 3296
- J. H. Thomson and K. Weekes, ionospheric information from observations of satellite 1957 α<sub>2</sub>, 3297
- Aitchison, R. E., breakdown voltage of Ge transistors, 3519
- with C. T. Murray, high-stability valve heater supply, 1697
- Aitken, D. K., long-transit-time multipactoring at u.h.f., 3524 c
- Aiya, S. V. C., average power of impulsive atmospheric noise, 1354
- Akimoto, S., T. Katsura and M. Yoshida, magnetic properties of TiFe<sub>2</sub>O<sub>4</sub>-Fe<sub>2</sub>O<sub>4</sub> system, 542
- Akita, K., with others, temperature fluctuations accompanying solar eclipse, 2559
- Akulov, N. S., and A. V. Chermushkina, Hall effect at Curie point, 2680
- Albanese, V. J., and W. P. Peyser, analysis of a broad-band coaxial hybrid ring, 3552
- Albrecht, H. J., instrument effects in ionosphere data, 807, great-circle propagation between Australia and Europe, 2727
- Alcock, B. J., 4-pole analysis for transistors, 48
- Aldrich, R. W., and N. Holonyak, Jr, Si-controlled rectifiers from oxide-masked diffused structures, 2418
- Aleksandrov, V. T., with S. V. Svechnikov, photoelectric properties of CdSe and CdTe, 468
- Alekseeva, V. G., and others, influence of group III and V elements on recombination in Ge, 1614
- Alers, G. A., J. R. Neighbours and H. Sato, dependence of sound attenuation on magnetization direction in Ni, 4125
- Alexander, W. M., with others, rotating-disk function generator, 2858
- Allimov, Yu. I., with G. V. Skrotksii, ferromagnetic resonance in circularly polarized e.m. field, 3646
- Allan, A. H., and J. E. Drummond, Doppler measurements on Soviet satellites, 443
- Allan, D. W., reversals of earth's magnetic field, 436
- Allanson, J. T., network synthesis, 1113; synthesis of LC networks, 2147; network characteristics, 2496
- Allcock, G. McK., electron density distribution in outer ionosphere, 3307
- and M. G. Morgan, solar activity with whistler dispersion, 144
- Allen, C. P., and M. Sherry, measurement of magnetic flux density, 3056
- Allen, E. J., frequency-shift telegraph receiver, 1675
- Allen, J. E., with J. H. Adlam, structure of collision-free hydromagnetic waves, 1162
- Allen, J. W., delay time in plastic flow of InSb, 3387
- and F. A. Cunnell, diffusion of Zn in GaAs, 1259
- Allen, P. J., and R. D. Tompkins, instantaneous microwave polarimeter, 3432
- Allerton, G. L., microwave directional couplers, 3936
- Allgaier, R. S., magnetoresistance in PbS, PbSe and PbTe, 1267
- and W. W. Scanlon, mobility in PbS, PbSe and PbTe, 181
- Allin, P. E. V., tuning of coupled-cavity reflex klystrons, 3524 cc
- Allred, W. P., with others, preparation and characteristics of single-crystal InP, 4114
- Allsopp, H. L., and D. F. Gibbs, electromechanical properties of BaTiO<sub>3</sub>, 3333
- Almer, F. H. R., and P. G. Van Zanten, transistor pyrometer, 3424
- Al'pert, Ya. L., ionosphere and artificial satellites, 1873; conditions in outer ionosphere, 2967; investigation of ionosphere by earth satellite, 3295
- and others, electron concentration of ionosphere from observations of first earth satellite, 3298
- van Alphen, P. M., interference of light in thin films, 1701
- Alsop, L. E., with others, maser amplifier for radio astronomy, 2892
- Ament, W. S., airborne radiometeorological research, 2726
- with others, measurements of 1250-Mc/s scatter propagation, 3096
- Amer, S., nonlinear theory of plasma oscillations, 88
- Ames, L. A., and T. F. Rogers, 220-Mc/s reception at 700-1000 miles, 1351
- E. J. Martin and T. F. Rogers, persistent v.h.f. field strengths beyond radio horizon, 2737
- Amster, L., with others, echo in television images, 3134
- Anan'eva, A. A., calculations for piston-type piezoelectric radiator, 1045
- Anastasiades, M., and L. Carapiperis, influence of meteorological factors on u.h.f. propagation, 1333 m
- C. Caroumbalos and C. Bouloheris, optimum radiation from sawtooth aerial, 3578
- Anders, H., transistor video amplifier, 4214
- Anderson, D. A., CdS and CdSe photistors, 1011
- Anderson, D. G., luminescence and luminescent materials, 1595
- Anderson, J. C., surface impedance, 1306
- and B. Donovan, internal ferromagnetic resonance in Ni, 2684
- and T. Winer, temperature-stabilized photo-transistor relay circuit, 1109
- Anderson, J. T., orbit of artificial satellite, 4047
- Anderson, K. A., radiation associated with solar radio noise storm, 429
- Anderson, L. J., with L. G. Trolese, foreground terrain effects, 3457
- Anderson, L. K., and A. Hendry, Ge mixer crystals at low temperatures, 3876
- Anderson, M. E., magnetic head reads tape at zero speed, 2020
- Anderson, O., and others, hydromagnetic capacitor, 1843
- Anderson, P. W., spectral diffusion, phonons and paramagnetic relaxation, 3652
- Anderson, S. R., and R. B. Flint, C. A. A. Doppler omnirange, 2610
- Anderson, W. P., and N. A. Godel, latching counters, 58
- Ando, K., and others, oxide-coated cathode, 3078
- André, P., with others, influence of high-energy electron bombardment on Ge, 3773
- Andreasen, M. G., propagation of fundamental modes in curved waveguides, 3929
- de Andrés, M. P., with W. Jellinghaus, crystal anisotropy and magnetostriction with Hall effect, 3803
- Andrešćiani, V., D. Sette and S. Tiberio, characteristic parameters of barrier layer in metal/semiconductor junction diodes, 2415
- Andrews, P., electroforming of waveguide components, 1436; broad-band circular wavemeters, 3066
- Andrich, W., with K. Kupfmüller, speech transmission with quantization, 3855
- Angel, Y., and G. A. Boutry, parametric amplifiers and cancellation of ferromagnetic hysteresis, 3244
- Angell, B. C., and others, propagation measurements at 3480 Mc/s, 2000 r
- Angstadt, R. T., with P. Rüetschi, self-discharge reactions in batteries, 2403
- Angulo, C. M., and W. S. C. Chang, excitation of dielectric rod by cylindrical waveguide, 3558
- Anisimova, Yu. V., with R. G. Mirimanov, circular waveguide partially filled with ferrite, 2116
- Anson, W. J., with others, water cooling of low-power klystrons, 312
- Antes, L. L., progress in CdS, 829
- Aoi, S., and others, magnetrons for min λ, 4248
- Aono, Y., and K. Kawakami, cosmic rays observed by satellite 1958 α, 448
- Aoyagi, K., with others, ferromagnetic domain structure in Co-Ni crystal, 192
- Apker, L., with others, exciton-induced photoemission from BaO, 2264
- Apple, E. F., with others, two-stage optical excitation in phosphors, 2996
- Applebaum, M., and E. Midgley, f.m. receiver using transistors, 4188
- Appleton, E. V., E region of ionosphere, 1554
- Arai, M., with others, mutually coupled CR-type directional coupler, 9
- Araki, T., with others, effect of solar eclipse on geomagnetic field, 2562
- Arams, F. R., low-field ruby maser, 3624
- and G. Krayer, low-loss L-band circulator, 1769
- and S. Okwit, tunable L-band ruby maser, 2523
- Arbell, H., with A. Halperin, excitation spectra and luminescence of ZnS, 2999
- Archer, R. W., with A. M. Thompson, comparator for 100-kc/s frequency standards, 1299
- von Ardenne, M., and H. B. Sprung, ingestible intestinal transmitter, 1327, 3834
- Arendt, P. R., magneto-ionic effect above F layer, 2961; measurements on Doppler shift of satellite emissions, 3697
- Argimbau, L. B., f.m. multiplex spectra and interference, 3857
- Aries, R., Ta capacitors, 2137
- Arima, Y., with T. Yonezawa, F<sub>2</sub> layer, semi-diurnal lunar variations of, 1196, variations in electron density of, 4055
- with others, electron and ion density distributions in F region, 2579
- Armstrong, E. B., temperature of atmosphere emitting nightglow, 1877
- Armstrong, G. T., P. K. Wong and L. A. Krieger, use of d.c. amplifier and recorder to balance resistance bridge, 3061
- Armstrong, H. L., avalanche multiplication in semiconductor devices, 186; revision in transistor terminology, 1008; transconductance as transistor parameter, 1403
- Armstrong, R. J., electrical recovery of gas after pulse discharge, 2531; eddy-current heating, 2716
- Armstrong, R. L., with M. S. Rao, radio reflections along meteor train, 2226
- Arnaud, J., and R. Warnecke, increase of bandwidth in O-type travelling-wave valves, 317
- with P. Palluel, results on delay lines for travelling-wave tubes, 3159 s
- with others, characteristics of carmatron tube, 2788 r
- Arnold, J. S., and J. G. Martner, resonances of BaTiO<sub>3</sub> cylinders, 2446
- Arnoldy, R., with others, auroral phenomena during storm, 3309
- Aroyan, G. F., spatial filtering, 4165
- Arp, F., with others, perceptibility of image details in television, 3136; visual properties of human eye, 3138
- Arthur, J. B., and others, minority carriers in dislocated Ge, 1618
- Artman, J. O., with others, cross-relaxation in spin systems, 3270
- Arzuffelli, H., and J. Henry, laws of magnetism and static electricity, 1514
- Asaba, T., with M. Nishimaki, discharge machining for mm-wave magnetrons, 3159 c
- Asanabe, S., electrical properties of SnSe, 3389
- and A. Okazaki, Hall coefficients of SnSe and GeSe, 2669
- Asch, G., magnetic resonance of polycrystalline Co, 3802
- Aschen, R., passive television relay, 2851; passive relay by microwave mirror, 2852
- with L. Chrétien, compatible system for colour television, 1700; synchrophase, 3116
- Ash, E. A., magnitude of locking signal for backward-wave oscillators, 2788 bb; slow-wave structure for min λ, 3159 u
- and J. D. Pallenden, modified transmission-line couplers for helices, 3159 y
- Ashby, D. E. T. F., wave matrices applied to periodically loaded travelling-wave tube, 1020
- and R. B. Dyott, measuring modulation noise of c.w. klystron amplifier, 3524 k
- Ashkin, A., parametric amplification of space-charge waves, 1025; dynamics of electron beams from magnetically shielded guns, 1031
- and others, parametric amplification of space-charge waves, 3159 k
- Aspinwall, J. F. H., 'third' method, 970
- Assaly, R. N., dielectric sphere as microwave lens, 714
- d'Ast, L., with F. Perrier, rapid testing of direct-voltage stabilizers, 608
- Atal, B. S., method of calculating reverberation-chamber coefficients, 3921
- Atalla, M. M., E. Tannenbaum and E. J. Scheitner, stabilization of Si surfaces by thermally grown oxides, 2650
- Athavale, V. N., with M. W. Chiplonkar, recording of atmospherics in l.f. region, 813
- Atiya, F. S., band-pass amplifiers, 2512
- Atkinson, M. P., W. T. Bane and D. L. A. Barber, automatic graph plotter, 2859

- Atlas, D., meteorological 'angel' echoes, 2603
- Atwood, J. B., and others, 468-Mc/s tropospheric scatter propagation, 245
- Audoin, C., with R. P. Musson-Genon, electronic hysteresis and secondary emission in reflex klystrons, 3524 gg
- Auer, P. L., and H. Hurwitz, Jr, space-charge neutralization in diodes, 2432
- H. Hurwitz, Jr, and S. Tamor, theory of cathode sheath in discharge, 82
- Augustyniak, W. M., with W. L. Brown, defect formation in electron irradiation of *n*-type Ge, 4110
- with others, annealing of radiation defects in semiconductors, 4089 o
- Aukerman, L. W., radiation-produced energy levels in semiconductors, 4089 m
- Ault, C. F., digital-to-analogue conversion for storage-tube deflection, 2135
- Austin, I. G., optical properties of Bi<sub>2</sub>Te<sub>3</sub>, 533; Faraday effect in anisotropic semiconductors, 3018
- Austin, N. A., and S. C. Fultz, 22-MeV electron linear accelerator, 2719
- Autler, S. H., maser amplifier system, 388
- Avak'yants, G. M., theory of transfer phenomena on semiconductor surface, 2280
- Avignon, Y., and M. Pick, relation between type-IV emissions and other solar activity, 3283
- Avins, J., T. Brady and F. Smith, synchronous and excited-carrier detection, 1378
- Awender, H., crystal-resonator techniques, 2142
- and A. Ludloff, crystal-controlled transistor oscillators, 1129
- Ayakawa, T., with others, life tests of microphone carbon, 1758
- Ayres, W. P., broad-band  $\lambda/4$  plates, 1081; mm-wave generation utilizing ferrites, 3983
- Azbel', M. Ya., quantum theory of conductivity, 762; h.f. surface impedance, quantum oscillations of, 763; quantum theory of, 1221
- Baba, K., with others, magnetrons for mm- $\lambda$ , 4248
- Babcock, H. W., with others, magnetic field associated with solar flare, 4043
- Babcock, W. E., tube effects cause circuit troubles, 311
- Babits, V. A., semiconductors in vidicon-type tubes, 1703; experimental colour television system, 2029
- Bachmann, A. E., transistor active filters, 2156; transistor amplifier for tape and drum playback, 2175; Q-multiplication with transistors, 3618
- Bachynski, M. P., microwave propagation over rough surfaces, 4184
- with others, effect of mountains with smooth crests on wave propagation, 3458
- Back, F. G., zoom lenses for closed-circuit television, 1370
- Badcoe, S. R., with others, atmospheric discontinuity layer effects on propagation, 2000 o
- Badessa, R. S., R. L. Kent and J. C. Nowell, measurement of time dilation in earth satellite, 3688
- Baer, W., with others, conduction of heat from anodes, 4252
- Baghdady, E. J., and G. J. Rubissow, dynamic trap for weak f.m. signals, 1350
- Bagi, R. R., with H. R. Johnson, electron beam technique for measuring circuit velocity, 3524 o
- Bahr, O. F., with E. Zeiler, quantitative electron microscopy, 3444
- Bailey, D. K., abnormal ionization in ionosphere and cosmic-ray enhancements, 1562; effect of echo on h.f. communication circuits, 3471
- Bailey, G. C., with others, effect of neutron irradiation on Curie temperature of ferrites, 898
- Bailey, R., and E. C. Fellows, stabilization of 9-kW electromagnet, 3072
- with others, Canadian caesium-beam standard of frequency, 2701
- Bailey, V. A., possible effects of gyro-waves in ionosphere, 3308
- Bailin, L. L., and R. J. Spellmire, radiation fields from slots in circular cylinders, 1093
- Bain, W. C., angular distribution of energy received by ionospheric scatter, 2000 h
- and E. D. R. Shearman, observations on U.S.S.R. earth satellites, 2952
- Baines, J. E., with D. H. Roberts, photoconductivity in PbSe films, 830
- Baker, B. W., with others, dual-cavity microwave discriminator, 1487
- Baker, D., machine for lapping semiconductor materials, 1943
- Baker, J. M., W. Hayes and D. A. Jones, paramagnetic resonance of impurities in CaF<sub>2</sub>, 3411
- with others, r.f. spectra of hydrogen deuteride, 1852
- Baker, W. P., high-speed-sweep single-stroke oscilloscope, 1317
- Baker, W. R., with others, hydromagnetic capacitor, 1843
- Bakhru, K., with others, triple splitting of F echoes, 1885
- Balashuk, S., with H. Dudley, automatic recognition of phonetic patterns in speech, 1061
- Balder, J. J., frame around television screen, 2764
- Baldinger, E., transistor applications in pulse circuits, 3228
- H. Bilger and M. A. Nicolet, influence and creation of lattice defects in junction transistors, 2771
- Baldwin, J. E., with J. R. Shakeshaft, radio emission from 'supergalaxy', 3660
- Balkanski, M., and R. D. Waldron, internal photo-effect and exciton diffusion in CdS and ZnS, 824
- Balluffi, R. W., with F. L. Vook, irradiated Ge, length and resistivity changes in, 2306; structure of, 2308
- Balsler, M., scattering by turbulent inhomogeneities, 1335
- W. B. Smith and E. Warren, reciprocity of ionospheric transmission, 1667
- Banbury, P. C., with J. D. Nixon, changes in excess-carrier concentrations, 1228
- Bancic-Grillot, M., and others, fluorescent emission lines and luminous absorption lines in CdS, 2618
- with others, influence of magnetic field on fluorescence of pure CdS, 2622
- Bane, W. T., with others, automatic graph plotter, 2859
- Banerji, R. B., asymmetric information channels, 3103
- Banks, E., with A. H. Mones, cation substitutions in BaFe<sub>12</sub>O<sub>19</sub>, 540; ferrimagnetism in system Na<sub>2</sub>O-ZnO-Fe<sub>2</sub>O<sub>3</sub>, 904
- Bannerman, R. C., J. A. Lucken and D. J. Woolton, design of gridless low-voltage reflex klystron, 3524 dd
- with others, experimental annular reflex klystron, 3524 bb
- Banno, N., with others, effect of solar eclipse on geomagnetic field, 2562
- Bappu, M. K. Vainu. See Vainu Bappu, M. K.
- Baranova, Z. N., and K. A. Velizhanina, acoustic properties of sound-absorbing material, 686
- Baranski, P. L., volume Peltier effect in Ge, 3776
- and V. E. Lashkarev, bulk thermo-e.m.f. in Ge, 524
- Barbato, D., build-up of sound oscillations, 3184
- Barber, D. L. A., reversible dekatron counter, 1110
- with others, automatic graph plotter, 2859
- Barber, M. R., and K. F. Sander, electron optics of e.s. electron guns, 3524 r
- Barber, N. F., 'optimum' arrays for d.f., 2471
- Barbier, D., auroral activity at low latitudes, 2592
- Barditch, I. F., ultralinear output stage, 1493
- Barducci, I., and U. Degano, research on probe microphones, 1429
- Barjon, R., and others, irradiation of photoconductive single crystals of CdS, 2617
- Barker, J., radar meter helps enforce traffic laws, 1981
- Barkhatov, A. N., acoustic field in medium with homogeneous surface layer, 666
- and I. I. Shmelov, attenuation of sound beam traversing layer of discontinuity, 669
- Bar-Lev, A., negatively biased multivibrator, 55
- Barlow, D. A., rigidity of loudspeaker diaphragms, 334
- Barlow, H. E. M., power radiated by circulating surface wave, 2098; propagation around bends in waveguides, 2106
- with L. M. Stephenson, power measurement at 4 Gc/s by Hall effect, 1312
- Barnes, R. C. M., and J. H. Stephen, operating experience with transistor digital computer, 2132
- Barnette, W. E., with H. Kihn, microminiature decoder for selective communication, 2018
- Baron, C., theory of microwave crystal mixer, 3159 o
- Barracough, J., with others, travelling-wave multiple-beam klystron, 3524 z
- Barrar, R. B., and C. H. Wilcox, Fresnel approximation, 1442
- Barrington, A. E., and J. R. Rees, 3-cm Q-meter, 562
- Barron, D. W., and K. G. Budden, numerical solution of equations governing reflection of long waves from ionosphere, 3455
- Barry, A. L., and P. J. Coppen, transistors reach for higher frequencies, 1399
- Barry, D. T., and J. M. Formwalt, underwater missile tracking instrumentation, 2597
- Barry, J. N., and D. M. Leakey, transistorized pulse amplifier, 2518
- Barsis, A. P., tropospheric radio wave propagation, 234
- Barsukov, Yu. K., blocking junction process in planar Ge diodes, 1708; circuit representation of semiconductor diode, 2035
- Bartels, J., cause of air resistance changes in satellite orbits, 1186
- Barth, B. P., with others, electrical properties of epoxy resins, 911
- Barthel, F., investigations of nonlinear Helmholtz resonators, 1424
- Bartram, R. H., and M. C. Pease, space-charge-limited crossed-field gun, 3894
- Bartschat, A., with H. Gobrecht, semiconductor properties of SnS, 886; elastic properties of hexagonal CdS, 2278; piezoelectric and elastic behaviour of CdS, 3746
- Baruch, P., with others, influence of high-energy electron bombardment on Ge, 3773
- Barzilai, G., and G. Gerosa, modes in guides filled with magnetized ferrite, 1770
- Bashkurov, Sh. Sh., with K. A. Valiev, stimulated r.f. paramagnetic amplifiers, 2181
- Bashshaleev, A. A., with G. B. Abdullaev, thermal conductivity of Se, 1606
- Basler, R. P., with others, auroral ionosphere studies using earth satellites, 4052
- Basov, N. G., and A. M. Prokhorov, molecular oscillators and amplifiers, 2888
- Bass, F. G., with E. A. Kaner, statistical theory of propagation over ideally conducting plane, 3840
- Batdorf, R. L., and F. M. Smits, diffusion of impurities into evaporating Si, 1925
- Bate, R. T., R. K. Willardson and A. C. Beer, transverse magneto-resistance and Hall effect in *n*-type InSb, 4119
- Bateman, R., and others, I.G.Y. observations of F-layer scatter in Far East, 2733
- Bateman, T. B., H. J. McSkimin and J. M. Whelan, elastic moduli of GaAs, 3380
- Bates, L. F., and D. J. Sansom, magnetothermal effects in Fe and SiFe, 4129
- Bath, H. M., and M. Culler, measurement of surface recombination velocity in Si by steady-state photoconduction, 1246
- Battaglia, A., G. Boudouris and A. Gozzini, refractive index of humid air, 133 a
- with F. W. Heineken, absorption and refraction of NH<sub>3</sub> at 6 mm  $\lambda$ , 2213
- Batterman, B. W., X-ray integrated intensity of Ge, 3376, effect of chemical impurities on, 177
- Baty, A. J. B., with others, electronic clock coder for coded radio beacons, 4069
- Bauer, H. J., temperature dependence of resistance of Ni alloys and thin films, 3805
- Bauer, S. J., with F. B. Daniels, Faraday fading of satellite signals, 450
- Bauerle, J. E., with others, thermoelectric materials, InAs and InSb, 3384, In(As,P), 3759
- Baumgardner, J., magnetic recording of pulse-amplitude data, 1989
- Baur, K., evaluation improvement with 2-channel c.r.d.f., 2258; investigation of polarization properties at 4 Gc/s, 3564
- and G. Ziehm, ferromagnetic transmitter aerial for distress at sea, 4223
- Baurmeister, H., with others, perceptibility of image details in television, 3136; visual properties of human eye, 3138
- Bauwens, J. C., digital-analogue converter, 3206
- Bayer, J., with F. Blüthgen, pulse generation controlled by heart phases, 4169
- Bayet, M., J. L. Delcroix and J. F. Denisso, wave interaction in gas, 1333 a
- Bayh, W., emission microscopy with secondary electrons, 1330
- Bazzard, G. H., with C. M. Minnis, indices of solar activity, 3281
- Beach, E. H., and others, electronic subsystem development problems in naval ordnance, 2803
- Beach, J. B., coincidence diodes gate electronic switch, 1792
- Beale, J. R. A., and others, surface-barrier height changes on transistors, 633
- Beam, R. E., advances in microwave theory and techniques, 3175
- Beam, W. R., noise-wave excitation of microwave beam amplifier, 1023; low-noise microwave-tube design, 3159 cc
- with J. Eilibrand, semiconductor diodes in parametric subharmonic oscillators, 3981
- Bean, B. R., ground-based radioducts, 4053
- and L. P. Riggs, synoptic variation of radio refractive index, 4177
- and G. D. Thayer, models of atmospheric radio refractive index, 2725
- Beard, C. I., and I. Katz, dependence of microwave signal spectra on ocean roughness, 242
- Beard, D. B., microwave emission from high-temperature plasmas, 1512
- Beard, J. V., multichannel v.f. telegraph systems, 2011
- Beardow, T., waveguide manufacturing techniques, 700
- Beattie, A. R., and P. T. Landsberg, Auger effect in semiconductors, 3341
- Beatty, R. W., with G. E. Schafer, measuring directivity of directional couplers, 3821
- with others, water cooling of low-power klystrons, 312
- Beauchamp, K. G., and A. J. Tyrrell, image converter equipment for observation of discharges, 3522
- Beaver, W. L., experimental high-perveance klystron amplifier, 3524 b
- Beck, A. H. W., high-current-density emitters, 3893
- and P. E. Dearing, space-charge waves on annular beams, 3159 h; 3-cavity L-band pulsed klystron amplifier, 3524 e
- and J. Lytollis, mobile Cs frequency standard, 3053
- Beck, G. E., and T. G. Thorne, airborne Doppler navigation equipment, 2259 e
- Becker, F. K., compatible stereophonic sound system, 3474
- Becker, G., properties of high-quality oscillator crystals, 1127; pulse-beat method for frequency and phase measurements, 1643; theory of inductive 3-terminal circuit, 1804
- Becker, J. J., domain boundary configurations during magnetization reversals, 2319
- Becker, R. C., with P. D. Coleman, rectangular and circular mm waveguides, 2463; mm-wave generation, 3982
- with others, slow-wave structures for power generation at mm and sub-mm  $\lambda$ , 1743
- Becker, W., routine determination of vertical distributions of electron density, 1333 b
- Beckmann, P., reflection of u.h.f. waves in troposphere, 1333 o
- Bedendo, G., and D. Sette, photoconductivity and lifetime of charge carriers, 3342
- Bedford, L. H., magnetic tape recording, 3923
- Bedinger, J. F., with others, wind determinations in upper atmosphere, 3302
- Beer, A. C., with others, transverse magneto-resistance and Hall effect in *n*-type InSb, 4119
- Beer, H. B., and G. V. Planer, preparing ferrites, 1959
- Beers, Y., cavity microwave spectrometer and molecular frequency standard, 1641
- Beesley, J. H., voltage-transfer circuits, 2443
- Beggs, J. E., and others, thermionic integrated micromodules, 2863
- Begliashvili, G. A., and E. V. Gedalin, motion of charged particle in anisotropic medium, 3635
- Behrend, W. L., reduction of co-channel television interference, 4221
- Beijersbergen, J. P., M. Beun and J. te Winkel, junction transistor as network element, 1719, 2781, 3518
- Beiser, A., external magnetic field of earth, 435
- Beitel, F. P., Jr, and E. M. Pugh, Hall effects of Fe-Co alloys, 1953
- Belger, E., measurement of pitch fluctuations, 3179; measurement of program level, 3187
- and F. von Ravensfeld, interference protection ratios for sound broadcasting, 3464
- Belgiano, R., Jr, turbulent mixing in scatter propagation, 3088

- Beljers, H. G., amplitude modulation of cm waves by ferroxcube, 1151
- Béll, B., meteorological research in Hungary, 452
- Bell, D. A., demodulation and detection, 959  
— and T. C. Duggan, relative speeds of telegraphic codes, 593
- Bell, J. D., with others, ring angles over south-east England, 2982
- Bell, J. S., and K. Brewster, matrices in transistor circuit analysis, 1141
- Bell, M. D., and W. J. Leivo, rectification and photo-effects in semiconducting diamond, 504
- Bell, R. O., with P. C. Fletcher, ferrimagnetic resonance modes in spheres, 2928  
— with others, magnetostatic modes of ferrimagnetic spheres, 3813
- Bell, W. E., A. Bloom and R. Williams, microwave frequency standard, 4150
- Bellchambers, W. H., and W. R. Piggott, ionospheric measurements at Halley Bay, 1881
- Belohoubek, E., propagation characteristics of slow-wave structures, 650
- Belousov, V. V., and B. I. Silkin, international scientific collaboration, 3674
- Belov, K. P., ferromagnetics and antiferromagnetics near Curie point, 3391
- Below, F., simple test pattern for monochrome television, 3502  
— W. Kroebel and H. Springer, detail recognition on television screen, 3135
- Belrose, J. S., and others, engineering of l.f. communication systems, 2750
- Bemski, G., recombination properties of Au in Si, 862; paramagnetic resonance in electron-irradiated Si, 4089 g  
— and J. D. Struthers, Au in Si, 2290
- Bendell, S. L., and K. Sadashige, image retention in image orthicon, 615
- Bender, P. L., with T. L. Skillman, measurement of earth's magnetic field, 112
- Beneking, H., influence of adjacent connections on characteristics of *p-n* junctions, 1398; characteristics of point-contact diodes, 3143
- Benel, H., thermoelectric properties of  $Sb_2Te_3$  and  $Sb_2Te_3-Bi_2Te_3$ , 1268
- Bengston, P. S., discriminators for data reduction, 2366
- Bennett, A. I., electrical phenomena on liquid Ge surfaces, 2656
- Bennett, F. D., with G. D. Kahl, coherence requirements for interferometry, 398
- Bennett, R. R., and others, circuits for space probes, 3286
- Bennett, W. H., solar proton stream forms with laboratory model, 1864
- Bennett, W. R., statistics of regenerative digital transmission, 957
- Bennington, T. W., ionosphere review 1958, 1199; sporadic E and F<sub>2</sub> layer, 2578
- Benny, A. H., and F. D. Morten, measurement of surface recombination velocity on Si, 859
- Benoit, H., and J. Hennequin, measurement of geomagnetic field by maser, 3823  
— P. Grivet and H. Ottavi, maser-type self-oscillator, 2521; weak-field maser, 2548
- Benoit, R., and J. Kernevez, circuit for recording atmospherics, 2870
- Benoit à la Guillaume, C., with others, light due to recombination of impurities in Ge, 3369
- Benson, F. A., and P. M. Chalmers, effects of argon content in glow-discharge tubes, 2442  
— and M. S. Seaman, surface structure of saturated-diode filaments, 1418
- Benson, K. E., with others, constitution of  $AgSbSe_2-AgSbTe_2-AgBiSe_2-AgBiTe_2$  system, 1270; improvement in floating-zone technique, 2337
- Berezák, P., transfer function of oscillating system, 3979
- Berezin, Yu. V., with others, large inhomogeneities in F<sub>2</sub> layer, 2581
- van Bergeljk, W. A., with others, mechanism of binaural fusion, 1055
- Berger, E. R., condition of passivity for linear quadrupole, 1800
- Berger, F. B., Doppler radar navigation, 2979
- Bergmann, S. M., thermal noise in gas discharge, 1158; 3-level solid-state maser, 1502; microwave mixer design, 2874
- Berk, A. D., with others, relaxation phenomena in diode parametric amplifiers, 3626
- Berkner, L. V., I.G.Y., 1538
- Berman, L. S., Hall effect in semiconductors for power measurements, 556
- Bernard, E., and E. Pio, operation of magnetic amplifiers, 3237
- Bernard, R., and R. Goutte, image of surface obtained with negative ions, 567
- Bernard, W. B., tunable f.m. multiplex adapter for stereo, 2754
- Berning, W. W., earth-satellite observations of ionosphere, 1548
- Berns, K. L., and B. E. Bishop, high-speed multiplexing with closed-ring counters, 3218
- Bernstein, H., with others, avalanche breakdown in *n-p* Ge diffused junctions, 3378
- Bernstein, R. L., with others, generalized Rayleigh processes, 210
- Berry, J., with others, recurrent variations in the intensity of primary cosmic radiation, 3278
- Berry, J. F., and L. E. Jansson, transistor 20-kc/s oscillator, 745
- Berry, R. W., and D. J. Sloan, Ta printed capacitors, 2867
- Bertaut, F., magnetostatic energy of  $\alpha-Fe_2O_3$ , 893  
— A. Deschamps and R. Pauthenet, substitution of Al, Ga and Cr in  $BaO_6Fe_2O_3$ , 541
- Bertheaud, A. J., with R. Vautier, Y-Fe garnet with substituted Cr, g-factor of 2328, width of absorption curve of, 2329; direct measurement of width of resonance curves, 3814
- von Bertele, H., electron emission from thin Hg films, 1157
- Berz, F., field effect at high frequency, 2640
- Besprozvannaya, A. S., with V. M. Driatski, ionospheric conditions in the circumpolar region, 3717
- Bessey, W. H., with others, electromechanical behaviour of  $BaTiO_3$ , 3334
- Béthoux, P., signal discrimination in Gaussian noise, 1357; discrimination between signals in telecommunication, 2008
- Betzenhammer, B., Al-telegraphy reception disturbed by fading, 1352
- Beun, M., with others, junction transistor as network element, 1719, 2781, 3518
- Bevc, V., J. L. Palmer and C. Süsskind, design of transition region of beam valves, 1017
- Beynon, W. J. G., and G. M. Brown, geomagnetic distortion of region E, 2246  
— and G. L. Goodwin, horizontal drifts and temperature in E region, 804
- Bhar, J. N., and P. Dhar Bhowmik, study of noon F<sub>2</sub> ionization, 2584
- Bhattacharyya, J. C., brightness of sun's disk at sunspot minimum, 785
- Bhonsle, R. V., and K. R. Ramanathan, cosmic radio noise on 25 Mc/s, 3699 f
- Bhowmik, P. Dhar, See Dhar Bhowmik, P.
- Bialecke, E. P., and A. A. Dougal, electron-ion recombination coefficient in nitrogen, 125
- Bianconi, G., with B. Percini, tropospheric-scatter multichannel telephone links, 1361
- Biard, J. R., with W. T. Matzen, differential amplifier features d.c. stability, 1496
- Bibby, R. J., with others, lightweight airborne navigation system, 2599
- Bibl, K., A. Paul and K. Rawer, variation of ionospheric absorption, 3716
- Bichara, M. R. E., one-triode multivibrator with no filament current, 3988
- Bickart, T. A., amplitude slicer for signal analysis, 1976
- Bickelhaupt, M. H., with others, tropospheric scatter system using angle diversity, 2751
- Bickerton, R. J., amplification of magnetic field by high-current discharge, 401
- Bickmore, R. W., effective aperture of scanned arrays, 2847  
— with H. E. Shanks, four-dimensional e.m. radiators, 2840
- Biermann, L., and R. Lüst, radiation and particle precipitation from solar flares, 1530
- Bilger, H., with others, influence and creation of lattice defects in junction transistors, 2771
- Billig, E., and D. B. Gasson, preparation of single-crystal Si by pulling technique, 168
- Billings, A. R., step detection, 590; sampling of signals, 1356; multiplex vocoder, 2394
- Billings, J. A., with T. G. Thorne, Doppler navigation systems, 2608
- Bimont, J., band-pass ladder filter half-sections, 3223
- Binder, R. C., with D. A. Gilbrech, portable instrument for locating noise sources, 2091
- Biondi, M. A., and others, evidence for energy gap in superconductors, 393  
— with others, measurement of attachment of slow electrons in oxygen, 2533
- Biorci, G., and D. Pescetti, behaviour of ferro-magnetic materials, 197  
— A. Ferro and G. Montalenti, instability of Bloch walls in ferromagnetic material, 535
- Bir, G. L., influence of surface recombination on photoconductivity of semiconductors, 2643  
— with G. E. Pikus, influence of deformation on properties of *p*-type Ge and Si, 2649
- Birdsall, C. K., travelling-wave tubes using parallel electron streams, 2788 i  
— and A. J. Lichtenberg, travelling-wave focusing for plasma containment, 4022  
— with C. C. Johnson, M-J crossed-field travelling-wave tube, 2788 ad  
— with others, multiple ladder circuits for mm-wave tubes, 3159 v
- Birdsall, T. G., with W. P. Tanner, Jr, definitions of *d'* and *m*, 3854
- Birk, M., with M. Simhi, sensitive single-channel pulse-height analyser, 59
- Birman, J. L., theory of piezoelectric effect in zincblende structure, 846; polarization of fluorescence in CdS and ZnS, 2268
- Birrell, A., Olfantsfontein and Derdepoort radio stations, 2015
- Bishop, B. E., with K. L. Berns, high-speed multiplexing with closed-ring counters, 3218
- Bishop, F. W., highly biased gun on electron microscope, 3443
- Bisson, D. K., and R. F. Dyer, bi-controlled rectifier, 4227
- Bittner, G., wave propagation in plasma cable, 2104
- Bjorkstam, J. L., and E. A. Uehling, magnetic resonance and relaxation in  $KD_2PO_4$ , 3743
- Black, J., S. M. Ku and H. T. Minden, semi-conducting properties of HgTe, 4112
- Black, W. N., combined broadcast transmitters, 623
- Blackband, W. T., and others, deduction of electron content from Faraday fading, 2572
- Blackburne, N. F., bridges for semiconductor measurements, 1648
- Blackman, L. C. F., Mg and MgMn ferrite system, 903; solubility of MgO in Mg ferrite, 2688
- Blackman, M., and F. Grünbaum, magnetic leakage field in Co, 202  
— and N. D. Lisgarten, magnetic models for interpreting domain effects on electron beam, 3407
- Blakemore, J. S., impurity conduction in In-doped Ge, 3368  
— with K. C. Nomura, decay of excess carriers in semiconductors, 1915
- Blanc, D., and others, ionization chambers as sources of current, 4152
- Blank, K., with A. Herspings, after-effect in ceramic dielectrics, 3328
- Blaser, J. P., and J. Bonanomi, comparison of NH<sub>3</sub> maser with Cs frequency standard, 915  
— and J. De Prins, comparison of astronomical time measurements with atomic frequency standards, 914
- Blatt, F., with others, Zeeman-type magneto-optical studies of interband transitions, 2283
- Blattner, D. J., and F. Stierzer, backward-wave oscillator tubes for 29-74-kMc/s range, 1740; voltage-tunable mm-wave oscillators, 3529  
— and F. E. Vaccaro, electrostatically focused travelling-wave tube, 1414
- Bleaney, B., materials for Bloembergen-type masers, 3242
- Bleil, C. E., with D. D. Snyder, mechanism for carrier excitation in CdS, 3004
- Blet, G., open-circuit e.m.f. of Se photocells, 3157  
— with D. Vidal, influence of annealing time on thermoelectric power of Se, 2648
- Elevis, B. C., u.h.f. auroral radar observations, 1573
- Bley, H., current noise of semiconductors, 3506
- Blinchikoff, H., with A. Zverev, network transformations for wave filter design, 3222
- Blinowski, K., with others, spin-fluctuation scattering of neutrons in magnetite, 4127
- Blitzer, L., earth oblateness in terms of satellite orbital periods, 2234
- Blodgett, F. W., properties of C<sub>60</sub>, 3415
- Bloembergen, N., and others, cross-relaxation in spin systems, 3270
- Blomquist, A., with B. Josephson, ground-wave v.h.f. propagation, 3089
- Blong, H., diffraction of ultrasonic wave by surface with periodic structure, 1047
- Bloom, A., with others, microwave frequency standard, 4150
- Blount, E. L., energy levels in irradiated Ge, 2664, 4109; ultrasonic attenuation in metals, 3336
- Blum, S. L., microstructure and properties of ferrites, 4133  
— and M. H. Sirovetz, magnetic resonance studies in reaction of Ni-Co ferrite, 3042
- Blumenson, L. E., with others, generalized Rayleigh processes, 210
- Blüthgen, F., and J. Bayer, pulse generation controlled by heart phases, 4169
- Blyakhman, E. A., and L. A. Chernov, pulsation frequency of field at focus of lens, 4031
- Bock, R., and others, fixed-frequency cyclotron with one dee, 1985
- Bockemuhl, R. R., transistor rectifier gives d.c., 3481
- Bödeker, H., German standards converter technique, 4213
- Bodó, Z., with others, tin-e-dependent spectra of ZnS:Cu, Pb, 4080
- Boekhorst, A., with others, stabilization, of line output circuits, 989, 3124, 3871, of line and frame output circuits, 3123
- Boella, M., television study centre, 2761
- Boensel, D. W., switching circuits for missile count-downs, 3598
- de Boer, E., acoustic interaction in loudspeaker enclosures, 2456
- de Boer, F., and W. F. Nienhuis, low-voltage oscilloscope tubes, 2713
- Böer, K. W., and H. Guljahr, spectral distribution of photoconductivity in CdS, 1904  
— and U. Kummel, electrostatic charging of CdS, 3731  
— H. J. Häslich and U. Kummel, rendering visible conductivity inhomogeneities of semiconductors, 3757  
— U. Kummel and W. Misselwitz, breakdown of CdS films, 2993  
— S. Oberländer and J. Voigt, evaluation of conductivity glow curves, 3321
- Bogert, B. P., delay distortion correction by time-reversal techniques, 981
- Bogle, G. S., and H. F. Symmons, paramagnetic resonance of Fe<sup>2+</sup> in sapphire, 1949; zero-field masers, 2889
- Bogner, G., and E. Mollwo, preparation of ZnO, 878
- Bogomolov, V. N., and V. A. Myasnikov, equipment for Hall-effect measurements in semiconductors, 503
- Bohlmann, H., and A. Reitig, installation for outside sound broadcasts, 4204
- Bohn, E. V., current distribution of cylindrical antennas, 1085
- Boiko, I. V., theory of field effect, 2639
- Boischot, A., and J. W. Warwick, radio emission following flare, 3276
- Boisvert, M., signal flow graphs, 3601
- Boithias, L., and P. Misme, guided propagation in the Mediterranean, 940
- Bok, J., and R. Veilax, semiconductor experiments on hot electrons in InSb, 3781  
— with Y. Simon, photoconductivity of ZnTe, 3726
- Böke, K., J. B. M. Spaepen and N. B. Speyer, diffusion capacitance in transistors, 3148
- Bokov, V. A., piezoelectric properties of polycrystalline solid solutions, 845; temperature dependence of total polarization, coercive force and hysteresis losses, 3745
- Boley, F. L., scattering of microwave radiation by plasma column, 769
- Bolgiano, R., Jr, convective transfer in turbulent mixing, 1661; wavelength dependence in transhorizon propagation, 1666
- Bolinder, E. F., Minkowski model of Lorentz space, 1799; geometric-analytic theory of transition, 3049; non-Euclidean geometry in quadrupole theory, 3606
- Bolle, A. P., cable circuits for television transmission, 273
- Bolle, G., operation of ionic loudspeakers, 1759; mixing colour subcarrier of variable frequency with black and white picture, 2032
- Bolt, F. D., four simultaneous transmissions from one aerial, 1443



- Boltaks, B. I., and B. T. Plachenov, self-diffusion in Se, 1605
- Boltax, A., behaviour of semiconductor and magnetic materials under radiation, 2646
- Bömmel, H. E., and K. Dransfield, hypersonic waves, attenua ion in quartz, 2636, excitation by ferromagnetic resonance, 3817
- Bonage, W. F., v.h.f. communication in port and harbour control, 3480
- Bonanomi, J., and others, improvements in NH<sub>3</sub> maser, 758 g
- with J. P. Blaser, comparison of NH<sub>3</sub> maser with Cs frequency standard, 915
- Bonch-Bruевич, V. L., interaction of electrons with phonons and impurities, 1859; theory of field effect, 3749; recombination centres and trapping levels, 3764
- Bond, M. E., with B. G. Higdon, thyatron stabilized d.c. supplies, 4208
- Bond, W. L., with R. A. Logan, density change in Si on melting, 2292
- Bonjoly, P., with I. Eyraud, differential bridge for impedance measurements, 3429
- Bonner, R. E., L. H. Kosowsky and P. F. Ordnung, functional characteristic of node determinant, 548
- Bonnerot, J., investigation of planar electron guns, 2708
- Booher, C., increased cooling for power transistors, 636
- Boone, E. M., M. Uenohara and D. T. Davis, Barkhausen-Kurz oscillator at cm  $\lambda$ , 1486
- and others, processing Ni-matrix cathodes, 4250
- van Boort, H. J. J., M. Klerk and A. A. Kruihof, interference from fluorescent lamps, 3463
- Boot, H. A. H., H. Foster and S. A. Self, design of high-power S-band magnetron, 2788 d
- Booth, A. D., physical realization of digital computer, 26
- Bopp, F., and E. Werner, theory of spin waves, 2214
- Borck, A., power density meter, 3831
- Borodovskii, G. A., with others, investigation of solar radiation using earth satellites, 3293
- Borel, J. P., and P. Gornaz, Overhauser effect in gas in presence of paramagnetic material, 2546
- Borgman, J., TV techniques in astronomy, 3082
- Borgnis, F., electric waves on delay lines, 696
- Bornemann, I., afterglow problems in colour television picture tubes, 2407
- Börner, M., flexural vibrations in mechanical filters, 2154
- E. Kettel and H. Ohnsorge, mechanical filters for communications technique, 2155
- Borodovskii, P. A., application of harmonic vibrations of electrons for u.h.f., 1725
- Boronkay, A. D., electronic ratio calculator, 1102
- Bosanquet, C. H., scale height of upper atmosphere, 1184; change of inclination of satellite orbit, 1542
- Bose, K. K., effect of magnetic field on point-contact transistors, 630
- Bösnecker, D., with E. Lutze, paramagnetic electron-resonance induction, 2927
- Bossard, B. B., superregenerative reactance amplifier, 3243
- Botka, A. T., with others, organized electrification and precipitation in thunderstorms, 2253
- Böttger, O., power limits of thermoelectric effects in semiconductors, 1231
- Bouchard, J., study of ionospheric propagation, 1333 c
- Boucher, G., carcinotrons for short and long wavelengths, 3524 q
- Boucherie, A., and J. Mey, pulse-height analyser, 377
- Boudarenko, P. N., with others, lifetime of injected current carriers in Sb-doped Ge, 1932
- Boudouris, G., with others, refractive index of humid air, 1333 n
- Bouix, M., application of distributions to equations of Maxwell and Helmholtz, 405
- Bouloheris, C., with others, optimum radiation from sawtooth aerial, 3578
- Bouman, M. A., with R. Plomp, hearing threshold and duration for tone pulses, 3909
- Bourassin, L., multichannel sound transmission from single transmitter, 983
- Boutry, G. A., with Y. Angel, parametric amplifiers and cancellation of ferromagnetic hysteresis, 3244
- Bouwkamp, C. J., method of calculating capacitance, 2193
- Bouzatat, J., with J. A. Ville, finite-duration signals with maximum filtered energy, 2390
- Bowden, F. P., J. B. P. Williamson and J. A. Greenwood, electrical conduction in solids, 485
- Bowers, K. D., with J. P. Gordon, microwave spin echoes from donor electrons in Si, 860
- Bowers, R., J. E. Bawerle and A. J. Cornish, In(As,P) as thermoelectric material, 3759
- and others, InAs and InSb as thermoelectric materials, 3384
- Bowhill, S. A., Faraday-rotation rate of satellite radio signal, 796
- Bowie, R. M., electroluminescent television display, 566
- Bowlden, H. J., with R. F. Wallis, impurity photoionization spectrum of semiconductors in magnetic fields, 1232
- Bowley, A. E., R. Delves and H. J. Goldsmid, magnetothermal resistance and magnetothermal-electric effects in Bi<sub>2</sub>Te<sub>3</sub>, 182
- Bowman, D. R., instability in radio receivers, 250
- Bowtell, J. N., electroluminescence and applications, 151
- Boyd, D. R., and Y. T. Sihvonen, growing CdS single crystals, 1905
- with others, properties of green and red-green luminescing CdS, 2621
- Boyd, M. R., with G. M. Roe, parametric energy conversion in distributed systems, 3240
- Boyd, R. L. F., and N. D. Twiddy, electron energy distributions in plasmas, 3260
- Boyle, W. S., and K. F. Rodgers, oscillations in infrared transmission of Bi, 2620
- with others, splitting of As donor ground state in Ge, 1615
- Bozorth, R. M., weak ferromagnetism in rare-earth orthoferrites, 905
- Braae, R., accuracy of ohmmeter, 1649
- Bracewell, R. N., and O. K. Garriot, rotation of earth satellites, 795
- Brachet, C., with others, irradiation of photoconductive single crystals of CdS, 2617
- Bradley, E. M., and M. Prutton, magnetization reversal by rotation and wall motion in NiFe films, 1955
- Bradley, R. C., secondary positive ion emission from metals, 1508
- Bradshaw, C. G., 1-Mc/s transistor decade counter, 1131
- Bradshaw, J. A., space-charge-limited current in planar-diode magnetron, 1018
- Brady, D. J., with others, transistor phase-locked oscillators, 2162
- Brady, M. M., frequency stability of coherent radar oscillators, 2607; oscillator design using voltage-variable capacitors, 3986
- Brady, T., with others, synchronous and exalted-carrier detection, 1378
- Braginskii, S. I., transport phenomena in plasma, 400
- Brand, F. A., W. G. Matthei and T. Saad, 'reactatron' microwave amplifier, 1150
- with others, microwave techniques in lifetime measurement, 3774
- Braner, H., with J. L. Easterday, derating requirements for carbon composition resistors, 2491
- Brannan, W., transistorized 3-phase power supplies, 3482
- Braslau N., with G. O. Brink, atomic-beam magnet-stabilization system, 4170
- Bratenahl, A., with others, hydromagnetic capacitor, 1843
- Bratina, W. J., deformation processes in armco iron, 4124
- Bratt, J. B., band-pass filter, 3977
- Braucks, F. W., remote-focus cathode, 936
- Braude, S. Ya., with others, phase fluctuations of 10-cm waves over sea, 2738
- Brauer, F., and D. Kammer, mobile-radio system, 262
- von Braun, W., the 'explorers', 1546
- Bray, D. W., with others, radio reflections from satellite-produced ionization, 2963
- Breazeale, M. A., and E. A. Hiedemann, investigation of progressive ultrasonic waves by light refraction, 1050
- B. D. Cook and E. A. Hiedemann, determination of ultrasonic waveform by light refraction, 3538
- Brebrick, R. F., interdiffusion in ionic semiconductors, 3343
- Bremmer, H., propagation through curved stratified medium, 4178
- Brenet, J., with J. P. Chevillot, semiconductivity of MnO, 3783
- Brennan, D. G., linear diversity combining techniques, 3102
- Brewer, G. R., characteristics of magnetically focused electron beam, 3888
- with T. Van Duzer, space-charge simulation in electrolytic tank, 2356
- Brewer, R., American electronics reliability symposium, 2805
- Brewster, K., with J. S. Bell, matrices in transistor circuit analysis, 1141
- Brice, J., with H. C. Wright, indium mono-telluride, 2312
- Brice, N. M., variations in F-region characteristics, 2241
- Brice, P. J., amplitude of v.h.f. signals reflected from E<sub>s</sub> layer, 2000 k
- Brick, D. B., and J. Galejs, radar interference, 465
- Bridges, T. J., with others, parametric amplification of space-charge waves, 3159 k
- Briggs, G. R., with others, transfluxor-controlled electroluminescent display panel, 568
- Brill, A., H. A. Klasens and T. J. Westerhof, cathodoluminescence, 2624
- Brill, P. H., and R. P. Schwarz, radiative recombination in Ge, 869
- Brink, G. O., and N. Braslau, atomic-beam magnet-stabilization system, 4170
- Brinkmann, C., printed circuits, 1788
- Britsyn, K. L., with V. S. Vavilov, quantum yield of photoionization in Si, 863
- Britt, C. O., with others, phantom radar targets at mm  $\lambda$ , 3315
- Britton, G. A. C. R., with C. W. Sowton, radio interference, 954
- Brockelsby, C. F., ultrasonic mercury delay lines, 361
- Brockhouse, B. N., lattice vibrations in Si and Ge, 2286
- and P. K. Ievngar, normal modes of Ge by neutron spectrometry, 173
- Broderick, D., D. Harthe and M. Willrodt, precision generator for radar range calibration, 2352
- Brodie, I., R. O. Jenkins and W. G. Trodden, evaporation of Ba from impregnated cathodes, 2792
- Brodwin, M. E., propagation in ferrite-filled microstrip, 2109
- Brömer, H. H., and V. Stille, electron recombination in afterglowing active nitrogen, 1510
- Broneer, C. S., with B. D. Solomon, constant-S equalizers, 3226
- Bronzi, G., tests on Kahn's theory of anti-fading reception, 952; asymmetrical modulation, 3465
- Brooks, F. E., Jr, with J. P. German, bandwidth of folded dipole, 2842
- Brooks, W. O., stepping-up frequency with counter circuits, 3614
- Brophy, J. J., influence of surfaces on 1/f noise in Ge, 172; Seebeck effect fluctuations in Ge, 178
- Broser, I., and R. Broser-Warminsky, energy transfer in CdS, 827
- Broser-Warminsky, R., with I. Broser, energy transfer in CdS, 827
- Broudy, R. M., with J. D. Venables, photo-anodization of InSb, 3782
- Broussaud, G., aeriels for long-range radio links, 1333 r
- with others, superdirectivity of aerial, 3572
- Brouwer, G., model for h.f. phenomena in junction transistor, 3154
- Brower, W. S., with P. H. Fang, temperature dependence of breakdown field of BaTiO<sub>3</sub>, 2627
- Brown, A., aeriels for television broadcasting, 3571
- Brown, A. V., transient phenomena in microwave tubes, 2788 n
- Brown, D. A. H., behaviour of square-loop magnetic cores, 3217
- Brown, G. M., with W. J. G. Beynon, geomagnetic distortion of region E, 2246
- Brown, J., and K. P. Sharma, launching of radial cylindrical surface waves by circumferential slot, 2110
- with A. Carne, reflections from rod-type artificial dielectric, 2123
- with J. S. Seeley, dispersive artificial dielectrics in beam-scanning prism, 2124
- Brown, J. N., automatic sweep-frequency ionosphere recorder, 1564
- Brown, M., greater gain bandwidth in trigger circuits, 2163
- Brown, R. K., and others, lightweight airborne navigation system, 2599
- Brown, R. R., latitude variation of 27-day cosmic-ray intensity decreases, 1862
- Brown, S. C., with J. L. Hirshfield, measuring probability of electron collision in gas, 768
- with R. G. Meyerand, Jr, high-current ion source, 1986
- Brown, W. B., with C. F. Hendee, stroboscopic operation of photomultiplier tubes, 1722
- Brown, W. L., and W. M. Augustyniak, defect formation in electron irradiation of n-type Ge, 4110
- W. M. Augustyniak and T. R. Waite, annealing of radiation defects in semiconductors, 4089 o
- Browne, G. D., a.f.c. in band-II f.m. receivers, 951
- Browne, M. E., with D. E. Kaplan, electron free precession in paramagnetic free radicals, 3408
- Brownless, S. F., common-channel common-programme operation of broadcasting stations, 1690
- Broyles, A. A., calculation of fields on plasma ions, 1160
- Bruaux, A., radiation diagram of linear aeriels, 3567
- Brueckner, K. A., and K. Sawada, magnetic susceptibility of electron gas, 759
- Bruilning, H. G., and A. Rademakers, pulse transformer with pre-magnetization, 1469
- Brumbaugh, J. M., E. D. Goodale and R. D. Kell, colour TV recording on black and white lenticular film, 1371
- Bruynseels, J. P., and R. Gonze, coaxial reflectometer for metre waves, 3431
- Bryant, F. J., R. B. Coulson and J. K. Fowler, low-noise travelling-wave tubes, 2063
- Bryant, M. O., beam and coupling parameters for broad-band klystrons, 3524 f
- J. F. Gittins and F. Wray, c.w. power travelling-wave tube, 2787
- Bryant, N. H., with others, antenna-beam distortion in transhorizon propagation, 1347
- Bryant, P. R., topological investigation of network determinants, 2157
- Bryngdahl, O., and E. Ingelstam, diffraction patterns in microscopes and microwave fields, 2206
- Brysk, H., measurement of scattering matrix with intervening ionosphere, 1345; scattering by low-density meteor trails, 1665
- and others, radar cross-section of finite cones, 4073
- Buchanan, D. N. E., with G. K. Wertheim, electro-bombardment damage in oxygen-free Si, 4089 k
- Buchanan, R. W., and B. Kautz, dynamic testing of computer blocks, 3591
- Buchar, E., motion of nodal line of 1957  $\beta$ , 118
- Buck, T. M., and F. S. McKim, chemical and atmospheric effects on surface properties of Si, 4097
- Buckelew, J. W., and E. D. Knob, through-connections for printed wiring, 38
- Bücks, K. E., with others, application of radio altimeters to aircraft approach, 2259 o
- de Buda, R. G., characteristic impedance of strip transmission line, 3555
- Budden, K. G., with D. W. Barron, numerical solution of equations governing reflection of long waves from ionosphere, 3455
- Buduls, L., with D. J. Howlett, noise-immune synchronizing circuits, 3120
- Bugnolo, D. S., correlation function and power spectra of radio links, 4203
- de Buhr, J., representation of general lossy quadri-pole, 1477
- Buick, R. I., A. Reddish and I. J. Zucker, frequency pushing in crossed-field oscillators, 2788 q
- Bukstein, E., how ring counters work, 2507
- Bulgakov, B. M., and V. P. Shestopalov, propagation in retarding systems with helix and dielectric, 3889
- Bullough, R., R. C. Newman and J. Wakefield, diffusion across semiconductor/vapour interface, 165
- and others, precipitation on a dislocation, 2289
- Bunting, E. N., with others, infrared studies on SiO<sub>2</sub> and GeO<sub>2</sub>, 205

- Burbank, R. D., with others, magnetic annealing in perminvar, 3797
- Burdick, G. A., short picture-tube design, 3127
- Bureau, J. L., sudden commencements at Taman-rasset, 1183
- Burfoot, J. C., model for switching of BaTiO<sub>3</sub> crystals, 2635
- and R. V. Peacock, growth of ferroelectric hysteresis loops, 3329
- Burger, J. F., with J. P. A. Lockner, subjective masking of delayed echoes, 5; intelligibility of reinforced speech, 3912
- Burgess, B., with others, deduction of electron content from Faraday fading, 2572
- Burgess, R. E., polarization fluctuations in ferroelectric crystal, 842; avalanche breakdown in Si, 4095
- Burkard, O., radio reflexions from moon and solar corona, 2583; ionosphere model, 3705
- Burke, B. F., with K. L. Franklin, observations of planet Jupiter, 1522
- Burke, P. F. C., 4-Gc/s travelling-wave tube for microwave radio links, 2788 o
- Burkett, R. H. W., pyrolytic carbon resistors, 2490; total-excitation resistor, 3216
- Burnham, J., dielectric films in Al and Ta capacitors, 725
- Burrus, C. A., maser pulse generator, 2500
- Burstein, E., and others, Zeeman-type magneto-optical studies of interband transitions, 2283
- Burt, E. G. C., satellite tracking, 122
- Buryak, E. M., with others, anomalously high Hall effect in CrTe, 2681
- Busch, G., and T. Fischer, field emission from semiconductors, 3016
- and P. Junod, electrical properties of Ag<sub>2</sub>Se, 758 a and R. Kern, magnetic properties of A<sup>III</sup>B<sup>V</sup> compounds, 2645
- F. Hullinger and R. Jaggi, field parameters of galvanic and thermo-magnetic effects in ferro-magnets, 758 c
- R. Kern and B. Lüthi, magnetic resistance variation of InSb, 758 b
- Busch, R., E. Harnischmacher and K. Rawer, ionospheric observations during solar eclipse of 30th June 1954, 131
- Buseck, H., and G. Klages, rectangular waveguide with attenuating foil, 1772
- Bushor, W. E., sample method displays mas pulses, 3828
- with others, '59 I.R.E. Show, 2801
- Bushore, K. R., with W. L. Teeter, microwave power divider and multiplexer, 1078
- Butcher, C. H., with others, new method for fine-wire grids, 2788 y
- Butcher, P. N., theory of three-level paramagnetic masers, 2894
- with others, travelling-wave solid-state masers, 2891
- Butler, F., transistor audio amplifier, 67; regenerative-modulator frequency divider using transistors, 1133; transistor invertors and rectifier-filter units, 3483
- Butler, K. H., and F. Koury, sylvatron electro-luminescent display, 224
- Butler, T. W., Jr, ferroelectric tune circuits, 1472
- and G. A. Roberts, ferroelectric capacitors, 3247; voltage-variable capacitor guide, 3599
- Butson, P. C., and G. T. Thompson, effect of flanges on radiation patterns, 3582
- Butterweck, H. J., with E. Schuon, linearization of f.m. characteristic of reflex klystron, 1739
- Button, K. J., analysis of field-displacement isolator, 2839
- and others, Zeeman effect of excitons in Ge, 2299
- with others, exciton- and magneto-absorption of transitions in Ge, 3364
- Buxton, A. J., and M. O. Felix, reduction of threshold by frequency compression, 2000 q
- Byatt, D. W. G., with J. F. Haich, direction finder with automatic read-out, 2600
- Bye, W., effects of temperature on junction transistors, 299
- Byers, H. G., and M. Katchky, slotted waveguide array for radar, 711
- Cabessa, R., pulse techniques in radio communication networks, 2014 b
- Cade, C. M., maser microwave oscillator, 1500
- with H. R. Whitfield, analysis of collision-course prediction, 2259 r
- Cahill, L. J., Jr, investigation of equatorial electro-jet, 2968
- Cahill, W. F., with others, satellite orbits from radio tracking data, 2568
- Cahn, J. H., irradiation damage in Ge and Si, 4089 r
- Caicoya, J. I., optical approach in microwave measurements, 563; electronics and communications in Brazil, 3176
- Cairns, R. B., and G. C. McCullagh, discharge modes using thermionic cathodes, 2441
- Caistor, A., S. J. Fray and W. C. Hopper, waveguides for use in cryostats, 1767
- van Cakenberghe, J., with J. M. Gilles, photoconduc-tivity and crystal size in evaporated CdS, 828
- with G. Offergeld, stoichiometry of Bi<sub>2</sub>Te<sub>3</sub>, 3785
- Caldwell, J. W., and T. C. G. Wagner, boosting power-transistor efficiency, 978
- Calhoun, B. A., with others, microwave resonance in Gd-Fe garnet crystals, 3043
- Callaby, D. R., with E. W. Lee, measurement of velocity of propagation of domain boundary in perminvar, 194
- Callaway, J., and M. L. Glasser, Fourier coefficients of crystal potentials, 782
- Callendar, M. V., loudspeaker enclosure calculations, 1763
- Calligaris, L., construction of horn-type aerials with parabolic reflectors, 1777
- Cameron, D. B., with R. N. Lane, current integration with soliton liquid diodes, 2023
- Cameron, W. A., coaxial-cable performance, 3925
- Campbell, J. O., with Y. J. Liu, collision detection without range data, 3722
- Campbell, L. L., properties of frequency-stabilizing circuit, 738
- Campbell, R. D., radar interference to microwave communication services, 1353
- Campbell, W. H., and B. Nobel, micropulsation measurements, 4045
- Cane, P. E., and W. E. Taylor, cooling high-power valves by vaporization, 654
- Cantz, R., diode circuit for a.v.c. in transistor receivers, 2742
- Cap, S. T., and N. P. White, guidance systems in space flight, 3839
- Capelli, M. P. G., A. E. Outten and K. E. Bücks, application of radio altimeters to aircraft approach, 2259 o
- Caplan, P. J., with others, analysis of emissive phase of pulsed maser, 756
- Capps, R. H., behaviour of intense relativistic electron beams, 4017
- Cappuccini, F., passive repeaters, 1778
- Caprioli, L., attenuation in circular waveguides, 3194
- Caraculo, A., and L. Guerri, final computer model of Pisa C.S.C.E., 3966
- Carapiperis, L., with M. Anastassiades, influence of meteorological factors on u.h.f. propagation, 1333 m
- Carassa, F., reactance-valve frequency modulator, 2034
- Carasso, J. I., and R. W. Pittman, thermoelectric observations on grey Se, 1272
- Card, W. H., 4-transistor inverter drives induction motor, 1983
- Carden, H. T., with A. D. Cawdery, application of magnetic amplifiers, 2516
- Cardona, M., and W. Paul, quadratic photoelectro-magnetic effect in Ge, 1253
- Carey, W. M., inductive control in computer circuits, 3967
- Carfort, F. de, with others, circular waveguides for long-distance transmission, 2107
- Carlin, H. J., with others, calorimeters for measurement of microwave power, 2358
- Carlson, G., with B. Josephson, fading and distortion of 3-kMc/s transhorizon signals, 3090
- Carne, A., and J. Brown, reflections from rod-type artificial dielectric, 2123
- Caroumbalos, C., with others, optimum radiation from sawtooth aerial, 3578
- Carpenter, H. E., Jr, with others, tracking orbits of man-made moons, 1190
- Carr, H. Y., steady-state free precession in nuclear magnetic resonance, 1853
- Carr, T. D., with others, night-time reception of major solar burst, 2554
- Carrara, N., P. F. Checacci and L. Ronchi, determination of satellite orbit, 441, 1188
- Carrassi, M., influence of anomalous magnetic moment on electron spin, 99
- Carrel, R. L., characteristic impedance of two infinite cones, 2843
- Carrerri, C., with P. F. Checacci, radio observations, on artificial satellites, 1192, of Sputnik III, 2569
- Carroll, J. M., developments in stereo broadcasting, 2397; Soviet equipment design, 3899
- W. E. Bushor and S. Weber, '59 I.R.E. Show, 2801
- Carstou, J., induced e.m. fields in the earth, 3668
- Carter, R., with V. J. Hammond, visualization of ultrasonic beam in fused quartz, 674
- Carter, R. E., effect of O<sub>2</sub> pressure on Mg ferrite, 1287
- Caruso, F., with others, current amplification of junction transistors, 631
- de Carvalho Fernandes, A. A. See Fernandes, A. A. de C.
- Casci, C., and V. Giavotto, indirect method of determining high-atmosphere density, 3686
- Cashen, J. F., with A. Havel, unified representation of transistor transient response, 2050
- Cashman, R. J., film-type infrared photoconductors, 4076
- Caspary, R., lifetime measurements on CdS using Kerr cell, 3322
- Cassedy, E. S., Jr, surface-wave parametric amplifier, 3625
- Casselman, C. J., D. P. Heritage and M. L. Tibbals, v.l.f. propagation measurements for Radux-Omega system, 2736
- Cassette, J., with N. Segard, theoretical investigation of ultrasonic field, 1423
- with others, crystal probe for measurement of ultrasonic power, 1752
- Cassidy, M., flight testing of radio facilities, 460
- Castelliz, L., with W. W. H. Clarke, ferromagnetic after-effect in mumetal, 2320
- Castro, P. S., and J. S. Needle, beam-defocusing microwave detector, 1413
- Cawdery, A. D., and H. T. Carden, application of magnetic amplifiers, 2516
- Cawsey, G. F., J. L. Farrands and S. Thomas, observations of detonation by interferometer, 3068
- Černý, L., and others, p-n junctions in Ge, 3485
- Chako, N., asymptotic development in diffraction theory, 1850
- Chakraborti, N. B., wide-band discrimination, 2526
- Chalikyan, G. A., with G. M. Garibyan, radiation from charged particle, 3634
- Chalmers, J. A., atmospheric electricity, (B)1201
- Chalmers, P. M., with F. A. Benson, effects of argon content in glow-discharge tubes, 2442
- Champion, F. C., and S. B. Wright, diamond conduction counters with small electrode separations, 1990
- Champion, J. A., grid emitting properties of Ti, 1030
- Champlin, K. S., microplasma fluctuations in Si, 3770
- Champness, C. H., transverse magnetoresistance in *b*-type InSb, 1265
- Chandler, H. G., electron-tube evaluation for missile applications, 2431
- Chaney, J. G., simple solution to problem of cylindrical antenna, 23
- Chang, K. K. N., harmonic generation with non-linear reactances, 61; 4-terminal parametric amplifier, 1148; low-noise tunnel-diode amplifier, 3246; analysis of parametric amplifier, 4005
- Chang, W. S. C., with C. M. Angulo, excitation of dielectric rod by cylindrical waveguide, 3558
- with others, travelling-wave solid-state masers, 2891
- Chanin, L. M., A. V. Phelps and M. A. Biondi, measurement of attachment of slow electrons in oxygen, 2533
- Chapman, S., thermal diffusion in ionized gases, 89; earth and its environment, 1540
- and K. Davies, daytime constancy of absorption of radio waves in lower ionosphere, 809
- Charakhch'yan, A. N., and T. N. Charakhch'yan, measurement of cosmic-ray intensity in stratosphere, 3277
- Charakhch'yan, T. N., with A. N. Charakhch'yan, measurement of cosmic-ray intensity in stratosphere, 3277
- Charnley, W. J., approach and landing aids, 2259 l; blind landing, 3723
- Charru, A., shape of paramagnetic-resonance signals, 1170
- Chase, K. H., and J. L. Pierzga, reducing radar interference, 3318
- Chasmar, R. P., and E. Cohen, electrical multiplier utilizing Hall effect, 349
- Chatterjee, K., with others, dielectric aerials, 2118
- Chatterjee, S. D., and S. K. Sen, induced conductivity at surface of contact, 1271
- Chatterjee, S. K., with others, dielectric aerials, 2118
- Chavasse, P. J. A. H., and R. Lehmann, loudspeaker measurements, 1761
- Checacci, P. F., and C. Carreri, radio observations, on artificial satellites, 1192, of Sputnik III, 2569
- and V. Russo, microwave configuration lens tests, 1450
- with others, determination of satellite orbit, 441, 1188
- Chechernikov, V. I., and Yu. D. Volkov, temperature dependence of paramagnetic susceptibility of Ni-Zn ferrites, 3041
- Chen, C. W., magnetic properties of Si-Fe, 193
- Chen, T. C., and O. B. Sivam, digital memory system, 2129
- Chenette, E. R., influence of inductive source on transistor noise, 2047
- Cheng, D. K., simulation of Fraunhofer radiation patterns, 1096
- Cheremushkina, A. V., with N. S. Akulov, Hall effect at Curie point, 2680
- Cherepanov, A. M., growing of BaTiO<sub>3</sub> single crystals, 1599
- Chernosky, E. J., and M. P. Hagan, Zurich sunspot number and variations, 1529
- Chernov, L. A., correlation of field fluctuations, 663
- with E. A. Blyakhman, pulsation frequency of field at focus of lens, 4031
- with M. N. Krom, effect of fluctuations on intensity distribution near focus of lens, 2917
- Chernov, Z. S., interaction of e.m. waves and electron beams with centrifugal e.s. focusing, 2788 cc
- Chevillat, J. P., and J. Brenet, semiconductivity of MnO<sub>3</sub>, 3783
- Chiesa, A., effect of mechanical vibrations on response of microphones, 690
- Child, M. R., and D. J. Sargent, accurate measurement of mutual conductance, 3059
- Chiplonkar, M. W., and V. N. Athavale, recording of atmospherics in I.f. region, 813
- and others, nature and origin of atmospherics, 3699 a
- Chirikov, B. V., passage of nonlinear oscillator through resonance, 2499
- with V. I. Volosok, compensation of space charge in electron beam, 1836
- Chisholm, D. A., with others, reflex klystron as negative-resistance-type amplifier, 1741
- Chisholm, J. H., and others, measurements of bandwidth of waves propagated beyond horizon, 3459
- Chivers, H. J. A., and H. W. Wells, new ionospheric phenomenon, 2582
- Chodorow, M., and others, current distribution in modulated electron beams, 644; high-power pulsed klystrons, 1410
- Cholet, P., with others, high-sensitivity infrared detectors, 1012
- Choudhury, N. K. D., and M. V. S. S. K. Rao, panel absorbers for low-frequency sound, 2821
- Chown, J. B., W. E. Scharfman and T. Morita, voltage breakdown characteristics of microwave antennas, 3581
- Choyke, W. J., with L. Patrick, SiC p-n junctions, electron emission from breakdown regions in, 1610, impurity bands of electroluminescence in, 1910
- Chrétien, L., and R. Aschen, compatible system for colour television, 1700; synchrophase, 3116
- Christ, K., O. Lauff and K. Schmid, radio-link installations for telephony and television, 1687
- Chu, K., and J. R. Singer, thin-film magnetization analysis, 3394
- Chudakov, A. E., with others, mechanism of terrestrial corpuscular radiations, 2216; investigation of cosmic radiation, 3663, by cosmic rockets, 2231
- Chudsenko, E. F., with others, electron concentration of ionosphere from observations of first earth satellite, 3298
- Chynoweth, A. G., radiation damage effect in triglycine sulphate, 2273; effect of space-charge fields on BaTiO<sub>3</sub>, 2274

- and J. L. Abel, polarization reversal in triglycine sulphate, 3742
- Ciucura, A.**, X radiation from television receivers, 4219
- Clapp, F. D.**, with A. Yariu, determination of cavity parameters, 4154
- Clark, C.**, checking jitter in moving-target radar, 3725
- Clark, J. L.**, with W. A. Prowse, u.h.f. gas breakdown, 395
- Clarke, E. L.**, auto self-excited transducers, 1791
- Clarke, G. M.**, power limitations in helix travelling-wave tubes and application of fluid cooling, 2788 f
- and R. D. Rookes, microwave reflectometer display system, (D)2703
- Clarke, R. L.**, diffusion of Cu in CdS, 3732
- Clarke, W. W. H.**, with L. Castelliz, ferromagnetic after-effect in mu-metal, 2320
- Clarricoats, P. J. B.**, perturbation method for circular waveguide, 2856
- Claudel, C.**, with others, properties of mixed Gd-Er and Gd-Y garnet, 1633
- Clavier, P.**, diversity systems and economic influence, 2014 c
- Clavier, P. A.**, parametric and pseudo-parametric amplifiers, 4247
- Clayton, C. G.**, B. C. Haywood and J. F. Fowler, conductivity induced by radiation in CdS and polyethylene, 2672
- Clegg, J. E.**, and J. W. Crompton, low-power c.w. Doppler navigation equipment, 2259 f
- and T. C. Thorne, Doppler navigation, 2259 d
- Cleland, J. W.**, with J. H. Crawford, Jr, bombardment damage and energy levels in semiconductors, 4091
- with others, radiation-induced recombination centres in Ge, 868
- Clogston, A. M.**, with others, low-temperature line-width maximum in Y-Fe garnet, 3812
- Cloud, W. H.**, crystal structure and ferrimagnetism in NiMnO<sub>3</sub> and CoMnO<sub>3</sub>, 199
- Coates, R. J.**, solar flare at 4.3 mm  $\lambda$ , 786
- Coates, R. V.**, and H. F. Kay, dielectric properties of metaniobate and metatantalate ceramics, 3326
- Cobbold, R. S. C.**, charge storage in junction transistor, 2773
- Cochran, W.**, lattice vibrations in Ge, 3367
- Cockroft, H. S.**, with J. D. Pearson, 20-kW pulsed travelling-wave tube, 2788 l
- Cocquerez, F.**, with others, crystal probe for measurement of ultrasonic power, 1752
- Coet, P.**, semi-automatic curve tracer, 3428
- Coffman, R. E.**, with I. A. Lesk, Ge diffused microcrystals and use in transistors, 637
- Cohen, A.**, with P. Davis, rigid radome design, 2475
- Cohen, E.**, with R. P. Chasmar, electrical multiplier utilizing Hall effect, 349
- Cohen, L. D.**, with J. A. Noland, BWO uses ridge-loaded ladder circuit, 2790
- Cohen, M. H.**, nuclear magnetic resonance in impure InSb, 1262
- and V. Heime, band structures of metals and alloys, 910
- Cohn, G. L.**, and H. M. Musal, transient response of phosphors, 1211
- and others, magnetostrictive delay line for video signals, 1134
- Cohn, S. B.**, dissipation loss in multiple-coupled-resonator filters, 3603
- Colchester, C. D.**, with E. Eastwood, ground radar for civil aviation, 2259 p
- Cole, C. F.**, Jr, characteristics of e.m. wave reflected from moving object, 410
- Cole, H.**, and E. Kineke, lattice vibrational spectra of Si and Ge, 857
- Cole, K. D.**, low-energy corpuscular radiation, 2551
- Cole, R. H.**, with S. E. Lovell, coaxial displacement dielectric cell, 3063
- Cole, W. A.**, magnetic matrix stores, 2482
- Coleman, H. P.**, with G. D. M. Peeler, stepped-index Luneberg lenses, 2854
- Coleman, P. D.**, and R. C. Becker, rectangular and circular mm waveguides, 2463; mm-wave generation, 3982
- with others, slow-wave structures for power generation at mm and sub-mm  $\lambda$ , 1743
- Coleman, P. J.**, Jr, with others, ionizing radiation at 3 500–36 000 km, 3691
- Collin, J. E.**, interchange of infinite-attenuation elements, 2150; filter technique in France, 2153; generalization of Zobel-type ladder filters, 3224
- Collin, L.**, with S. Weisbrod, refraction of v.h.f. signals, 3698
- Collin, R. E.**, properties of slotted dielectric interfaces, 3584
- Collings, E. W.**, filament noise source for 3 kMc/s, 2344
- Collins, C.**, and P. A. Forsyth, bistatic radio investigation of auroral ionization, 2001
- with G. C. Reid, abnormal v.h.f. absorption, 2380
- Collins, D. J.**, and J. E. Smith, regulated power supplies, 2401
- Collins, K. D.**, with P. A. Lindsay, design of helical coupler for 2-Gc/s band, 3159 x
- Collins, R. J.**, edge emission in CdS, 4089 c
- Colombani, A.**, and G. Goureaux, conductivity of thin Ni films, 3395
- P. Huet and C. Vautier, measurement of very slight variations of resistance, 555
- C. Vautier and P. Huet, properties of Sb films, 2693
- with G. Goureaux, magnetic properties of very thin films of nickel, 3039
- with others, Hall effect in Ni films, 1279
- Como, R. J.**, with A. Y. Rumsell, rapid insertion device for coaxial attenuators, 3927
- Comte, G.**, and others, circular waveguides for long-distance transmission, 2107
- Conda, A. M.**, with J. R. Wait, pattern of antenna on curved lossy surface, 3195
- Conwell, E. M.**, lattice mobility of carriers in Ge, 4101
- Cook, A. H.**, determination of the earth's gravitational potential, 4048
- Cook, B. D.**, with others, determination of ultrasonic waveform by light refraction, 3538
- Cook, E. J.**, axially symmetric electron beams, 3526
- Cook, G. H.**, vidicon camera lenses, 1375; modern optics in relation to television, 3498
- Cook, W. S.**, with others, diffraction of e.m. waves by ridge, 241
- Coole, H.**, f.m. tuner uses four transistors, 251
- Coole, R. E.**, impedance and phase angle of loud-speaker loads, 2823
- Cooley, G. C.**, Jr, wide-band sweep generator, 558
- Coolidge, A. W.**, with H. N. Price, development of ceramic hydrogen thyratrons, 3535
- Coon, R. M.**, with others, radio system performance in noise, 963
- Cooper, B. K.**, electronics in railway industry, 2717
- Cooper, E. R.**, magnetic anisotropy constant of Y-Fe garnet, 901
- Cooper, R. B.**, Jr, sporadic-E skip on 200 Mc/s?, 574
- Cooper, V. J.**, differential phase distortion in colour television transmitters, 614
- Cooper-Jones, D. L.**, with C. W. Earp, evolution of commutated-aerial d.f. systems, 2259 k
- Cooperman, M.**, magnetic demodulators for colour TV, 1379
- Coppen, P. J.**, with A. L. Barry, transistors reach for higher frequencies, 1399
- with P. A. Iles, delineation of p-n junctions in Si, 514
- Copper, E. G.**, use of automatic error correcting equipment, 3104
- Coppola, P. P.**, with others, dispenser cathodes, 2791
- Corazza, G. C.**, and G. Zoldan, physical realizability of microwave junction, 2139
- Corbett, J. W.**, with others, spin resonance in electron-irradiated Si, 4089 h
- Correns, E.**, with others, magnetic moments of Fe and Co with rare-earth metal additions, 2321
- Corliss, E. L. R.**, uniform transient error, 216
- Cormier, M.**, with W. A. Cumming, design data for annular slots, 2849
- Cornaz, P.**, with J. P. Borel, Overhauser effect in gas in presence of paramagnetic material, 2546
- Cornet, W. H.**, Jr, with others, processing Ni-matrix cathodes, 4250
- Cornish, A. J.**, with others, thermoelectric materials, InAs and InSb as, 3384, In(As,P) as, 3759
- Coroniti, S. C.**, and R. Penndorf,  $f_0F_2$  over polar regions, 1882
- with R. Penndorf, polar E<sub>s</sub>, 1561
- with others, geophysical effects of high-altitude nuclear explosions, 2969
- Costas, J. P.**, notes on space communications, 3860
- Coste, J. P.**, with others, recurrent variations in the intensity of primary cosmic radiation, 3278
- Cotte, M.**, propagation in medium with dielectric losses, 2208
- Cotterill, M. J.**, and J. W. Halina, bridge negative-feedback amplifiers in carrier telephony, 974
- Cotton, S. J.**, transient response of a.m. and f.m. signals, 2186
- Cotton, H. V.**, and A. C. Wilson, gains of corner-reflector antennas, 3205
- and others, U.R.S.I. report on antennas and waveguides, 3565
- Coughlin, B. J.**, G. L. Davis and R. L. Kingsnorth, orientation control for Ge wafers, 1935
- Coulomb, J.**, possible auroral origin of certain geomagnetic pulses, 2947
- Coulson, R. B.**, with others, low-noise travelling-wave tubes, 2063
- Coupland, M. J.**, diffusion of P into Si, 2651
- Coutrez, R.**, principles and present results of radio astronomy, 3273
- Cowen, J. A.**, W. R. Schafer and R. D. Spence, polarization of Al nuclei in ruby, 3792
- Cowie, A.**, comparison of telemetry systems, 4172
- Cox, B. C.**, triode-connected pentode with stabilized anode current, 750
- Cox, J. T.**, and G. Hass, antireflection coatings for Ge and Si in infrared, 864
- Crabbe, H. J. F.**, electronics and the phonetician, 2450
- Cragg, T.**, with others, magnetic field associated with solar flare, 4043
- Craik, D. J.**, and P. M. Griffiths, domain configurations on ferrites, 1283
- Crane, H. D.**, logic system using magnetic elements, 1104
- Craven, G.**, and V. H. Knight, integrally constructed waveguide assemblies, 2826
- Crawford, A. B.**, D. C. Hogg and W. H. Kummer, tropospheric propagation beyond horizon, 4185
- Crawford, J. H.**, Jr, and J. W. Cleland, bombardment damage and energy levels in semiconductors, 4091
- with others, radiation-induced recombination centres in Ge, 868
- Cressey, J.**, with others, tracking weather with satellites, 2715
- Cretella, M. C.**, and H. C. Gatos, reaction of Ge with HNO<sub>3</sub>, 2310
- Cripps, L. G.**, transistor h.f. parameter  $f_t$ , 4236
- Croft, W. F.**, with others, capabilities of coaxial cable, 2457
- Croisdale, A. C.**, teleprinting over long-distance radio links, 960
- Cromack, J. C.**, with others, travelling-wave solid-state masers, 2891
- Crompton, J. W.**, with J. E. Clegg, low-power c.w. Doppler navigation equipment, 2259 f
- Cronauer, E. A.**, with E. W. Lehtonen, a.c.-controlled magnetic amplifiers, 382
- Cronmeyer, D. C.**, photoconductive response of Ge layers, 867; infrared absorption of reduced rutile, 3034
- Crosby, M. G.**, compatible system of stereo transmission, 1363
- Crowley, T. H.**, with U. F. Gianola, 'Laddie', 1463
- Crysdale, J. H.**, and others, diffraction of e.m. waves by ridge, 241
- Cuccia, C. L.**, voltage control of magnetron frequency, 3528
- Culbertson, A. F.**, with M. H. Kebby, 6-kMc/s system for toll telephone service, 2393
- Cullen, A. L.**, and I. M. Stephenson, experimental investigation of velocity-modulated electron beams, 3524 g
- B. Rogal and S. Okamura, torque-operated wattmeters for 3 cm  $\lambda$ , 2359
- Cullington, A. L.**, artificial aurora, 1569
- Cummack, C. H.**, 'Chapman behaviour' in lower ionosphere, 3301
- and G. A. M. King, disturbance in F region, following nuclear explosion, 3712
- Cummerow, R. L.**, thermally induced glide in Ge, 3363
- Cumming, W. A.**, radiation measurements at r.f., 2714
- and M. Cormier, design data for annular slots, 2849
- Cunliffe, A.**, and R. N. Gould, high-Q echo boxes, 740
- Cunnell, F. A.**, with J. W. Allen, diffusion of Zn in GaAs, 1259
- Curie, C.**, and Y. Descamps, compensation for fluctuations in anode current, 1369
- Curnow, H. J.**, design of multicavity klystrons, 3524 h
- with others, coaxial-line diode, 3524 m
- Currie, C. H.**, carcinotron harmonics boost receiver range, 2006
- Currie, M. R.**, and D. C. Forster, noise-reduction mechanism in electron beams, 1727; minimum noise generation in backward-wave amplifiers, 1734
- Currin, C. G.**, guide for Si dielectrics, 2694
- Curtis, H. E.**, echoes cause f.m. intermodulation, 2396
- Curtis, H. W.**, with others, path combinations in whistler echoes, 1577
- Curtis, O. L.**, Jr, radiation effects on recombination in Ge, 4107
- J. W. Cleland and J. H. Crawford, Jr, radiation-induced recombination centres in Ge, 868
- Cushner, S. H.**, optical-microwave system considerations, 4010 l
- Cutler, M.**, with H. M. Bath, measurement of surface recombination velocity in Si by steady-state photoconductance, 1246
- Cutler, P. H.**, and D. Williams, scatter-signal analyser, 2000 b
- Cutolo, M.**, self-demodulation of waves in ionosphere, 1333 d
- Czaja, W.**, application of thermodynamics of irreversible processes to semiconductors, 2638
- Daams, H.**, with others, Canadian caesium-beam standard of frequency, 2701
- Daddario, A. S.**, transistor blocking-oscillator circuits, 56
- Dahlberg, R.**, theory of thermoelectric cooling, 3449
- Dain, J.**, u.h.f. power amplifiers, 380
- Daisenberger, G.**, with K. H. Fischer, amplification of wide frequency bands, 1490
- Damany, H.**, with S. Minn, influence of Se on conductivity of gold film, 488
- Dammers, B. G.**, A. Boekhorst and D. Hoogmoed, stabilization of line output circuits, 3124
- A. G. W. Uijtens and W. Ebbinge, transistor circuits, temperature-stable, 71, based on half-supply-voltage principle, 755
- A. G. W. Uijtens and H. Heyligers, protection device for stabilized line timebase circuit, 282
- and others, stabilization, of line output circuit, 989, of line and frame output circuits, 3123
- Danforth, J. L.**, design of 10-MeV particle accelerator, 934
- Danforth, W. E.**, polarization studies with ThO<sub>2</sub>, 3335
- Daniel, A. F.**, with D. Linden, power sources for space age, 2399
- Daniel, P. J.**, and others, control of luminescence by charge extraction, 473
- Daniels, F. B.**, causes of geomagnetic fluctuations, 1532
- and S. J. Bauer, Faraday fading of satellite signals, 450
- Daniels, H. L.**, and D. K. Sampson, magnetic drum provides analogue time delay, 1655
- Daniels, J. M.**, with H. Wesemeyer, influence of saturation of paramagnetic resonance absorption on Faraday effect, 2547
- Danielson, G. C.**, with S. Sawada, electrical conduction in WO<sub>3</sub>, 2668
- Danielson, W. E.**, low noise in solid-state parametric amplifiers, 1503
- H. L. McDowell and E. D. Reed, helix travelling-wave amplifier, 2788 a
- Danilin, B. S.**, and others, pressure and density measurements in high atmosphere by earth satellites, 3694
- Danko, S. F.**, W. L. Doxey and J. P. McNaul, micro-module approach to miniaturization, 2485
- Darmony, M.**, and B. Dreyfus-Alain, solid-state diffusion applied to semiconductor devices, 184
- with B. Dreyfus-Alain, Si transistors by alternate doping, 301
- Das, J.**, coder and decoder for teleprinter signals, 1685
- Das, J. N.**, semiconducting properties of pyrolusite, 1266
- with P. V. Khandekar, I/V characteristics of n-p contacts on galena, 3874
- Dash, W. C.**, growth of Si crystals free from dislocations, 3354
- Datta, S.**, electron production rate in F<sub>2</sub> region, 800
- Dautremont, J. L.**, Jr, grounded-grid power-amplifier design, 2884
- Dauvillier, A.**, structure and mechanism of sunspots, 3665

- Davern, W., with P. Dubont, calculation of statistical absorption coefficient, 3920
- David, E. E., Jr, artificial auditory recognition in telephony, 331
- N. Guttman and W. A. van Bergeijk, mechanism of binaural fusion, 1055
- Davidse, J., adaptation of N.T.S.C. system to European standard, 4212
- Davidson, M., H. Joseph and N. Zucker, markerless pulse trains for communication, 956
- Davidson, R., ferrite-cored capacitors, 726
- Davies, D. E. N., radar-systems with electronic sector scanning, 818
- Davies, D. H., and K. F. Sander, electron trajectories in gun of M-type carcinotron, 318
- Davies, D. W., with J. H. Wilkinson, automatic computing engine at N.P.L., 2128
- Davies, J. G., and A. C. B. Lovell, observations of the Russian moon rocket Lunik II, 4051
- and others, radar observations of 1957  $\beta$ , 3290
- Davies, K., with S. Chapman, daytime constancy of absorption of radio waves in lower ionosphere, 809
- Davies, L. W., and D. K. Milne, metallic contacts to Ge and Si, 491
- Davies, M. W., phase-shift consideration in television, 3137
- Davies, R. S., and C. S. Weaver, minimum transmitter weight for space communications, 3141
- Davis, C. F., Jr, M. W. P. Strandberg and R. L. Khyll, electron spin-lattice relaxation times, 417
- Davis, C. M., Jr, with S. F. Ferebee, effect of divalent-ion substitutions on Ni ferrite, 1292
- Davis, D. T., with others, Barkhausen-Kurz oscillator at cm  $\lambda$ , 1486
- Davis, D. W., iatron storage tube, 1746
- Davis, G. L., with others, orientation control for Ge wafers, 1935
- Davis, J. I., with L. W. Schmidt, solar-cell power supply, 4206
- Davis, P., and A. Cohen, rigid radome design, 2475
- Davis, R. M., Jr, E. K. Smith and C. D. Ellyett, sporadic E at v.h.f. in U.S.A., 2587
- Davis, S., magnetic amplifiers for servo systems, 2173
- Davis, W. D., lifetimes and cross-sections in Au-doped Si, 3769
- Davoust, C., with D. Lepchinsky, effects of nuclear explosions on ionospheric soundings, 3710
- Davydov, B. E., with others, producing polymers with semiconductor properties, 4121
- Daw, A. N., with S. Deb, lifetime and diffusion constant of injected carriers, 2043
- Dawson, J. M., nonlinear electron oscillations in cold plasma, 2535
- Day, J. W. B., with others, diffraction of e.m. waves by ridge, 241
- Da-Yu, Ma. See Ma Da-Yu.
- Dearborn, E. F., with J. W. Nielson, growth of single crystals of magnetic garnets, 1289
- Deb, S., and A. N. Daw, lifetime and diffusion constant of injected carriers, 2043
- Decker, R. P., design of rhombic antenna, 3956
- Deeley, E. M., quadratic interpolation in tapped-potentiometer function generators, 2133
- Deering, P. E., with A. H. W. Beck, space-charge waves on annular beams, 3159 k; 3-cavity L-band pulsed klystron amplifier, 3524 e
- Degano, U., with I. Barducci, research on probe microphones, 1429
- DeGrasse, R. W., E. O. Schulz-DuBois and H. E. D. Scovil, 3-level solid-state travelling-wave maser, 2177
- with others, spin refrigeration and maser action at 1 500 Mc/s, 3654
- De Hoop, A. T., with J. P. Schouten, reflection of plane e.m. wave, 1333 v
- De Jager, C., solar radio bursts, 1333 g
- Dekhtyar, M. V., antiferromagnetic orientation in  $\text{Ni}_2\text{Fe}$ , 537
- Dekleva, J., and K. W. Robinson, shunt impedance measurement, 3421
- De Lange, O. E., timing of regenerative repeaters, 967
- and M. Pustelnik, timing of regenerative repeaters, 968
- Delcroix, J. L., with others, wave interaction in gas, 1333 a
- De Loach, C. B., and W. M. Sharpless, X-band parametric amplifier, 4006
- Delves, L. M., with H. A. Whale, relations between bearing and amplitude of fading radio wave, 947
- Delves, R., with others, magnetothermal resistance and magnetothermoelectric effects in  $\text{Bi}_2\text{Te}_3$ , 182
- Delves, R. T., transport coefficients for polar semiconductors, 2642
- Demmy, R. C., with others, 21-in glass colour picture tube, 280
- Denes, P., mechanical speech recognizer, 2451
- Dennis, J. F., with M. R. Kundu, solar radiation at dm  $\lambda$  as index for ionospheric studies, 787
- with others, wave interaction in gas, 1333 a
- Dennard, R. H., ferroresonant series circuit containing square-loop reactor, 2141
- De Prins, J., with J. P. Blaser, comparison of astronomical time measurements with atomic frequency standards, 914
- with others, improvements in  $\text{NH}_3$  maser, 758 g
- Derick, L., with C. J. Frosch, diffusion control in Si, 4096
- Dermitt, G., with F. A. Stahl, Ge photo-tetrode, 308
- Deryagin, B. V., with V. P. Smilga, role of surface properties of semiconductors in adhesion, 495
- Desautels, A. N., stable d.c. transistor servo pre-amplifier, 2176
- Descamps, Y., effect of thermal delay with grid compensation, 3864
- with C. Curie, compensation for fluctuations in anode current, 1369
- Deschamps, A., with others, substitution of Al, Ga and Cr in  $\text{BaO}_6\text{Fe}_2\text{O}_3$ , 541
- Desloge, E. A., S. W. Malthysse and H. Margenau, conductivity of plasmas to microwaves, 1842
- Dessler, A. J., hydromagnetic waves, above ionosphere, 110, ionospheric heating by, 2585; effect of magnetic anomaly on particle radiation, 3662; upper-atmosphere density variations due to hydromagnetic heating, 4057
- Dessoulaye, R., feedback in transistor amplifiers, 3239
- Destriau, G., 'memory' effect in enhancement of luminescence, 1213
- Detert, K., with G. W. Wiener, cube-oriented magnetic sheet, 896
- Deutsch, J., ferrites and their microwave applications, 4140
- Deutsch, S., reduced television bandwidth, 982
- Deutscher, K., interference photocathodes of increased yield, 2053
- De Vaux, L. H., with others, infrared detectors, 4239
- Deverall, G. V., with others, optics and photography in flying-spot store, 2363
- DeVore, H. B., powder photoconductors, 1902
- Devyatkov, N. D., electronic devices for extremely high frequencies, 641
- Devyatkova, E. D., and I. A. Smirnov, thermo-conductivity of Ge, 1620
- De Waard, R., and E. M. Wormser, thermal detectors, 4010 g
- De Witt, R. N., with others, auroral ionosphere studies using earth satellites, 4052
- Dhar Bhowmik, P., with J. N. Bhar, study of noon  $\text{F}_2$  ionization, 2584
- Diamantides, N. D., converting recorders to rectilinear outputs, 1695
- Dickerson, A. F., with others, thermionic integrated micromodules, 2863
- Dickinson, W. A., and W. D. Schuster, picture tubes with  $110^\circ$  deflection, 284
- Diemer, G., G. J. van Gurp and W. Hoogenstraaten, exciton diffusion in CdS crystals, 2265
- and A. J. Van der Horwen van Oordt, nature of blue edge emission in CdS, 2269
- H. A. Klasens and P. Zalm, electroluminescence and image intensification, 1597
- Dieminger, W., pulse propagation experiments, 1333 e
- H. G. Möller and C. Rose, long-distance single-F-hop transmission, 943; sweep-frequency oblique-incidence pulse transmissions, 2378
- Dierck, E. A., with others, temperature dependence of electron emission of Bi films, 2619
- Diesel, T. J., with others, primary pyroelectricity in  $\text{BaTiO}_3$  ceramics, 156
- Diestel, H. G., and W. Mühe, reciprocity method for vibration measurements, 3178
- Dieter, F. A., with others, analysis of emissive phase of pulsed maser, 756
- Dillenburg, W., standards converter using vidicon camera, 2405; limiters in television equipment, 3491
- Dillon, J. A., Jr, R. E. Schier and H. E. Farnsworth, surface properties of SiC crystals, 3022
- Dillon, J. F., Jr, observation of domains in ferrimagnetic garnets by transmitted light, 200; ferrimagnetic resonance in Y-Fe garnet, 907; magnetostatic modes in ferrimagnetic spheres, 908
- and H. E. Earl, Jr, domain-wall motion and resonance in Mn ferrite, 1958
- and J. W. Nielsen, effect of impurities on resonance in Y-Fe garnet, 3811
- Dion, A., nonresonant slotted arrays, 3202
- Diserens, N. J., with K. H. Kreuchen, development of high-power klystrons, 3524 i
- Ditchfield, C. R., and P. A. Forrester, maser action in 60°K region, 1143
- Ditl, A., amplitude and frequency of modulated carrier wave, 2007; power transmission at high efficiency, 3944
- Dix, C. H., and R. G. Robertshaw, pulsed travelling-wave tubes in 10-Gc/s region, 2788 m
- Dix, J. C., and M. Sherry, microwave reflectometer display system, 1308, (D)2703
- Dixon, J. R., and D. P. Enright, effect of heat treatment on InAs, 3032
- with F. Stern, narrowing energy gap in semiconductors by compensation, 1917
- Dixon, N. E., phase relations in stagger-tuned klystron amplifier, 3524 d
- Dizer, M., sudden disappearance of filaments and magnetic storms, 2948
- Diugatch, I., optimizing antenna switches, 3568; miniature resonators for u.h.f., 3604
- Dnestrovskii, Yu. N., variation of natural frequencies of membranes, 1039
- Doak, P. E., fluctuations of sound pressure when receiver position is varied, 3915
- Dobesch, H., characteristics of all-pass filters for delay equalization, 737
- F. Weide and H. Sulanke, equalization in television transmission by cable, 3488
- Dobrov, W. I., with others, primary pyroelectricity in  $\text{BaTiO}_3$  ceramics, 156
- Dobryakova, F. F., with others, electron concentration of ionosphere from observations of first earth satellite, 3298
- Doctor, N. J., with others, D.O.F.L. microelectronics program, 2484
- Doehler, O., A. Dubois and D. Maillart, M-type pulsed amplifier, 2788 k
- B. Epsztajn and J. Arnaud, characteristics of carmatron tube, 2788 f
- with others, electron velocities and pass band in travelling-wave amplifiers, 316
- Doehring, A., with others, fixed-frequency cyclotron with one dee, 1985
- Doherty, L. H., and G. Neal, 215-mile radiolink, 4202
- Dolginov, S. Sh., with N. V. Pushkov, investigation of earth's magnetic field using earth satellite, 3693
- Dolphin, L., with others, radar investigations of auroral echoes, 4065
- Domb, C., fluctuation phenomena and stochastic processes, 4007
- Döme, P., with J. Lüscher, transistor simulator, 4156
- Dome, R. B., inexpensive sound for television receivers, 2027; amplifier design reduces plate dissipation, 2514
- Doniach, S., lattice screening in polar semiconductors, 3344
- Donovan, B., with J. C. Anderson, internal ferromagnetic resonance in Ni, 2684
- Dooley, J. C., Melbourne-Toolangi magnetic observatory, 1531
- Dorbrotn, N. A., investigation of cosmic rays by earth satellites, 3690
- Doremus, L. W., charge release of ceramic ferro-electrics, 2630
- Dorendorf, H., dislocations in Ge, 1247
- Dorgelo, E. G., output and load resistance of triodes for r.f. heating, 2072; oscillator triodes in h.f. generators with variable load, 2795; current limitation of c.w. magnetrons, 3162
- and J. C. van Warmerdam, intermittent use of valves in r.f. heating generators, 2071
- Dortort, I. K., current-balancing reactors for semiconductor rectifiers, 606
- Dosse, D., theory of wide-band distributed amplifiers, 747
- Douce, J. L., and J. C. West, magnetic-drum store for analogue computing, 348
- Doucette, E. I., with others, semiconductor current limiter, 1368
- Dougal, A. A., with E. P. Bialecke, electron-ion recombination coefficient in nitrogen, 125
- Dougharty, W., broad-band coupled circuits, 3995
- Dousmanis, G. C., semiconductor surface potential from field-induced changes, 851; effects of carrier injection on recombination velocity, 1916
- and R. C. Duncan, Jr, space-charge regions in semiconductor surfaces, 848
- and others, evidence for carriers with negative mass, 875
- Dowden, R. L., and G. T. Goldstone, 'whistler mode' echoes, 2731
- Doxey, W. L., with others, micro-module approach to miniaturization, 2485
- Doyle, R. J., R. A. Meyer and R. P. Pedowitz, automatic failure recovery in data processing system, 1453
- Doyle, W. T., selective photoelectric effect, 4075
- Drabble, J. R., galvanomagnetic effects in p-type  $\text{Bi}_2\text{Te}_3$ , 183; effect of strain on thermoelectric properties of many-valley semiconductor, 854
- and C. H. L. Goodman, chemical bonding in  $\text{Bi}_2\text{Te}_3$ , 531
- and R. D. Groves, strain-induced changes in Seebeck coefficient of n-type Ge, 3374
- Drachev, L. A., with others, large inhomogeneities in  $\text{F}_2$  layer, 2581
- Dracott, E. D., with others, high-power 400-Mc/s klystron, 3524 j
- Dransfield, K., with H. E. Bömmel, attenuation of hypersonic waves in quartz, 2636; excitation of hypersonic waves by ferromagnetic resonance, 3817
- Drechsel, D., test equipment for ferrites, 4155
- Drechsel, W., with J. Kranz, observation of Weiss domains in polycrystalline material, 1281
- Dreher, J. J., with J. J. O'Neill, word masking by prolonged vowel sounds, 680
- Dresner, J., with H. Kallmann, excitation of luminescent materials by ionizing radiation, 3325
- Drewes, G. W. J., with others, h.f. susceptibilities of paramagnetic alums, 2332
- Dreyfus-Alain, B., and M. Darmony, Si transistors by alternate doping, 301
- with M. Darmony, solid-state diffusion applied to semiconductor devices, 184
- Driatski, V. M., and A. S. Besprozvannaya, ionospheric conditions in the circumpolar region, 3717
- Drickamer, H. G., with T. E. Slykhouse, effect of pressure on absorption edge of Ge and Si, 1243
- Drougard, M. E., with others, electromechanical behaviour of  $\text{BaTiO}_3$ , 3334
- Drozdo, N. G., with others, investigations on Li-Zn ferrites, 1957
- Drummond, J. E., microwave propagation in hot magneto-plasmas, 1841
- with A. H. Allan, Doppler measurements on Soviet satellites, 443
- Dryden, J. S., measurement of dielectric properties of liquids in  $\text{H}_2$  resonator, 922
- and R. J. Meakins, impregnants for paper capacitors, 1474
- Dubois, A., with others, M-type pulsed amplifier, 2788 k
- Dubois, R., Ge power transistors, 302
- Dubont, P., and W. Davern, calculation of statistical absorption coefficient, 3920
- Duclaux, F., and R. Will, lunar-diurnal variation of geomagnetic field, 2228
- Dudding, R. W., and D. J. Finnett, application of organic films to phosphor screens, 2438
- Dudkin, L. D., and N. Kh. Abrikosov, alloying of semiconductor compound  $\text{CoSb}_3$ , 2667
- Dudley, H., phonetic pattern recognition vocoder for narrow-band speech transmission, 1057
- and S. Balashek, automatic recognition of phonetic patterns in speech, 1061
- Dudley, M. D., phosphors for c.r. tubes, 4254
- Duffus, H. J., J. A. Shand and C. Wright, causes of geomagnetic fluctuations with 6-sec period, 2945
- and others, geographical variations in geomagnetic micropulsations, 2946
- Duggan, T. C., with D. A. Bell, relative speeds of telegraphic codes, 593
- DuHamel, R. H., and J. W. Duncan, launching efficiency of wires and slots, 2830
- with J. W. Duncan, radiation from dielectric rod waveguides, 1095
- Duinker, S., traditors, 2872

- Duivenstijn, A. J., 30 years' s.w. broadcasting in Netherlands, 265
- Dulberger, L. H., pulse amplifier with nonlinear feedback, 386; improved RC oscillator, 1808
- Dummer, G. W. A., future electronic components, 354
- Dumont, A., and H. d'Hoop, measurement of pulsed powers at m, 3829
- Duncan, J. W., and R. H. DuHamel, radiation from dielectric rod waveguides, 1095
- with R. H. DuHamel, launching efficiency of wires and slots, 2830
- Duncan, R., and G. R. Ellis, subvisual aurorae and radio noise bursts, 2974
- Duncan, R. A., computations of electron density distributions in ionosphere, 126
- Duncan, R. C., Jr., with G. C. Dousmanis, space-charge regions in semiconductor surfaces, 848
- with others, evidence for carriers with negative mass, 875
- Dunham, B., and others, multipurpose bias device of logical elements, 1461
- Dunn, A. F., unit of capacitance, 2699
- Dunn, D. A., wide-band microwave tubes, 642; travelling-wave amplifiers and backward-wave oscillators for v.h.f., 1024
- with others, 20–40-kMc/s backward-wave oscillator, 1742
- Dunn, G. A., and N. C. Hekimian, tube-transistor hybrids, 2877
- Dunn, J. H., and D. D. Howard, effects of a.g.c. on accuracy of monopulse radar, 1894
- D. D. Howard and A. M. King, scintillation noise in radar tracking systems, 2609
- Dunsmuir, R., theory of circular magnetrons with rotating space charge, 2788 g
- Dunstan, E. M., and M. J. Somerville, i.f. noise reduction in feedback integrators, 369
- Durandeu, P., B. Fagot and C. Fert, spherical aberration in magnetic lenses, 3838
- B. Fagot and M. Laudet, measurement of induction in magnetic electron lenses, 2704
- Dutka, J., error-correcting techniques, 1358
- Dutton, D., anisotropy of edge luminescence in CdS, 474; fundamental absorption edge in CdS, 1208
- with A. Smith, behaviour of PbS photocells in ultraviolet, 1407
- Dutton, J., and E. Jones, electrical discharges, 2196
- van Duuren, K., and J. Hermens, halogen-quenched end-window Geiger counters, 3079
- A. J. M. Jaspers and J. Hermens, G-M counters, 3446
- Dwight, K., with N. Menyuk, low-temperature transition in Ni-Fe ferrite, 902
- D'yakonova, T. S., with A. I. Likhner, dependence of Hall effect on pressure in n-type Ge, 2663
- Dye, N. E., and others, vacuum-diode microwave detection, 2794
- Dyer, R. F., with D. K. Bisson, Si-controlled rectifier, 4227
- Dymanus, A., high-Q Stark cell for microwave spectrometers, 2209
- Dyott, R. B., with D. E. T. F. Ashby, measuring modulation noise of c.w. klystron amplifier, 3524 k
- Dyson, J. D., capacitance of two infinite cones, 3820; equiangular spiral antenna, 3949
- Earl, H. E., Jr., with J. F. Dillon, Jr., domain-wall motion and resonance in Mn ferrite, 1958
- Early, J. M., structure-determined gain-band product of junction triode, 997
- Earp, C. W., and D. L. Cooper-Jones, evolution of commutated-aerial d.f. systems, 2259 k
- Easter, B., G. H. Maddock and R. G. Medhurst, dependence of combiner diversity gain on signal-level distribution, 4191
- Easterday, J. L., and H. Braner, derating requirements for carbon composition resistors, 2491
- Eastman, P. C., with M. S. Sodha, nondegenerate semiconductors, Hall mobility in, 856; mobility of electrons in, 1225; drift and Hall mobility in, 3340
- Easton, R. L., and M. J. Volaw, Vanguard I, 1868
- Eastwood, E., and C. D. Colchester, ground radar for civil aviation, 2259 p
- J. D. Bell and N. R. Phelps, ring angels over south-east England, 2982
- Eastwood, W. S., L. B. Mullett and J. L. Putman, miniature nuclear generator, 2757
- Ebbinge, W., with others, transistor circuits, temperature-stable, 71, based on half-supply-voltage principle, 755
- Eber, D., and A. Straub, design of Südwestfunk studio building, 3182
- Eberbeck, W., K-edge structures of elements of  $A_{111}B_v$  compounds, 853
- Eberhard, E., with W. R. McSpadden, designing transistor oscillators, 746
- Ebermann, R., influence of carrier f.m. on p.w.m., 4194
- Echizenya, Y., with others,  $F_2$ -layer multiple reflections, 1342
- Eckardt, W., measurements on television-camera preamplifiers, 3115
- Eckart, G., rotation of polarization of electric waves, 3451
- Eckels, A., with others, earth's gravitational potential from satellite orbit, 1867; Vanguard measurements of earth's figure, 2236
- Ecker, G., and J. Fassbender, conduction mechanism of CdS sandwich photocells, 1406
- Eckhardt, H. E., and A. G. Robeer, 100-kW s.w. broadcast transmitter, 293
- Edels, H., with Y. Ettinger, time-controlled unit-function constant-voltage generator, 4205
- Eden, E., designing optimum transmitter networks, 3501
- Edens, A. H., sealing window and cone of television picture tubes, 1035
- Edge, D. O., P. A. G. Scheuer and J. R. Shakeshaft, spatial distribution of radio sources at 159 Mc/s, 103
- Edmond, J. T., behaviour of impurities in III-V compounds, 2641
- Edmonds, D. T., and R. G. Petersen, effective exchange constant in Y-Fe garnet, 3401
- Edsman, S., new electron tubes for wide-band amplifiers, 1032
- Edwards, C., influence of output time-constant of cathode follower, 751
- Edwards, K. A., O. Golubjatnikov and D. J. Brady, transistor phase-locked oscillators, 2162
- Edwards, L. C., with D. A. Hedlund, polarization fading over oblique-incidence path, 1668
- Edwards, S. F., classical plasma, equilibrium properties of, 86; charge density of, 87; evaluation of conductivity in metals, 1507
- Efimov, E. A., and I. G. Erusalimchik, Ge electrode with p-n junction, 527
- Efermov, A. I., with S. L. Mandel'shtam, ultraviolet solar radiation, 3664
- Egan, R. D., with others, 3-frequency back-scatter sounder, 1565
- Egorov, V. A., dynamic problems of flight to moon, 3675
- Ehlers, H., and H. Thies, synchronizing transmitter frequencies, 4224
- Ehrenreich, H., transport of electrons in intrinsic InSb, 4117
- with others, observation of phonons during tunnelling in junction diodes, 4226
- Eichenbaum, A. L., and R. W. Peter, exponential gun, 2064
- Eichhoff, G., emission spectra and absorption edge of S in CdS, 1216
- Eichholz, J. J., C. F. Nelson and G. T. Weiss, extended-range distributed-amplifier design, 1492
- Eichin, V. A., with A. P. Vyatkin, origin of fluctuation of crystal triode parameters, 628
- Eichin, W., and G. Landauer, gain and stability of travelling-wave valve, 1411
- Eidman, Y. Ya., with V. L. Ginzburg, Cherenkov radiation from dipoles, 3647
- Einspruch, N. G., with others, temperature dependence of fractional velocity changes in Si, 3355
- Eisenhauer, C. M., with others, lattice vibrations in Ge by neutron scattering, 2304
- Eklund, F., with B. Josephson, microwave propagation experiences, 3091
- Eklund, K., operational amplifiers in current regulators, 3113
- Ekstrom, J. L., simplified product detector design, 2898
- Elders, D., construction concept for linear delay lines, 697
- Eldredge, K. R., F. J. Kamphoefner and P. H. Wendi, automatic input equipment for data processing, 3586
- Eldridge, D., digital technique for computer use, 2127
- Elford, W. G., with others, c.w. technique for measurement of meteor velocities, 105
- Elgarøy, Ø., fine structure of solar bursts in 200-Mc/s range, 2935
- Elias, P., computation in presence of noise, 345
- Eliezer, C. J., consistency condition for electron wave functions, 2537
- Elliot, R. J., T. P. McLean and G. G. Macfarlane, effect of magnetic field on absorption edge in semiconductors, 501
- Elliot, R. S., pulse waveform degradation in waveguide, 1071
- and K. C. Kelly, serrated waveguide, 1074
- with others, U.R.S.I. report on antennas and waveguides, 3565
- Ellis, G. R., trapping of cosmic radio waves beneath ionosphere, 788
- with R. Duncan, sub-visual aurorae and radio noise bursts, 2974
- Ellis, S. G., growth of GaAs crystals from melt, 3382
- Ellyett, C., and H. Leighton, solar-cycle influence on lower ionosphere and v.h.f. scatter, 130
- Ellyett, C. D., with others, sporadic E at v.h.f. in U.S.A., 2587
- Elmsore, B., positions of 17 intense radio stars, 2932
- Emreus, K. G., and D. W. Mahaffey, transit-time relation for plasma electron oscillations, 1840
- Endler, H., A. D. Berk and W. L. Whirry, relaxation phenomena in diode parametric amplifiers, 3626
- Eneev, T. M., with D. E. Okhotsimskii, variational problems of satellite launching, 3680
- with others, determination of lifetime of artificial earth satellite, 3681
- Enemark, D., transistors improve telemeter transmitter, 2373
- Engbert, W., manufacture and characteristics of junction transistors, 4229
- Engel, H. A., ion focusing properties of quadrupole lens pair, 2721
- Engelmann, R. H., wide-band amplifier design data, 1491
- Engen, G. F., amplitude stabilization of microwave signal source, 2353
- Enkel, F., automatic monitoring of broadcast channels, 1397
- Enoch, J. M., and G. A. Fry, model retinal receptor, 1325
- Enright, D. P., with J. R. Dixon, effect of heat treatment on InAs, 3032
- Enslein, K., Si junction diodes as voltage-reference devices, 2039
- Enz, U., relation between disaccommodation and magnetic properties of Mn ferrite, 2327
- Epprecht, G. W., low-reflection discontinuities in diameter of coaxial lines, 1073; circle diagram for transformations in transmission-line technique, 2460; compensated support disks for coaxial lines, 3926
- Epstein, M., with others, magnetostrictive delay line for video signals, 1134
- Epsztein, B., large-signal behaviour in M-type valves, 2788 ee
- with others, electron velocities and pass band in travelling-wave amplifiers, 316; characteristics of carmatron tube, 2788 r
- Ernest, J., radiation from fine slot, 21, 22; conical radiation from travelling-wave slot, 3580
- Erusalimchik, I. G., with E. A. Efimov, Ge electrode with p-n junction, 527
- Esaki, L., with T. Yajima, excess noise in narrow Ge p-n junctions, 1257
- Eshelby, J. D., elastic model of lattice defects, 1173
- Eshleman, V. R., with L. A. Manning, meteors in ionosphere, 1526; Booker's theory of meteoric reflection, 1527
- Esin, O. A., with V. L. Zyznev, influence of short-range order on type of conductivity, 3750
- Essen, L., E. G. Hope and J. V. L. Parry, circuits in N.P.L. Cs standard, 2340
- and others, comparison of Cs frequency standards, 212
- Ettinger, Y., and H. Edels, time-controlled unit-function constant-voltage generator, 4205
- Evans, D. M., dependence of minority-carrier lifetime on majority-carrier density, 849; temperature dependence of mobility and lifetime in Si transistors, 3150
- Evans, H. W., with S. D. Hathaway, radio attenuation at 11 kMc/s, 1673, 2381
- Evans, J. V., with others, radar observations of 1957  $\beta$ , 3290
- Evseev, V. M., operational amplifier without stabilized power supply, 1494
- Ewing, R. D., with R. D. Spence, antiferromagnetism in  $\text{Cu}(\text{CO})_3(\text{OH})$ , 1947
- Eyraud, I., and P. Bonijoly, differential bridge for impedance measurements, 3429
- Eyraud, J. P., with others, instrumenting Explorer I, 1547
- Fagot, B., with others, magnetic lenses, measurement of induction in, 2704, spherical aberration in, 3838
- Fabring, R. H., with W. E. Medcalf, growth of CdS crystals, 4077
- Fain, V. M., with V. L. Ginzburg, quantum effects in interactions in resonators, 1844
- Fakidov, I. G., and E. A. Zavadskii, oscillation of resistance of n-type Ge in pulsed magnetic fields, 872
- Fälker, R., and E. E. Hücking, magnetic measurements on ferrite U-cores, 3057
- Fan, H. Y., and A. K. Ramdas, infrared absorption and photoconductivity in irradiated Si, 4089 b
- with P. Fisher, absorption effects of group III impurities in Ge, 3366
- with R. A. Laff, magnetoresistance in n-type Ge, 870
- with others, photoconduction of Ge after bombardment, 3027
- Fan Shou-syan'. See Shou-syan' Fan.
- Fang, P. H., conductivity of plasmas to microwaves, 2202
- and W. S. Brower, temperature dependence of breakdown field of  $\text{BaTiO}_3$ , 2627
- Fant, G., acoustic studies of speech, 1058
- Farber, R. J., with S. P. Ronzheimer, measurement of colour television receiver performance, 986
- Farmer, J. C., long-range radio navigation aids, 2259 b
- Farnell, G. W., axial phase anomaly for microwave lenses, 713
- Farnsworth, H. E., with H. H. Madden, high-vacuum studies of surface recombination velocity for Ge, 1248
- with others, surface properties of SiC crystals, 3022
- Farrands, J. L., with others, observations of detonation by interferometer, 3068
- Farris, H. W., alternative detection of co-channel f.m. signals, 581
- Fassbender, J., with G. Ecker, detection mechanism of CdS sandwich photocells, 1406
- Fatehchand, R., characteristics of random noise in television, 3140
- and R. Ahmed, electronic speech sampler, 2820
- Favre, M., cross-field carcinotrons under pulse operation, 2788 s
- Feaster, G. R., thermionic diodes as energy converters, 324
- Federici, M., sound echo reflected from sphere under pulse conditions, 1046
- Fedorov, E. K., investigation of upper atmosphere by rockets and satellites, 439
- Fedorov, G. V., with others, Hall-effect in pure Ni at He temperatures, 2322; change of sign of Hall constant in alloys, 2675
- Fehler, G., nuclear polarization via 'hot' conduction electrons, 4011; electron-spin-resonance experiments on donors in Si, 4098
- and E. A. Gere, electron-spin-resonance experiments on donors in Si, 4099
- D. K. Wilson and E. A. Gere, electron-spin-resonance experiments on Ge, 3775
- Feibelman, W. A., 27-kc/s anomaly in sudden enhancement of atmospherics, 1579; geophysical effects of nuclear explosions, 4056
- Feigin, M. I., with N. A. Zhelezisov, operating conditions of symmetrical multivibrator, 1806
- Feinberg, E. L., propagation of radiowaves along inhomogeneous surface, 3841
- Feinberg, R., effect of temperature on persistence of c.r. tube screens, 2440; luminescence of short-persistence phosphors, 3001; effect of trigger pulse polarity in cold-cathode tetrode, 3174
- Feldman, E. J., microwave diodes, 3877
- Feldman, L. F., f.m. tuner adaptor for multiplexed stereo, 1679

- Feldmann, W. L., with G. L. Pearson, powder-pattern techniques, for delineating domain structures, 4085
- Felix, M. O., with A. J. Buxton, reduction of threshold by frequency compression, 2000 q
- Fellows, E. C., with R. Bailey, stabilization of 9-kW electromagnet, 3072
- Felsen, L. B., radiation from ring sources, 3965
- Fen, G. I., valence semiconductors—Ge and Si, 3351
- Fennick, B., phase-selective gate rejects quadrature, 719
- Fenton, A. G., and others, decreases in cosmic-ray intensity during period October 1956–January 1958, 4037
- Fer, F., cyclotrons with star-shaped field, 2370
- Ferebee, S. F., and C. M. Davis, Jr, effect of divalent-ion substitutions on Ni ferrite, 1292
- Ferguson, K. H., with others, generation of stable carrier frequencies, 3987
- Fernandes, A. A. de C., design of rhombic antenna arrays, 3576
- Ferro, A., with others, instability of Bloch walls in ferromagnetic material, 535
- Fert, C., and F. Pradal, energy spectrum of electron beam passing through thin film, 3255
- with others, spherical aberration in magnetic lenses, 3838
- Fewer, D. R., transistor nonlinearity, 1817
- Fiala, W. T., acoustic-front damping, 2455
- with J. K. Hilliard, generating high-intensity sound with loudspeakers, 692
- Fiedler, H., influence of penetration factor fluctuations on triode Type 2C40, 2437
- Fiedler, H. C., with others, cube-oriented magnetic sheet, 896
- Fieguth, J., tropospheric scatter propagation and equipment, 3452
- Field, A. G., predicting reliability of complex equipment, 2806
- Field, G. C., trap improves TV picture, 988
- Fife, S. L., 3-band aerial combining network, 733
- Finn, G., and R. Parsons, Si and rectifier design, 604
- Finnett, D. J., with R. W. Dudding, application of organic films to phosphor screens, 2438
- Finney, J. W., with others, I.G.V. observations of F-layer scatter in Far East, 2733
- Finzi, L. A., and J. J. Swozzi, feedback in magnetic amplifiers, 2172, 3998
- Firsov, Yu. A., magnetic susceptibility in Te-type semiconductors, 1607; cyclotron resonance in semiconductors, 2647
- Fischbacher, R. E., reliability in electronic instrumentation, 2076
- Fischell, R. E., with others, radiation effects in magnetic materials, 196
- Fischer, F. A., equivalent circuits for transient vibrations of transducers, 3904
- Fischer, G., FeSe<sub>2</sub> semiconductor, 885
- Fischer, K., multicoupler and antenna amplifier for v.h.f., 749
- Fischer, K. H., and G. Daisenberger, amplification of wide frequency bands, 1490
- Fischer, T., with G. Busch, field emission from semiconductors, 3016
- Fischman, M., transistorized horizontal deflection, 3870
- Fischmann-Arbel, A., sampling comparator, 919
- Fisher, F., and I. P. Valkó, new mechanism for generation of flicker noise, 1028
- Fisher, M. E., and M. F. Sykes, Ising model of ferromagnetism, 3263
- Fisher, P., and H. Y. Fan, absorption effects of group III impurities in Ge, 3366
- Fistul', V. L., with R. N. Rubinshteyn, determination of surface conductivity of semiconducting crystals, 2671
- Fitch, E., and R. Ruddlesden, aerial height for ionospheric scatter links, 2000 c
- Fitzgerald, E. R., mechanical resonance dispersion in quartz at a.f., 1219
- Fitzky, H. G., frequency standard for microwave spectrometers, 3054
- Fix, H., portable television cameras for outside broadcasts, 2026
- Fleischer, H., radio observations of earth satellites, 3289
- Fleischer, I., communication theory for infinite alphabets, 958
- Fleishman, B. S., optimum detector for weak signals in noise, 2004
- Fletcher, P. C., and R. O. Bell, ferrimagnetic resonance modes in spheres, 2928
- I. H. Solt, Jr, and R. O. Bell, magnetostatic modes of ferrimagnetic spheres, 3813
- Flinn, M., with others, high-power 400-Mc/s klystron, 3524 j
- Flint, R. B., with S. R. Anderson, C.A.A. Doppler omnirange, 2610
- Flippen, R. B., with J. H. Wasilik, piezoelectric effect in InSb, 180
- Florine, J., practical applications of semiconductors, 3233
- Flubacher, P., A. J. Leadbetter and J. A. Morrison, heat capacity of pure Si and Ge, 3353
- Flügge, S., Handbuch der Physik, Vol. 16, (B)3657
- Flunkert, H., with H. E. Müser, upper Curie temperature and domain structure in Rochelle salt, 1218
- Flynn, J. B., saturation currents in Ge and Si electrodes, 4093
- Foldes, P., travelling-wave cylindrical antenna design, 3569
- and L. Solymar, lens-aerial design, 1100
- Follingstad, H. G., linear characterization of transistors, 2048
- Fomenko, L. A., magnetic spectra of ferrites, 3398
- Foner, S., L. R. Momo and A. Mayer, multilevel pulsed-field maser, 3623
- Foot, J. B. L., with others, propagation measurements at 3480 Mc/s, 2000 r
- Forbes, G. R., Jr, with others, tracking earth satellites, 123
- Forbush, S. E., cosmic-ray intensity variations during solar cycles, 1523
- Forgue, S. V., with G. A. Morton, infrared pickup tube, 4242
- Forman, J. M., and G. P. Kirkpatrick, screen persistence of colour picture tubes, 4218
- Formwalt, J. M., with D. T. Barry, underwater missile tracking instrumentation, 2597
- Forrer, M. P., analysis of mpw pulse transmission, 362
- Forrester, A. T., with others, evidence for energy gap in superconductors, 393
- Forrester, P. A., with G. R. Ditchfield, maser action in 60°K region, 1143
- Forster, D. C., with M. R. Currie, noise-reduction mechanism in electron beams, 1727; minimum noise generation in backward-wave amplifiers, 1734
- Forster, J. H., and N. S. Velovic, effect of surface potential on junction characteristics, 3390
- Forsyth, P. A., forward-scattered signal from overdense meteor trail, 576
- with C. Collins, bistatic radio investigation of auroral ionization, 2001
- Fort, E., with others, ionization chambers as sources of current, 4152
- Forte, S. S., synthesis of 2-terminal-pair networks, 2146; design of band-pass filters in waveguides, 3939
- Fortini, M. M., and J. Vilms, solid-state generator for microwave power, 3991
- Fortunatova, N. N., with others, Ge with Fe impurity, recombination of current carriers in, 1933, effect of annealing on carrier lifetime in, 1934
- Foster, H., with others, design of high-power S-band magnetron, 2788 d
- Foster, J. S., microwave antenna with sawtooth scan, 2121
- Foster, K., impedance and phase velocity of triplate line, 701
- Foulds, K. W. H., and P. M. J. C. da S. Sampaio, electric-field distributions in waveguide containing dielectric slab, 3940
- Fowler, A. B., contact potential measurements on cleaned Ge surfaces, 3360
- Fowler, J. F., with others, conductivity induced by radiation in CdS and polyethylene, 2672
- Fowler, J. K., with others, low-noise travelling-wave tubes, 2063
- Fowler, P. H., and C. J. Waddington, artificial aurora, 1888
- Fowler, T. C. R. S., 6-channel high-frequency telemetry system, 4173
- Fraloli, A. V., solid-state electrolytic capacitors, 1111
- Frank, L. A., with J. A. Van Allen, radiation around the earth, 2553; radiation measurements with Pioneer IV, 4041
- Frankl, D. R., electroluminescence of ZnS crystals with cathode barriers, 835
- Franklin, C. A., with others, lightweight airborne navigation system, 2599
- Franklin, K. L., and B. F. Burke, observations of planet Jupiter, 1522
- Franklin, P. J., with others, voltage-sensitive switch, 39
- Fransen, J. J. B., and H. J. R. Perdijk, Ba getter films, 2613
- Frantz, G. R., development of DEW line, 1592
- Fränz, K., P. A. Mann and J. Vocotides, conductance of dipoles, 1089
- Fray, S. J., with others, waveguides for use in cryostats, 1767
- Frazier, W., and R. E. Schemel, modulator as phase detector, 2899
- Fredericks, W. J., with R. L. Kelly, polarization of excitation bands in CdS, 2991
- Freedman, A. L., magnetic-core matrices for logical functions, 2860
- Freethey, F. E., with others, ceramic X-band cavity resonators, 363
- Frei, A. H., and M. J. O. Strutt, analogue-computer measurements on diodes and transistors, 3508
- Freier, P. S., E. P. Ney and C. J. Waddington, cosmic-ray  $\alpha$  particles during solar maximum, 3279
- with others, protons from sun 12th May 1959, 4040
- Freitag, W., and H. J. Martin, electronic ultrasonic image converter, 2084
- Fréon, A., J. Berry and J. P. Coste, recurrent variations in the intensity of primary cosmic radiation, 3278
- Frerichs, R., and R. Handy, electroluminescence in Cu<sub>2</sub>O, 3005
- Fric, C., magnetic-field stabilizer with feedback, 1365
- Fricke, S. J., and others, u.h.f. signals reflected from moon, 1525
- Fridrikhov, S. A., with others, secondary emission from Ni, 3789
- Fried, L., forced-convection cooled electronic equipment, 1750
- Friedel, J., electron structure of metals, 418
- Friedhelm, H. O., hybrid transformers, 1468
- Friedman, H., rocket observations of ionosphere, 1559
- Friedman, I. B., constant-voltage regulators, 607
- Friedrich, J., with H. Schirmer, electrical conductivity of plasma, 1161
- Frielinghaus, R., with others, generation of very short ultrasonic pulses, 2078
- Frisch, E., two-valve oscillators in  $\pi$ -network form, 3985
- Frisch, H. L., with others, formation of donor states in heat-treated Si, 1926
- Frischmann, P. G., with others, cube-oriented magnetic sheet, 896
- Fritzche, H., resistivity and Hall coefficient of Sb-doped Ge, 526
- and K. Lark-Horovitz, effect of minority impurities in p-type Ge, 2658
- Frøese, C., calculation of velocity of sound in sea-water, 3903
- Fröling, H. E., short aerial systems, 3946
- Froome, K. D., velocity of e.m. waves, 2190
- Frosch, C. J., and L. Derick, diffusion control in Si, 4096
- with others, infrared properties of SiC film, 2298
- Frösche, E., etching method for manufacture of thin base layers of n-type Ge, 2665
- Frumkin, A. L., with others, investigations on Li-Zn ferrites, 1957
- Fry, D. B., theory of mechanical speech recognition, 2452
- Fry, G. A., with J. M. Enoch, model retinal receptor, 1325
- Fryer, T. B., frequency analyser with two reference signals, 2712
- Fubini, E. G., and E. A. Guillemin, minimum-insertion-loss filters, 1117
- Fujii, S., with others, proof of mode theory of v.l.f. ionospheric propagation, 3094
- Fujii, T., and A. Saburi, analysis of electron beam by mechanical scanner, 3524 i
- with others, waveguide for low-loss transmission, 2829
- Fujii, Y., with others, diffraction at v.h.f. and u.h.f. by ridges, 243
- Fujisaki, H., with others, preparation of ZnS single crystals, 2625
- Fujisawa, K., klystron resonant cavities, 3890
- Fujita, T., mesosystems associated with radar echoes, 2604
- Fukushima, Y., with others, measurements of field patterns for comb-type slow-wave structure, 3524 n
- Fuller, C. S., and J. M. Whelan, behaviour of Cu in GaAs, 882
- with K. Wolfstirn, comparison of radio-copper and hole concentrations in Ge, 1250
- Fulop, W., cut-off characteristics of magnetrons, 2057
- with others, electrode spacing in disc-seal triodes, 2788 u
- Fultz, S. C., with N. A. Austin, 22-MeV electron linear accelerator, 2719
- Fumeron-Rodot, H., and M. Rodot, properties of HgTe, 3779
- Funakawa, K., with others, measurement of attenuation by rain, 4187
- Funk, H., with J. Goldmann, film-recording of television transmissions in Germany, 2024
- Furduev, V. V., interference and coherence of acoustic signals, 3910
- Furth, H. P., with others, hydromagnetic capacitor, 1843
- Fürth, R., and E. Morris, charge penetration into conductor, 3251
- Furukawa, A., with others, microwave power standard, 3433
- Furutsu, K., antenna circuit theory based on variational method, 1090; wave propagation over irregular terrain, 2723; e.m. radiation from vertical dipole, 3950
- Fuse, S., Y. Takahashi and A. Furukawa, microwave power standard, 3433
- Futtermenger, W., with H. J. Schmitt, multistage resonance absorbers for cm waves, 1846
- Gabler, H., and M. Wächter, component determination in d.f. for coherent waves, 816
- Gabor, D., and others, c.r. tube for monochrome and colour television, 619
- Gailit, T. A., with others, large inhomogeneities in F<sub>2</sub> layer, 2581
- Gair, F. C., design principle for resistance-network analogue, 2480
- Galaiko, V. P., and L. E. Pargamanik, correlation function for particles carrying like charges, 1829
- Galejs, J., with D. B. Brick, radar interference, 465
- Galkin, G. N., with others, Si solar batteries for earth satellites, 3862
- Gallaher, L. E., servo system for flying-spot store, 2364
- Gallet, R. M., v.l.f. emissions generated in earth's exosphere, 1575
- and R. A. Helliwell, origin of v.l.f. emissions, 4066
- Gal'perin, F. M., interatomic distances in ferromagnetics, 891
- Gal'perin, Yu. I., with others, discovery of 10-keV electrons in upper atmosphere, 3294
- Gamlen, D. R., with R. G. Sharpe, radio communications in Ghana, 961
- Ganapathy, C. V., and others, temperature-sensitive ceramic reactance element, 45
- Gander, M. C., and P. L. Mothersole, frame multi-vibrator and diode separator, 3499; multi-triode flywheel synchronizing circuit, 3500
- Gandy, H. W., cathodoluminescence of SrO, (Be: SrO) and MgO, 150
- Ganzhorn, K., square hysteresis loop of ferrites, 2326
- Gardner, F. F., effect of S.I.D.'s on pulse reflections, 2971
- Garfield, W. L., TACAN, 2259 i
- Garfunkel, M. P., with others, evidence for energy gap in superconductors, 393
- Garibyan, G. M., and G. A. Chalikyan, radiation from charged particle, 3634
- Garner, K. C., linear multitapped potentiometers, 2159
- Garner, W. R., discriminability criterion for loudness scale, 1062
- Garriott, O. K., whistler propagation in regions of low electron density, 1578
- with R. N. Bracewell, rotation of earth satellites, 795
- Garrison, G. R., with others, sound absorption at 50 to 500 kc/s, 2082
- Garstens, M. A., calculating resonance conditions in maser, 3622

- Gärtner, R., cathode-follower circuits, 3235
- Gärtner, W. W., and others, current amplification of junction transistor, 631
- with others, surface-barrier photodiodes as photocapacitors, 3885
- Garton, J. H., with others, lightweight airborne navigation system, 2599
- Garver, R. V., E. G. Spencer and M. A. Harper, microwave semiconductor switching techniques, 3597
- Garwin, E. L., 20- $\mu$ s linear gate, 2880
- Garwin, R. L., A. M. Paltach and H. A. Reich, transistorized crystal-controlled marginal oscillator, 1805
- Gaskins, F. J., with R. C. Kennedy, electronic composites in television, 612
- Gassner, J. A., 60-kW r.f. power amplifier, 290
- Gasson, D. B., with E. Billig, preparation of single-crystal Si by pulling technique, 168
- Gates, D. M., N.B.S. radio and ionospheric observations during I.G.Y., 4046
- Gates, H. W., and A. G. Gatfield, scan converter for radar relay, 2605
- Gatfield, A. G., with H. W. Gates, scan converter for radar relay, 2605
- Gatlin, B., with P. A. Rizzi, rectangular-guide ferrite phase shifters, 1771
- Gatos, H. C., with M. C. Cretella, reaction of Ge with  $\text{HNO}_3$ , 2310
- Gauthé, B., electron characteristic energy losses in intermetallic compounds, 4092
- Gautier, P., and C. Latour, field of series of magnetic lenses, 3445
- and M. Laudet, calculation of fields, 4023
- Gavin, M. R., W. Fulop and L. J. Herbst, electrode spacing in disc-seal triodes, 2788 u
- Gay, M. J., measurements of transistor parameters, 3430
- Gayford, M. L., column loudspeakers for public-address systems, 2824
- Gazaryan, Yu. L., waveguide sound propagation in stratified medium, 665; sound field generated by point source, 1040
- Gazzard, A. D., lunar tides in  $E_{2z}$  at Brisbane, 132
- Gaz Sacasa, R., ionospheric propagation, 1339; mobile maritime service, 3859
- Geballe, T. H., radiation effects in semiconductors, 4089 c
- with others, phonon-drag thermomagnetic effects in  $n$ -type Ge, 2662
- Gedalin, E. V., with G. A. Begiashvili, motion of charged particle in anisotropic medium, 3635
- van Geel, W. C., and C. A. Pistorius, current/time relations of electrolytic rectifiers, 3112
- Gelderikh, M. A., with others, producing polymers with semiconductor properties, 4121
- Geist, D., and E. Preuss, etching and polishing of Ge surfaces, 1252
- Gekker, I. R., energy distribution of electrons in transit-type klystron, 2424
- van Gelder, G., and E. Scholten, radar echo box, 1590
- Geller, S., and J. H. Wermick, ternary semiconductor compounds:  $\text{AgSbSe}_2$ ,  $\text{AgSbTe}_2$ ,  $\text{AgBiSe}_2$ ,  $\text{AgBiTe}_2$ , 1269
- with others, constitution of  $\text{AgSbSe}_2$ - $\text{AgSbTe}_2$ - $\text{AgBiSe}_2$ - $\text{AgBiTe}_2$  system, 1270
- Gelles, I. L., with others, multiple quantum transitions in paramagnetic resonance, 1856
- Gemmel, F., definition of lossy quadrupoles by voltage node displacements, 1114; analysis of lossy symmetrical quadrupoles, 1801
- Genco, J. L., with others, preparation and characteristics of single-crystal InP, 4114
- Genna, W. N., with others, microwave model for study of s.w. aerials, 709
- Genoud, R. H., infrared search-system range performance, 4070
- Gentry, F. E., current surge failure in semiconductor rectifiers, 1367
- Genzel, L., and R. Weber, theory of interference modulation, 2191; spectroscopy in far infrared, 2192
- George, R. G., magnetic viscosity displayed on hysteresis-loop traces, 2325
- Gerard, V. B., propagation of world-wide sudden commencements, 3285
- with others, magnetic effects of two high-altitude explosions, 3671
- Gerber, E. A., and L. F. Koerner, measurements of parameters of piezoelectric vibrators, 211
- Gerdes, E., generation of ultrasonics in liquids, 2812
- Gere, E. A., with G. Fehér, electron spin resonance experiments on donors in Si, 4099
- with others, electron-spin-resonance experiments on Ge, 3775
- Gereth, R., and H. A. Müser, test equipment for photosensitive semiconductors, 4078
- Gergely, G., cathodoluminescence efficiency of ZnS-type phosphors, 472
- and I. Hangos, energy losses at binder films in c.r. tubes, 3173
- Gerhard, F. H., with W. Hochwald, amplifier with transistor chopper, 2519
- Gerlach, L., with others, grain growth in Ni ferrites, 544
- German, J. P., and F. E. Brooks, Jr, bandwidth of folded dipole, 2842
- Gerosa, G., with G. Barrilati, modes in guides filled with magnetized ferrite, 1770
- Gerritsen, H. J., W. Ruppel and A. Rose, photo-properties of ZnO, 826
- and others, structure and relaxation times of  $\text{Cr}^{3+}$  in  $\text{TiO}_2$ , 3333
- with others, approach to intrinsic ZnO, 877
- Gershtein, E. Z., T. S. Stavitskaya and L. S. Stil'bens, thermoelectric properties of PbTe, 1941
- Gerson, N. C., very-long-distance ionospheric propagation, 942
- Gerstenberg, D., magnetic investigations on Pd mixed crystals, 3790
- Getmantsev, G. G., V. L. Ginzburg and I. S. Shklovskii, radio-astronomy investigation by earth satellites, 3292
- Geusic, J. E., M. Peter and E. O. Schulz-DuBois, paramagnetic resonance spectrum of  $\text{Cr}^{3+}$  in emerald, 1628
- and others, spin refrigeration and maser action at 1500 Mc/s, 3654
- Geyger, W. A., frequency control of magnetic multivibrators, 3612
- Ghandhi, S. K., photoelectronic circuit applications, 1108
- Gheorghiu, O. C., with T. V. Ionescu, coupling of oscillator and tube of ionized gas, 1156
- Ghose, A., and others, lattice vibrations in Ge by neutron scattering, 2304
- Ghose, R. N., field intensities from linear radiating source, 17
- Ghosh, B. B., and S. N. Mitra, measurement of atmospheric noise, 2743
- Giacoletto, L. J., junction capacitance using graded-impurity semiconductors, 852; avalanche-controlled semiconductor amplifier, 3620
- Gianola, U. F., and T. H. Crowley, 'Laddie', 1463
- Glavotto, V., with C. Casci, indirect method of determining high-atmosphere density, 3686
- Gibbons, D. F., and C. A. Renton, velocity of sound in Sn, 4122
- Gibbons, J. F., Hall effect in high electric fields, 1235
- with W. Shockley, current build-up in semiconductor devices, 889; transient build-up in avalanche transistors, 2416
- with others, avalanche-transistor pulse circuits, 2878
- Gibbons, J. J., and A. H. Waynick, D region of ionosphere, 1553
- Gibbons, W. F., and A. V. Whale, ceramic waveguide window for X-band valves, 3159 a
- Gibbs, D. F., with H. L. Alsopp, electromechanical properties of  $\text{BaTiO}_3$ , 3333
- Gibson, A. F., and E. G. S. Paige, transport properties in dislocated Ge, 1619
- with others, minority carriers in dislocated Ge, 1618
- Giele, J. P. M., 4-kMc/s amplifier with disk-seal triode, 2798
- Gielessen, J., with K. H. v. Klitzing, influence of pressure on magnetizability of Au, Mn, 1273
- Giese, C. F., ion source for mass spectrometers, 2720
- Gilbert, E. G., with M. S. Uberoi, measurement of cross-sectional density of random functions, 2349
- Gilbert, E. N., and E. F. Moore, variable-length binary encodings, 3467
- Gilbrech, D. A., and R. C. Binder, portable instrument for locating noise sources, 2091
- Gilford, C. L. S., acoustic design of talks studios, 2822
- Gill, A., transistor switch design, 723; evaluating logarithmic diodes, 2038
- Gill, P. J., with others, magnetic effects of two high-altitude explosions, 3671
- Gilland, J. R., transistor circuitry for radiation counting, 3231
- Gilles, J. M., and J. van Cakenbergh, photoconductivity and crystal size in evaporated CdS, 828
- Gillette, P. R., and K. Oshima, pulser design for magnetron operation, 648
- K. Oshima and R. M. Rowe, measurement of pulse-front response of transformers, 357
- Gintsburg, M. A., surface waves on boundary of gyrotropic medium, 1076; exchange effects in ferromagnetic resonance, 2926
- Ginzburg, V. L., e.m. waves in isotropic and crystalline media, 1169; nonlinear interaction of waves propagating in plasma, 3847; use of earth satellites for verification of theory of relativity, 3684
- and V. Ya. Etlman, Cherenkov radiation from dipoles, 3647
- and V. M. Paln, quantum effects in interactions in resonators, 1844
- with others, radio-astronomy investigation by earth satellites, 3292
- Ginzton, E. L., microwave  $Q$  measurements, 3619
- with others, high-power pulsed klystrons, 1410
- Glordmaine, J. A., and others, maser amplifier for radio astronomy, 2892
- Glovanelli, R. G., flare-puffs as cause of type III radio bursts, 431
- and J. A. Roberts, observations of solar disturbances causing type II radio bursts, 432
- Gipplus, A. A., with others, reflection coefficients of Ge and Si, 3765
- Giralt, G., measurement of peak value of h.v. pulse, 920
- Girling, D. S., d.c. breakdown of paper capacitors, 1473
- Giron, V. S., and R. Pauthenet, variation of magnetization of uniaxial substances, 3806
- Gittins, J. F., with others, c.w. power travelling-wave tube, 2787
- Gladhorn, U., with H. Lindner, automatic recorder for c.r. oscillography, 1978
- Gladstone, R., electronic timer with voltage control, 2865
- Glaram, S. H., microwave dielectric measurements, 921
- Glass, D. G., with A. Kavadas, polarization of radar echoes from aurora, 4064
- Glass, M. S., leakage flux around t.w.t. focusing magnet, 315
- Glasser, M. L., with J. Callaway, Fourier coefficients of crystal potentials, 782
- Gleghorn, G. J., with others, circuits for space probes, 3286
- Glücksman, M., and M. C. Steele, plasma pinch effects in InSb, 3388
- and K. Weiser, electron mobility in InP, 4115
- with others, electron mobilities in GaAs, 529
- Glücksman, R., with C. K. Morehouse, dry cells with C-nitroso compounds, 2402; Mg-BiO dry cells, 3865
- Glinchuk, K. D., E. G. Miselyuk and N. N. Fortunatova, Ge with Fe impurity, recombination of current carriers in, 1933, effect of annealing on carrier lifetime in, 1934
- Glotov, V. P., reverberation tank for study of sound absorption, 1043
- Gnaedinger, R. J., Jr, precision evaporation and alloying, 307
- Gobell, G. W.,  $\alpha$ -particle irradiation of Ge at  $4\text{-}2^\circ\text{F}$ , 1254
- with others, thermal and radiation annealing of Ge, 2305
- Gobiet, G., Weissfloch transformation theorem, 4153
- Goblock, T. J., Jr, with others, radar echoes from Venus, 2556
- Gobrecht, H., and A. Bartschat, semiconductor properties of SnS, 886; elastic properties of hexagonal CdS, 2278; piezoelectric and elastic behaviour of CdS, 3746
- and others, cathode-electroluminescence phenomena in ZnS phosphors, 834
- Godard, B. E., with others, electrical properties of epoxy resins, 911
- Godel, N. A., with W. P. Anderson, latching counters, 58
- Godfrey, A. I., statistical methods in receiver manufacture, 1676
- Godziński, Z., ground-wave propagation over inhomogeneous earth, 2375
- Goering, H. L., with others, preparation and properties, of MgTe, 1258, of single-crystal InP, 4114
- Goetz, W. E., and N. J. Woodland, data reduction of spot diagram information, 1105
- Goff, K. W., with others, instrumentation for study of sound propagation, 2081
- Gofman, I. I., and others, e.s. electron emission of semiconductors, 1922
- Golay, M. J. E., binary decoding, 2747
- Gold, D. C., and W. J. Perkins, electroencephalograph telemeter system, 3085
- Gold, L., sputnik for geodetic information, 1185; solutions for static junction, 1506;  $I/V$  behaviour in plasma, 1509; kinetic theory of space charge, 3160; hot-electron behaviour in Ge, 3777
- Gold, R. D., and J. W. Schwartz, drive factor and gamma of conventional kinescope guns, 1417
- with others, pulse amplification using impact ionization in Ge, 2882
- Gold, T., origin of radiation near earth, 2552
- Goldberg, P., particle size effects in ZnS phosphors, 3738
- Golden, R. M., and others, power-line aerial, 1672; v.l.f. c.w. transmitter for ionospheric investigation, 3873
- with others, antenna to eliminate groundwave interference in ionospheric sounding, 710
- Goldie, J. M., two terminal  $p$ - $n$ - $p$ - $n$  switches, 3883
- Golding, J. F., c.r.o. survey, 1977
- and L. G. White, linear amplifier for decimicrosecond pulses, 3993
- Goldmann, J., and H. Fank, film-recording of television transmissions in Germany, 2024
- Goldschmidt, R., h.f. cables, 335
- Goldsmid, H. J., C. C. Jenks and D. A. Wright, thermoelectric power of semiconducting diamond, 1924
- with others, magnetothermal resistance and magnetothermoelectric effects in  $\text{Bi}_2\text{Te}_3$ , 182
- Goldsmith, P., and J. V. Jelley, optical transition radiation, 4018
- Goldstein, B., and L. Pensak, high-voltage photo-voltaic effect, 1907
- Goldstein, L., nonreciprocal e.m. wave propagation, 2541
- Goldstone, G. T., with R. L. Dowden, 'whistler mode' echoes, 2731
- Goldthorp, J., synchronization separator, 3122
- Göllnitz, H., with others, conduction of heat from anodes, 1252
- Golubjatnikov, O., with others, transistor phase-locked oscillators, 2162
- Goncharov, K. V., theory of piezoelectric transducers, 672; frequency-sensitivity characteristics of transducers, 3906
- Gonzalez, R. E., with I. A. Lesh, selective etching of junction transistors, 1402
- Goetze, R., with J. P. Bruynseels, coaxial reflectometer for metre waves, 3431
- Goodale, E. D., with others, colour TV recording on black and white lenticular film, 1371
- Goodall, E. G. A., hemi-isotropic radiators, 2850
- and J. A. C. Jackson, transmission of e.m. waves through wire gratings, 3964
- Goodenough, J. B., magnetic properties of perovskite-type mixed crystals, 890
- Goodenough, J. G., cooling techniques for infrared detectors, 4010 h
- Goodman, A. M., photoconductivity as function of optical absorption, 1828
- Goodman, C. H. L., semiconducting properties in inorganic compounds, 847
- with J. R. Drabble, chemical bonding in  $\text{Bi}_2\text{Te}_3$ , 531
- Goodwin, F. E., and H. R. Senf, volumetric scanning of radar with ferrite phase shifters, 1896
- Goodwin, G. L., with W. J. C. Beynon, horizontal drifts and temperature in E region, 804
- Goodyear, R. S., solving thermistor problems, 40
- Goorissen, J., and F. Karstensen, pulling of Ge crystals, 3029
- van der Goot, J., synchronization of television receivers, 3121
- Gorbach, V. I., with others, phase fluctuations of 10-cm waves over sea, 2738
- Gordon, D. I., R. S. Sery and R. E. Fischell, radiation effects in magnetic materials, 196

- Gordon, J. P., and K. D. Bowers, microwave spin echoes from donor electrons in Si, 860
- Gordon, W. E., scattering by free electrons and space exploration by radar, 451
- Gordon-Smith, A. C., and J. A. Lane, gas-discharge noise sources at cm  $\lambda$ , 658
- Gordyakova, G. N., G. V. Kokosh and S. S. Sinani, thermoelectric properties of Bi<sub>2</sub>Te<sub>3</sub>-Bi<sub>2</sub>Se<sub>3</sub>, 3758
- Gore, D. C., with A. D. Williams, low-noise triode for use up to 1 kMc/s, 1419
- with others, new method for fine-wire grids, 2788 y
- Gorelik, A. G., and V. V. Kostarev, radioechoes from invisible objects in troposphere, 2240
- Gorkov, L. P., with others, superconductor in high-frequency field, 2195
- Görlich, P., A. Krohs and W. Lang, photoresistors, photodiodes and phototransistors, 3520
- and others, image converters for quantity production, 1404; resolving power of scintillation multipliers, 3081
- Gorshkov, M. M., with others, reflection coefficients of Ge and Si, 3765
- Gorter, C. J., with others, h.f. susceptibilities of paramagnetic alums, 2332; absorption in paramagnetic salts at 1325 Mc/s, 2674
- Gosar, P., propagation through medium with cubic periodic structure, 93; *p-n* junctions, lateral photovoltaic effect in, 2614, photomagneto-mechanical forces on, 3357
- Gosnet, A., O. Parodi and C. Benoit à la Guillaume, light due to recombination of impurities in Ge, 3369
- Goss, A. J., metallurgy of semiconductors, 3020
- and R. E. Adlington, effects of seed rotation on Si crystals, 3021
- Gossard, A. C., and A. M. Portis, nuclear resonance in ferromagnet, 4126
- Gossett, R. E., with others, manufacture of waveguide parts, 3553
- Gossick, B. R., disordered regions in semiconductors, 4089
- with L. Stubbe, Debye potential measurements in Ge, 3359
- Goswami, S. N., effect of magnetic field on electrodeless discharge, 83
- Goto, E., parametron, 3588
- Goubau, G., and C. E. Sharp, model surface-wave transmission line, 10
- Gough, M. W., analysis of field-strength records 584; diurnal influences in tropospheric propagation, 1337
- Gouin, P., electronic seismic transducer, 3069
- Gould, J. E., permanent magnet stability, 1960
- Gould, R. N., with A. Curkijfe, high-Q echo boxes, 740
- Gould, R. W., characteristics of travelling-wave tubes with periodic circuits, 1732; travelling-wave couplers for longitudinal beam-type amplifiers, 2067
- and A. V. Truelpiece, electromechanical modes in plasma waveguides, 2800 f
- Goulding, F. S., nucleonic instrumentation—transistorization, 3446
- Gourceaux, M., thin absorbent films, 3268; optimum absorption thickness of thin film, 3651
- Goureaux, G., and A. Colombani, magnetic properties of very thin films of nickel, 3039
- P. Huet and A. Colombani, Hall effect in Ni films, 1279
- with A. Colombani, conductivity of thin Ni films, 3395
- Gourgé, G., exo-electron emission and luminescence of inorganic crystals, 3002
- Gouskov, L., and N. Nifontoff, chemical action and oxidation of oriented Ge surfaces, 3370
- Goutte, R., with R. Bernard, image of surface obtained with negative ions, 567
- Gove, H. E., 10-MeV particle accelerator at Chalk River, 935
- Gozzini, A., with others, refractive index of humid air, 1333 n
- Graf, C. R., concentric-feed Yagi, 344
- Grahner, W., frequency spectrum of power-law double tones, 3908
- Gramatke, B., R. Netzband and E. Paulsen, r.f. protection ratios for v.h.f. f.m., 1348
- Gränicher, H., K. Hübler and K. A. Müller, hyperfine splitting in paramagnetic resonance of Pr<sup>3+</sup> in ceramic LaAlO<sub>3</sub>, 758 f
- with A. Steinemann, dielectric properties of ice crystals, 1600
- Grant, D. S., R. O. Jones and T. Scott, power transistors, 2769
- Grant, J. A., scatter equipment for Canadian use, 975
- Grant, J. P., 'Plymouth effect', 577
- Granville, J. W., with others, minority carriers in dislocated Ge, 1618
- Grattidge, W., with others, thermionic integrated micromodules, 2863
- Grave, G., and W. Heimann, thermocouples and bolometers for radiation measurements, 1652
- Gravel, C. L., with A. D. Kurtz, diffusion of Ga in Si, 513
- Gray, D. A., with others, high-power 400-Mc/s klystron, 3524 j
- Gray, M. G., Si diodes as radar modulators, 3110
- Gray, T., and M. J. Moran, Decca Doppler, 820
- Graydon, A., application of pulse-forming networks, 742
- Greefkes, J. A., with F. de Jager, 'Frena' speech transmission system, 2753
- Green, A., binary multiplication in digital computers, 2856
- Green, D. A., transistor equivalent circuit, 1718
- Green, D. M., detection of multiple-component signals, 3540
- Green, H. H. H., with others, manufacture of waveguide parts, 3553
- Green, J. H., Jr., and R. L. San Soucie, error-correcting encoder and decoder, 257
- Green, J. J., with E. Schlömann, decline of ferromagnetic resonance absorption with increasing power level, 4139
- Green, M., space charge in semiconductors, 3012
- Green, P. E., Jr., with others, radar echoes from Venus, 2556
- Greenburg, J., effect of magnetic field on thermionic emission from Mo, 1945
- Greene, J. C., and J. F. Lyons, receivers with zero intermediate frequency, 1677
- Greene, R. F., with D. R. Muss, reverse breakdown in In-Ge alloy junctions, 534
- Greenhow, J. S., and E. L. Newfeld, turbulence measurements in upper atmosphere, 4058
- with others, radar observations of 1957  $\beta$ , 3290
- Greenland, K. M., wider scope of optics, 391
- Greenspan, M., and R. M. Wilmotte, distributed transducer, 673
- Greenwood, J. A., with others, electrical conduction in solids, 485
- Grenet, G., self-inductance of magnetic-core windings, 3058
- Grenoble, H. E., with others, cube-oriented magnetic sheet, 896
- Grener, E., eidophor system, 620
- Grier, M. B., behaviour of single-stage thermoelectric microrefrigerator, 4010 i; infrared colour translation, 4010 o
- Grierson, J. K., with L. R. O. Storey, time-symmetric filters, 365
- Griesinger, W., E. Popp and E. Schulz, distribution of lightning currents in earthing system of radio mast, 1451
- Griffiths, H. V., long-distance v.h.f. reception, 2003
- Griffiths, J. H. E., and J. W. Orion, weak lines in paramagnetic resonance spectrum of impure MgO, 3410
- Griffiths, J. W. R., signal/noise ratio in p.c.m. systems, 2009
- Griffiths, P. M., with D. J. Craik, domain configurations on ferrites, 1283
- Grigorov, N. L., with others, mechanism of terrestrial corpuscular radiation, 2216
- Grillot, E., with others, fluorescent emission lines and luminous absorption lines in CdS, 2618; influence of magnetic field on fluorescence of pure CdS, 2622
- Grimm, F., car radio design, 252
- Grimsdale, R. L., and others, automatic recognition of patterns, 2372
- Grimsdell, G., diode hole storage, 626; new Ge diodes and circuit applications, 994
- Grinberg, A. A., calculation of transients in transistors, 2774
- Grinberg, G. A., new method for solution of diffraction problem, 1851
- and Yu. V. Pimenov, diffraction of e.m. waves at flat screens, 1515
- Grindlay, J., and D. ter Haar, ferroelectric behaviour of KH<sub>2</sub>PO<sub>4</sub>, 3331
- Gringauz, K. I., and M. Kh. Zelikman, measurement of ion concentration along satellite orbit, 3696
- Grinich, V. H., transistor video amplifiers, 69, stagger-tuned, 754
- Grivet, P., with others, maser-type self-oscillator, 2521; weak-field maser, 2548
- Groce, J. C., with R. J. Kelso, encoder measures random-event time intervals, 2339
- Groendijk, H., microwave triodes, 2788 z; noise diode for u.h.f., 3533
- de Groot, D. G., with P. Winkel, impedance of dielectric layers, 2271
- and R. Schwitz, E., with E. Hofmeister, influence of point contact of Ge diodes, 2411
- Grocs, B., dielectric losses with rectangular voltage pulses, 2493
- Gross, E. F., and B. S. Razbirin, effect of deformations on spectrum of CdS, 3730
- and B. P. Zakharchenya, Zeeman effect and exciton structure in Cu<sub>2</sub>O, 1623
- B. S. Razbirin and M. A. Yakobson, line spectra of absorption edge of CdS, 471
- and others, influence of magnetic field on fluorescence of pure CdS, 2622
- with others, fluorescent emission lines and luminous absorption lines in CdS, 2618
- Grosskopf, H., importance of video receiver in black-level transmission, 1377
- Grosskopf, J., metre-wave propagation by meteoric ionization, 4198
- M. Scholz and K. Vogt, correlation measurements in s.w. range, 953
- Grossner, N. R., transformer design for zero phase shift, 720
- Grover, F. W., numerical evaluation of expressions involving complete elliptic integrals, 549
- Grover, N. B., with others, phase-shift method of carrier lifetime measurements, 515
- Groves, G. V., irregularities of satellite drag, 1543; atmospheric tides and earth-satellite observations, 2565; air density in upper atmosphere, 3689
- Groves, R. D., with J. R. Drabble, strain-induced changes in Seebeck coefficient of n-type Ge, 3374
- Grow, R. W., and others, 20–40-kMc/s backward-wave oscillator, 1742
- with C. M. Lin, broadband microwave coaxial connector, 3551
- with others, multiple ladder circuits for mm-wave tubes, 3159 v
- Grubbs, W. J., Hall-effect circulator, 2113; Hall-effect devices, 2692
- Grumet, A., transient e.m. fields in conductor, 2905
- Grünbaum, E., with M. Blackman, magnetic leakage field in Co, 202
- Grunewald, H., and W. Neumann, conductivity of lead oxide, 3784
- Gubanov, A. L., charge of semiconductor properties with fusion, 1918
- Gubkin, A. N., phenomenological theory of electrets, 1602
- and G. I. Skanavi, stability of inorganic polycrystalline electrets, 1603
- Gudmandsen, P., and B. F. Larsen, microwave propagation measurements in Denmark, 579
- Guerrini, L., with A. Caracciolo, final computer model of Pisa C.S.C.E., 3966
- Guertler, R. J. F., characteristic impedance of balanced two-wire line, 3928
- Gugan, D., change of spontaneous magnetization with hydrostatic pressure, 892
- Guggenbühl, W., and W. Wunderlin, equivalent circuit of h.f. transistors, 2423
- Guillemin, E. A., with E. G. Fubini, minimum-insertion-loss filters, 1117
- Gumlich, H. E., with others, cathodo-electroluminescence phenomena in ZnS phosphors, 834
- Gumowski, I., effect of reaction on gain of non-linear amplifiers, 2167
- Günther, K. G., vapour-deposited films of III-V compounds, 3349, 3761
- Guptill, E. W., with others, coefficient of thermal expansion of BaTiO<sub>3</sub>, 2629
- Gurevich, A. V., temperature of electrons in plasma in variable field, 2532
- Guro, G. M., stationary electronic processes in semiconductors, 2637
- van Gorp, G. J., with others, exciton diffusion in CdS crystals, 2265
- Gusev, V. D., and others, large inhomogeneities in F<sub>2</sub> layer, 2581
- Gutin, S. S., with others, electron-hole transition in point-contact rectifiers, 185
- Gutjahr, H., with K. W. Böer, spectral distribution of photoconductivity in CdS, 1904
- Gutman, A., asymptotic integration of wave equation, 2461
- Gutsche, E., measurement of elastic constants of CdS, 3728; displacement of absorption edge of CdS, 3729
- Guttman, N., with others, mechanism of binaural fusion, 1055
- Gyorgy, E. M., modified rotational model of flux reversal, 900
- with F. B. Humphrey, flux reversal in soft ferromagnetics, 3405
- Haantjes, J., and G. J. Lubben, errors of magnetic deflection, 3125
- ter Haar, D., with J. Grindlay, ferroelectric behaviour of KH<sub>2</sub>PO<sub>4</sub>, 3331
- Haar, H., multitrack and stereo heads, 3550
- Håård, B., f.m. broad-band microwave systems, 2014 d
- Haas, G. A., and F. H. Harris, X-Y pulse measuring system, 4160
- and J. T. Jensen, Jr, preconversion of oxide cathodes, 3891
- Haas, H. H., with S. D. Hathaway, TJ radio system, 3106
- Haase, A. P., with others, thermionic integrated micromodules, 2863
- Haben, J. F., with others, sendust flake, 894
- Haberecht, R. R., with others, preparation and properties of AlSb, 2311
- Hadders, H., P. R. Locher and C. J. Gorter, absorption in paramagnetic salts at 1.325 Mc/s, 2674
- Hadley, C. P., W. G. Rudy and A. J. Stoekert, moulded Ni cathode, 2069
- Haering, R. R., Zeeman splitting of donor states in Ge, 525; electrons and holes in perturbed lattices, 2528
- Haga, E., thermoelectricity in two-band semiconductors, 3015
- Hagan, M. P., with E. J. Chernosky, Zurich sunspot number and variations, 1529
- Hagelbarger, D. W., recurrent codes, 3468
- with others, improvement in floating-zone technique, 2337
- Hager, C. K., network design of microcircuits, 3972
- Hagfors, T., and B. Landmark, simultaneous variation of amplitude and phase of Gaussian noise, 583; direction of arrival of long-duration meteor echoes, 1993
- Hagg, E. L., D. Muldrew and E. Warren, spiral occurrence of E<sub>s</sub>, 3304
- Hahn, D., and F. W. Seemann, significance of boundary layers and polarization fields for electroluminescence, 833
- Hahn, E., computation of e.s. immersion objectives, 3073
- Hahn, H., and M. Sauzade, transistor stabilized supply at 5–9 V 800 mA, 601
- Haines, J. H., and G. R. Tingley, vitancan flying-spot colour scanner, 279
- Hakura, Y., power spectrum of solar radio outburst, 1178
- and Y. Takenoshita, s.w. transmission disturbance of 11th Feb. 1958, 573
- with others, world wide distribution of *f<sub>min</sub>* and Dellinger effect, 2588
- Halina, J. W., with M. J. Cotterill, bridge negative-feedback amplifiers in carrier telephony, 974
- Hall, C. J., dual-standard television receivers, 4217
- Hall, G. C., electronic structure of diamond, Si and Ge, 1238
- Hall, J. E., with others, radar observations of 1957  $\beta$ , 3290
- Hall, R. C., crystal anisotropy and magnetostriction of ferromagnetic alloys, 3393
- Hall, R. N., with others, observation of phonons during tunnelling in junction diodes, 4226
- Hall, T. C., with M. F. Millea, surface mobility in Ge and Si, 505
- Halperin, A., and H. Arbell, excitation spectra and luminescence of ZnS, 2999
- Halpern, J., and R. H. Rediker,  $\mu$ ps switching diodes, 3144
- Halsey, R. J., and A. R. A. Rendall, prospects for transatlantic television by cable, 4211
- Halstead, M. B., with others, activation of ZnS and (Zn,Cd)S phosphors, 3736



- Halsted, R. E., electrophotoluminescent amplification, 831
- *E. F. Apple and J. S. Prener*, two-stage optical excitation in phosphors, 2996
- Hamakawa, Y., with *J. Yamaguchi*, Ge *p-n* junction, high-electric-field effects in, 3023; barrier temperature at turnover in, 3024
- Hamberger, S. M., wide-band multi-way electronic switch, 2800 *c*
- Hambley, N., low-frequency phasemeter, 1319
- Hame, T. G., and *E. M. Kennaugh*, transmissions from 1958 82, 2570
- Hamilton, D. J., *J. F. Gibbons and W. Shockley*, avalanche-transistor pulse circuits, 2878
- Hammerlag, J., circuit design using Si capacitors, 3974
- Hammond, V. J., and *R. Carter*, visualization of ultrasonic beam in fused quartz, 674
- Hamrick, J. J., measuring and evaluating noise, 6
- Handler, P., with *G. Heiland*, influence of atomic hydrogen on conductivity of Ge, 2301
- Handy, R., with *R. Frerichs*, electroluminescence in Cu<sub>2</sub>O, 3005
- Hanel, R., and others, tracking weather with satellites, 2715
- with others, current amplification of junction transistor, 631
- Hangos, I., with *G. Gergely*, energy losses at binder filters in c.r. tubes, 3173
- Hante, W., and *H. Schneider*, scintillation counters, 3080
- Hannam, H. J., and *A. van der Ziel*, noise in oxide cathodes, 1027
- Hannon, J. R., attenuation of coaxial cables above 3 kMc/s, 337
- Hänsch, H. J., with others, rendering visible conductivity inhomogeneities of semiconductors, 3757
- Hansel, P. G., VOR-compatible Doppler omnirange, 1897
- Hansen, R. C., with *R. W. Hougardy*, scanning surface-wave antennas, 3201
- Hansen, R. T., recurrent geomagnetic storms and solar prominences, 1865
- with *C. S. Warwick*, geomagnetic activity following large solar flares, 3284
- Hanssen, K. J., asymmetric unipolar electron lenses, 937
- Happ, W. W., with *T. R. Nisbet*, Jacobians, 2775
- with others, estimate of transistor life in satellites, 2780
- Harada, R. H., and *A. J. Strauss*, preparation of InAs, 1624
- Harang, L., and *J. Tröim*, angle of arrival of auroral echoes, 2254
- Harbecke, G., and *G. Lutz*, crystal structure of Ga<sub>2</sub>Te, doped with Cu, 3031
- Hardcastle, C., 3-valve preamplifier, 63
- Harden, B. N., with *J. A. Saxton*, performance of directive aerials at u.h.f., 2845
- Hardin, C. D., and *J. Salerno*, miniature X-band radar, 1584
- Hare, E. W., evaluation of Dectra, 463
- Harel, A., and *J. F. Cashen*, unified representation of transistor transient response, 2050
- Hargreaves, J. K., radio observations of lunar surface, 1863
- Harkins, D., f.m. multiplexing for studio-transmitter links, 3107
- Harkless, E. T., network for combining radio systems, 3954
- Harling, D. W., cable links for television, 275
- Harman, T. C., *M. J. Logan and H. L. Goering*, preparation and properties of MgTe, 1258
- and others, preparation and characteristics of single-crystal InP, 4114
- Harden, J. D., Jr., controlled rectifier, 2421
- Harnik, E., *A. Many and N. B. Grover*, phase-shift method of carrier lifetime measurements, 515
- Harnischmacher, E., ionospheric wind observations, 1333 *f*
- and *K. Reuter*, drift observations evaluated by method of 'similar fades', 801
- with others, ionospheric observations during solar eclipse of 30th June 1954, 131
- Harp, M. C., nonvacuum devices control klystrons, 1737
- Harper, M. A., with others, microwave semiconductor switching techniques, 3597
- Harrick, N. J., properties of semiconductor surface, 2281; measuring particle drift mobilities in semiconductors, 2313
- Harrington, R. D., and *A. L. Rasmussen*, permeability spectra of Y-Fe garnet, 1291
- Harrington, R. F., scattering by large conducting bodies, 4029
- and *A. T. Villeneuve*, reciprocity relations of gyrotropic media, 3044
- Harris, B., and *K. C. Morgan*, binary symmetric decision feedback systems, 591
- and others, binary communication feedback systems, 2387
- Harris, D. J., microwave amplification using unstable electron beam, 3159 *j*
- Harris, F. H., and *J. Ainsworth*, single-line-scan television, 2033
- with *G. A. Haas*, X-Y pulse measuring system, 4160
- Harris, I., *R. Jastrow and W. F. Cahill*, satellite orbits from radio tracking data, 2568
- Harris, L. A., toroidal electron guns for hollow beams, 3527
- Harrison, D. E., and *F. A. Hummel*, system ZnO.CdO.B<sub>2</sub>O<sub>3</sub>, 3735
- Harrison, D. P., and *C. D. Watkins*, radio echoes from aurora australis and aurora borealis, 140
- Harrison, S. E., with others, structure and relaxation times of C<sup>3+</sup> in TiO<sub>2</sub>, 2333
- Harrowell, R. V., characteristic impedances of elliptic waveguide, 702
- Hartke, D., with others, precision generator for radar range calibration, 2352
- Hartmann, G., braking action in magnetic-tape recorders, 694
- Hartz, T. R., auroral radiation at 500 Mc/s, 139
- Harvey, A. F., r.f. aspects of electro-nuclear accelerators, 1328; optical techniques at microwave frequencies, 2099; parallel-plate microwave transmission systems, 2108
- Hashimoto, T., life of dispenser-type cathodes, 3159 *d*
- Hashimoto, U., with *K. Komatsubara*, annealing of radiation-induced 1/f noise in Ge *p-n* junction, 298
- Haslam, C. G. T., with others, high-resolution survey, of Andromeda nebula, 2937, of Coma Cluster, 2938
- Hass, G., with *J. T. Cox*, antireflection coatings for Ge and Si in infrared, 864
- Haszko, S. E., with others, line width in Y-Fe garnet, 2330
- Hatch, J. F., and *D. W. G. Byatt*, direction finder with automatic read-out, 2600
- Hathaway, S. D., and *H. W. Evans*, radio attenuation at 11 kMc/s, 1673, 2381
- and *H. H. Haas*, T.J. radio system, 3106
- Hatsopoulos, G. N., with others, diode thermo-electron engine, (D)2435
- Hatta, Y., telemetering using principle of gas-filled stepping tube, 2374
- Hattiangadi, M. S., with others, nature and origin of atmospherics, 3699 *a*
- Hatton, W. L., with others, engineering of l.f. communication systems, 2750
- Haubert, A., radio echoes observed on sea swell at Casablanca, 2724
- Haufe, G., correction of aperture error in e.s. lenses, 4171
- Hauge, Ø., short periodic variations in solar noise storms, 2934
- Haugk, G., with others, system design of flying-spot store, 2362
- Haun, R. D., Jr., and *T. A. Osial*, gain measurements on pulsed ferromagnetic microwave amplifier, 2184
- Hauptschein, A., with others, binary communication feedback systems, 2387
- Hauri, E. R., limits of transistor characteristics, 629; transistor amplifier, with negative feedback, 1142, for acoustic measurements, 1499
- Haus, H. A., power-flow relations in lossless nonlinear media, 3045
- Hauser, W., theory of anisotropic obstacles in waveguides, 706; guided e.m. waves in anisotropic materials, 707
- Hawkes, H. W., method of generating rotating radiation diagram, 2120
- Hawkins, G. S., search for magnetic effects from meteors, 106
- Hawkins, P. O., active microwave duplexing systems, 2800 *c*
- *H. J. Curnow and R. Redstone*, coaxial-line diode, 3524 *m*
- Hay, D. R., tropopause height and transmission loss at 490 Mc/s, 3097
- and *G. E. Poaps*, prolonged fade-out on short microwave path, 3098
- Hayasaka, T., and *M. Suzuki*, errors of electro-acoustic standards, 3186
- Hayes, J. D., lenses for vidicon-type cameras, 1376
- Hayes, W., with others, paramagnetic resonance of impurities in CaF<sub>2</sub>, 3411
- Haynes, H. E., and *D. T. Hoger*, stop-go scanning saves spectrum space, 277
- Haywood, B. C., with others, conductivity induced by radiation in CdS and polyethylene, 2672
- Head, H. T., measurement of television field strength, 288
- Head, J. W., with *C. G. Mayo*, wide-range RC oscillator, 54
- Heaps, H. S., filter functions for detection of pulsed signals in noise, 247
- Heasell, E. L., *N. R. Howard and E. W. Timmins*, apparatus for measuring electrical resistivity of Si, 214
- Heath, J. H., differential transformer as measuring device, 557
- Heathcote, V. A., and others, travelling-wave multiple-beam klystron, 3524 *r*
- Heaton-Armstrong, L. J., and *J. D. Holland*, h.f. receiver RX.5C, 3462
- Hebborn, J. E., and *E. H. Sondheimer*, diamagnetism of conduction electrons in metals, 2194
- Hechtel, J. R., and *K. R. Johne*, electron-ray tracing in electric and magnetic fields, 3524 *t*
- Hechtel, R., multigap klystron, 2785
- Heck, C., magnetic reversal of storage-type ferrites, 4137
- and *H. Reiner*, storage properties of square-loop ferrites, 3397
- with *J. Rupprecht*, dielectric properties of oriented Ba ferrite, 3807
- Heck, L., multiple-track magnetic sound recording, 3190
- Hecker, K., video output stage with wound resistor, 2347
- Heckl, M., sound insulation of cylinders, 3547
- and *K. Seifert*, influence of self resonances of measurement chambers on sound insulation measurements, 2090
- Hedgcock, F. T., magnetic susceptibility of semiconductors, 3017
- Hedges, C. P., digital recorder holds data after shock, 2365
- Hedlund, D. A., and *L. C. Edwards*, polarization fading over oblique-incidence path, 1668
- Heeger, A. J., *T. R. Nisbet and W. W. Happ*, estimate of transistor life in satellites, 2780
- Heffner, H., solid-state microwave amplifiers, 4004
- and *G. Wade*, characteristics of variable-parameter amplifiers, 77
- with *J. E. Sterrett*, periodic magnetic focusing structures, 1021
- with *G. Wade*, gain, bandwidth and noise in cavity-type parametric amplifier, 2066; microwave parametric amplifiers and converters, 2896
- with others, parametric amplifiers as super-regenerative detectors, 3245
- Heidenreich, R. D., *E. A. Nesbitt and R. D. Burbank*, magnetic annealing in perminvar, 3797
- with *E. A. Nesbitt*, magnetic annealing in perminvar, 3798
- Heider, E., with *E. O. Willoughby*, omnidirectional paraboloid aerial, 1447
- Heldester, R., and *K. Vogt*, diversity reception by aerial selection method, 2741
- Heijn, H. J., and *N. C. de Troye*, fast method of reading magnetic-core memories, 3587
- Heiland, G., field effect and photoconductivity in ZnO, 880
- and *P. Handler*, influence of atomic hydrogen on conductivity of Ge, 2301
- Heilmann, W., with *G. Grave*, thermocouples and bolometers for radiation measurements, 1652
- Heilmke, G., anomaly in characteristics of Ba ferrite, 2685
- Hein, H., input-admittance curves of 2-stage band filters, 734
- Heine, K., measurement of short afterglows of electronically excited luminophores, 2350
- Heine, V., with *M. H. Cohen*, band structures of metals and alloys, 910
- Heineken, F. W., and *A. Battaglia*, absorption and refraction of NH<sub>3</sub> at 6 mm  $\lambda$ , 2213
- Heinlein, W., time-lag of Ge diodes, 2767
- Heinze, W., *H. Göllmiz and W. Baer*, conduction of heat from anodes, 4252
- Heisler, L. H., giant travelling ionospheric disturbances at night, 2580
- with *G. H. Munro*, recording signals from earth satellites, 2573
- Hekimian, N. C., with *G. A. Dunn*, tube-transistor hybrids, 2877
- Held, H. J., error probability of binary coded messages, 2389; reliability of binary transmissions, 2746
- Hellenthal, W., magnetic resistance variation in Ni films, 1944; magnetization vectors in Ni and Fe films, 3040
- Heller, G. S., with *L. C. Kravitz*, resonance isolator at 70 kMc/s, 1439
- Hellwell, R. A., properties of lightning impulses which produce whistlers, 142
- and *M. G. Morgan*, atmospheric whistlers, 1576
- with *R. M. Gallet*, origin of v.l.f. emissions, 4066
- Hellwarth, G. A., constant-amplitude random-function generator, 373
- Helm, H. A., Z transformation, 1637
- Helmer, J. C., small-signal analysis of molecular-beam masers, 1501
- and *M. W. Muller*, noise figure of maser amplifier, 2343
- Helmers, K., simple model for impurity-band conduction, 3010
- Helsdon, P. B., transistor line deflection circuits, 3126
- Hendee, C. F., and *W. B. Brown*, stroboscopic operation of photomultiplier tubes, 1722
- Henderson, K. W., elliptic-function filter design, 367
- Henderson, S. T., *P. W. Ranby and M. B. Halstead*, activation of ZnS and (Zn,Cd)S phosphors, 3736
- Hendricks, C. D., Jr., *G. W. Swenson, Jr. and R. A. Schorn*, radio reflections from satellite-produced ion columns, 121
- Hendrix, C. E., neon bulb as nonlinear circuit element, 358
- Hendry, A., noise temperature ratio in Ge diodes, 627
- with *L. K. Anderson*, Ge mixer crystals at low temperatures, 3876
- Henisch, H. K., semiconducting SiC, 3771
- Henkel, H. J., formation of barrier layers in AlSb, 3030
- Henkels, H. W., and *G. Strull*, very-high-power transistors, 1001
- Hennequin, J., with *H. Benoit*, measurement of geomagnetic field by maser, 3823
- Henniger, H., temperature coefficient of initial permeability of dust core materials, 1282
- Henry, J., with *H. Arzelids*, laws of magnetism and static electricity, 1514
- Henry, R. M., temperature reached by *p-n* junction, 295; point-contact Ge and Si diodes, 296; Si transistors, 300
- Henry, W. E., magnetization and structure of Ba ferrite III, 899
- Hensel, J. C., and *M. Peter*, Stark effect for cyclotron resonance, 3346
- Hepburn, F., interpretation of smooth-type atmospheric waveforms, 3312
- Hepper, H., delay equipment for unattended operation, 3924
- Heppner, J. P., with others, results obtained with rocket-borne ion spectrometers, 3703
- Herbert, J. M., ferroelectric crystals and ceramics, 153
- Herbst, L. J., with others, electrode spacing in disc-seal triodes, 2788 *u*
- Herczog, A., *R. R. Haberecht and A. E. Middleton*, preparation and properties of AlSb, 2311
- Hergenhanh, G., orbit of satellite 1958 82, 3685
- Hérinckx, C., and *A. Monfils*, determination of thermal parameters of semiconducting thermoelements, 3348
- Heritage, D. P., with others, v.l.f. propagation measurements for Radux-Omega system, 2736
- Herman, F., with others, single phonon emission in breakdown of semiconductors, 3013
- Hermann, P., with *R. J. Turner*, transistor design for picture i.f. stages, 1385
- Hermesen, J., with *K. van Duuren*, halogen-quenched end-window Geiger counter, 3079
- with others, G-M counters, 3446

- Herndon, R. C., with T. Sekiguchi, thermal conductivity of electron gas, 766
- Hernqvist, K. G., M. Kanefsky and F. H. Norman, thermionic energy converter, 325
- Herrinck, P., disturbances of geomagnetic field, 2944; prediction of sunspot numbers, 3282
- Herring, C., T. H. Geballe and J. E. Kunzler, phonon-drag thermomagnetic effects in *n*-type Ge, 2662
- Herrriott, D. R., polyhedral satellite for measurement of orbit data, 794  
— with others, flying-spot store, system design of, 2362, optics and photography in, 2363
- Herrmann, J., with others, improvements in NH<sub>3</sub> maser, 758 g
- Hersee, G., and J. R. T. Royle, B.B.C. transparencies for testing camera channels, 984
- Hershinger, L. W., with others, control of luminescence by charge extraction, 473
- Hersping, A., and K. Blank, after-effect in ceramic dielectrics, 3328
- den Hertog, J. M., with G. Klein, sine-wave generator, 2876
- Herz, A. J., and others, radiation observations with satellite 1958  $\delta$ , 4042
- Herzenberg, A., geomagnetic dynamos, 108
- Herzog, A. W., computer for simulation of aircraft, 2477
- Hess, H. A., recording Sputnik II on 40 002 kc/s, 3291
- Hessler, J., Jr, with others, vacuum-diode microwave detection, 2794
- Hessler, V. P., and E. M. Westcott, correlation between earth-current and geomagnetic disturbance, 4044
- Hewish, A., scattering of radio waves in solar corona, 2939
- Hey, J. S., and T. B. A. Senior, e.m. scattering by thin plates, 772  
— J. T. Pinson and P. G. Smith, radio observations of hypersonic shock waves, 1658
- Heydenrych, J. C. R., design of transducers for maximum power transfer, 381
- Heyligers, H., with others, protection device for stabilized line timebase circuit, 282; stabilization of line output circuits, 989, 3871, of line and frame output circuits, 3123
- Heymann, O., application of Laplace transformation, 2695
- Hiatt, R. E., with others, radar cross-section of finite cones, 4073
- Hibbard, W. R., with others, cube-oriented magnetic sheet, 896
- Hibberd, F. H., with J. A. Thomas, satellite Doppler measurements and ionosphere, 1874
- Hibberd, R. G., transistors and semiconductor devices, 3147
- Hiedemann, E. A., with M. A. Breazeale, investigation of progressive ultrasonic waves by light refraction, 1050  
— with R. B. Miller, intensity distribution of light diffracted by ultrasonic waves, 1051  
— with K. L. Zankel, amplitude distortion of ultrasonic waves, 2814  
— with others, determination of ultrasonic waveform by light refraction, 3538
- Hierholzer, F. J., Jr, linear power amplifiers using dynistors or triistors, 2174
- Higdon, B. G., and M. F. Bond, thyatron-stabilized d.c. supplies, 4208
- Higley, J. B., with others, precision guarded resistance measuring facility, 561
- Hillbrand, J., and W. R. Beam, semiconductor diodes in parametric subharmonic oscillators, 3981  
— with C. W. Mueller, 'thyristor' switching transistor, 1005
- Hill, E. R., emission at 3.5 m from local supergalaxy, 2223  
— O. B. Slee and B. Y. Mills, pencil-beam survey of galactic plane at 3.5 m, 2220  
— with others, radio sources between declinations +10° and -20°, 423
- Hill, J. E., and K. M. van Vliet, carrier-density fluctuations in Ge, 1617
- Hill, J. J., precision thermoelectric wattmeter, 1320
- Hill, L. O., with L. K. Wannas, digital-analogue conversion with cryotrons, 1103
- Hill, N. E., application of Onsager's theory to dielectric dispersion, 392
- Hilliard, J. K., and W. T. Fiala, generating high-intensity sound with loudspeakers, 692
- Hilsom, G., multiplication by semiconductors, 350; effects of Cu in InAs, 2666; properties of *p*-type InSb, 4118  
— and A. C. Rose-Innes, new method of measuring susceptibility, 1313
- Hines, C. O., motions in ionosphere, 1556  
— and L. R. O. Storey, time constants in geomagnetic storm effect, 1535
- Hirabayashi, H., deterioration of microphone carbon powder, 3189  
— and others, life tests of microphone carbon, 1758
- Hirai, M., Y. Fujii and H. Saito, diffraction at v.h.f. and u.h.f. by ridges, 243  
— with others, long-distance u.s.w. propagation, 244
- Hirano, J., characteristics of interdigital circuits, 3159 aa
- Hirao, K., diurnal variation of fading at v.h.f., 256  
— K. Akita and I. Shiro, temperature fluctuations accompanying solar eclipse, 2559
- Hird, E. V., use of radio carrier in telephone system, 1362
- Hirschfeld, J. L., and S. C. Brown, measuring probability of electron collision in gas, 768
- Hitchcock, R. J., future difficulties facing long-distance h.f. communications, 261
- Hoare, F. E., with others, pulse techniques, 2449
- Hochman, R. H., with G. C. Kuczynski, light-induced plasticity in Ge, 1938
- Hochwald, W., and F. H. Gerhard, amplifier with transistor chopper, 2519
- Hodara, H., h.f. integrator design, 1479
- Hoell, P. C., d.c. amplifier with whole-loop feedback, 1137
- Hofer, R., influence of unsymmetric r.f. stages on signal bands with a.m., 3992
- Hoffman, D., and E. Schulzman, analysis of noise-signal amplitudes, 3826
- Hoffman, L. A., with others, circuits for space probes, 3286
- Hoffman, R., with others, auroral phenomena during storm, 3309
- Hoffman, R. W., with T. G. Knorr, geometric magnetic anisotropy in Fe films, 2683
- Hoffman, T. R., feedback design for transistor amplifiers, 3619
- Hoffman, W. C., optimum apertures of aerials, 1333 s
- Hoffmann, A., mode of operation of *n-p-n* phototransistors, 4233
- Hoffmann, F., with U. Schley, noise in radiation thermocouples, 1653
- Hoffmann, R., interconnection of television cable links, 992
- Hoffmann, W., broadcasting equipment at Karlsruhe studio, 2016
- Hofmeister, E., and E. Groschwitz, influence of point contact of Ge diodes, 2411
- Hogan, C. L., with J. E. Pippin, resonance measurements on Ni-Co ferrites and Ni-ferrite aluminates, 2689  
— with others, ferrimagnetic resonance in polycrystalline rare-earth garnets, 2690
- Hoger, D. T., with H. E. Haynes, stop-go scanning waves spectrum space, 277
- Hogg, D. C., with others, tropospheric propagation beyond horizon, 4185
- Hogg, H. A. C., photo-etching Mo foil, 3159 b; periodic e.s. beam focusing, 3524 ii
- Hoisington, R. W. R., L. Kellner and M. J. Pentz, source-modulated microwave cavity spectrometer, 416
- Hojo, H., with others, world-wide distribution of  $f_{mn}$  and Dellinger effect, 2588
- Holcomb, D. F., magnetic resonance line shapes at onset of saturation, 1948
- Holden, J. T., with others, Ti getter pump, 1204
- Holford, K., and L. M. Newall, video amplifiers using transistors, 385
- Holland, J. D., with L. J. Heaton-Armstrong, h.f. receiver RX.5C, 3462
- Holland, L., getter-ion pumps, 1899  
— L. Laurenson and J. T. Holden, Ti getter pump, 1204
- Hollander, L. E., Jr, piezoresistivity in TiO<sub>2</sub>, 887
- Hollefer, W. O., construction of miniature magnetic microphones, 1431
- Hollis, J. L., frequency shifts improve pulse communications, 3470
- Holloway, J. H., with others, comparison of Cs frequency standards, 212
- Holmes, J. C., with others, results obtained with rocket-borne ion spectrometers, 3703
- Holonyak, N., Jr, and others, observation of phonons during tunnelling in junction diodes, 4226  
— with R. W. Aldrich, Si-controlled rectifiers from oxide-masked diffused structures, 2418
- Holstein, T., ultrasonic absorption in metals, 2444
- Holt, E. H., with S. Takeda, microwave propagation method of studying decaying gas plasmas, 4021
- Holter, M. R., and W. L. Wolfe, optical-mechanical scanning techniques, 4010 k
- Holtzman, J., reducing errors caused by power-supply variations, 3615
- Hong, K., carbonization of thoria cathodes, 3530
- Honig, H., and E. Stupp, electron spin-lattice relaxation in *p*-doped Si, 512
- Honnell, P.M., with R. E. Horn, matrix programming of analogue computers, 347
- Hoogenstraeten, W., electron traps in ZnS phosphors, 1596  
— with others, exciton diffusion in CdS crystals, 2265
- Hoogmoed, D., microphonic effects in electron tubes, 3896  
— A. Boekhorst and H. Heyligers, stabilization of line output circuits, 3871  
— with others, stabilization of line output circuits, 3124
- d'Hoop, H., with A. Dumont, measurement of pulsed powers at  $m\lambda$ , 3829
- Hoover, C. W., Jr, G. Haugh and D. R. Herrriott, system design of flying-spot store, 2362
- Hoover, M. V., advances in very-high-power grid-controlled tubes, 2788 v
- Hope, E. G., with others, circuits in N.P.L. Cs standard, 2340
- Hope, J., with others, horizontal drift measurements near equator, 1557
- Hopengarten, A., with others, colour purity adjustment for 'apple' c.r. tube, 1386
- Hopf, H., delay equalization for residual-sideband television, 3490
- Hopfield, J. J., contribution of exciton to complex dielectric constant, 1831
- Hopkins, H. G., and B. G. Pressey, current d.f. practice, 2259 j
- Hopner, E., modulation-demodulation system for data transmission, 1684
- Hopper, W. C., with others, waveguides for use in cryostats, 1767
- Hori, J., with N. Saito, thermodynamics of harmonic oscillator, 81
- Hormuth, W., statistics of fading-dependent noise, 3858
- Horn, F. H., melted-layer crystal growth, 1251
- Horn, R. E., and P. M. Honnell, matrix programming of analogue computers, 347
- Horne, R. A., effect of oxide impurities on Bi, Sb, Te and Bi-Te alloys, 2315
- Horner, F., atmospheric radio noise and lightning, 814
- Hornig, A. W., R. C. Rempel and H. E. Weaver, electron paramagnetic resonance in BaTiO<sub>3</sub>, 476
- Horowitz, H., moving-magnetic stereo, 2818
- Horowitz, R., and H. E. LaGow, auroral-zone atmospheric-structure measurements, 1560
- van der Horst, H. L., and P. H. C. van Vliet, induction-heating generator using hydrogen thyratrons, 3439
- Horton, B. M., noise-modulated distance measuring system, 2611
- Horton, C. W., and A. E. Sobey, Jr, near fields of acoustic sources, 3537
- Hoshino, S., and others, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and (NH<sub>4</sub>)<sub>2</sub>BeF<sub>6</sub> transitions, 836  
— with others, ferroelectricity in Li(N<sub>2</sub>H<sub>5</sub>)SO<sub>4</sub>, 840; (NH<sub>4</sub>)HSO<sub>4</sub> ferroelectric with low coercive field, 841
- Hoskins, R. F., signal flow graphs, 3602
- Hoskins, R. H., two-level maser materials, 3037; spin-level inversion and spin-temperature mixing in ruby, 4123
- Hougardy, R. W., and R. C. Hansen, scanning surface-wave antennas, 3201
- Houseley, P. J., rotating-loop reflectometer for waveguide, 2117
- Houston, J. M., efficiency of thermionic energy converter, 3437
- Howard, D. D., with J. H. Dunn, effects of a.g.c. on accuracy of monopulse radar, 1894  
— with others, scintillation noise in radar tracking systems, 2609
- Howard, J. N., transmission of atmosphere in infrared, 4010 b
- Howard, N. R., with others, apparatus for measuring electrical resistivity of Si, 214
- Howard, R., T. Cragg and H. W. Babcock, magnetic field associated with solar flare, 4043
- Howard, R. L., with others, balloon gear monitors cosmic radiation, 437
- Howland, B., half-cycle resonant delay circuit, 2501
- Howlett, D. J., and L. Buduls, noise-immune synchronizing circuits, 3120
- Hozumi, H., with others, measurements of field patterns for comb-type slow-wave structure, 3524 n
- Hrbek, G., with R. Adler, low-noise electron-beam parametric amplifier, 321
- Hriana, J., with B. Rothenstein, mobility of Bloch walls, 3794; influence of temperature on distribution of ferromagnetic domains, 3795
- Hrostowski, H. J., and R. H. Kaiser, infrared spectra of heat-treatment centres in Si, 167; absorption spectrum of As-doped Si, 1244
- Hsu, C. S., simple subharmonics, 4146
- Hsu, W. K., reversible dekartron counter, 1812
- Hu, Yueh-Ying. See Yueh-Ying Hu.
- Hubbard, R. M., shunt-coupled magnetic-amplifier circuits, 3997
- Hubbard, W. M., E. Adams and J. F. Haben, sendust flake, 894
- Huber, H., microwave tube techniques, 4243  
— and M. Warnecke, Ti pump, 1205
- Hübner, K., with others, hyperfine splitting in paramagnetic resonance of Pr<sup>3+</sup> in ceramic LaAlO<sub>3</sub>, 758 f
- Hücking, E. E., with R. Falke, magnetic measurements on ferrite U-cores, 3057
- Hudson, A. C., and E. J. Stevens, data on ferrite core materials, 897
- Huet, F., with others, measurement of very slight variations of resistance, 555; Hall effect in Ni films, 1279; properties of Sb films, 2693
- Huey, B. M., noise in communications and servo systems, 1682
- Hüfner, W., transistor oscillators in carrier-frequency techniques, 1811
- Hugenholz, E. H., A. Seljak and A. Towle, frequency stepper for propagation tests, 1485
- Hughes, C. J., with D. W. Morris, phase characteristics of radio signals, 2384
- Hughes, D. J., with others, lattice vibrations by neutron scattering in Si, 2291, in Ge, 2304
- Hughes, R. C., with others, dispenser cathodes, 2791
- Hughes, V. W., molecular frequency standard, 4149  
— with H. E. Radford, microwave Zeeman spectrum of atomic oxygen, 4032
- Hughes, W. A., designing with ferrite isolators, 11
- Hühn, C. F., Ge-diode manufacture, 1709
- Huibregtse, E. J., W. H. Bessey and M. E. Dronsgard, electromechanical behaviour of BaTiO<sub>3</sub>, 3334
- Huld, L., optical method for determining carrier lifetimes, 1230  
— and T. Staffin, infrared absorption of photo-generated carriers in Ge, 176; valence-band structure of Si, 508
- Hullinger, F., with others, field parameters of galvanic and thermo-magnetic effects in ferromagnets, 758 c
- Hulst, G. D., communication technique for multipath channels, (D)596
- van de Hulst, H. C., light scattering by small particles, 1519
- Hülster, F., with E. Rosas, microwave amplification by intrinsic negative resistances, 3159 p
- Hultqvist, B., auroral isochasms, 2975, (D)4062  
— and J. Örtner, ionization below 50 km after strong solar flares, 2576
- Hummy, A. M., equatorial sunset effect, 3461
- Hummel, F. A., with D. E. Harrison, system ZnO.CdO.B<sub>2</sub>O<sub>3</sub>, 3735
- Humphrey, F. B., and E. M. Gyorgy, flux reversal in soft ferromagnets, 3405
- Hunter, L. P., anomalous transmission of X-rays by Ge, 2309; X-ray measurement of microstrains in Ge, 3377
- Hurd, J. D., A. W. Simpson and R. H. Tredgold, anomalous polarization in ferroelectrics, 1911
- Hurd, R. A., magnetic fields of ferrite ellipsoid, 403; scattering from small anisotropic ellipsoid, 413

- Hurley, R. B., designing transistor circuits, 43, 3613
- Hurney, P., with R. Wasserman, tones find data in high-speed tape systems, 932
- Hurwitz, H., Jr, with P. L. Auer, space-charge neutralization in diodes, 2432  
— with others, theory of cathode sheath in discharge, 82
- Husa, V., with others, p-n junctions in Ge, 3485
- Husimi, K., ultra-low velocity component of spontaneous polarization in BaTiO<sub>3</sub>, 160; polarizability in BaTiO<sub>3</sub>, 3744  
— and K. Kataoka, pulse-width dependence of switching velocity in BaTiO<sub>3</sub>, 2275
- Huster, E., and E. Ziegler, spreading of discharge in counter tubes, 1332
- Huzimura, R., and T. Sideri, effects of impurities and temperature on electroluminescence spectra, 152
- Hyde, F. J., drift transistors, internal current gain of, 999, current gain of, 3880, h.f. power gain of, 3881; current gain of alloy-junction transistor, 3878  
— with R. W. Smith, transistor current gain, 3426
- Hyde, N. G., telemetering information from satellites, 124
- Hynek, J. A., with F. L. Whipple, I.G.Y. optical satellite tracking program, 2566
- Hyvärinen, L., Fourier analysis, 1298
- Iglitsyn, M. I., Yu. A. Kontsevo and A. I. Sidorov, non-equilibrium charge carriers, distribution of in base region of p-n junction, 1919, lifetime of in Ge, 1929
- Igo, T., E. Yamaka and M. Yatani, band structure of InSb, 1940
- Igras, E., with others, domain structure of ferroelectrics, 158
- Ikeda, T., internal friction of BaTiO<sub>3</sub> ceramics, 475; studies on (Ba-Pb) (Ti-Zr) O<sub>3</sub>, 3006
- Iles, P. A., and P. J. Coppen, delineation of p-n junctions in Si, 514
- Imamutdinov, F. S., N. N. Neprimevov and L. Ya. Shekun, magnetic double refraction of microwaves, 776
- Imyanitov, I. M., measurements of e.s. fields in upper atmosphere, 3713
- Inage, N., with others, parametric amplifier using Ge diode, 1149
- Indiresan, P. V., negative resistance for d.c. computers, 3605
- Ingalls, R. P., with others, u.h.f. signals reflected from moon, 1525
- Ingelstam, E., with O. Bryngdahl, diffraction patterns in microscopes and microwave fields, 2206
- Ingraham, R., theory of the cosmic-ray equator, 3661
- Ingram, D. J. E., applications of microwave physics, 779; application of magnetic resonance to solid-state electronics, 2924
- Intrator, A. M., reduction of interference from television receivers, 955
- Ioffe, A. F., semiconductor thermocouples and thermoelectric cooling, (B)207; present and future of semiconductors, 489; development of theory of semiconductors, 490
- Ionescu, G., u.s.v. propagation in towns, 3850
- Ionescu, T. V., and O. C. Gheorghiu, coupling of oscillator and tube of ionized gas, 1156
- Iordanishvili, E. K., and L. G. Thalich, semiconductor thermostat for self-oscillators, 609
- Irie, H., with others, microwave propagation over sea beyond line of sight, 2734
- Ireland, E. A., data signalling system, 259
- Isaev, A. A., I. G. Mikhailov and A. S. Khimunin, ultrasonic interferometer design, 2816
- Isbell, D. E., log-periodic reflector feed, 2853
- Isenberg, C. R., with others, solubilities of Sn in Si and Ge, 4094
- Ishida, T., with others, reception of radio waves from Russian earth satellite I, 120
- Ishizawa, K., with others, F<sub>2</sub>-layer multiple reflections, 1342
- Isted, G. A., round-the-world echoes, 1343; meteor activity and scatter propagation, 1344; radio interference in ionospheric scatter communication, 2000 e; analysis of Gibraltar-U.K. ionospheric scatter signal recordings, 2600 f; Marconi and communication beyond horizon, 2000 l
- Istomin, V. G., with B. A. Mirtov, investigation of ionic composition of atmosphere, 3702
- Isupov, V. A., with others, nonferroelectric phase transitions in solid solutions, 1912; new ferroelectric, 2632
- van Iterson, P. W. L., television transmitters, 3493; video correction equipment, 3495
- Ives, R. L., negative-supply outboard Codan, 3101
- Iwasaki, H., thermoelastic loss in quartz vibrators, 206
- Iyengar, P. K., with B. N. Brockhouse, normal modes of Ge by neutron spectrometry, 173
- Izhak, I. A., influence of unilateral compression on permittivity of BaTiO<sub>3</sub> ceramics, 481
- Jacchia, L. G., atmospheric effects in orbital acceleration of artificial satellites, 2564; corpuscular radiation and acceleration of artificial satellites, 2960
- Jackson, J. A. C., with E. G. A. Goodall, transmission of e.m. waves through wire gratings, 3964
- Jackson, J. E., with J. C. Seddon, ionosphere electron densities, 3714
- Jackson, W. H., with others, semiconductor current limiter, 1368
- Jacobs, H., with others, microwave techniques in lifetime measurement, 3774
- Jacobs, I. S., and R. W. Schmitt, low-temperature behaviour of dilute alloys Mn-Cu and Co-Cu, 2673
- Jacobs, J. A., with others, geographical variations in geomagnetic micropulsations, 2946
- Jacobs, P. G., micro-module design progress, 2486
- Jacobsen, E. H., piezoelectric production of microwave phonons, 2277  
— N. S. Shiren and E. B. Tucker, effects of 9-2-kMc/s ultrasonics on resonances in quartz, 3816
- Jacobson, M. J., correlation with similar uniform collinear arrays, 1066
- Jacobson, R. L., with R. K. Mueller, grain-boundary photovoltaic cell, 1723
- Jaeschke, F., N.T.S.C. colour modulator for C.C.I.R. standard, 2762
- Jaffe, H., piezoelectric ceramics, 4086
- de Jager, F., and J. A. Greefkes, 'Frena' speech transmission system, 2753
- Jaggi, R., with others, field parameters of galvanic and thermo-magnetic effects in ferromagnets, 758 c
- Jagy, J. P., design of resonant notch filters, 368
- Jakits, O., thermal behaviour of semiconductor rectifiers, 3109
- James, A. V., with others, calorimeters for measurement of microwave power, 2358
- James, B. H. L., and M. T. Stockford, microwave frequency standard, 1300
- James, I. L. P., vidicon camera for industrial colour television, 2025
- James, J. C., with M. I. Meeks, frequencies for meteor-burst communication, 597
- James, M., microwave network spans Canada, 973
- Jamieson, J. A., non-image-forming infrared systems, preamplifiers for, 4010 j, circuits for, 4010 n
- Jänecke, J., with others, fixed-frequency cyclotron with one dec, 1985
- Janes, H. B., with M. C. Thompson, Jr, phase stability over low-level tropospheric path, 4176
- Janik, J., with others, spin-fluctuation scattering of neutrons in magnetite, 4127
- Jansen, L., molecular theory of dielectric constant, 761
- Janssen, J. H., reciprocity in acoustical systems, 332
- Jansson, L. E., with J. F. Berry, transistor 20-kc/s oscillator, 745
- Jarrett, H. S., and R. K. Waring, ferrimagnetic resonance in NiMnO<sub>4</sub>, 543
- Jasberg, J., with others, high-power pulsed klystrons, 1410; high-power windows at microwave frequencies, 3159 c
- Jaspers, A. J. M., with others, G-M counters, 3446
- Jastrow, R., with others, satellite orbits from radio tracking data, 2565
- Jaumann, J., and E. Neckenbürger, dielectric behaviour of Se, 2285
- Jauquet, C., excitation of surface wave on dielectric cylinder, 1438
- Javan, A., production of negative temperature in discharges, 3656
- Jean, A. G., L. J. Lange and J. R. Wail, ionospheric reflection coefficients from sferics, 2589
- Jelley, J. V., with P. Goldsmith, optical transition radiation, 4018
- Jellinghaus, W., and M. P. de Andrés, crystal anisotropy and magnetostriction with Hall effect, 3803
- Jenkins, R. O., theory of ballast tubes or barretters, 270  
— with others, evaporation of Ba from impregnated cathodes, 2792
- Jennings, D. A., and W. H. Tamtla, frequency modulator for marginal oscillator, 1826
- Jennison, R. C., interferometer for measurement of brightness distributions, 1177; detection of coherent harmonics in solar outbursts, 4035
- Jenks, C. C., with others, thermoelectric power of semiconducting diamond, 1924
- Jensen, J. T., Jr, with G. A. Haas, preconversion of oxide cathodes, 3891
- Jeremy, R., single sideband, present and future, 263
- Joglekar, P. J., power distribution diagrams for dipole arrays, 2470
- Johler, J. R., and L. C. Walters, mean absolute value and standard deviation of phase, 3416; propagation of ground-wave pulse, 3842
- John, H. F., properties of Ge single crystals grown from molten metals, 4102
- Johne, K. R., with J. R. Hechtel, electron-ray tracing in electric and magnetic fields, 3524 l
- Johnson, B. R., receiver for Australian d.m.e. beacon, 145
- Johnson, C. C., and C. K. Birdsall, M-J crossed-field travelling-wave tube, 2788 ad
- Johnson, C. M., ferrite phase shifter, 3941
- Johnson, C. Y., and others, results obtained with rocket-borne ion spectrometers, 3703
- Johnson, E. C., with H. Vantine, Jr, transceivers compute distance, 146
- Johnson, E. O., and A. Rose, analysis of amplifier devices, 2041
- Johnson, F. A., lattice absorption bands in Si, 1608 — and J. M. Lock, vibrational spectrum and specific heat of Ge, 517
- Johnson, F. M., and A. H. Nethercot, Jr, antiferromagnetic resonance in MnF<sub>2</sub>, 3791
- Johnson, F. S., temperature in high atmosphere, 1876
- Johnson, H. M., feature of galactic radio emission, 4034
- Johnson, H. R., and R. R. Bagi, electron beam technique for measuring circuit velocity, 3524 o
- Johnson, M. A., tropospheric scatter propagation theory and application to experiment, 2000 v  
— with F. A. Kitchen, turbulent scattering in propagation at m λ, 575
- Johnson, M. D., and D. A. G. Tail, filter attenuation characteristics, 731
- Johnson, S. D., and J. R. Singer, current regulator using transistors, 979  
— with J. R. Singer, transistorized nuclear-resonance magnetic-field probe, 1810
- Johnson, W. C., with others, path combinations in whistler echoes, 1577
- Johnston, T. W., perturbations in electron beams from shielded and immersed guns, (D)2429; nonlaminar electron beams in high magnetic fields, 3524 s
- Jones, C. I., with R. C. Lyman, electroluminescent panels for automatic displays, 3434
- Jones, D. A., anisotropic field plotting, 3825  
— with others, paramagnetic resonance of impurities in CaF<sub>2</sub>, 3411
- Jones, E., with J. Dutton, electrical discharges, 2196
- Jones, E. E., inductance of eccentric tubular conducting system, 3191
- Jones, E. M. T., and J. K. Shimizu, wide-band strip-line balun, 3931  
— with J. K. Shimizu, coupled-transmission-line directional couplers, 3556
- Jones, I. L., with others, deduction of electron content from Faraday fading, 2572
- Jones, O. C., R. S. Maddever and J. H. Sanders, radioisotope measurement of electric field and polar conductivity, 1195
- Jones, R. C., radiation detectors, response and detecting ability of, 4164, noise in, 4166; detective quantum efficiency of television camera tubes, 4216
- Jones, R. F., radar echoes from atmospheric inhomogeneities, 819
- Jones, R. O., with others, power transistors, 2769
- Jonker, G. H., semiconducting properties of Co ferrite, 4135  
— and W. Kwestroo, ternary systems with BaO-TiO<sub>2</sub>, 838
- Jonscher, A. K., V/I characteristics of junction diodes, 625
- Jordan, E. C., with others, U.R.S.I. report on antennas and waveguides, 3565
- Joseph, H., with others, markerless pulse trains for communication, 956
- Josephson, B., and A. Blomquist, ground-wave v.h.f. propagation, 3089  
— and G. Carlsson, fading and distortion of 3-kMc/s transhorizon signals, 3090  
— and F. Eklund, microwave propagation experiences, 3091
- Joshi, M. N., with others, radio patrol of solar flares, 3699 p
- Joshi, M. V., design of transistor i.f. amplifier, 2517
- Jost, K., and G. Schiefer, evaluation of quadrupole and material measurements using chart, 2702
- Jouguet, M., propagation in discontinuous periodic structures, 2103; effects of amplitude and phase distortion on signal carried by h.f. wave, 3473
- Jovanovic, D. T., multivibrator circuit using junction transistors, 2503
- Jowett, J. K. S., measurement and prediction of v.h.f. tropospheric field strengths, 2000 n
- Joy, W. R. R., long-range propagation at 10 cm λ, 2000 i; 3-2 cm λ propagation beyond horizon, 2000 u  
— with others, influence of ocean duct on scatter propagation beyond horizon, 578
- Julesz, B., coding television signals, 3489
- Jungfer, H., properties of Mathieu and related functions, 2509
- Junius, W., automatic evaluation of sound reflections, 3545
- Junod, P., with G. Busch, electrical properties of Ag<sub>2</sub>Se, 758 a
- Jurgen, R. K., solid-state panels for display or storage, 1654
- Kaganov, M. I., and V. M. Tsukernik, theory of kinetic processes in ferromagnetic dielectrics, 1285
- Kahl, G. D., and F. D. Bennett, coherence requirements for interferometry, 398
- Kahn, L. R., compatible s.s.b. modulation system, 971
- Kahnig, D., with others, processing Ni matrix cathodes, 4250
- Kaiser, R. H., with H. J. Hrostowski, infrared spectra of heat-treatment centres in Si, 167; absorption spectrum of As-doped Si, 1244
- Kaiser, W., H. L. Frisch and H. Reiss, formation of donor states in heat-treated Si, 1926
- Kakita, K., with K. Morita, fading in microwave relays, 3475
- Kalashnikov, S. G., E. Yu. L'vova and V. V. Ostrobordova, properties of Ge doped with Zn, 1613  
— with others, influence of group III and V elements on recombination in Ge, 1614
- Kallistratova, M. A., scattering in turbulent atmosphere, 2083
- Kallmann, H., and J. Dresner, excitation of luminescent materials by ionizing radiation, 3325
- Kallmann, H. K., model atmosphere based on rocket and satellite data, 3300
- Kalman, G., one-dimensional nonstationary flow in plasma, 2800 g
- Kalman, P. G., with others, c.r. tube for monochrome and colour television, 619
- Kalnach, L. P., with others, influence of group III and V elements on recombination in Ge, 1614
- Kalnajs, J., with A. Snaškula, O<sub>2</sub> impurity in Si single crystals, 511
- Kaira, S. N., R. Bailey and H. Daams, Canadian caesium-beam standard of frequency, 2701  
— C. F. Patterson and M. M. Thomson, Canadian standard of frequency, 2700
- Kamat, D. S., control apparatus for serial drum memory, 346
- Kambouris, G. N., low frequencies vary T-parameters, 2782
- Kamigaito, O., with others, oxide-cored cathode, 3078
- Kamiryo, K., and others, measurements of field patterns for comb-type slow-wave structure, 3524 n

- Kamiya, Y., with others, oxide-cored cathode, 3078
- Kammer, D., with F. Brauer, mobile radio system, 262
- Kampfoefner, F. J., with others, automatic input equipment for data processing, 3586
- Kanai, Y., electrical conductivity, in *p*-type InSb, 179, in *n*-type InSb, 530
- Kanaya, S., and K. Ueno, h.f. propagation related to annular eclipse, 2730
- Kane, J. A., arctic measurements of collision frequencies in D region, 1886
- Kane, J. V., time to pulse-height converter, 2879
- Kanefsky, M., with others, thermionic energy converter, 325
- Kanellakos, D. P., with others, magnetostrictive delay line for video signals, 1134
- Kaner, E. A., and F. G. Bass, statistical theory of propagation over ideally conducting plane, 3840
- Kanner, M., error reduction in loaded potentiometers, 3969
- Kanzaki, S., with others, double-vane torque-operated wattmeter for 7 kMc/s, 223
- Kaplan, D. E., and M. E. Browne, electron free precession in paramagnetic free radicals, 3408
- Kaplan, S. H., error correction in colour television tubes, 990
- Kaplunova, E. I., and K. B. Tolpygo, temperature dependence of Hall coefficient in semiconductors, 1621
- Kaposi, A. A., transistor blocking oscillator for digital systems, 3970
- Kaposi, J. F., magnetic cores as switching elements, 2492
- Kapur, K. N., and J. W. McGrath, r.f. unit for n.m.r. spectrometer, 2544
- Kapustinskii, A. F., effective radius of electron in crystal lattices, 1858
- Karal, F. G., Jr, and S. N. Karp, diffraction of skew plane e.m. wave by absorbing wedge, 3266
- Karavainikov, V. N., amplitude and phase fluctuations in spherical wave, 662
- Karbowiak, A. E., guided wave propagation in sub-mm region, 13
- Karekar, R. N., with others, nature and origin of atmospherics, 3699 a
- Kargin, V. A., with others, producing polymers with semiconductor properties, 4121
- Karnovskii, M. I., with N. F. Vollermer, concentration coefficient of directional acoustic systems, 3905
- Karo, D., impedance measurement circuit, 554
- Karp, A., fast-wave interactions with electron film, 3159 m
- Karp, S. N., with F. C. Karal, Jr, diffraction of skew plane e.m. wave by absorbing wedge, 3266
- Karpova, I. V., with others, influence of group III and V elements on recombination in Ge, 1614
- Karstensen, F., with J. Goorissen, pulling of Ge crystals, 3029
- Kartaschoff, P., with others, improvements in NH<sub>3</sub> maser, 758 g
- Kaschchev, B. L., with E. G. Proshkin, inhomogeneous structure of F region, 2244
- Kashprovskii, V., radio wave propagation and soil conductivity, 434
- Kasuya, I., variations of E<sub>s</sub> layer in Japan, 127
- Y. Hakura and H. Hojo, world-wide distribution of *f*<sub>min</sub> and Dellinger effect, 2588
- Kasuya, T., theory of impurity conduction, 1223; general theory of transport, 4014
- and S. Koide, theory of impurity conduction, 1224
- and K. Yamada, electrical and thermal conductivity of monovalent metals, 4015
- Katano, S., with others, F<sub>2</sub>-layer multiple reflections, 1342
- Kataoka, K., with K. Husimi, pulse-width dependence of switching velocity in BaTiO<sub>3</sub>, 2275
- Katchky, M., with H. G. Byers, slotted waveguide array for radar, 711
- Katô, J., with others, measurement of attenuation by rain, 4187
- Kato, S., prevailing wind in ionosphere and S<sub>q</sub> variations, 453
- with others, ionospheric scattering, under influences of ion production and recombination, 4059, in electro-dynamically controlled turbulence, 4060
- Kato, Y., and T. Watanabe, geomagnetic storm in relation to geomagnetic pulsation, 1537
- Katsenelenbaum, B. Z., critical cross-sections in irregular waveguides, 699
- Katsura, T., with others, magnetic properties of TiFe<sub>2</sub>O<sub>7</sub>-Fe<sub>2</sub>O<sub>3</sub> system, 542
- Katz, H., trends of construction in development of valves, 2793
- Katz, I., with C. I. Beard, dependence of microwave signal spectra on ocean roughness, 242
- Kaufman, A. B., solders for nuclear and space environments, 4144
- Kaufman, I., band between microwave and infrared regions, 1845
- Kaufman, M. M., with others, end-fired memory, 36
- Kaus, P., negative effective mass in negative resistance, 3632
- Kautz, B., with R. W. Buchanan, dynamic testing of computer blocks, 3591
- Kavadas, A., and D. G. Glass, polarization of radar echoes from aurora, 4064
- with G. F. Lyon, radar echoes from aurora, 2255
- Kawai, M., with K. Miya, propagation of long-distance h.f. signals, 3453
- Kawai, N., acoustic field of vibrating source, 1044
- Kawakami, K., with Y. Aono, cosmic rays observed by satellite 1958  $\alpha$ , 448
- Kay, A. F., spherically symmetric lenses, 3583; scattering of surface wave, 3844
- Kay, H. F., with R. V. Coates, dielectric properties of metaniobate and metantalate ceramics, 3326
- Kay, I., measurement of virtual height, 3715
- Kay, L., comparison of echo ranging systems, 1893
- Kay, R. H., C. G. Phillips and R. H. Teal, versatile stimulator, 229
- Kaye, J., with others, diode thermo-electron engine, (D)2435
- Kazan, B., feedback light-amplifier panel for picture storage, 1408
- Keast, D. N., with F. M. Wiener, propagation of sound over ground, 3900
- with others, instrumentation for study of sound propagation, 2081
- Keays, S. K., with others, distress beacon for crash position indicator, 1891
- Kebby, M. H., and A. F. Culbertson, 6-kMc/s system for toll telephone service, 2393
- Keeling, H., air trials of Decca, 462
- Keen, A. W., topological nonreciprocal network element, 2871
- Keesom, P. H., and G. Seidel, specific heat of Ge and Si, 2287
- Keibs, L., and W. Tismer, measuring acoustic impedance of air spaces, 3180
- Keidel, L., acoustic design of studio in Karlsruhe, 1756
- Keiser, B. E., digital-counter techniques for radar, 2981
- Keldysh, L. V., influence of lattice vibrations on production of electron-hole pairs, 850
- Kell, R. D., with others, colour TV recording on black and white lenticular film, 1371
- Kelleher, K. S., and J. P. Shelton, limitations of satellite antennas using spherical arrays, 1091
- Keller, J. B., with B. R. Levy, propagation of e.m. pulses around earth, 1662; diffraction by smooth object, 3265
- with B. D. Sechler, theory of diffraction, geometric, 2538, asymptotic, 2539
- Keller, P. R., and L. K. Wheeler, automatic error correction, 966
- Keller, S. P., and G. D. Pettit, phosphor with fluorescence larger than energy gap, 2623
- Kellerer, J., magnetic coupling in disk-seal triodes, 2788 w
- Kellner, L., with others, source-modulated microwave cavity spectrometer, 416
- Kellogg, P. J., possible explanation of Van Allen radiation at high altitudes, 2217
- and E. P. Ney, new theory of solar corona, 2943
- E. P. Ney and J. R. Winckler, geophysical effects associated with high-altitude explosions, 2575
- Kelly, G. E., Jr, ferromagnetic circuit, 2140
- Kelly, K. C., with R. S. Elliott, serrated waveguide, 1074
- Kelly, M., with others, radio control of ventricular contraction, 929
- Kelly, R. L., and W. J. Fredericks, polarization of excitation bands in CdS, 2991
- Kelso, R. J., and J. C. Groce, encoder measures random-event time intervals, 2339
- Kemhadjian, H., transistor amplifiers for d.c. signals, 1498; temperature-control system for transistors, 1693
- Kemp, J., with others, radiation damping effects in 2-level maser, 1818
- Kendall, J. T., Si transistors, 1007
- and J. S. Walker, h.f. tetraode transistors, 3516
- Kendall, M. G., and A. Stuart, The Advanced Theory of Statistics, Vol. 1, (B)1639
- Kenmoku, M., constant-reflector-voltage klystron, 3524 ee
- and S. Yasuda, package-type travelling-wave amplifier, 2788 p
- Kennaugh, E. M., with T. G. Hame, transmissions from 1958  $\delta$  2, 2570
- Kennedy, R. C., and F. J. Gaskins, electronic composites in television, 612
- Kent, G. S., short bursts of amplitude of 50-Mc/s wave received over 480 km, 2000 j
- Kent, R. L., with others, measurement of time dilation in earth satellite, 3688
- Kern, R., with G. A. Busch, magnetic properties of A<sup>III</sup>BV compounds, 2645
- with others, magnetic resistance variation of InSb, 758 b
- Kernevez, J., with R. Benoit, circuit for recording atmospherics, 2870
- Kerney, I., and W. D. Mischler, equalization of aural and visual delay, 3132
- Kessler, J. O., and A. R. Moore, magnetic susceptibility of carriers in Ge, 2300
- Ketchledge, R. W., logic for digital servo system, 1459
- Kettel, E., with others, mechanical filters for communications technique, 2155
- Key, F. A., and W. G. P. Lamb, analogue computer for prediction of acoustic propagation, 3207
- Keyes, R. W., effects of electron-electron scattering in semiconductors, 492; mobility and effective mass in semiconductors, 2279
- Keys, J. E., and R. I. Primich, nose-on radar cross-sections, 3320
- Keystone, J. R. G., J. D. Macpherson and E. W. Guptill, coefficient of thermal expansion of BaTiO<sub>3</sub>, 2629
- Khalkin, S., radio astronomy, 420; determination of velocity of artificial satellite, 442
- Khalkovich, L. M., and L. A. Khalifin, sound propagation in inhomogeneous media, 1041
- Khalatnikov, I. M., with others, superconductor in high-frequency field, 2195
- Khalifin, L. A., with L. M. Khalkovich, sound propagation in inhomogeneous media, 1041
- Khan, K. M. I., with others, amplitude/frequency response display using ratio method, 219
- Khandekar, P. V., and J. N. Das, I/V characteristics of *n-p* contacts on galena, 3874
- Kharybin, A. E., analysis of errors in determination of mean value, 1638
- Khaskind, M. D., diffraction and radiation of acoustic waves in liquids and gases, 664
- Khastgir, S. R., with others, triple splitting of F echoes, 1885
- Khe-Yui-Lyan, with A. V. Sandulova, diffusion and solubility of Ta in Ge, 4104
- Khirmunin, A. S., with others, ultrasonic interferometer design, 2816
- Khlebnikov, N. S., new photoelectron multipliers, 3155
- Kholodenko, L. P., and M. Ya. Shirobokov, ferroelectric properties of polarized BaTiO<sub>3</sub> ceramics, 479
- Khutsishvili, G. R., Overhauser effect in paramagnetic salts and semiconductors, 3653
- Khyl, R. L., with others, electron spin-lattice relaxation times, 417; maser amplifier with large bandwidth, 1144
- Kibler, L. U., directional-bridge parametric amplifier, 2183
- Kidokoro, T., with others, proof of mode theory of v.l.f. ionospheric propagation, 3094
- Kiel, A., and others, propagation in crossed-field periodic structure, 1731
- v. Kienlin, A., magnetic materials with permivar effect, 1284, 2324
- v. Kienlin, U., and A. Kürzl, waveguide termination with film-type resistors, 1082
- Kihara, T., irreversible processes in highly ionized gas, 4020
- Kihn, H., and W. E. Barnette, microminiature decoder for selective communication, 2018
- Kikoin, I. K., E. M. Buryak and Yu. A. Murovkin, anomalously high Hall effect in CrTe, 2681
- Kikuchi, C., and others, ruby as maser material, 3793
- Kilburn, T., with others, automatic recognition of patterns, 2372
- Kilvington, T., effects of noise in television, 3139
- Kimpara, A., ionospheric disturbances by atomic explosion, 3711
- Kinariwala, B. K., synthesis of active RC networks, 3978
- Kinder, E., charging of photosensitive material in electron microscopes, 1988
- Kineke, E., with H. Cole, lattice vibrational spectra of Si and Ge, 857
- King, A. M., with others, scintillation noise in radar tracking systems, 2609
- King, D. D., with S. P. Schlesinger, dielectric image lines, 2827
- King, G. A. M., with C. H. Cummack, disturbance in F region following nuclear explosion, 3712
- King, H. E., directivity of broadside array of isotropic radiators, 3955
- King, J. C., anelasticity of quartz at low temperatures, 2334
- King, J. W., ionospheric self-demodulation and self-distortion, 2252
- King, P. G. R., 5%-bandwidth 2.5-MW S-band klystron, 3524 a
- King, R., rectangular loop antenna as a dipole, 3579
- King, R. A., experimental Clugston-2 transmission line, 2102
- King, R. W. P., with T. T. Wu, driving point and input admittance of linear antennas, 1440
- King-Hele, D. G., progress of Sputnik 3, 1545; effect of earth's oblateness on satellite orbit, 2233; density of the atmosphere from analysis of satellite orbits, 2955
- and R. H. Merson, new value for earth's flattening, 2567
- and D. M. C. Walker, last minutes of satellite 1957 B, 447; irregularity in atmospheric drag effects, 797; irregularities in density of upper atmosphere, 2571; predicting orbits of near earth satellites, 2232
- with R. H. Merson, use of artificial satellites to explore earth's gravitational field, 792
- with others, changes in inclination of satellite orbits to equator, 2235
- Kingsnorth, R. L., with others, orientation control for Ge wafers, 1935
- Kingston, R. H., u.h.f. solid-state maser, 4002
- with others, radar echoes from Venus, 2556
- Kinnear, J. A. C., automatic swept-frequency impedance meter, 220
- Kino, G. S., with P. T. Kirstein, solution to equations of space-charge flow, 764
- Kinzer, G. D., with B. B. Phillips, electrification of droplets in cumulonimbus clouds, 456
- Kirby, R. S., service area for television broadcasting, 287
- Kirchner, P. H., with others, radio reflections from satellite-produced ionization, 2963
- Kirenskiĭ, L. V., and V. V. Veter, measurement of boundary layer width between domains, 2676
- Kirkpatrick, G. P., with J. M. Forman, screen persistence of colour picture tubes, 4218
- Kirschstein, F., and H. Krieger, phase and group delay, 698, (D)3193
- Kirstein, P. T., electrodes required to produce given electric field distribution, 323; Pierce-type electron gun, (D)653; equations of space-charge flow, 3886
- and G. S. Kino, solution to equations of space-charge flow, 764
- Kiryushin, V. P., influence of dielectric on phase constants of helix, 2100
- Kiselev, M. I., and V. I. Tseylyaev, oblique shock waves in plasma, 1163
- Kita, S., H. Sanpei and T. Okajima, transmitting frequency converter, 3145
- with others, parametric amplifier using Ge diode, 1149
- Kitchen, F. A., and M. A. Johnson, turbulent scattering in propagation at m  $\lambda$ , 575
- and G. Millington, Gibraltar-U.K. ionospheric scatter measurements, 2000 a
- W. R. R. Joy and E. G. Richards, influence of ocean duct on scatter propagation beyond horizon, 578
- E. G. Richards and I. J. Richmond, m- $\lambda$  propagation in transhorizon region, 2000 p

- Kitchen, G. F., with others, atmospheric discontinuity layer effects on propagation, 2000 o
- Kitchen, H. D., simplified mains transformer design, 356; cathode compensation, 1814
- Kittaka, S., static charge on high polymer, 4013
- Kittel, C., energy absorption by charge carriers of negative effective mass, 3747; anomalous magnetocrystalline anisotropy peaks in ferromagnetic crystals, 4138
- Kiyonovskii, M. P., with others, large inhomogeneities in  $F_2$  layer, 2581
- Klages, G., with H. Buseck, rectangular waveguide with attenuating foil, 1772
- Klasens, H. A., intensity dependence of photoconduction and luminescence, 1207  
— with others, electroluminescence and image intensification, 1597; cathodoluminescence, 2624
- Klasky, P. S., with others, capabilities of coaxial cable, 2457
- Kleiger, L. B., improving relay reliability, 610
- Klein, C. A., radiation-induced energy levels in Si, 4089 j
- Klein, G., and J. M. den Hertog, sine-wave generator, 2876
- Klein, J. M., with D. E. Thomas, automatic transistor  $\alpha$  measuring set, 3427
- Klein, M. W., image converters and image intensifiers, 2783  
— with R. S. Wiseman, photoemissive image-forming systems, 4238
- Klein, W., transformer as 2-terminal network, 1467  
— and H. Neufischer, travelling-wave tubes for 4- and 6-Gc/s bands, 2788 b
- Kleiner, W. H., and L. M. Roth, deformation potential in Ge, 2655  
— with others, Zeeman effect of excitons in Ge, 2299
- Kleinman, D. A., with others, infrared properties, of SiC, 2297, of SiC film, 2298; anisotropic mobilities in deformed Ge, 3362
- Klemp, H. J., with H. Redlich, electromechanical transducer for stereophonic recording, 2096
- de Klerk, J., ultrasonic wave propagation in Ni, 1951
- Klerk, M., with others, interference from fluorescent lamps, 3463
- Kletschy, E. J., design criteria for magnetic modulators, 2165
- Kley, W., with others, lattice vibrations in Si by neutron scattering, 2291
- Klick, C. C., Ag luminescent centres in sulphides, 2998
- Klinger, M. L., magnetic susceptibility of semiconductors with impurity zone, 499  
— and G. A. Makarycheva, theory of semiconductors with excited impurity band, 3752  
— and Yu. I. Zaslava, theory of semiconductors with excited impurity zone, 1604
- Klipsch, P. W., stereophonic sound with two tracks, three channels, 1064
- v. Klitzing, K. H., and J. Gieslesen, influence of pressure on magnetizability of Au, Mn, 1273
- Klivans, L. S., d.c. amplifiers for control systems, 748
- Klontz, E. E., with J. W. Mackay, annealing studies in Ge, 4089 p  
— with others, thermal and radiation annealing of Ge, 2305; photoconduction of Ge after bombardment, 3027
- Klopfenstein, R. W., corner-reflector antennas, 1099
- von Klüber, H., intensities, polarization and electron densities of solar corona, 1182
- Klumpp, R. G., with others, evaluation of modulated-air-flow loudspeaker, 3922
- Klüver, J. W., aspects of M-type interaction, 2788 ff
- Klyachkin, V. I., effect of independent noise sources on receiving system, 691
- Knapp, W., radiation field of delta aerial, 3199
- Knauer, W., with R. C. Knechtli, electron cooling by heat exchange, 397
- Knecht, O., with others, fixed-frequency cyclotron with one dee, 1985
- Knecht, R. W., lunar influence on  $E_2$  at Huancayo, 3305
- Knechtli, R. C., effect of electron lenses on beam noise, 1726  
— and W. Knauer, electron cooling by heat exchange, 397  
— and R. D. Weglein, low-noise parametric amplifier, 2185
- Kneller, E., temperature dependence of spontaneous magnetization in ferromagnetic particles, 2678
- Knight, A. J., with others, vacuum-diode microwave detection, 2794
- Knight, K. V., range equation for active devices, 4010 f
- Knight, P., horizontal radiation patterns of dipole arrays, 343
- Knight, V. H., with G. Craven, integrally constructed waveguide assemblies, 2826
- Knob, E. D., with J. W. Buckelew, through-connections for printed wiring, 38
- Knopf, W., radio interference in u.s.w. range, 2386
- Knorr, T. G., and R. W. Hoffman, geometric magnetic anisotropy in Fe films, 2683
- Knowles, C. H., 'mesa' transistor, 635
- Knowles, R. B., with others, electronic subsystem development problems in naval ordnance, 2803
- Knudsen, H. L., earth currents near top-loaded monopole, 3948
- Ko, H. C., amplitude scintillation of extraterrestrial radio waves, 427
- Koch, B., radio waves from detonations, 3650
- Koch, L., with others, influence of high-energy electron bombardment on Ge, 3773
- Koch, W., high-resolution emission microscope, 1987
- Kociński, J., influence of demagnetizing field on domain structure, 2677
- Kock, W. E., related experiments with sound and e.m. waves, 3249
- Kockel, B., Sommerfeld ground wave, 1334
- Kodis, R. D., variational principles in h.f. scattering, 412
- Koenig, S. H., interelectron collisions and 'temperature' of hot electrons, 3345
- Koepke, G., measurement of dielectric constant of ferrites, 4158
- Koerner, L. F., portable frequency standard, 3052  
— with E. A. Gerber, measurements of parameters of piezoelectric vibrators, 211
- Koester, L., with others, fixed-frequency cyclotron with one dee, 1985
- Kogbetliantz, E. G.,  $\sin N$ ,  $\cos N$  and  $N^{1/m}$  using electronic computer, 2857
- Kogelnik, K., energy relations in electron beams, 4245
- Köhler, J., subjective assessment of shared-channel interference, 3479  
— with H. Niese, influence of peak content on sensation of loudness, 1754
- Kohn, G., generation of steep pulse edges in nonlinear amplifiers, 1488
- Koide, S., with T. Kasuya, theory of impurity conduction, 1224
- Kokaku, T., with others,  $F_2$ -layer multiple reflections, 1342
- Kokin, A. A., with G. V. Skrotskii, system of magnetic moments in weak variable magnetic field, 3644
- Kokosh, G. V., with others, thermoelectric properties of  $\text{Bi}_2\text{Te}_3\text{-Bi}_2\text{Se}_3$ , 3758
- Kokurin, Yu. L., with V. V. Vitkevich, irregularities in ionospheric refraction, 2251
- Kolachevskii, N. N., measurement of noise from cyclic remagnetization, 3796
- Kollanyi, M., gas-discharge tubes as noise sources, 559
- Kolomenskii, A. A., and Fan Shou-yan', cyclic motion of charged particles in electric field, 3835
- Kolomiets, B. T., with T. N. Vengel', vitreous semiconductors, 1920
- Komar, A. P., N. V. Volkenshtein and G. V. Fedorov, change of sign of Hall constant in alloys, 2675
- Komatsubara, K., noise at Ge fused junction, 1255; change of surface recombination velocity of Ge by gamma rays, 3372  
— and U. Hashimoto, annealing of radiation-induced  $1/f$  noise in Ge  $p$ - $n$  junction, 298
- Komesaroff, M., polarization measurements of solar radio bursts, 101  
— and C. A. Shain, refraction of extraterrestrial radio waves, 2973
- Kompaneets, A. S., radio emission from atomic explosion, 3649
- Kompfner, R., with J. R. Pierce, transoceanic communication by means of satellites, 2012  
— with others, reflex klystron as negative-resistance-type amplifier, 1741
- Kondo, G., with others, double-vane torque-operated wattmeter for 7 kMc/s, 223
- Kondratiev, B. V., with V. P. Shestopalov, space resonance in helix waveguide, 2464
- Köno, H., ferromagnetic phase in Mn-Al system, 2679
- Konose, A., with others, waveguide for low-loss transmission, 2829
- Kontsevoi, Yu. A., with others, distribution of non-equilibrium charge carriers in base region of  $p$ - $n$  junction, 1919; lifetime of non-equilibrium charge carriers in Ge, 1929
- Kool, C. F., R. W. Moss and D. C. Stinson, oriented ferrites with cubic anisotropy, 3399
- Kopp, H. J., and W. Peizold, linearization of multipliers at high anode currents, 2054
- Koppelman, J., R. Frielinghaus and F. J. Meyer, generation of very short ultrasonic pulses, 2078
- Kornetzi, M., hysteresis losses of ferrites, 3400
- Kornfeld, N. R., with others, end-fired memory, 36
- Kornienko, L. S., with others, chromium corundum paramagnetic amplifier, 1145
- Korpeil, A., with A. J. Seyler, voltage-controlled low-pass filter, 1119
- Korthals Altes, J. P., computer with resistance-network analogues, 2481
- Kosche, E., with P. Lindner, single-lens reflex television camera, 3496
- Kosowsky, L. H., with others, functional characteristics of node determinant, 548
- Kostarev, V. V., with A. G. Gorelik, radio echoes from invisible objects in troposphere, 2240
- Koster, G. F., and H. Stutz, Zeeman splittings of paramagnetic ions, 2549
- Kostyshyn, B., and D. D. Roshon, Jr, magnetic field probe, 1973
- Kotadia, K. M., meteors and  $E_2$  ionization, 3699 g
- Koury, F., with K. H. Butler, sylvatron electroluminescent display, 224
- Kovalenko, E. S., gyrotropic elliptical waveguide, 3933
- Kovrizhnykh, L. M., with V. I. Vekster, cyclic acceleration of particles in h.f. fields, 3440
- Koyama, J., application of spatial-harmonic wave on large-diameter helix, 2788 c
- Koyasu, M., absorption coefficients of fibrous materials, 3549  
— with K. Sato, effect of room shape on sound field, 3916
- Kozak, W. S., capacitor storage in analogue memory, 32
- Kozlovskii, V. Kh., stability of ferroelectric crystals, 483
- Kraft, L. G., Jr, with others, radar echoes from Venus, 2556
- Krajewski, I., transistor circuits for 1-Mc/s computer, 3229
- Kramer, A. G., and P. M. Platzman, microwave manometer, 565
- Kramer, A. S., c.r. storage tubes for direct viewing, 1744
- Kranz, J., and W. Drechsel, observation of Weiss domains in polycrystalline material, 1281
- Krasil'nikov, V. A., acoustics conference, 661
- Krasovskii (Krassovsky), V. I., investigation of upper atmosphere with Sputnik III, 1550, 1872  
— Yu. M. Kushnir and G. A. Bordovskii, investigation of solar radiation using earth satellites, 3293  
— and others, discovery of 10-keV electrons in upper atmosphere, 3294
- Kraus, C. R., experiments in television over telephone cable, 274; city-wide personal signalling, 3477
- Kraus, J. D., Ohio State University radio telescope, 3962
- Kravitz, L. C., and G. S. Heller, resonance isolator at 70 kMc/s, 1439
- Krayer, G., with F. R. Arams, low-loss L-band circulator, 1769
- Krentsel', B. A., with others, producing polymers with semiconductor properties, 4121
- Kreuchen, K. H., and N. J. Diserens, development of high-power klystrons, 3524
- Krieger, H., with F. Kirschsstein, phase and group delay, 698, (D)3193
- Krieger, L. A., with others, use of d.c. amplifier and recorder to balance resistance bridge, 3061
- Krinitz, A., magnetic circuits for pulse radar, 3316
- Krishna Prasad, H. D., with A. R. Ravi Varma, effect of restricted frequency characteristics on intelligibility of speech, 2755
- Krishnamurthi, M., G. S. Sastry and T. S. Rao, abnormal ionospheric behaviour at 10 m  $\lambda$ , 808; emission from sun at 30 Mc/s, 3699 o
- Krishnan, R., with others, temperature-sensitive ceramic reactance element, 45
- Krishnan, S., diode phase detectors, 1152; cathode-follower for d.c. reference level, 2164
- Křiz, J., with others,  $p$ - $n$  junctions in Ge, 3485
- Krochmann, E., control techniques, 3861
- Kroebeil, W., assessing quality of television images and projection systems, 1393; assessment of picture quality, 4222  
— F. Arp and H. Baummeister, perceptibility of image details in television, 3136; visual properties of human eye, 3138  
— with others, detail recognition on television screen, 3135
- Kröger, F. A., and H. J. Vink, concentrations of imperfections in solids, 1175
- Krohn, G., development of vocoder, 1753
- Krohs, A., with others, image converters for quantity production, 1404; resolving power of scintillation multipliers, 3081; photoresistors, photodiodes and phototransistors, 3520
- Krom, M. N., field fluctuations near focus of lens, 4027  
— and L. A. Chernov, effect of fluctuations on intensity distribution near focus of lens, 2917
- Krömer, H., negative-mass amplifier, 1824
- Krug, W., and J. Schusta, electronic production of lines of equal density, 4167
- Krugman, L. M., nomographs for narrow-band transistor amplifiers, 1497
- Kruthoff, A. A., with others, interference from fluorescent lamps, 3463
- Kruse, P. W., InAs infrared detector, 2987
- Krusemeyer, H. J., surface potential, mobility and conductivity of ZnO, 3778
- Krzyszowski, R., planning telecommunications systems, 1355
- Ksenzov, Ya. M., with others, relaxation polarization and losses in nonferroelectric dielectrics, 480
- Ku, S. M., with others, semiconducting properties of  $\text{HgTe}$ , 4112
- Kuck, R. G., expansion of Pacific coast microwave network, 2398
- Kuczynski, G. C., and R. H. Hochman, light-induced plasticity in Ge, 1938
- Kuebler, W., with C. F. Pulvari, polarization reversal in  $\text{BaTiO}_3$ , 159
- Kuhl, W., characteristics of reverberation plates, 1755
- Kühn, U., v.h.f. field-strength measurements near Berlin, 2740; propagation conditions at 1.3 Gc/s, 3095; propagation over nonuniform terrain, 3456
- Kuhr, F., with H. J. Lippmann, influence of geometry on Hall effect and magnetoresistance effect, 1234
- Kukarkin, B. V., launching of cosmic rockets, 3677
- Kulcsar, F., electromechanical properties of  $\text{Pb}(\text{Zr,Ti})\text{O}_3$  ceramics, 3739
- Kümmel, U., and K. W. Böer, electrostatic charging of CdS, 3731  
— with others, breakdown of CdS films, 2993; rendering visible conductivity inhomogeneities of semiconductors, 3757
- Kummer, M., ideal plane reflector, 1097
- Kummer, W. H., with others, tropospheric propagation beyond horizon, 4185
- Kundu, M. R., investigations of persistent solar sources at cm  $\lambda$ , 424; dimensions of sources of solar bursts, 425; time relations of metre-wave and 3-cm wave bursts, 2555; high-resolution interferometer, 2936  
— and J. F. Demisse, solar radiation at dm  $\lambda$  as index for ionospheric studies, 787
- Kundu, P., phase-angle measurement, 1970
- Kunkel, W. B., with others, hydromagnetic capacitor, 1843
- Kunze, C., inertia effects in vidicon-type tubes, 985;  $\text{Sb}_2\text{S}_3$  films, optical properties, 1209; photoelectric properties, 1210
- Kunzler, J. E., with others, phonon-drag thermomagnetic effects in  $n$ -type Ge, 2662
- Küpfmüller, K., and W. Andrich, speech transmission with quantization, 3855
- Kuprevich, N. F., television techniques in astronomy, 3083
- Kurbatov, L. V., with G. V. Skrotskii, anisotropy of width of ferromagnetic resonance absorption lines, 2210
- Kurnosova, L. V., investigations on cosmic rays by earth satellites, 2959

- with G. A. Skuridin, scientific investigations by earth satellite, 440
- Kurokawa, K.**, expansions of e.m. fields in cavities, 2143
- Kurokawa, S.**, T. Takahashi and M. Araki, mutually coupled CR-type directional coupler, 9
- with others, double-vane torque-operated wattmeter for 7 kMc/s, 223
- Kurov, G. A.**, and Z. G. Pinsker, thin layers of variable composition in In-Sb system, 3780
- Kuroyanagi, N.**, flux-controlling-type adder, 3210
- Kurth, C.**, band filters with bandwidth control, 735
- Kurtz, A. D.**, and C. L. Gravel, diffusion of Ga in Si, 513
- with others, avalanche breakdown in *n-p* Ge diffused junctions, 3378
- Kurtze, G.**, and B. G. Watters, wall design for high transmission loss, 3917
- Kürzl, A.**, with U. v. Kienlin, waveguide termination with film-type resistors, 1082
- Kushnir, Yu. M.**, with others, investigation of solar radiation using earth satellites, 3293
- Kustanovich, I. M.**, with others, producing polymers with semiconductor properties, 4121
- Kuttruff, H.**, characteristics of reverberation curves, 3546
- Kwestroo, W.**, with G. H. Jonker, ternary systems with BaO-TiO<sub>2</sub>, 838
- Kyle, R. F.**, super-gain aerial beam, 3952
- Laaff, O.**, with others, radio link installations for telephony and television, 1687
- Lacoste, R.**, criterion for surface conduction on insulating solids, 3252
- with others, ionization chambers as sources of current, 4152
- Lacroix, R.**, effect of cubic field on Gd<sup>3+</sup> ion, 758 e; theory of paramagnetic resonance of Eu and Gd, 1630
- Lacy, R. E.**, gain across mountainous obstacles, 1333 i; U.S. Army communications, 2744
- Ladany, I.**, d.c. characteristics of junction diode, 2410
- with A. Levitas, semiconductor-semiconductor 'point-contact' diode, 2037
- Ladnar, J.**, with others, *p-n* junctions in Ge, 3485
- Lafargue, M.**, and R. Millicamps, c.m. properties of glacier ice, 1994
- Laff, R. A.**, and H. Y. Fan, magnetoresistance in *n*-type Ge, 870
- Laffleur, C.**, transfer properties of a linear system, 3220
- Lagasse, J.**, with others, ionization chambers as sources of current, 4152
- Lagercrantz, C.**, homodyne detector for periodic waveforms, 3065
- Lagerstrom, R. P.**, with others, 20-40-kMc/s backward-wave oscillator, 1742
- LaGow, H. E.**, with R. Horowitz, auroral-zone atmospheric-structure measurements, 1560
- Laine, E. L.**, dividing wide frequency bands, 2508
- Lakshmanan, T. K.**, influence of Se microstructure on photocell characteristics, 2056
- Lamb, J. M.**, Redwood and Z. Shteinshleifer, absorption of compressional waves in solids, 3536
- Lamb, W. G. P.**, with F. A. Key, analogue computer for prediction of acoustic propagation, 3207
- Lambe, J.**, with others, ruby as maser material, 3793
- Lambert, M.**, with others, irradiation of photoconductive single crystals of CdS, 2617
- Lamming, J. S.**, h.f. Ge transistors, 1000
- Lamoral, R.**, diffusion measurements and room acoustics, 3918
- Lampert, M. A.**, and A. Rose, transient behaviour of ohmic contact, 2903
- F. Herman and M. C. Steele, single phonon emission in breakdown of semiconductors, 3013
- with A. Rose, gain-bandwidth product for photoconductors, 1900; photoconductor performance and Fermi level, 2988
- Landauer, G.**, with W. Eichen, gain and stability of travelling-wave valve, 1411
- Landmark, B.**, with T. Hagfors, simultaneous variation of amplitude and phase of Gaussian noise, 583; direction of arrival of long-duration meteor echoes, 1993
- Landsberg, P. T.**, with A. R. Beattie, Auger effect in semiconductors, 3341
- Landsman, A. P.**, with others, Si solar batteries for earth satellites, 3862
- Lane, J. A.**, resistive-film calorimeters for microwave power measurement, 4162
- with A. C. Gordon-Smith, gas-discharge noise sources at cm  $\lambda$ , 658
- Lane, R. N.**, and D. B. Cameron, current integration with solenoid liquid diodes, 2023
- Lang, W.**, with others, photoresistors, photodiodes and phototransistors, 3520
- Langbein, D.**, solution of Bloch's integral equation for metal electrons, 1914
- Lange, F. H.**, coding law of information theory, 4195
- Lange, L. J.**, with others, ionospheric reflection coefficients from spheres, 2589
- Langer, D.**, with others, cathode-electroluminescence phenomena in ZnS phosphors, 834
- Langford, R. C.**, versatile van istor, 42
- Langmuir, R. V.**, with others, power-line aerial, 1672; v.l.f. c.w. transmitter for ionospheric investigation, 3873
- Lapin, A. D.**, scattering of sound waves in irregular waveguides, 1042
- Laponsky, A. B.**, with N. R. Whetten, secondary emission from MgO thin films, 2316
- Laporte, O.**, and J. Meixner, Kirchhoff-Young theory of diffraction, 2918
- Lapostolle, P.**, heices for travelling-wave valves, 649
- Large, M. I.**, D. S. Mathewson and C. G. T. Haslam, high-resolution survey, of Andromeda nebula, 2937, of Coma Cluster, 2938
- Larish, E.**, and I. Shekhtman, production of two temperatures in ionized gas, 2536
- Lark-Horovitz, K.**, with H. Fritzsche, effect of minority impurities in *p*-type Ge, 2658
- with others, photoconduction of Ge after bombardment, 3027
- Larimore, L.**, range equation for passive infrared devices, 4010 e
- Larrabee, R. D.**, drift velocity saturation in *p*-type Ge, 3361
- Larsen, B. F.**, with P. Gudmandsen, microwave propagation measurements in Denmark, 579
- Lashkarev, V. E.**, and others, lifetime of injected current carriers in Sb-doped Ge, 1932
- with P. I. Baranski, bulk thermo-e.m.f. in Ge, 524
- with V. A. Zhidkov, diffusion and electric state of thermal acceptors in Ge, 520
- Lasser, M. E.**, P. Cholet and E. C. Wurst, Jr, high-sensitivity infrared detectors, 1012
- with others, control of luminescence by charge extraction, 473
- Latham, R.**, and others, high-power 400-Mc/s klystron, 3524 j
- Latour, C.**, with P. Gautier, field of series of magnetic lenses, 3445
- LaTourrette, J. T.**, with others, r.f. spectra of hydrogen deuteride, 1852
- Laudet, M.**, with P. Gautier, calculation of fields, 4023
- with others, measurement of induction in magnetic electron lenses, 2704
- Laurenson, L.**, with others, Ti getter pump, 1204
- Laurent, T.**, physical relations in ladder-type filters, 1116
- Lauter, E.**, and K. Sprenger, detecting solar flare effects in ionosphere, 1181
- Lautz, G.**, with G. Harbeck, crystal structure of Ga<sub>2</sub>Te<sub>3</sub> doped with Cu, 3031
- Laverick, E.**, calibration of microwave attenuators, 1123
- and J. Welsh, automatic standing-wave indicator, 2711
- Lavine, J. M.**, apparatus for measuring Hall coefficient, 918; ordinary Hall effect in Fe<sub>3</sub>O<sub>4</sub>, 3403
- Lawley, A.**, processing materials with electron bombardment, 4168
- Lawrie, J. A.**, V. B. Gerard and P. J. Gill, magnetic effects of two high-altitude explosions, 3671
- Lawson, G. J.**, with others, deduction of electron content from Faraday fading, 2572
- Lawson, J. D.**, permeance and Bennett pinch relation in electron beams, 84; e.m. wave problems, 4025
- Lax, B.**, with others, Zeeman effect of excitons in Ge, 2299; exciton- and magneto-absorption of transitions in Ge, 3364; optical magneto-absorption effects in semiconductors, 3365
- Lax, M.**, with R. Rosenberg, free-carrier absorption in *n*-type Ge, 1249
- Lea, N.**, quartz servo oscillator, 371
- Leadbrand, R. L.**, and A. M. Peterson, radio echoes from auroral ionization, 1670
- and I. Yabroff, geometry of auroral communications, 1671
- L. Dolphin and A. M. Peterson, radar investigations of auroral echoes, 4065
- Leadbetter, A. J.**, with others, heat capacity of pure Si and Ge, 3353
- Leagus, D. C.**, C. Y. Lee and G. H. Mealy, verification of logic system by digital computer, 2134
- Leakey, D. M.**, with J. N. Barry, transistorized pulse amplifier, 2518
- Leary, F.**, microwave health hazards, 2075
- Lebacqz, J. V.**, and others, high-power windows at microwave frequencies, 3159 c
- with others, high-power pulsed klystrons, 1410
- Lebedinskii, A. I.**, with others, mechanism of terrestrial corpuscular radiation, 2216
- Leblond, A. F.**, electron trajectories in guns for M-type tubes, 3524 jf
- Lecar, M.**, J. Sorenson and A. Echels, earth's gravitational potential from satellite orbit, 1867
- Lechelder, J. W.**, mode conversion at junction of waveguide and pipe, 3932
- LeCorguillier, J.**, Ge and Si industrial rectifiers, 269
- LeCraw, R. C.**, with E. G. Spencer, magnetoacoustic resonance in Y-Fe garnet, 201
- with others, low-temperature line-width maximum in Y-Fe garnet, 3812
- Ledig, G.**, h.f. transistor, 2768
- Lee, C. Y.**, representation of switching circuits, 3215
- with others, verification of logic system by digital computer, 2134
- Lee, E. W.**, and D. R. Callaby, measurement of velocity of propagation of domain boundary in permivar, 194
- Lees, C. H.**, digital computers in Britain, 1779
- Lefevre, H. W.**, and J. T. Russell, vernier chronotron, 1965, 2338
- Lefkowitz, I.**, and T. Mitsui, effect of irradiation on coercive field of BaTiO<sub>3</sub>, 1913
- Lego, P. E.**, and T. W. Sze, obtaining transient response using digital computer, 2130
- Legrand, J. P.**, forecasting solar activity by study of cosmic radiation, 1179
- Lehmann, R.**, absolute calibration of standard microphones, 1430
- with P. J. A. H. Chavasse, loudspeaker measurements, 1761
- Lehmann, W.**, electroluminescence of ZnS phosphors as equilibrium process, 832; particle size and efficiency of electroluminescent ZnS, 2266
- Lehtonen, E. W.**, and E. A. Cronauer, a.c.-controlled magnetic amplifiers, 382
- Leighton, H.**, with C. Elyett, solar-cycle influence on lower ionosphere and v.h.f. scatter, 130
- Leighton, L. G.**, and A. Makulec, improvements in lamps for television studios, 286
- Leinbach, H.**, and G. C. Reid, upper-atmosphere ionization by particles from solar flare, 1521
- with C. G. Little, riometer, 1566
- Leivo, W. J.**, with M. D. Bell, rectification and photo-effects in semiconducting diamond, 504
- Lekhtinen, G. N.**, M. A. Raev and L. S. Stil'bans, temperature dependence of work function of semiconductors, 494
- Lempicki, A.**, polarization of fluorescence in ZnS and CdS, 2267; anomalous photovoltaic effect in ZnS, 2989
- Leng, L.**, medium-wave aerials for simultaneous transmission, 16
- Lennartz, H.**, magnetic-tape recorder for ultrasonic frequencies, 2085
- Lenz, F.**, distribution of stream of particles with multiple scattering, 1837; stigmatic image in asymmetric electron lenses, 3075
- Lenz, K. L.**, transmission lines for low-reflection absorption, 1765
- and O. Zinke, absorption of e.m. waves in absorbers and lines, 1068
- Leonard, R. S.**, v.h.f. radar for auroral research, 1574
- Lépéchinisky, D.**, magneto-ionic theory and its results, 572
- and G. Dapoust, effects of nuclear explosions on ionospheric soundings, 3710
- Lépineux, M.**, discrimination between chromospheric eruptions, 1180
- Leroux, J. P.**, and P. Thureau, photoluminescence of ZnS-Cu, 1908
- Lesk, I. A.**, and R. E. Coffman, Ge diffused mini-crystals and use in transistors, 637
- and R. E. Gonzalez, selective etching of junction transistors, 1402
- with others, observation of phonons during tunnelling in junction diodes, 4226
- Levesque, P.**, L. Geylach and J. E. Zneimer, grain growth in Ni ferrites, 544
- Levi, L.**, correction of slant range distortion in high-altitude radars, 821; high-fidelity video recording, 931
- Levi, R.**, with others, dispenser cathodes, 2791
- Levin, E.**, R. B. Muchmore and A. D. Wheelon, aperture-to-medium coupling on line-of-sight paths, 4183
- Levin, I.**, photovoltaic pile, 231
- Levine, D.**, dynamic compression for radar receivers, 1588
- Levinstein, H.**, impurity photoconductivity in Ge, 4106
- Levitas, A.**, and I. Ladany, semiconductor-semiconductor 'point-contact' diode, 2037
- Levy, B. R.**, and J. B. Keller, propagation of e.m. pulses around earth, 1662; diffraction by smooth object, 3265
- Levy, R.**, hybrid junctions, 3560
- Lewin, L.**, theory of cylindrical antennas, 3945
- Lewis, B.**, ferroelectric materials, 154; energy loss processes in ferroelectric ceramics, 1217
- Lewis, D. J.**, mode couplers and multimode measurement techniques, 3935
- Lewis, H. R.**, with others, structure and relaxation times of Cr<sup>3+</sup> in TiO<sub>2</sub>, 2333
- Lubin, I. Sh.**, multivibrator with negative feedback, 1807
- Licht, J.**, with others, tracking weather with satellites, 2715
- Lichtenberg, A. J.**, with C. K. Birdsall, travelling-wave focusing for plasma containment, 4022
- Li-Chzhi-Tszyan**, induced conductivity of CdS and CdSe films bombarded by slow electrons, 2616
- Lidard, A. B.**, with M. J. S. Stephen, Faraday effect in semiconductors, 4088
- Lieb, A.**, electron-beam voltage indicator tube, 2073
- Liebscher, R.**, and R. Müller, frequency noise in travelling-wave tubes, 3159 dd
- Lifschitz, L.**, with R. der Agobian, propagation of non-ionizing shock waves, 4016
- Lignon, J.**, with others, centipede aerial, 1333 u
- Likhter, A. I.**, and T. S. D'yakonova, dependence of Hall effect on pressure in *n*-type Ge, 2663
- Lin, C. M.**, and R. W. Grow, broadband microwave coaxial connector, 3551
- Lin, H. C.**, and B. H. White, single-ended amplifiers for class-B operation, 2885
- Linden, D.**, and A. F. Daniel, power sources for space age, 2399
- Linden, D. A.**, sampling theorem's, 3417
- Lindmayer, J.**, and R. Zuleeg, determining transistor high-frequency limits, 4232
- with R. Zuleeg, sweep equipment displays transistor  $\beta$ , 928
- Lindner, H.**, and U. Gladhorn, automatic recorder for c.r. oscillography, 1978
- Lindner, P.**, and E. Kosche, single-lens reflex television camera, 3496
- Lindsay, J. E.**, and H. J. Woll, design of transistor d.c. amplifiers, 65
- Lindsay, P. A.**, and K. D. Collins, design of helical coupler for 2-Gc/s band, 3159 z
- with others, travelling-wave multiple-beam klystron, 3524 z
- van Lint, V. A. J.**, and H. Roth, electron irradiation of Ge and Te, 4089 l
- Lipkin, D. M.**, transfer function of linear filter, 3607
- Lipman, R. A.**, and I. B. Negnevitskii, theory of half-wave magnetic amplifier, 1495
- Lippincott, E. R.**, and others, infrared studies on SiO<sub>2</sub> and GeO<sub>2</sub>, 205
- Lippmann, H. J.**, and F. Kuhri, influence of geometry on Hall effect and magnetoresistance effect, 1234
- Lisgarten, N. D.**, with M. Blackman, magnetic models for interpreting domain effects on electron beam, 3407
- Liszka, L.**, variation of signal strength from 1958  $\delta$  2, 2953
- Litovchenko, V. G.**, with others, lifetime of injected current carriers in Sb-doped Ge, 1932
- Little, A. G.**, with others, parametric amplifiers as superregenerative detectors, 3245
- Little, C. G.**, and H. Leinbach, riometer, 1566
- Little, R. P.**, H. M. Ruppel and S. T. Smith, beam noise in crossed electric and magnetic fields, 313

- Little, V. I., i.f. measurement of dielectric constant of conducting liquids, 215
- Liu, S. H., with R. H. Mattson, switching v.h.f. with Si diodes, 3486
- Liu, Y. J., and J. O. Campbell, collision detection without range data, 3722
- Lo, A. W., with others, transfluxor-controlled electroluminescent display panels, 568
- Löb, E., dielectric properties of quartz sands, 2272
- Lobanov, A. M., with G. P. Mikhailov, dielectric losses and permittivity of polymers, 3818
- Lobanov, I. V., suppression of unwanted sideband, 589
- Locher, P. R., with others, absorption in paramagnetic salts at 1 325 Mc/s, 2674
- Löcherer, K. H., noise of space-charge diodes, 2436
- Lochner, J. P. A., and J. F. Burger, subjective masking of delayed echoes, 5; intelligibility of reinforced speech, 3912
- Lock, J. M., with F. A. Johnson, vibrational spectrum and specific heat of Ge, 517
- Lockwood, J. A., with L. C. Towle, cosmic-ray increases associated with solar flares, 2557
- Loeb, J., binary channels in cascade, 2388; physical interpretation of Shannon's ambiguity, 3853
- Loebner, E. E., and E. W. Poor, Jr, bimolecular transitions in GaP, 3737
- Loferski, J. J., and P. Rappaport, effect of radiation on Si solar-energy converters, 1366; electron-bombardment-induced recombination centres in Ge, 4108
- Logachev, E. G., passage of random noise signals through detector, 2005
- Logachev, Yu. I., with others, cosmic rays and terrestrial corpuscular radiation by cosmic rocket, 2231; investigation of cosmic radiation, 3663
- Logan, M. J., with others, preparation and properties of MgTe, 1258
- Logan, R. A., and W. L. Bond, density change in Si on melting, 2292
- G. L. Pearson and D. A. Kleinman, anisotropic mobilities in deformed Ge, 3362
- Loh, S. C., electric potential and capacity of toroid, 4012; toroidal functions, 4145
- and J. Y. Wong, radiation field of elliptic loop, 20
- with J. Y. Wong, radiation resistance of elliptic loop, 1776; radiation field of elliptic helical antenna, 3577
- Lomax, R. J., effect of inclination of focusing electrodes on electron-beam formation, 2060
- Lombardo, P. P., and E. W. Sard, low-frequency travelling-wave reactance amplifier, 2524
- Lomer, P. D., passive protection cells, 2800 d
- and R. M. O'Brien, microwave pulsed attenuator, 2800 b; high-power microwave duplexer, 2833
- Long, D. C., D. Motchenbacher and J. Myers, impurity compensation and magnetoresistance in Si, 2293
- with others, effect of pressure on Hall-coefficient reversal in Te, 1237
- Long, R. R., and G. H. Munro, radio signals from first earth satellite, 444
- Long, W. G., and R. R. Weeks, quadruple-diversity tropospheric scatter systems, 972
- Looney, C. H., Jr, with others, tracking orbits of man-made moons, 1190
- Loriers, J., with G. Villers, properties of mixed Dy-Y, Dy-Gd and Dy-Er garnets, 2331
- with others, magnetic properties of Er garnet, 1290; properties of mixed Gd-Er and Gd-Y garnet, 1633
- Lothian, B. W., A. C. Robinson and W. Sucksmith, properties of dilute ferromagnetic alloys, 1631
- Lotkin, M., smoothing of data, 208
- Loughlin, B. D., colour-signal distortions in envelope-type second detectors, 1392
- Louis, H. P., anomalous noise in magnetically focused electron beams, 2789
- Louisell, W. H., parametric amplifier and frequency converter, 2065
- with others, parametric amplification of space-charge waves, 3159 j
- Lovell, A. C. B., with J. G. Davies, observations of the Russian moon rocket Lunik II, 4051
- Lovell, S. E., and R. H. Cole, coaxial displacement dielectric cell, 3063
- Low, F. E., Lagrangian formulation of Boltzmann-Vlasov equation, 2911
- Low, W., and D. Shaltiel, electron paramagnetic resonance in BaTiO<sub>3</sub>, 477; paramagnetic-resonance spectrum of Gd in ThO<sub>2</sub>, 909
- with M. Weger, paramagnetic-resonance spectrum of Gd in LaCl<sub>3</sub>·7H<sub>2</sub>O, 780
- Lowe, G. C., magnetic field measurement by nuclear resonance, 1644
- Lubben, G. J., with J. Haantjes, errors of magnetic deflection, 3125
- Lübcke, E., noise measurement, 2453; frequency evaluation of noise spectra, 3914
- Lubszynski, H. G., half-tone image storage tubes, 1745
- Lucardie, J. A. van der Vorm. See van der Vorm Lucardie, J. A.
- Lucas, A. R., relativistic flow of electrons in straight lines, 396
- Lucas, I., matching waveguide directional couplers, 1083
- Lucas, W. J., with others, propagation measurements at 3 480 Mc/s, 2000 r
- Lucasson-Lemasson, A., L-spectrum of Ge, 3772
- Lucke, W. H., magnetic amplifier commutating and pulse-width encoding circuit, 2188
- Lucken, J. A., with others, experimental annular reflex klystron, 3524 bb; design of gridless low-voltage reflex klystron, 3524 dd
- Lüdicke, E., synchronization characteristics of television receivers, 1388
- Ludloff, A., with H. Awender, crystal-controlled transistor oscillators, 1129
- Ludwig, G. H., cosmic-ray instrumentation in earth satellite, 2964
- with others, radio observations with satellite 1958e, 2238
- Ludwig, G. W., and H. H. Woodbury, electron spin resonance in Ni-doped Ge, 2661
- Lueg, H., W. Schallehn and H. Toedter, Telefunken traffic radar, 1898
- Luft, W., cooling of semiconductor devices, 3146
- Lundh, Y., digital techniques for small computations, 1452
- Lunze, K., stabilization of transistor circuits at variable temperature, 2051
- Lüscher, J., and P. Döme, transistor simulator, 4156
- Lüst, R., with L. Biermann, radiation and particle precipitation from solar flares, 1530
- Lüthi, B., magnetoresistance of metals in high fields, 3337
- with others, magnetic resistance variation of InSb, 758 b
- Luttinger, J. M., Hall effect in ferromagnetics, 1277
- Lutze, E., and D. Bösnecker, paramagnetic electron-resonance induction, 2927
- Lutzky, M., and J. S. Toll, formation of discontinuities in nonlinear electrodynamics, 2914
- L'vova, E. Yu., with others, properties of Ge doped with Zn, 1613
- Lyamshv, L. M., sound scattering by thin rod, 676
- Lyman, R. C., and C. I. Jones, electroluminescent panels for automatic displays, 3434
- Lynch, R. D., measuring load characteristics of Si cells, 3484
- Lynn, G. E., with others, transfer efficiency of magnetic amplifiers, 3238
- Lyon, G. F., and A. Kavadas, radar echoes from aurora, 2255
- Lyons, J. F., with J. C. Greene, receivers with zero intermediate frequency, 1677
- Lyons, J. F., Jr, analysing multipath delay, 4192
- Lysanov, Yu. P., sound scattering on inhomogeneous surfaces, 675; theory of wave-scattering on periodic surfaces, 775
- Lytollis, J., with A. H. W. Beck, mobile Cs frequency standard, 3053
- Ma Da-Yu (Maa, D. Y.), normal modes of vibration in rectangular room, 684; acoustics in China, 2808
- Macario, R. C. V., avalanche transistors, 2772
- MacArthur, J. W., origin of v.l.f. radio emissions, 3311
- Macdiarmid, I. F., waveform distortion in television links, 4209
- MacDonald, A. D., h.f. breakdown in air at high altitudes, 1834
- MacDonald, C., narrow-band image transmission system, 276
- MacDonald, D. K. C., thermoelectricity at very low temperatures, 2529
- MacDonald, F. C., with others, measurements of 1 250-Mc/s scatter propagation, 3096
- Macdonald, N. J., with others, geomagnetic disturbances and changes in atmospheric circulation at 300 mb, 2229
- Macek, O., television monitoring installations, 2763, 3869
- Macfarlane, G. G., and others, fine structure in absorption-edge spectrum of Si, 509
- with others, effect of magnetic field on absorption edge in semiconductors, 501
- Mack, G., measurement of lattice constant of Ge, 1936; X-ray investigations on Ge-In p-n alloy junctions, 1937
- Mackay, J. W., and E. E. Klontz, annealing studies in Ge, 4089 p
- E. E. Klontz and G. W. Gobeli, thermal and radiation annealing of Ge, 2305
- with others, photoconduction of Ge after bombardment, 3027
- Mackellar, A. C., with others, electronic clock coder for coded radio beacons, 4069
- Mackimmie, G. B., quadruplexer for simultaneous transmission of television stations, 2119
- with others, 468-Mc/s tropospheric scatter propagation, 245
- Mackinnon, L., with others, pulse techniques, 2449
- Mackworth, J. F., and N. H. Mackworth, eye fixations recorded by television eye-marker, 930
- Mackworth, N. H., with J. F. Mackworth, eye fixations recorded by television eye-marker, 930
- Maclean, D. J. H., design curves for simple filters, 366
- MacLeod, G. A., with others, Doppler satellite measurements, 1191
- Macmillan, R. S., W. V. T. Rusch and R. M. Golden, antenna to eliminate groundwave interference in ionospheric sounding, 710
- with others, power-line aerial, 1672; v.l.f. c.w. transmitter for ionospheric investigation, 3873
- Macpherson, J. D., with others, coefficient of thermal expansion of BaTiO<sub>3</sub>, 2629
- Madden, H. H., and H. E. Farnsworth, high-vacuum studies of surface recombination velocity for Ge, 1248
- Maddever, R. S., with others, radiosonde measurement of electric field and polar conductivity, 1195
- Maddock, C. H., with others, dependence of combiner diversity gain on signal-level distribution, 4191
- Madsen, E. R., application of velocity microphones to stereophonic recording, 7
- Maeda, H., geomagnetic disturbances due to nuclear explosions, 3670
- with others, lattice scattering mobility in CdS, 2990
- Maeda, K., electroluminescence of insulated particles, 1215
- Maeda, K. I., and T. Sato, F region during magnetic storms, 1563
- S. Kato and T. Tsuda, ionospheric scattering, under influences of ion production and recombination, 4059, in electro-dynamically controlled turbulence, 4060
- Maehlum, B., diurnal variation of  $f_oF_2$  near auroral zone during magnetic disturbances, 803
- Maguire, T., microwave systems using low-noise devices, 3971
- Mahaffy, D. W., plasma electron oscillations, 2910
- with K. G. Emeleus, transit-time relation for plasma electron oscillations, 1840
- Maher, T. M., with R. McFee, effect of surface reflections on rain cancellation of radars, 4072
- Maier, W., and H. K. Wimmel, quantum theory of dielectric polarization of gases, 2901
- Maier-Leibnitz, H., with others, fixed-frequency cyclotron with one dee, 1985
- Mallart, D., with others, M-type pulsed amplifier, 2788 k
- Mainberger, W. A., frequency standard using Cs, 550
- with others, comparison of Cs frequency standards, 212
- Mainstone, J. S., W. G. Elford and A. A. Weiss, c.w. technique for measurement of meteor velocities, 105
- Majumder, D. D., track switching system for magnetic-drum memory, 718
- Makarycheva, G. A., with M. I. Klinger, theory of semiconductors with excited impurity band, 3752
- Makhov, G., with others, ruby as maser material, 3793
- Makovskii, L. L., dependence of current amplification factor on emitter current at high temperatures, 3882
- Makow, D., generation of oscillations with equally spaced frequencies, 741
- Makow, D. M., and others, distress beacon for crash position indicator, 1891
- Makulec, A., with L. G. Leighton, improvements in lamps for television studios, 286
- Maloff, I. G., bilateral conductivity in power transistors, 306
- Malovetskaya, V. M., with others, Si solar batteries for earth satellites, 3862
- Malurkar, S. L., geomagnetic work at Alibag, 3699 c; solar control of unusual geophysical events, 3699 n
- Malyuzhinets, G. D., scattering of sound in sea, 3902
- Mambo, M., with others, reception of radio waves from Russian earth satellite I, 120
- Mandel, L., image fluctuations in cascade intensifiers, 3521
- Mandel'shtam, S. L., and A. I. Efremov, ultraviolet solar radiation, 3664
- Mandrell, W. L., with C. A. Master, variable-frequency instrument calibration source, 1696
- Manenkov, A. A., with others, chromium corundum paramagnetic amplifier, 1145
- Manfield, H. G., advances in potted and printed circuits, 2862
- Mangiaracina, R. S., with E. Stern, ferrite high-power effects in waveguides, 3937
- Mann, F. A., with others, conductance of dipoles, 1089
- Manning, L. A., oblique echoes from over-dense meteor trails, 2225
- and V. R. Eshleman, meteors in ionosphere, 1526; Booker's theory of meteoric reflection, 1527
- Manogian, H. A., challenge of space, 2807
- Manring, E., and others, wind determinations in upper atmosphere, 3302
- Mansfield, R., and W. Williams, electrical properties of Bi<sub>2</sub>Te<sub>3</sub>, 532
- Mansford, H. L., K. M. I. Khan and D. T. A. Margetts, amplitude/frequency response display using ratio method, 219
- Many, A., semiconductor surface phenomena, 3019
- with others, phase-shift method of carrier lifetime measurements, 515
- Marais, A., effect of Co on magnetic dispersion of Ni-Zn ferrites, 3808
- and T. Merceron, disaccommodation of permeability of Ni-Zn ferrites, 4136
- with R. Vautier, switching time of square-loop ferrite, 3404
- Marasigan, V., bifurcations in F region at Baguio, 802; height gradient of electron loss in F region, 805
- March, F. C., solderless grounding for braided shields, 336
- Marchal, M., and M. T. Marchal, ingestible radio capsule, 1326
- Marchal, M. T., with M. Marchal, ingestible radio capsule, 1326
- Marchant, H., with R. W. Williams, resistance potentiometers as function generators, 35
- Marcus, S. M., with J. T. Wallmark, semiconductor devices for microminiaturization, 3213
- Marcuse, D., attenuation of TE<sub>01</sub> wave in curved helix waveguide, 704
- Margenau, H., with others, conductivity of plasmas to microwaves, 1842
- Margetts, D. T. A., with others, amplitude/frequency response display using ratio method, 219
- Mariani, F., world-wide distribution of F<sub>2</sub>-layer electron density, 3706
- Mariot, L., and Pham Mau Quan, e.m. tensor in presence of induction, 407
- Marique, J., bandwidth occupied by class-A1 transmission, 962; direct measurement of transmission frequency of aircraft, 3423
- Mark, M., and M. Stephenson, air-cooled chassis for electronic equipment, 353
- Markow, E. W., servo phase control shapes antenna pattern, 1092
- Martin, A. V. J., ultrasonic velocity in liquids under pressure, 1; sound distribution at Brussels exhibition, 1691; propagation of sound in sea water, 2810
- Martin, E., design of transistor for i.f. amplifier, 305
- Martin, E. J., with others, persistent v.h.f. field strengths beyond radio horizon, 2737
- Martin, E. J., Jr, calibrated source of  $\mu\text{ps}$  pulses, 2706

- Martin, H. J., with W. Freitag, electronic ultrasonic image converter, 2084
- Martin, J. R., G. W. Warnick and R. N. Vandeland, remote-control carrier systems in two-way closed-circuit television, 285
- Martin, R. J., with J. E. Rowe, electron-trajectory calculator and Poisson cell, 3524 kb
- Martin, W. A., inverter for 20 kc/s using power transistors, 2021
- Martineau, M., photoconductivity of irradiated CdS, 1594
- with others, irradiation of photoconductive single crystals of CdS, 2617
- Martner, J. G., with J. S. Arnold, resonances of BaTiO<sub>3</sub> cylinders, 2446
- Marton, L., Advances in Electronics and Electron Physics, Vol. 9, (B)327
- Martyn, D. F., F region of ionosphere, 1555; sporadic-E, spread-F and twinkling of radio stars, 2970
- Maruse, S., and Y. Sakaki, electron-optical properties of point cathodes, 3077
- Maslov, A. A., analogue multiplier-divider using thyrites, 1458
- Maslov, V. P., characteristic functions of equation  $\Delta u + k^2 u = 0$ , 2696
- Mason, D. R., and J. C. Sarace, contacts to p-type Si, 2296
- Mason, R. G., and M. J. Vitousek, geomagnetic phenomena associated with nuclear explosions, 3672
- Mason, W. C., with others, u.h.f. signals reflected from moon, 1525
- Massey, H. S. W., molecular vibration and rotation by electron impact, 3259
- Master, C. A., and W. L. Mandrell, variable-frequency instrument calibration source, 1696
- Mataré, H. F., dislocation planes in semiconductors, 3338
- with others, conductivity of grain boundaries in Ge bicrystals, 2657; grain-boundary amplifier, 3241
- Mathams, R. F., voltage-operated logarithmic amplifier, 3996
- Mather, R., and J. Sharpe, tuning cavities for reflex klystrons, 3525
- Mathewson, D. S., with others, high-resolution survey, of Andromeda nebula, 2937, of Coma Cluster, 2938
- Matlow, S. L., and E. L. Ralph, ohmic Al/n-type Si contact, 3356
- Matossi, F., quenching of photoconductivity and electron lifetime, 2263
- Matsumaru, K., reflection of tapered waveguides, 1768
- Matsumura, T., H. Fujisaki and Y. Tanabe, preparation of ZnS single crystals, 2625
- Matsumura, S., study of morphology of ionospheric storms, 2248; upper atmosphere in auroral zone, 3704; geomagnetic and ionospheric phenomena associated with nuclear explosions, 3709
- Matsuzawa, K., microphones for airborne ultrasonics, 2448
- Matthei, W. G., with others, 'reactatron' microwave amplifier, 1150; surface-barrier photodiodes as photocapacitors, 3885
- Matthews, D. J., with H. Sutcliffe, transistor junction temperature, 1974
- Mathias, B. T., with H. Suhl, impurity scattering in superconductors, 3633
- Matthysse, S. W., with others, conductivity of plasmas to microwaves, 1842
- Mattingley, R. L., B. McCabe and M. J. Traube, split reflector for microwave antennas, 712
- Mattis, D. C., and M. J. Stevenson, theory of negative-mass cyclotron resonance, 3760
- Mattson, R. H., and S. H. Liu, switching v.h.f. with Si diodes, 3486
- Matukura, Y., Ge-Si alloy junctions, 3379
- Matuura, N., and T. Nagata, turbulence in upper atmosphere, 2577
- Matveev, A. N., capture mechanism and limiting current in betatrons, 2718
- Matzen, W. T., and J. R. Beard, differential amplifier features d.c. stability, 1496
- Maurer, R., pin triode in television bands IV and V, 2796
- Mautner, R. S., with R. E. Murphy, transistorized i.f.-strip design, 70
- Maxwell, E., with J. H. Phillips, broad-band amplifier for radar and scatter, 64
- Maxwell, E. L., with others, radio system performance in noise, 963; l.f. propagation paths in arctic areas, 4182
- May, J., pulse amplitude discriminator, 2505
- Mayaud, P. N., scientific reports of French polar expeditions S IV 2, 111
- Mayer, A., with others, multilevel pulsed-field maser, 3623
- Mayer, C. H., with others, maser amplifier for radio astronomy, 2892
- Mayer, F., Faraday effect and birefringence in ferrites, 1632
- Mayer, H. J. G., infrared absorption by conduction electrons in Ge, 871
- Mayer, L., magnetic writing with electron beam, 539; electron mirror microscopy of stray fields, 3800
- Mayer, N., colour television experiments, 1372
- Mayer, W., industrial television installations, 1394
- Mayeur, J. P., impedance of capacitors, 2136; probable life of paper capacitors, 3219
- Mayo, B. J., effect of reactive loads on reflex klystrons, 3524 ff
- Mayo, C. G., and J. W. Head, wide-range RC oscillator, 54
- and H. Page, a.m. transmitter class-C output stage, 624
- Mayr, S., iterative analysis of asymmetric quadri-poles, 2869
- Mazumi, T., relaxation-time anisotropy in CdS, 2992
- McCabe, B., with others, split reflector for microwave antennas, 712
- McClure, J. W., analysis of multicarrier galvanomagnetic data for graphite, 1241
- McCollom, K. A., nucleonic instrumentation—discriminators, 3446
- McCousland, M. A. H., with others, dynamic nuclear polarization, 3412
- McCracken, K. G., and N. R. Parsons, unusual cosmic-ray intensity fluctuations, 1860
- with others, decreases in cosmic-ray intensity during period October 1956 – January 1958, 4037
- McCullagh, G. C., with R. B. Cairns, discharge modes using thermionic cathodes, 2441
- McDonnell, D., and R. W. Perkins, interpolation and prediction of signals plus noise, 2391
- McDowell, H. L., with others, helix travelling-wave amplifier, 2788 a
- McElhinny, M. W., E-layer measurements during solar eclipse, 3306
- McFadden, M. H., with R. J. A. Paul, measurement of phase and amplitude at l.f., 1651
- McFee, R., and T. M. Maher, effect of surface reflections on rain cancellation of radars, 4072
- McGrath, J. W., with K. N. Kapur, r.f. unit for n.m.r. spectrometer, 2544
- McGuire, W. S., radio links for control of aeronautical equipment, 1689
- McIlwain, C., with P. Rothwell, satellite observations of solar cosmic rays, 3692
- McIlwain, C. E., with others, radio observations with satellite 1958e, 2238; ionizing radiation at 3 500–38 000 km, 3691
- McIntosh, B. A., interception noise in electron streams, 3165
- McIntyre, J. W., with C. C. Willhite, analogue computer for evaluating radar performance, 1465
- McKenna, M. F., low-loss structures in waveguides, 340
- McKerrow, C. A., with others, engineering of l.f. communication systems, 2750
- McKim, F. S., with T. M. Buck, chemical and atmospheric effects on surface properties of Si, 4097
- McLaughlin, S. W., with others, 20–40-kMc/s backward-wave oscillator, 1742
- McLean, T. P., with others, effect of magnetic field on absorption edge in semiconductors, 501; fine structure in absorption-edge spectrum of Si, 509
- McLeish, C. W., and R. S. Roger, h.f. direction-finding errors caused by vertical radiators, 1203
- McLeod, M. G., with others, circuits for space probes, 3286
- McMahon, R. E., transistorized core memory, 1783
- McNamara, F., noise problem in coincident-current core memory, 1787
- McNaney, J. T., electron gun operates high-speed printer, 34
- McNaughton, R., and B. Mitchell, rectifier nets with multiple outputs, 29
- McNaul, J. P., with others, micro-module approach to miniaturization, 2485
- McNeill, W., preparation of cadmium niobate, 2276
- McNicol, A. S., t.r. switch, 44
- McSkimin, H. J., ultrasonic measurements on solids at high temperature, 2815
- with others, elastic moduli of GaAs, 3380
- McSpadden, W. R., and E. Eberhard, designing transistor oscillators, 746
- McWhorter, A. L., and R. H. Rediker, cryosar, 3211
- Meadows, E. B., with others, results obtained with rocket-borne ion spectrometers, 3703
- Meadows, R. W., reflections from meteor trails and E<sub>s</sub> on N-S path at v.h.f., 2000 i
- Meads, S. K., design of pulsed distributed amplifiers, 2166
- Meakins, R. J., with J. S. Dryden, impregnants for paper capacitors, 1474
- Mealy, G. H., with others, verification of logic system by digital computer, 2134
- Medcalf, W. E., and R. H. Fahrimg, growth of CdS crystals, 4077
- Medhurst, R. G., echo distortion in f.m., 3472
- with others, dependence of combiner diversity gain on signal-level distribution, 4191
- Medici, I., transmission quality in f.m. radio-telephony, 2014; expression for a signal at output of limiter, 4189
- Medicus, G., energy spectrum of plasma electrons, 765
- Medina, M. A., with E. N. Skomal, medium-power microwave limiter, 2468
- Medved, D. B., electronic scan ferrite-aperture Luneberg-lens system, 2473
- Meeks, M. L., and J. C. James, frequencies for meteor-burst communication, 597
- Meewezen, W. D., permeability tuning, 1678
- Megla, G., planning radio links, 1364; metallic reflectors for location purposes, 1582; origin of multipath propagation of microwaves, 4186
- Melboom, S., with A. Szöke, radiation damping, 2543
- Meier, D. A., nms magnetic gating and storage element, 1462
- Meier, W., technological problems in valve manufacture, 3523
- Meinhardt, J., low-frequency small-signal transistor amplifiers, 3999
- Meinke, H., properties of lossy inhomogeneous lines, 3192
- and A. Rihaczek, bandwidth compression of radar displays, 3724
- Meissinger, H. F., simulation of infrared systems, 4071
- Meixner, J., with O. Laporte, Kirchhoff-Young theory of diffraction, 2918
- Melamed, N. T., energy transfer in phosphors, 4081
- Melamid, A. E., manufacture of photoelectron multipliers, 3156
- Melchior, G., with others, echo in television images, 3134
- Melchor, J. L., and P. H. Varlistian, temperature effects in microwave ferrite devices, 3938
- Melicherik, J., with H. Rabenhorst, dielectric properties of BaTiO<sub>3</sub>, 1601
- Mellichamp, J. W., with others, electroluminescence of AlN, 4082
- Mel'nik, I. G., with others, electron-hole transition in point-contact rectifiers, 185
- Mel'nik, V. G., I. G. Mel'nik and S. S. Gulin, electron-hole transition in point-contact rectifiers, 185
- Meltzer, B., with G. A. Stuart, effect of anode aperture on dense beam, 3524 v
- Memelink, O. W., depletion semiconductor switching device, 2420
- Men', A. V., S. Ya. Braude and V. I. Gorbach, phase fluctuations of 10-cm waves over sea, 2738
- Mende, H., K. Rauer and E. Vassy, rocket measurements of absorption in lower ionosphere, 2972
- Menyuk, N., and K. Dwight, low-temperature transition in Ni-Fe ferrite, 902
- Merceron, T., with A. Marais, disaccommodation of permeability of Ni-Zn ferrites, 4136
- Merclier, J. M., development of semiconductor devices, 294
- Mercurio, J. F., 1-Mc/s oscillator, 1484
- Merkulov, V. V., e.m. wave propagation in media with random heterogeneities, 414
- Merson, R. H., and D. G. King-Hele, use of artificial satellites to explore earth's gravitational field, 792
- D. G. King-Hele and R. N. A. Plimmer, changes in inclination of satellite orbits to equator, 2235
- with D. G. King-Hele, new value for earth's flattening, 2567
- Merten, L., lattice oscillations in crystals with zinc blende structure, 3413
- Messenger, G. C., deterioration of transistor life, 1715
- Meszáros, G. W., transistor voltage regulators, 980
- Meth, M., television sound detector uses drift transistor, 2028
- Metz, G. H., conductivity of oxide cathodes, 2428
- Metz, A., deflection of waves by movement of propagating media, 3248
- Metze, O., automatic tuning of transmitter aerials, 3197
- Metzger, P. H., with E. P. Warehous, X-ray method for <sup>238</sup>U compounds, 3786
- Mevell, J., study of interaction between adjacent spheres, 1333 b
- Mey, J., with A. Boucherie, pulse-height analyser, 377
- Meyer, F. J., with others, generation of very short ultrasonic pulses, 2078
- Meyer, N. I., variation of transistor small-signal parameters, 995
- Meyer, R. A., with others, automatic failure recovery in data processing system, 1453
- Meyer, W. E., space-charge aberration in electron microscopes, 3074
- Meyer-Brötz, G., junction-transistor applications, 4228
- Meyerand, R. G., Jr., and S. C. Brown, high-current ion source, 1986
- Meyerhofer, D., transition to ferroelectric state in BaTiO<sub>3</sub>, 843
- Meynieux, R., method of Liouville applied to Weber's equation, 912;  $\gamma$  functions applied to Weber's equation, 913
- Middleton, A. E., with others, preparation and properties of AlSb, 2311
- Middleton, D., with others, multipurpose bias device of logical elements, 1461
- Midgley, E., with M. Applebaum, f.m. receiver using transistors, 4188
- Miesch, R. A., with others, vacuum-diode microwave detection, 2794
- Mikazan, P. S., diffraction of e.m. waves at open end of helix waveguide, 3958
- Mikhail, H., with Y. L. Yousef, electrodynamic magnetic field gradiometer, 218
- Mikhailov, G. P., and A. M. Lobanov, dielectric losses and permittivity of polymers, 3818
- Mikhailov, I. G., ultrasonic absorption in viscous liquids, 671
- and V. A. Shutilov, diffraction of light by ultrasonic waves, 678
- with others, ultrasonic interferometer design, 2816
- Mikhnevich, V. V., upper atmosphere, investigations of, 2965; pressure measurements in, 3701
- with others, pressure and density measurements in high atmosphere by earth satellites, 3694
- Miles, M. W., radio interferometers, 1583
- Miles, R. J., standard block for digital computing system, 2855
- Millar, R. F., diffraction by wide slit and complementary strip, 411; radiation and reception properties of wide slot, 3203
- Millard, G. H., triple v.h.f. reflectometer, 923; nonlinearity in cracked-carbon resistors, 1106
- Millea, M. F., and T. C. Hall, surface mobility in Ge and Si, 505
- Millecamps, R., with M. Lafargue, e.m. properties of glacier ice, 1994
- Miller, I. C., and C. W. Sharek, designing ultrasonic delay lines, 28
- Miller, J. D., temporary threshold shift and masking, 681
- Miller, K. S., R. I. Bernstein and L. E. Blumenson, generalized Rayleigh processes, 210
- Miller, N. B., reflections from gradual-transition absorbers, 3548
- Miller, R. B., and E. A. Hiedemann, intensity distribution of light diffracted by ultrasonic waves, 1051
- Miller, R. C., motion of 180° domain walls in BaTiO<sub>3</sub>, 155



- and A. Savage, observations of antiparallel domains in BaTiO<sub>3</sub>, 2634; hysteresis loops and pyroelectric effect in BaTiO<sub>3</sub>, 3332
- Miller, R. E., with others, antenna-beam distortion in transhorizon propagation, 1347
- Miller, R. H., coincidence circuits using transistors and diodes, 3230
- Millet, M. R., microwave switching by crystal diodes, 2866
- Millington, G., propagation at great heights in the atmosphere, 1336; I.E.E. radio and telecommunications section: chairman's address, 1421
- with F. A. Kitchen, Gibraltar-U.K. ionospheric scatter measurements, 2000 a
- Millman, G. H., geometry of earth's magnetic field, 3849
- Mills, B. Y., O. B. Slee and E. R. Hill, radio sources between declinations +10° and -20°, 423
- with others, pencil-beam survey of galactic plane at 3.5 m, 2220
- Milne, D. K., with L. W. Davies, metallic contacts to Ge and Si, 491
- Milort, W., Techebycheff parameter filters, 3608
- Milosevic, L. J., and I. R. Vautey, travelling-wave resonators, 2144
- Milwright, A. L. P., harbour approach aids, 2259 n; developments in marine radar, 2259 q
- Minakovic, B., coupling of three coaxial helices, 3159 z
- Minden, H. T., intermetallic semiconductors, 163
- with others, semiconducting properties of HgTe, 4112
- Minn, S., and H. Damany, influence of Se on conductivity of gold film, 488
- Minnhagen, L., and L. Sigmark, excitation of ionic spectra by 100-kW h.f. pulses, 376
- Minnis, C. M., accuracy of ionospheric forecasts, 1333 h; ionospheric changes at Singapore during solar eclipse, 1883
- and G. H. Bazzard, indices of solar activity, 3281
- Minorsky, N., parametric excitation, 1963
- Minow, D. E., timed-signal generator with flexible output, 1966
- Minton, R., high-quality a.f. transistor amplifier, 2886
- Mints, M. Ya., theory of magnetron, with single-anode, 646, with split-anode, 647
- with L. E. Pargamnik, diffusion theory of magnetron, 645
- Mirmanov, R. G., and Yu. V. Anisimova, circular waveguide partially filled with ferrite, 2116
- Mirkotan, S. F., with others, large inhomogeneities in F<sub>2</sub> layer, 2581
- Mirtov, B. A., rocket investigation of atmosphere, 3700
- and V. G. Istomin, investigation of ionic composition of atmosphere, 3702
- Misawa, T., theory of p-n junction device using avalanche multiplication, 998
- Mischler, W. D., with I. Kerney, equalization of aural and visual delay, 3132
- Miselyuk, E. G., with others, Ge with Fe impurity, recombination of current carriers in, 1933, effect of annealing on carrier lifetime in, 1934
- Mishima, M., with others, helix-type travelling-wave amplifier, 1415
- Mishin, L. N., increasing stability of sound amplification systems, 693
- Misme, P., influence of frontal discontinuities, 1333 q
- with L. Boithias, guided propagation in the Mediterranean, 940
- Misra, R. P., planar reference diode, 4253
- and W. H. Moll, servo system for processing oxide-coated cathodes, 651
- Misselwitz, W., with others, breakdown of CdS films, 2993
- Missen, J. I., rating of semiconductor rectifiers under dynamic conditions, 2341
- Misugi, T., with K. Takashima, measurement of input impedance of u.h.f. triodes, 2788 aa
- Mitchell, B., with R. McNaughton, rectifier nets with multiple outputs, 29
- Mitchell, J., with others, lightweight airborne navigation system, 2599
- Mitchell, W. H., and E. H. Pulley, cryostat for semiconductors, 1967
- Mito, S., with others, magnetrons for mm-A, 4248
- Mitra, A. P., Indian program for I.G.Y., 3299; ionospheric disturbances at low latitudes, 3699 e; time and height variations in daytime ionosphere, 3708
- and others, radio patrol of solar flares, 3699 p
- with M. N. Rao, effect of vertical drifts on nocturnal ionization of lower ionosphere, 1878
- Mitra, S. N., with B. B. Ghosh, measurement of atmospheric noise, 2743
- Mitsui, T., ferroelectric effect in Rochelle salt, 484
- with I. Lefkowitz, effect of irradiation on coercive field of BaTiO<sub>3</sub>, 1913
- Miwa, T., M. Mishima and I. Yanaoka, helix-type travelling-wave amplifier, 1415
- Miya, K., and M. Kawai, propagation of long-distance h.f. signals, 3453
- Y. Taguchi and S. Tabuchi, radio observation of satellite 1957α, 446
- Miyamoto, N., with others, 4-kMc/s-band v.s.w.r. scanner, 1975
- Miyauchi, K., with others, waveguide for low-loss transmission, 2829
- Miyazawa, H., H. Maeda and H. Tomishima, lattice scattering mobility in CdS, 2990
- Mizuno, H., conduction mechanism of oxide cathode, 1026
- Moats, R. R., output windows for microwave power tubes, 643
- Moerder, C., transistor equivalent circuits, 1009
- Möhring, F., power reflex klystron TK7, 1730; electron oscillations in vacuum tubes, 4251
- Molenda, P. J., with others, thermionic integrated micromodules, 2863
- Moles, A., voice characteristics, 4; iteration method in room acoustics, 1428
- and V. Ussachevsky, use of acoustic spectrograph, 1425
- Moll, A., properties of thin single-crystal films of Ba-Sr titanate, 4083
- Moll, W. H., with R. P. Misra, servo system for processing oxide-coated cathodes, 651
- Möller, H. G., with others, long-distance single-F-hop trans mission, 943; sweep-frequency oblique-incidence pulse transmissions, 2378
- Mollwo, E., with G. Bogner, preparation of ZnO, 878
- Mollwo, L., electron temperature and noise in h.f. torch discharges, 3253
- with J. Smejkal, measurement of u.h.f. quadri-pole, 1968
- Molmud, P., Langevin equation and conductivity of plasmas, 3261
- Molo, F., impedance converters, 1480
- Momo, L. R., with others, multilevel pulsed-field maser, 3623
- Mones, A. H., and E. Banks, cation substitutions in BaFe<sub>2</sub>O<sub>7</sub>, 540; ferrimagnetism in system Na<sub>2</sub>O-ZnO-Fe<sub>2</sub>O<sub>3</sub>, 904
- Monfils, A., with C. Hrinckz, determination of thermal parameters of semiconducting thermoelements, 3348
- Monk, A. J., 3.8-mm-wavelength pulsed magnetron, 2788 h
- Monod-Herzen, G., and Nguyen Chung-Tu, luminescent complexes of CdI<sub>2</sub> and PbI<sub>2</sub>, 149
- Montalenti, R., H<sub>2</sub> emissions in aurora and air-glow, 3310
- Montalenti, G., with others, instability of Bloch walls in ferromagnetic material, 535
- Monteath, G. D., reciprocity in r.f. measurements, 917
- Montgomery, G. F., diode reactance modulator, 2187
- Monti-Guarneri, G., transappennine radio link, 2014 a
- Moody, N. F., with others, lightweight airborne navigation system, 2599
- Moock, C. P., meteorological study of whistlers, 3719
- Moon, P., and D. E. Spencer, solution of integral equations, 209
- Moorcroft, G. J., precision approach radar, 2259 m
- Moore, A. R., with J. O. Kessler, magnetic susceptibility of carriers in Ge, 2300
- Moore, C. B., with others, organized electrification and precipitation in thunderstorms, 2253; wind determinations in upper atmosphere, 3302
- Moore, E. F., with E. W. Gilbert, variable-length binary encodings, 3467
- Moore, E. J., galvanomagnetic, thermomagnetic and thermoelectric effects, 161
- Moore, G. E., dissociation of SrO by electron impact, 3892
- Moore, R. C., A. Hopengarten and P. G. Wolfe, colour purity adjustment for 'apple' c.r. tube, 1386
- Mooser, E., and W. B. Pearson, structure and properties of group VB to VIII elements, 1226
- Moran, M. J., with T. Gray, Decca Doppler, 820
- Morcom, W. J., linear-amplifier transmitters, 291
- Morehead, F. F., Jr, electron traps and electroluminescence brightness, 1214
- Morehouse, C. K., and R. Glicksman, dry cells with C-nitroso compounds, 2402; Mg-BiO dry cells, 3865
- Morgan, K. C., with B. Harris, binary symmetric decision feedback systems, 591
- with others, binary communication feedback systems, 2387
- Morgan, M. G., correlation of whistlers and lightning flashes, 458
- H. W. Curtis and W. C. Johnson, path combinations in whistler echoes, 1577
- with G. McK. Alcock, solar activity and whistler dispersion, 144
- with K. A. Helliwell, atmospheric whistlers, 1576
- Morgan, S. P., solution of Luneberg lens problem, 24
- Morgenthaler, F. R., velocity modulation of e.m. waves, 2207; radiation from ferromagnetically coupled electrons in transient magnetic fields, 4026
- Mori, T., with others, F<sub>2</sub>-layer multiple reflections, 1342
- Morlarty, T. H., resonant-ring duplexing in forward scatter, 3196
- Moriguchi, Y., Se rectifiers with artificial layers, 3111
- Morin, F. J., oxides showing metal/insulator transition, 3756
- Morita, K., and K. Kakita, fading in microwave relays, 3475
- Morita, T., Bose-Einstein lattice gases equivalent to Heisenberg model, 2913
- with others, voltage breakdown characteristics of microwave antennas, 3581
- Morleigh, S., ferroelectric storage devices, 717; sensing system for punched cards, 1455
- Morozov, A. I., with others, influence of group III and V elements on recombination in Ge, 1614
- Morozov, Yu. A., with others, secondary emission from Ni, 3789
- Morrell, A. M., with others, 21-in glass colour picture tube, 280
- Morris, A. L., microwave ferrite modulators, 1825
- Morris, D. P., R. R. Preston and I. Williams, search for new Heusler alloys, 1950
- Morris, D. W., and C. J. Hughes, phase characteristics of radio signals, 2384
- E. W. Thurlow and W. N. Gemma, microwave model for study of s.w. auroras, 709
- Morris, E., with R. Fürth, charge penetration into conductor, 3251
- Morris, R. J., R. L. Khyll and M. W. P. Strandberg, maser amplifier with large bandwidth, 1144
- with A. E. Siegman, 'staircase' maser, 2522
- Morrison, J. A., with others, heat capacity of pure Si and Ge, 3353
- Morrison, S. R., slow capture of holes and electrons by surface states, 3352
- Morten, F. D., with A. H. Benny, measurement of surface recombination velocity on Si, 859
- Mortimer, G., Bi as a donor-type impurity in Ge, 4105
- Morton, G. A., infrared photoemission, 4010 d
- and S. V. Forgue, infrared pickup tube, 4242
- Morton, J. Y., artificial ear for insert earphones, 3
- Moses, H. E., solution of Maxwell's equations, 2900
- Moss, R. W., with others, oriented ferrites with cubic anisotropy, 3399
- Moss, T. S., and A. K. Walton, effective electron mass in GaAs, 4113
- with A. K. Walton, magneto-photoelectric theory for three carriers, 1923; photoelectromagnetic effect in Ge, 2660; free-carrier Faraday effect in n-type Ge, 3375
- Motchenbacher, C. D., with others, impurity compensation and magnetoresistance in Si, 2293
- Mothersole, P. L., video amplifier using PCL 84, 379
- with M. C. Gansler, frame multivibrator and diode separator, 3499; multi-triode flywheel synchronizing circuit, 3500
- Motzke, K., influence of magnetic annealing on permivar rings, 3396
- Mourier, G., surface waves in electron beams, 2786
- Mowery, V. O., surface conductivity changes and space charge in Ge and Si, 858
- with M. Nesenbergs, logic synthesis of digital comparators, 1456
- Moxon, L. A., evaluating aerial performance, 1087
- Mozumder, A., energy states of one-dimensional crystal, 1174
- Muchmore, R. B., with others, aperture-to-medium coupling on line-of-sight paths, 4183
- Mueller, C. W., and J. Hilsbrand, 'thyristor' switching transistor, 1005
- Mueller, R. K., grain boundaries, transient response of, 3788, capacitance and barrier height in, 3339
- and R. L. Jacobson, grain-boundary photo-voltaic cell, 1723
- Mühe, W., with H. G. Diestel, reciprocity method for vibration measurements, 3178
- Mühldorf, E., ternary switching algebra, 1636; circuits for ternary switching variables, 1789
- Mulders, C. E., nonlinear properties of carbon resistors, 41
- Muldrew, D., with others, spiral occurrence of Es, 3304
- Müller, E. W., with R. D. Young, energy distribution of field-emitted electrons, 2198
- Müller, K. A., electron paramagnetic resonance of Mn IV in SrTiO<sub>3</sub>, 2633
- with others, hyperfine splitting in paramagnetic resonance of Pr<sup>3+</sup> in ceramic LaAlO<sub>3</sub>, 758 f
- Müller, K. E., radiation characteristics of open waveguides, 3959
- Muller, M. W., with J. C. Helmer, noise figure of maser amplifier, 2343
- Müller, R., with R. Liesbscher, frequency noise in travelling-wave tubes, 3159 dd
- Mullett, L. B., with others, miniature nuclear generator, 2757
- Mumford, H., television transmission over long-distance cable links, 4210
- with E. J. Osborne, Laguerre-function equalizer, 1481
- von Münch, W., transistor with thyatron characteristics, 1006; theory of switching transistor, 1401
- and H. Salow, storing and switching transistor, 2777
- Mungall, A. G., dielectric properties of low-loss materials at mm A, 2348
- Munro, G. H., diurnal lapse of signals from Sputnik III, 2954
- and L. H. Heisler, recording signals from earth satellites, 2573
- with R. R. Long, radio signals from first earth satellite, 444
- Murach, N. N., high-purity metals and semiconductors, 486
- Murakami, T., and R. W. Sonnenfeld, detection of asymmetric-sideband signals in presence of noise, 248
- Muramkin, Yu. A., with others, anomalously high Hall effect in CrTe, 2681
- Murphy, A., with J. R. Wait, influence of ridge on l.f. ground wave, 233
- Murphy, B. T., method of focusing electron beams, 3524 mva
- Murphy, E. B., electroforming of electronic components, 4143
- Murphy, J., with others, avalanche breakdown in n-p Ge diffused junctions, 3378
- Murphy, R. E., and R. S. Mautner, transistorized i.f.-strip design, 70
- Murphy, S. R., G. R. Garrison and D. S. Potter, sound absorption at 50 to 500 kc/s, 2082
- Murray, A. M., with C. Strachan, spin-orbit coupling and extraordinary Hall effect, 1952
- Murray, C. A., error in determination of ΔT, 4147
- Murray, C. T., and R. E. Aitchison, high-stability valve heater supply, 1697
- Murray, R. P., transistor RC amplifiers, 1816
- Murrmann, H., with C. Schwink, field superposition for electron-optical shadow method, 3441
- Murty, D. S., with B. R. Rao, c.w. method for study of drifts, 3699 l
- Murty, V. R., with others, effect of magnetic activity on F<sub>2</sub> drifts, 2586
- Murzin, V. S., with others, mechanism of terrestrial corpuscular radiation, 2216
- Musal, H. M., with G. I. Cohn, transient response of phosphors, 1211

- Müser, H. A., with R. Gereth, test equipment for photosensitive semiconductors, 4078
- Müser, H. E., ferroelectric hysteresis in Rochelle salt, 3008
- and H. Flunkert, upper Curie temperature and domain structure in Rochelle salt, 1218
- Muss, D. R., and R. F. Greene, reverse breakdown in In-Ge alloy junctions, 534
- Musson-Genon, R. P., and C. Audoin, electronic hysteresis and secondary emission in reflex klystrons, 3524 gg
- Myasnikov, V. A., with V. N. Bogomolov, equipment for Hall-effect measurements in semiconductors, 503
- Myers, A., L. Mackinnon and F. E. Hoare, pulse techniques, 2449
- Myers, J., with others, effect of pressure on Hall-coefficient reversal in Te, 1237; impurity compensation and magnetoresistance in Si, 2293
- Nag, B. R., ultraharmonic and subharmonic resonance, 3611; study of oscillator by differential analyzer, 3980
- Nagaraja, N. S., Fourier analysis by electronic analogue computer, 33
- Nagata, T., with N. Matsumura, turbulence in upper atmosphere, 2577
- Nail, C. D., falling of dielectrics, 2336
- Nair, K. K., with M. N. Srikantawamy, matrix analysis of valve circuits, 2497
- Nakagawa, E., with others, effect of solar eclipse on geomagnetic field, 2561
- Nakajima, S., with others, magnetrons for mm- $\lambda$ , 4248
- Nakamura, T., indirect coupling of nuclear spins in antiferromagnet, 3036
- Nakata, Y., auroral echoes in ionogram, 457
- Nall, J. R., with others, D.O.F.L. microelectronics program, 2484
- Nalofs, E. J., hybrid-type travelling-wave tube for pulsed amplification, 1733
- Nalot, J., and R. Viscoekas, anomalous behaviour in M-type carcinotron, 2788 t
- Naresky, J. J., numerical approach to electronic reliability, 2804
- Narud, J. A., and M. R. Aaron, transistor blocking oscillator, 2504
- Nasmyth, P. W., with others, geographical variations in geomagnetic micropulsations, 2946
- Nassibian, G., with others, high-power 400-Mc/s klystron, 3524 j
- Naugle, A. B., with others, measurement and interpretation of photodetector parameters, 4240
- Naugolnykh, K. A., absorption of finite amplitude sound waves, 668
- Nazarova, T. N., with S. M. Poloskov, investigation of interplanetary matter, 3718
- Neal, G., with L. H. Doherty, 215-mile radiolink, 4202
- Nebel, B., with W. H. Campbell, micropulsation measurements, 4045
- Neckenbünger, E., with J. Jaumann, dielectric behaviour of Se, 2285
- Needle, J. S., with P. S. Castro, beam-defocusing microwave detector, 1413
- Néel, L., effect of coupling between grains of ferromagnetic material, 203; coupling between elementary ferromagnetic domains, 546; random creep and thermal fluctuation fields, 4024
- Negnevitskii, I. B., with R. A. Lipman, theory of half-wave magnetic amplifier, 1495
- Neher, H. V., change of cosmic rays in space, 4036
- Neighbours, J. R., with others, dependence of sound attenuation on magnetization direction in Ni, 4125
- Neizvestnyi, I. G., with others, field effect and surface recombination in Ge, 1928
- Nelkowskii, H., with others, cathodo-electro-luminescence phenomena in ZnS phosphors, 834
- Nelson, C. E., with W. L. Whirry, microwave cavity filters, 2467
- Nelson, C. F., with others, extended-range distributed amplifier design, 1492
- Nelson, H., surface-immune transistor structure, 4230
- Neprimerov, N. N., with others, magnetic double refraction of microwaves, 776
- Nergaard, L. S., nonlinear-capacitance amplifiers, 1820
- Neroda, I. P., calibration of electroacoustic transducers, 330
- Nesbitt, E. A., and R. D. Heidenreich, magnetic annealing in perminvar, 3798
- J. H. Wernick and E. Corenweit, magnetic moments of Fe and Co with rare-earth metal additions, 2321
- with others, magnetic annealing in perminvar, 3797
- Nesenbergs, M., and V. O. Mowery, logic synthesis of digital comparators, 1456
- Nethercot, A. H., Jr, with F. M. Johnson, anti-ferromagnetic resonance in MnF<sub>2</sub>, 3791
- Netzband, R., with others, r.f. protection ratios for v.h.f. f.m., 1348
- Neu, H., extension of Townsend's formula, 2200
- Neufeld, E. L., with J. S. Greenhow, turbulence measurements in upper atmosphere, 4058
- with others, radar observations, of 1957 $\beta$ , 3290
- Neufischer, H., with W. Klein, travelling-wave tubes for 4- and 6-Gc/s bands, 2788 b
- Neugebauer, H. E. J., with others, effect of mountains with smooth crests on wave propagation, 3458
- Neuhauser, R. G., sensitivity of television camera tubes, 4215
- Neumann, L., transistorized generator for pulse circuit design, 2161
- Neumann, W., with H. Grunewald, conductivity of lead oxide, 3784
- Neuringer, L. J., effect of pressure on infrared absorption, 3014
- Newall, L. M., with K. Holford, video amplifiers using transistors, 385
- Newby, J. R., with others, travelling-wave multiple-beam klystron, 3524 z
- Newell, A. F., design of logical circuits, 351; use of transistors in inductive circuits, 722
- Newhouse, V. L., N. R. Kornfield and M. M. Kaufman, end-fired memory, 36
- Newman, R., optical properties of n-type InP, 883
- Newman, R. C., with others, diffusion across semiconductor/vapour interface, 165; precipitation on a dislocation, 2289
- Newton, C. E., and G. M. C. Stone, I.G.Y. v.h.f. programme, 115
- Newton, R. H. C., magnetic oscillations in electron beams, 3159 i
- Newton, R. R., motion of satellite around unsymmetrical central body, 1541
- Ney, E. P., J. R. Winckler and P. S. Freier, protons from sun 12th May 1959, 4040
- with P. J. Kellogg, new theory of solar corona, 2943
- with others, geophysical effects associated with high-altitude explosions, 2575; cosmic-ray  $\alpha$  particles during solar maximum, 3279
- Nguyen Chung-Tu, with G. Monod-Herzen, luminescent complexes of CdI<sub>2</sub> and PbI<sub>2</sub>, 149
- Nguyen Van Dang, creep of asymmetric hysteresis cycles, 204, 547, 1294
- N'guyen, Van Dong. See Van Dong, N.
- Nichols, B., auroral ionization and magnetic disturbances, 1570
- Nichols, J. W., A. C. MacKellar and A. J. B. Baty, electronic clock coder for coded radio beacons, 4069
- Nicholson, S. B., and O. R. Wulf, diurnal variation of geomagnetic fluctuations, 1533
- Nicolet, M., constitution of upper atmosphere, 1551; atomic nitrogen in thermosphere, 3699 d
- Nicolet, M. A., equivalent circuit of junction transistors, 2770
- with others, influence and creation of lattice defects in junction transistors, 2771
- Nielsen, C. E., and A. M. Sessler, space-charge effects in particle accelerators, 1984
- Nielson, J. W., and E. F. Dearborn, growth of single crystals of magnetic garnets, 1289
- with J. F. Dillon, Jr, effect of impurities on resonance in Y-Fe garnet, 3811
- Nienhuus, W. F., with F. de Boer, low-voltage oscilloscope tubes, 2713
- Niese, H., testing 'echo parameter' criterion, 685; loudness of rhythmic sounds, 1426; proposal for loudness meter, 1427; sensation of loudness of rhythmic sounds, 3911
- and J. Köhler, influence of peak content on sensation of loudness, 1754
- Niesen, E., R. W. Beatty and W. J. Anson, water cooling of low-power klystrons, 312
- Niessen, K. F., non-magnetic ions in antiferromagnetic, 189; distribution of magnetic domains between two phases in Fe, 3038
- Nifontoff, N., with L. Gouskov, chemical action and oxidation of oriented Ge surfaces, 3370
- with M. Teboul, flicker effect in photovoltaic diodes, 639
- Nightingale, A., sensitivity of i.f. amplifiers for electromyography, 230
- Niklas, W. F., current characteristic of TV picture tubes, 1704
- and J. Wimpffen, oscilloscope tube with travelling-wave deflection, 927
- with W. O. Reed, shutter image converter tube for multiple-frame photography, 2369
- Nikol'skii, V. V., phase shifts of gyrotropic inhomogeneities in waveguide, 2115
- Ninomiya, Y., N. Miyamoto and A. Yanagi, 4-kMc/s-band v.s.w.r. scanner, 1975
- Nisbet, T. R., and W. W. Happ, Jacobians, 2775
- with others, estimate of transistor life in satellites, 2780
- Nishikori, K., A. Takahira and H. Irie, microwave propagation over sea beyond line of sight, 2734
- Nishimaki, M., and T. Asaba, discharge machining for mm-wave magnetrons, 3159 e
- Nishizaki, R., with others, F<sub>2</sub>-layer multiple reflections, 1342
- Niwa, S., with others, long-distance u.s.w. propagation, 244
- Nixon, J. D., and P. C. Banbury, changes in excess-carrier concentrations, 1228
- Noda, K., and others, waveguide for low-loss transmission, 2829
- Noggle, T. S., and J. O. Stiegler, electron-microscope studies on etching of irradiated Ge, 4089 q
- Noland, J. A., and L. D. Cohen, BWO uses ridge-loaded ladder circuit, 2790
- Nomura, K. C., and J. S. Blakemore, decay of excess carriers in semiconductors, 1915
- Nomura, S., with others, thermal conductivity of BaTiO<sub>3</sub> ceramics, 2628
- Nomura, Y., and others, F<sub>2</sub>-layer multiple reflections, 1342
- Nonweiler, T., effect of solar flares on satellite 1957 $\beta$ , 449
- Norman, F., line and properties of strip junction, 2828
- Norman, F. H., with others, thermionic energy converter, 325
- Norquist, R. G., testing high-speed computer circuits, 3585
- North, J. H., with others, multipurpose bias device of logical elements, 1461
- Northwood, T. D., and E. J. Stevens, acoustical design of Alberta Jubilee Auditoria, 688
- Norton, K. A., system loss in radiowave propagation, 4174
- Norton, L. E., spontaneous microwave emission by pulsed resonance excitation, 1165
- Nottingham, W. B., diode as heat-to-electrical-power transducer, 2434
- G. N. Hatsopoulos and J. Kaye, diode thermo-electron engine, (D)2435
- Novikova, Z. I., with L. I. Rabkin, design of coils with ferrite cores for a.f., 1790
- Novototskii-Vlasov, Yu. F., with others, field effect and surface recombination in Ge, 1928
- Nowell, J. C., with others, measurement of time dilation in earth satellite, 3688
- Nowicki, J. R., 4-W 500-kc/s transistor transmitter, 3504
- Nozières, P., and D. Pines, dielectric formulation of many-body problem, 1830; electron interaction in solids, 2931
- Nupp, W. D., critical analysis of communication systems derived from amplitude modulation, 2752
- Nussbaum, A., J. Myers and D. Long, effect of pressure on Hall-coefficient reversal in Te, 1237
- Nye D. D., Jr, low-pass RC filter, 51
- Obayashi, T., anomalous changes in ionosphere related to magnetic storm, 134; F<sub>2</sub> layer deduced from 'frequency spectrum' of Q figures, 135; v.l.f. spectra of atmospheres, 3313; geomagnetic pulsations and earth's outer atmosphere, 3673
- S. C. Coromiti and E. T. Pierce, geophysical effects of high-altitude nuclear explosions, 2969
- S. Fujii and T. Kidokoro, proof of mode theory of v.l.f. ionospheric propagation, 3094
- Oberhettinger, F., diffraction by wedges and corners, 1167
- Oberländer, S., with others, evaluation of conductivity glow curves, 3321
- Oberlin, A., and C. Tchoubar, shadow-casting carbon films for electron microscopy, 938
- Obraztsov, Yu. N., drift velocity, 3751
- O'Brien, B. J., energy spectrum of particles bombarding earth, 419
- O'Brien, R. M., with P. D. Lomer, microwave pulsed attenuator, 2800 b; high-power microwave duplexer, 2833
- O'Connell, J. H., and T. M. Scott, measurement of transistor characteristics in 3-250-Mc/s range, 1304
- Oehrli, W., G. Seeger and H. G. Stäblein, theory of multiple lines, 2458
- Oertel, G., secondary emission of Se, 3762
- Offergeld, G., and J. van Cakenbergh, stoichiometry of Bi<sub>2</sub>Te<sub>3</sub>, 3785
- Ogawa, T., frequency variations in s.w. propagation, 916
- Ogilvie, K. W., with others, radiation observations with satellite 1958 $\delta$ , 4042
- Oguchi, B., and K. Yamaguchi, centre-excited mode transducer, 2831
- and others, parametric amplifier using Ge diode, 1149
- Oguchi, T., with others, measurement of attenuation by rain, 4187
- O'Hara, F. J., and H. Scharfman, ferrite serrodyne for microwave frequency translation, 3942
- Ohnsorge, H., with others, mechanical filters for communications technique, 2155
- Okada, J., recombination centres in Ge, 516
- Okajima, T., with others, parametric amplifier using Ge diode, 1149; transmitting frequency converter, 3145
- Okamoto, S., and K. Takeuchi, dielectric loss of oxidized high-density polyethylene, 3414
- Okamura, S., and others, double-vane torque-operated wattmeter for 7 kMc/s, 223; measurement of attenuation by rain, 4187
- with others, torque-operated wattmeters for 3 cm  $\lambda$ , 2359
- Okaya, Y., with others, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and (NH<sub>4</sub>)<sub>2</sub>BeF<sub>4</sub> transitions, 836; ferroelectricity in Li(N<sub>2</sub>H<sub>5</sub>)SO<sub>4</sub>, 840; (NH<sub>4</sub>)<sub>2</sub>HPO<sub>4</sub> ferroelectric with low coercive field, 841
- Okazaki, A., crystal structure of GeSe, 876
- with S. Asanabe, Hall coefficients of SnSe and GeSe, 2669
- O'Keefe, J. A., A. Eckels and R. K. Squires, Vanguard measurements of earth's figure, 2236
- Okhotsimskii, D. E., and T. M. Eneev, variational problems of satellite launching, 3680
- T. M. Eneev and G. P. Taratynova, determination of lifetime of artificial earth satellite, 3681
- Oksman, A. K., interference in television channel of coaxial cable, 611
- Okwit, S., with F. R. Arams, tunable L-band ruby maser, 2523
- Oliner, A. A., and W. Rotman, periodic structures in trough waveguide, 3934
- with W. Rotman, asymmetrical trough-waveguide antennas, 3960
- Oliver, B. M., gamma-derived capacitor, 3973
- Oliver, W., what goes wrong?, 253
- Ollendorff, F., wave-mechanics correction of emission formula, 2912
- Olley, J., with others, radiation observations with satellite 1958 $\delta$ , 4042
- Olson, F. A., C. P. Wang and G. Wade, parametric devices tested for phase-distortionless limiting, 2182
- Olson, H. F., and J. Preston, e.s. uniaxial microphone, 1432
- O'Meara, T. R., single-crystal wide-band filters, 1120; characteristics of four-crystal lattice filter, 1121
- and R. L. Sydnor, balun transformer for v.h.f. and u.h.f., 338
- Omelyanovskaya, N. M., with others, lifetime of injected current carriers in Sb-doped Ge, 1932
- O'Neill, G. D., mu of receiving tubes, 3170
- O'Neill, J. J., and J. J. Dreher, word masking by prolonged vowel sounds, 680
- Onoe, M., M. Hirai and S. Niwa, long-distance u.s.w. propagation, 244
- Oranovskii, V. E., electroluminescence, 1909
- Orbach, R., and P. Pincus, excitation of spin waves in antiferromagnet, 2925
- Ordung, P. F., with others, functional characteristics of node determinant, 548

- Ortloff, M., radio-telephone suppression equipment, 4193
- Ortner, J., with B. Hultquist, ionization below 50 km after strong solar flares, 2576
- Orton, J. W., with J. H. E. Griffiths, weak lines in paramagnetic resonance spectrum of impure MgO, 3410
- Osborne, E. J., and H. Mumford, Laguerre-function equalizer, 1481
- Osborne, W. E., receiver for space vehicles, 4197
- Oshima, H., with others, effect of solar eclipse on geomagnetic field, 2562
- Oshima, K., with P. R. Gillette, pulser design for magnetron operation, 648
- with others, measurement of pulse front response of transformers, 357
- Osiat, T. A., with R. D. Hawn, Jr, gain measurements on pulsed ferromagnetic microwave amplifier, 2184
- Oskam, H. J., microwave investigation of disintegrating plasmas, 2203
- Osterberg, H., propagation of e.m. wave in inhomogeneous media, 771
- Ostrobodova, V. V., with others, properties of Ge doped with Zn, 1613
- Oswald, H., and H. Straubel, photoelectric amplifier, 1405
- Oswald, J., branched filters, 2151
- Otley, K. O., P. J. Shoemaker and P. J. Franklin, voltage-sensitive switch, 39
- Otpushchennikov, N. F., velocity of ultrasound in water, 2811
- Ottavi, H., with others, maser-type self-oscillator, 2521; weak-field maser, 2548
- Outten, A. E., with others, application of radio altimeters to aircraft approach, 2259
- Ovcharov, V. T., theory of formation of electron beams, 2059
- Overmeyer, J., with others, microwave resonance in Ga-Fe garnet crystals, 3043
- Overton, B. R., transistors in television receivers, 987
- Oxenius, J., Hall generators in analogue multipliers, 2131
- Packard, K. S., optimum dimensions for strip transmission line, 1072; cut-off wavelength of trough waveguide, 3554
- Packard, R. H., and M. G. Schorr, power supply for video circuits, 602
- Paetzold, H. K., and H. Zschörner, radio observations at 20 Mc/s of first Russian earth satellites, 2237; density of outer atmosphere from satellite observations, 3695
- Pafomov, V. E., with others, Cherenkov radiation in medium with spatial dispersion, 3648
- Page, C. H., harmonic generation with ideal rectifiers, 60
- Page, H., with C. G. Mayo, a.m. transmitter class-C output stage, 624
- Paije, E. G. S., electron temperature in electric fields applied to Ge, 518
- with A. F. Gibson, transport properties in dislocated Ge, 1619
- with others, minority carriers in dislocated Ge, 1618
- Pajak, Z., and J. Stankowski, polarization changes during aging of BaTiO<sub>3</sub>-type ferroelectrics, 844
- Palevsky, H., and others, lattice vibrations in Si by neutron scattering, 2291
- with others, lattice vibrations in Ge by neutron scattering, 2304
- Pallett, J. E., parametric amplification, (C)2897
- Palluel, P., and J. Arnaud, results on delay lines for travelling-wave tubes, 3159
- Palma, M. U., with M. B. Palma-Vittorelli, microwave spectrometer, 96
- Palma-Vittorelli, M. B., and M. U. Palma, microwave spectrometer, 96
- Palmer, J. L., with others, design of transition region of beam valves, 1017
- Palmer, W. F., peak flyback voltage in horizontal deflection circuits, 4220
- and C. Schiess, transistorized vertical deflection systems, 1381
- Palmisano, R. R., and A. Sherman, waveguide coils make compact delay lines, 339
- Palmiter, R. B., digital system positions shaft over phone line, 1656
- Pankove, J. I., radiative surface effect in Ge, 523
- Pantell, R. H., power relation for nonlinear resistive elements, 729; backward-wave oscillations in unloaded waveguide, 3164
- P. D. Coleman and R. C. Becker, slow-wave structures for power generation at mm and sub-mm  $\lambda$ , 1743
- Paolini, E., response of loudspeaker near principal resonance, 1433
- Papenhuijzen, P. J., transmitting triode for frequencies up to 900 Mc/s, 2797
- Papoulis, A., strongly nonlinear oscillations, 80
- Papp, G., with others, vacuum-diode microwave detection, 2794
- Pargamanik, L. E., and M. Ya. Mints, diffusion theory of magnetron, 645
- with V. P. Galatko, correlation function for particles carrying like charges, 1829
- Paris, J. M., with others, circular waveguides for long-distance transmission, 2107
- Parker, A. B., new form of X-band pre-r. cell, 2800
- Parker, E. N., inadequacy of ring-current theory for main phase of geomagnetic storm, 1536; auroral phenomena, 1568
- Parker, M. J., with others, electronic subsystem development problems in naval ordnance, 2803
- Parker, R., resistivity of compounds with ordered spin arrangements, 1220
- and M. S. Smith, dispersion phenomena in inhomogeneous dielectrics, 837
- Parker, R. J., permanent magnets in audio devices, 1760
- Parkyn, D. G., atmospheric tides and earth satellite observations, 2565
- Parmenter, R. H., acoustoelectric effect, 2189
- Parodi, O., with others, light due to recombination of impurities in Ge, 3369
- Parravano, G., with others, magnetic properties of (Ni,Li)O, 3799
- Parry, C. A., over-horizon links in telecommunication networks, 600; C.C.I.T.T. recommendations for multichannel relay, 4199
- Parry, J. V. L., with others, comparison of Cs frequency standards, 212; circuits in N.P.L. Cs standard, 2340
- Parson, D., W. Sucksmith and J. E. Thompson, magnetization of ferromagnetic alloys, 3392
- Parsons, N. R., with K. G. McCracken, unusual cosmic-ray intensity fluctuations, 1860
- Parsons, R., and G. Finn, Si and rectifier design, 604
- Parthasarathy, R., and G. C. Reid, signal-strength recordings of satellite 1958 8 2, 1193
- R. P. Basler and R. N. De Wit, auroral ionosphere studies using earth satellites, 4052
- with G. Swarup, solar brightness distribution at 60 cm, 430
- Parthasarathy, S., acoustics research at N.P.L. of India, 3177
- and C. B. Tipnis, diffraction of light by ultrasonic waves, 1049, 1751
- Parzen, P., with others, propagation in crossed-field periodic structure, 1731
- Paschke, F., dispersion of interdigital delay lines, 1022; generation of second harmonic in v.m. electron beam, 1409; propagation of perturbations along magnetically focused electron beams, 4246
- Patlach, A. M., with others, transistorized crystal-controlled marginal oscillator, 1805
- Patrick, L., and W. J. Choyke, SiC p-n junctions, electron emission from breakdown regions in, 1610, impurity bands and electroluminescence in, 1910
- Pattenden, J. D., with E. A. Ash, modified transmission-line couplers for helices, 3159
- Pattenson, C. F., with others, Canadian standard of frequency, 2700
- Paul, A., with others, variation of ionospheric absorption, 3716
- Paul, D. I., scattering in beyond-horizon transmission, 1663
- Paul, R. J., onset of oscillations in transistor oscillators, 1809
- Paul, R. J. A., and M. H. McFadden, measurement of phase and amplitude at l.f., 1651
- Paul, W., and D. M. Warschauer, optical properties of semiconductors under hydrostatic pressure, 506
- with M. Cardona, quadratic photoelectromagnetic effect in Ge, 1253
- Paulsen, E., with others, r.f. protection ratios for v.h.f.-f.m., 1348
- Pauthenet, R., with V. S. Giron, variation of magnetization of uniaxial substances, 3806
- with others, substitution of Al, Ga and Cr in BaO.6Fe<sub>2</sub>O<sub>8</sub>, 541; magnetic properties of Er garnet, 1290
- Pawling, J. F., and P. Tharma, 4-5W sliding-bias amplifier using OC16, 384
- Pawsey, D. C., dissipative effects in Tchebycheff filters, 50
- Peach, L. C., with others, magnetostrictive delay line for video signals, 1134
- Peacock, R. V., with J. C. Burfoot, growth of ferroelectric hysteresis loops, 3329
- Peal, R. R., with others, distress beacon for crash position indicator, 1891
- Pearce, A. F., structure with resonant coupling elements for travelling-wave tube, 3159
- Pearson, G. L., and W. L. Feldmann, powder-pattern techniques for delineating domain structures, 4085
- and R. P. Riesz, switching diodes from plastically deformed Ge, 2412
- with others, anisotropic mobilities in deformed Ge, 3362
- Pearson, J. D., and H. S. Cockroft, 20-kW pulsed travelling-wave tube, 2788
- Pearson, W. B., with E. Mooser, structure and properties of group VB to VIIb elements, 1226
- Peart, R. F., T. B. Rymer and D. H. Tomlin, Ge junction cells for photoelectric control circuits, 309
- Pease, M. C., with R. H. Bartram, space-charge-limited crossed-field gun, 3894
- Pease, R. L., propagation of surface waves over ferrite slab, 1435
- Pech, H., ground resistivity measurements, 3420
- Pechhold, W., excitation problems in acoustic resonators, 3907
- Pedowitz, R. P., with others, automatic failure recovery in data processing system, 1453
- Peeler, G. D. M., and H. P. Coleman, stepped-index Luneberg lenses, 2854
- Pekar, S. I., e.m. waves in crystal with excitons, 409
- Pelah, I., with others, lattice vibrations in Ge by neutron scattering, 2304
- Peless, Y., response of cascaded double-tuned circuits, 1815
- Penfold, A. S., linear amplifier for negative pulses, 62
- Pengelly, P., with F. Rosner, transistors and cores in counting circuits, 2479
- Penhall, B. W. G., and J. D. Thomson, signalling for single-channel and mobile radio-telephone systems, 4200
- Penndorf, R., and S. C. Coroniti, polar E<sub>2</sub>, 1561
- with S. C. Coroniti,  $f_0E_2$  over polar regions, 1882
- Penning, P., generation of dislocations by thermal stresses, 3028
- Pensak, L., with B. Goldstein, high-voltage photo-voltaic effect, 1907
- with others, pulse amplification using impact ionization in Ge, 2882
- Pentecost, J. L., and P. E. Ritt, lightweight ceramic materials, 839
- Pentz, M. J., with others, source-modulated microwave cavity spectrometer, 416
- Pepinsky, R., and K. Vedam, room-temperature ferroelectric, 4084
- and others, ferroelectricity in Li(N<sub>2</sub>H<sub>5</sub>)SO<sub>4</sub>, 840; (NH<sub>4</sub>)HSO<sub>4</sub> ferroelectric with low coercive field, 841
- with others, (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and (NH<sub>4</sub>)<sub>2</sub>BeF<sub>6</sub> transitions, 836
- Perakis, N., J. Wucher and G. Parravano, magnetic properties of (Ni,Li)O, 3799
- Perdijk, H. J. R., with J. J. B. Fransen, Ba getter films, 2613
- Perrell, J., stabilization by Zener diodes, 271
- Perkins, A. F., with others, transistorized compandor, 2395
- Perkins, J. C., Jr, D. A. Perreault and A. F. Perkins, transistorized compandor, 2395
- Perkins, R. W., with D. McDermott, interpolation and prediction of signals plus noise, 2391
- Perkins, W. H., with others, night-time reception of major solar burst, 2554
- Perkins, W. J., with D. C. Gold, electroencephalograph telemeter system, 3085
- Peris, T. A., T. J. Diesel and W. I. Dobrov, primary pyroelectricity in BaTiO<sub>3</sub> ceramics, 156
- Pernett, J. M., with others, measurement and interpretation of photodetector parameters, 4240
- Peroni, B., and G. Bianconi, tropospheric-scatter multichannel telephone links, 1361
- Perreault, D. A., with others, transistorized compandor, 2395
- Perrier, F., and L. d'Ast, rapid testing of direct-voltage stabilizers, 608
- Perry, V. G., maintenance of television studio equipment, 622
- Persham, P. S., with others, cross-relaxation in spin systems, 3270
- Pescetti, D., with G. Biorci, behaviour of ferro-magnetic materials, 197
- Peter, M., mm-wave paramagnetic resonance spectrum of MgWO, 2691
- and M. W. P. Strandberg, efficiency of frequency measurements with atomic clock, 1311
- with J. C. Hensel, Stark effect for cyclotron resonance, 3346
- with others, paramagnetic-resonance spectrum of Cr<sup>3+</sup> in emerald, 1628
- Peter, R. W., with A. L. Eichenbaum, exponential gun, 2064
- Peters, J. M., elements of electronic circuits, 1795, 2138, 2494, 3221, 3600
- Peters, L., Jr, end-fire echo area of long, thin bodies, 1446
- Peters, W., theory of helical aerials, 3570
- Petersen, R. G., with D. T. Edmonds, effective exchange constant in Y-Fe garnet, 3401
- Peterson, A. M., R. D. Egan and D. S. Pratt, 3-frequency back-scatter sounder, 1565
- with R. L. Leadbrand, radio echoes from auroral ionization, 1670
- with others, radar investigations of auroral echoes, 4065
- Peterson, D. W., vertical polarization to solve 'ghosting' problems, 289; tests of u.h.f. television broadcasting aerials, 1088
- Peterson, G. E., W. S. Wang and E. Sivertsen, segmentation techniques in speech synthesis, 1059
- with W. S. Wang, segment inventory for speech synthesis, 1060
- Peterson, L., and J. R. Winckler,  $\gamma$ -ray burst from solar flare, 104
- R. L. Howard and J. E. Winckler, balloon gear monitors cosmic radiation, 437
- with others, auroral phenomena during storm, 3309
- Petriz, R. L., fundamentals of infrared detectors, 4010
- with G. R. Pruett, detectivity and preamplifier considerations for InSb photovoltaic detectors, 4241
- Pettengill, G. H., with others, radar echoes from Venus, 2556
- Pettit, G. D., with S. P. Keller, phosphor with fluorescence larger than energy gap, 2623
- Pettit, H. B., with others, wind determinations in upper atmosphere, 3302
- Petukhov, V. A., possible mechanism of nonstable solar processes, 3666
- Petzold, W., with H. J. Kopp, linearization of multipliers at high anode currents, 2054
- Peyser, W. P., with V. J. Albanese, analysis of a broad-band coaxial hybrid ring, 3552
- Pfann, W. G., K. E. Benson and D. W. Hagelbarger, improvement in floating-zone technique, 2337
- Pfund, E. T., Jr, and others, capabilities of coaxial cable, 2457
- Pham Mau Quan. See Quan, Pham Mau.
- Phelp, N. R., with others, ring angels over south-east England, 2982
- Phelps, A. V., with others, measurement of attachment of slow electrons in oxygen, 2533
- Philipp, H., with others, exciton-induced photo-emission from BaO, 2264
- Philipp, H. R., and E. A. Taft, optical constants of Ge, 2659
- Phillipson, L. L., analytical study of scattering by thin dielectric rings, 1517
- Phillips, B. B., and G. D. Kinzer, electrification of droplets in cumuliform clouds, 456
- Phillips, C. G., with others, versatile stimulator, 229
- Phillips, J. C., energy-band interpolation based on pseudopotential, 1236; vibration spectra of diamond-type lattices, 2284
- Phillips, J. H., and E. Maxwell, broad-band amplifier for radar and scatter, 64
- Piazza, R., surface absorption of sound in ducts, 683
- Pick, M., with Y. Avignon, relation between type-IV emissions and other solar activity, 3283

- Pick-Gutmann, M., and J. L. Steinberg, 16-aerial array at 9 300 Mc/s, 3659
- Pickett, J. M., and J. Pollack, speech intelligibility at high noise levels, 3543
- Pickin, J. R., and D. H. Trevena, new development of monotron oscillator, 3524 a
- Picus, G. S., with others, Zeeman-type magnetooptical studies of interband transitions, 2283
- Piddington, J. H., interplanetary magnetic field and its control of cosmic-ray variations, 783; growth of waves in moving ion streams, 3267
- Piefke, G., propagation in diaphragm-type and corrugated waveguide, 1075; theory of helical line of ferrite wire thickness, 2459
- Piening, J., phase and amplitude fluctuations in subcarrier transmission in colour television, 993
- Piepers, H., with J. J. M. Warringa, open rectangular waveguides in r.f. oscillators, 3984
- Pierce, E. T., with others, geophysical effects of high-altitude nuclear explosions, 2969
- Pierce, J. R., noisiness of drifting electron stream, 3159 b
- and R. Kompfner, transoceanic communication by means of satellites, 2012
- with W. W. Rigrod, space-charge-wave excitation in Brillouin beams, 1735
- Piercy, B., dielectric properties of polycrystalline titanates and cerates, 2626
- Pierzga, J. L., with K. A. Chase, reducing radar interference, 3318
- Piggott, W. R., obtaining accurate virtual heights from ionogram, 2249
- with W. H. Belchambers, ionospheric measurements at Halley Bay, 1881
- Piglione, L., voltage- and current-controlled negative resistance 2-poles, 1476
- Pignedoli, A., temperature distribution in junction transistors, 3149
- Pikus, G. E., and G. L. Bir, influence of deformation on properties of *p*-type Ge and Si, 2649
- and O. V. Sorokin, measuring magnetic field intensity, 1972
- with others, determination of surface recombination velocity, 500
- Pilkington, W., with others, instrumenting Explorer 1, 1547
- Pilz, F., with R. Theile, television transmission of non-transparent still pictures, 1374
- Pimenov, Yu. V., with G. A. Grinberg, diffraction of c.m. waves at flat screens, 1515
- Pinckney, C. B., calibration of precision voltage-dividers, 4157
- Pincus, P., with R. Orbach, excitation of spin waves in antiferromagnet, 2925
- Pines, D., with P. Nozières, dielectric formulation of many-body problem, 1830; electron interaction in solids, 2931
- Pinsker, Z. G., with G. A. Kurov, thin layers of variable composition in In-Sb system, 3780
- Pinson, J. T., with others, radio observations of hypersonic shock waves, 1658
- Pippin, J. E., and C. L. Hogan, resonance measurements on Ni-Co ferrites and Ni-ferrite-aluminates, 2689
- with others, ferrimagnetic resonance in polycrystalline rare-earth garnets, 2690
- Pio, E., operating characteristic of magnetic amplifier, 3617
- with E. Bernard, operation of magnetic amplifiers, 3237
- Pires de Carvalho, A., band structure of Te, 3763
- Pistorius, C. A., with W. C. van Geel, current/time relations of electrolytic rectifiers, 3112
- Pitt, C. F., B. P. Barth and B. E. Godard, electrical properties of epoxy resins, 911
- Piteway, M. L. V., reflexion from stratified ionosphere, 2250
- Pittman, R. W., with J. I. Carasso, thermoelectric observations on grey Se, 1272
- Plwowski, T., Bi-Te photovoltaic *p-n* sandwich layer, 2055; semiconductor properties of Bi-Te solid solutions, 4120
- Plachenov, B. T., with B. I. Boltaks, self-diffusion in Se, 1605
- Planer, G. V., with H. B. Beer, preparing ferrites, 1959
- Plass, G. N., selective radiators, 4010
- Platzman, P. M., with A. G. Kramer, microwave manometer, 565
- Pleskov, Yu. V., injection and extraction of minority carriers at surface of Ge electrode, 3025
- Plimmer, R. N. A., with others, changes in inclination of satellite orbits to equator, 2235
- Plomp, R., and M. A. Bowman, hearing threshold and duration for tone pulses, 3909
- Plummer, A. R., breakdown characteristics of Si *p-n* junctions, 1609
- Plummer, R. E., surface-wave beacon antennas, 1449
- Plush, R. W., with A. D. Watt, worldwide standard-frequency broadcasting system, 4201
- with others, radio system performance in noise, 963
- Poaps, G. E., with D. R. Hay, prolonged fade-out on short microwave path, 3098
- Pobedonostsev, Yu. A., laws of motion of earth satellite, 2950
- Pocock, W. E., Al finishes for use in electronics, 1962
- Podoshevnikov, B. F., and B. D. Tartakovskii, attenuation of plane sound waves, 2809
- Pohl, H. G., measurement limit of photocell compensators, 2354
- with others, image converters for quantity production, 1404; resolving power of scintillation multipliers, 3081
- Pohrte, T. W., with others, geomagnetic disturbances and changes in atmospheric circulation at 300 mb, 2229
- Poincelot, P., edge condition in diffraction problems, 774; diffraction of c.m. wave by conducting half-plane, 1168; criterion of uniqueness for solutions of Maxwell's equations, 3628
- Pokrovskii, V., F. Ulinich and S. Savvinykh, non-local reflection in waveguides of variable cross-section, 1766
- Polak, L. S., with others, producing polymers with semiconductor properties, 4121
- Polimerou, L. G., spectrum analysis of random noise generators, 1309
- Pollack, I., with J. M. Pickett, speech intelligibility at high noise levels, 3543
- Pollak, M., piezoresistance in heavily doped *n*-type Ge, 174
- Pollard, J. R., catapult end-speed recorder, 924
- Polonsky, J., L. Amster and G. Melchior, echo in television images, 3134
- Poloskov, S. M., and T. N. Nazarova, investigation of interplanetary matter, 3718
- Polovin, P. V., and N. L. Tsintsadze, longitudinal vibrations of electron-ion beams, 1835
- Polynskaya, V. A., field of pulse radiator under water, 3901
- Ponthus, A., with others, circular waveguides for long-distance transmission, 2107
- Poor, E. W., Jr, with E. E. Loebner, bimolecular transitions in GAP, 3737
- Poorter, T., and F. W. de Vrijer, projection of colour-television pictures, 3119
- Popkin-Ciurman, J. R., video testing techniques for monochrome and colour, 613
- Popov, S. N., with others, effect of polarization on Pb<sub>2</sub>NiNb<sub>2</sub>O<sub>7</sub>, Pb<sub>2</sub>MgNb<sub>2</sub>O<sub>7</sub>, 2631
- Popp, E., with others, distribution of lightning currents in earthing system of radio mast, 1451
- Porbansky, E. M., with others, solubilities of Sn in Si and Ge, 4094
- Porreca, A., with I. Ranssi, skip-distance determination by back-scatter sounding, 1340
- Porreca, F., energy and intensity of electrons in microtron, 3837
- Porter, G., applications for Zener diodes, 1711
- Portis, A. M., and D. Teaney, microwave Faraday rotation, 770
- with A. C. Gossard, nuclear resonance in ferromagnet, 4126
- Poschrieder, W., electromechanical wave filters, 3225
- Pöschl, K., and W. Veith, focal length of diaphragm for electron beams, 1416
- Posel, K., balanced unsymmetrical parallel-T network as 3-terminal bridge, 3062
- Posthumus, K., merits of telegraph codes and methods of detection, 2010
- Pottel, R., absorption of cm waves in artificially anisotropic media, 1847
- Potter, D. S., with others, sound absorption at 50 to 500 kc/s, 2082
- Potter, N. L., electrical analogue for heat flow problems in semiconductors, 4087
- Potter, R. F., J. M. Pernell and A. B. Naugle, measurement and interpretation of photo-detector parameters, 4240
- Powell, C., Decca navigator system, 2259 c
- Prache, P. M., ferromagnetic granular structures, 2318
- Pradal, F., and R. Saporte, energy spectrum of reflected electron beam, 399
- and R. Simon, energy spectrum of secondary electrons, 1838
- with C. Fert, energy spectrum of electron beam passing through thin film, 3255
- Pratt, D. S., with others, 3-frequency back-scatter sounder, 1565
- Prene, J. S., with others, two-stage optical excitation in phosphors, 2996
- Pressey, B. G., marine radio navigational aids, 2978 b; signals from satellite 1958 82, 4049
- with H. G. Hopkins, current d.f. practice, 2259 j
- Preston, J., with H. F. Olson, e.s. uniaxial microphone, 1432
- Preston, R. R., with others, search for new Heusler alloys, 1950
- Preuss, E., with D. Geist, etching and polishing of Ge surfaces, 1252
- Price, H. N., and A. W. Coolidge, development of ceramic hydrogen thyristors, 3535
- Price, M., high voltage gain from transistors, 66; twin-T response, 730
- Price, P. J., noise theory for hot electrons, 2902
- Price, R., and others, radar echoes from Venus, 2556
- Primich, R. I., transmission and reflection properties of strip grating, 94
- with J. E. Keys, nose-on radar cross sections, 3320
- Prince, M. B., and M. Wolf, Si photovoltaic devices, 640
- Prins, B. H. G., and J. M. G. Seppen, Rotterdam Harbour radar system, 1589
- Proctor, E. K., and M. H. Rees, scanning lens design for minimum phase error, 1101
- Prokhorov, A. M., molecular amplifier for sub-mm waves, 1146
- with N. G. Basov, molecular oscillators and amplifiers, 2888
- with others, chromium corundum paramagnetic amplifier, 1145
- Prokhorov, V. G., with others, relaxation polarization and losses in nonferroelectric dielectrics, 480
- Pröpstl, G., and G. Zielasek, Sb distribution in Ge-Sb alloys, 3026
- Proshkin, E. G., and B. L. Kashcheev, inhomogeneous structure of F region, 2244
- Provost, F., Si junction diodes, 297
- Prowse, W. A., and J. L. Clark, u.h.f. gas breakdown, 395
- Prudhon, M., gyrators and nonreciprocal systems, 2145
- Pruett, G. R., and R. L. Petritz, detectivity and pre-amplifier considerations for InSb photovoltaic detectors, 4241
- Prugh, T. A., J. R. Nall and N. J. Doctor, D.O.F.L. microelectronics program, 2484
- Prussin, S., and A. Stevenson, infrared strain-optic coefficient of Si, 2295
- Prutton, M., ferroelectrics and computer storage, 1781
- with E. M. Bradley, magnetization reversal by rotation and wall motion in NiFe films, 1955
- Pry, R. H., with others, cube-oriented magnetic sheet, 896
- Przedpejski, A. B., reversing ferrite temperature coefficients, 2686
- Pshenichnikov, A. M., static transmitting device for pulse-frequency telemetry, 1659
- Psutka, M. E., with others, diffraction of e.m. waves by ridge, 241
- Pucillo, G. L., determination of h.f. sky-wave absorption, 1341
- Pugh, E. M., with F. P. Beitel, Jr, Hall effects of Fe-Co alloys, 1953
- Pugh, E. W., and F. M. Ryan, susceptibility of Cu-Ni and Ag-Pd alloys, 190
- Pula, T. J., transfer efficiency in fast-response magnetic amplifiers, 2171
- G. E. Lynn and J. F. Ringelman, transfer efficiency of magnetic amplifiers, 3238
- Pullman, J. O., microwave antenna saves space, 3961
- Pulvari, C. F., transpolarizer, 2864
- and W. Kuebler, polarization reversal in BaTiO<sub>3</sub>, 159
- Pursey, H., and F. C. Pyatt, measurement of equivalent noise resistance, 3055
- Purton, R. F., common base versus common emitter, 1139
- Purvis, M. B., G. V. Deverall and D. R. Herriott, optics and photography in flying-spot store, 2363
- Pushkov, N. V., and S. Sh. Dolginov, investigation of earth's magnetic field using earth satellite, 3693
- Pustelnik, M., with O. E. De Lange, timing of regenerative repeaters, 968
- Putley, E. H., concentration of impurity carriers in Si, 510; conduction in *p*-type InSb, 1260; oscillator transverse magnetoresistance effect in InSb, 1264; conduction in *n*-type InSb, 1625
- with W. H. Mitchell, cryostat for semiconductor, 1967
- Putman, J. L., with others, miniature nuclear generator, 2757
- Pütter, P. S., and F. Sauter, statistics of plasma, 1159
- Pyatnitskii, A. I., energy distribution of electrons from Sb-Cs cathodes, 2070
- Pyatt, E. C., with H. Pursey, measurement of equivalent noise resistance, 3055
- Pye, T. R., transistor power converters, 1470, 4207
- Quan, Pham Mau, singular e.m. induction, 406
- with L. Mariot, e.m. tensor in presence of induction, 407
- Quarrington, J. E., with others, fine structure in absorption-edge spectrum of Si, 509
- Quarta, P., propagation tests at 1 kMc/s, 2002
- Quate, C. F., R. Kompfner and A. Chisholm, reflex klystron as negative-resistance-type amplifier, 1741
- with others, parametric amplification of space-charge waves, 3159 k
- Quenby, J. J., and W. R. Webber, cosmic-ray cut-off rigidity, 3280
- de Quervain, A., h.f. transmission on h.v. lines, 2748
- Quilter, W. A. E., radio relay systems and C.C.I.F., 264
- Quinn, W. E., and others, r.f. spectra of hydrogen deuteride, 1852
- Quirk, J. B., u.h.f. tuner using r.f. amplifier, 1383
- Rabenhorst, H., and J. Melichertik, dielectric properties of BaTiO<sub>3</sub>, 1601
- Rabkin, L. I., and Z. I. Novikova, design of coils with ferrite cores for a.f., 1790
- Radelt, H., lamination-type structure of CdS crystals, 3727
- Rademakers, A., with H. G. Bruijning, pulse transformer with pre-magnetization, 1469
- Radford, H. E., and Y. W. Hughes, microwave Zeeman spectrum of atomic oxygen, 4032
- Radstake, G., Netherlands broadcasting centre at Lopik-Radio, 266
- Raemer, H. R., and A. B. Reich, correlation devices detect weak signals, 3099
- Ragavan, D. G., slit resonators as sound absorbers, 687
- Rainville, L. P., with others, measurements of bandwidth of waves propagated beyond horizon, 3459
- Raisbeck, G., nonuniformities in laminated transmission lines, 2101
- Raizer, M. D., and I. S. Shpigel', microwave investigation of plasma, 3262
- Raja Rao, K. S., seat of L currents causing geomagnetic tides, 2247
- and K. R. Sivaraman, lunar geomagnetic tides at Kodaikanal, 1534
- Rajchman, J. A., magnetics for computers, 1782
- G. R. Briggs and A. W. Lo, transfluxor-controlled electroluminescent display panels, 568
- Raju, T. A., with others, nature and origin of atmospheric, 3699 a
- Ralph, E. L., with S. L. Matlow, ohmic Al<sub>n</sub>-type Si contact, 3356
- Ramamurti, T. V., with others, temperature-sensitive ceramic reactance element, 45
- Ramana, K. V. V., with B. R. Rao, diurnal variation of absorption on 5-65 Mc/s, 3699 j
- Ramanathan, K. R., with R. V. Bhonsle, cosmic radio noise on 25 Mc/s, 3699 f
- Ramdas, A. K., with H. Y. Fan, infrared absorption and photoconductivity in irradiated Si, 4089 b
- Ramsa, A. P., H. Jacobs and F. A. Brand, microwave techniques in lifetime measurement, 3774
- Ramsey, N. F., with others, r.f. spectra of hydrogen deuteride, 1852
- Ranby, P. W., with others, activation of ZnS and (Zn,Cd)S phosphors, 3736

- Randolph, L. W., *with others*, instrumenting Explorer I satellite, 1547
- Rangan, C. S., *with others*, temperature-sensitive ceramic reactance element, 45
- Ranzl, I., back-scatter ionospheric sounding experiments, 1197
- and A. Porreca, skip-distance determination by back-scatter sounding, 1340
- Rao, B. R., and D. S. Murty, c.w. method for study of drifts, 3699 i
- and K. V. V. Ramana, diurnal variation of absorption on 5-65 Mc/s, 3699 j
- and E. B. Rao, horizontal drifts in  $F_1$  and  $F_2$  regions at Waltair, 2242; effect of enhanced solar activity on  $F_2$  drifts, 3699 k
- R. Chatterjee and S. K. Chatterjee, dielectric aerials, 2118
- E. B. Rao and Y. V. R. Murty, effect of magnetic activity on  $F_2$  drifts, 2586
- *with others*, magneto-ionic fading in pulsed radio waves, 944
- Rao, B. V. T. and M. K. Rao, ionospheric absorption over Delhi, 810
- Rao, E. B., *with B. R. Rao*, horizontal drifts in  $F_1$  and  $F_2$  regions at Waltair, 2242; effect of enhanced solar activity on  $F_2$  drifts, 3699 k
- *with others*, effect of magnetic activity on  $F_2$  drifts, 2586
- Rao, M. K., *with B. V. T. Rao*, ionospheric absorption over Delhi, 810
- Rao, M. N., and A. P. Mitra, effect of vertical drifts on nocturnal ionization of lower ionosphere, 1878
- *with others*, hourly median field strength of 1940-Mc/s signal, 255
- Rao, M. S., irregularities in E region, 4054
- and R. L. Armstrong, radio reflections along a meteor train, 2226
- *with others*, magneto-ionic fading in pulsed radio waves, 944
- Rao, M. V. S. S. K., *with N. K. D. Choudhury*, panel absorbers for low-frequency sound, 2821
- Rao, N. N., *with Y. V. Somayajulu*, galactic radiation at 30 Mc/s, 3699 i
- Rao, P. R., analysis of circuit transients using Laplacian transformation, 728
- Rao, P. V. S., character display system for digital computer output, 3968
- Rao, R. A., *with A. Singh*, ferrite-tuned magnetron, 3163
- Rao, T. S., *with others*, abnormal ionospheric behaviour at 10 mλ, 808
- *with others*, emission from sun at 30 Mc/s, 3699 o
- Rapaport, H., ferrite frequency separator, 2466
- Rappaport, P., *with J. J. Loferski*, effect of radiation on Si solar-energy converters, 1366; electron-bombardment-induced recombination centres in Ge, 4108
- Rappaport, W., pitch distribution in German language, 2088
- Rasmussen, A. L., *with R. D. Harrington*, permeability spectra of Y-Fe garnet, 1291
- Rassadin, B., single-sideband modulation, 587
- Rastogi, R. G., geomagnetic influence of  $F_1$  and  $F_2$  regions, 2245; diurnal development of equatorial  $F_2$ , 3707
- Ratcliffe, J. A., information by radio from satellites, 1869
- Rath, H. L., properties of Si rectifiers for communications, 2022
- Rausch, R. H., and T. T. True, reference generator for colour TV receivers, 1324
- von Rautenfeld, F., evaluation of field-strength measurements, 3419
- *with E. Belger*, interference protection ratios for sound broadcasting, 3464
- Ravi Varma, A. R., and H. D. Krishna Prasad, effect of restricted frequency characteristics on intelligibility of speech, 2755
- Rawer, K., The Ionosphere, (B)1200; problems in ionospheric forecasting, 1333 i
- and K. Suchy, 'fourth reflection condition' of e.m. waves in plasma, 1164; equivalent theorems of wave absorption in plasma, 1669; dispersion formula of Lorentz plasma, 3641
- *with E. Harnischmacher*, drift observations evaluated by method of 'similar fades', 801
- *with others*, ionospheric observations during solar eclipse of 30th June 1954, 131; rocket measurements of absorption in lower ionosphere, 2972; variation of ionospheric absorption, 3716
- Rayner, G. H., calibration of inductors, 2346
- Razbiri(n)e, B. S., *with E. F. Gross*, effect of deformations on spectrum of CdS, 3730
- *with others*, line spectra of absorption edge of CdS, 471; fluorescent emission lines and luminous absorption lines in CdS, 2618
- Reber, G., radio interferometry at 3 km above Pacific Ocean, 2219; suppressed-sidelobe antenna, 3575
- Reddish, A., *with others*, frequency pushing in crossed-field oscillators, 2788 q
- Reddy, C. A., B. R. Rao and M. S. Rao, magneto-ionic fading in pulsed radio waves, 944
- Reder, F. H., frequency shift in sealed atomic-beam frequency standards, 4148
- *with others*, comparison of Cs frequency standards, 212
- Rediker, R. H., *with J. Halpern*, mpw switching diodes, 3144
- *with A. L. McWhorter*, cryosar, 3211
- Redlich, H., and H. J. Klemp, electromechanical transducer for stereophonic recording, 2096
- Redstone, R., *with others*, coaxial-line diode, 3524 m
- Redwood, M., *with others*, absorption of compressional waves in solids, 3536
- Reed, B., O. A. Weinreich and H. F. Mataré, conductivity of grain boundaries in Ge bicrystals, 2657
- *with others*, grain-boundary amplifier, 3241
- Reed, E. D., *with others*, helix travelling-wave amplifier, 2788 a
- Reed, J., multiple-branch waveguide coupler, 3559
- Reed, W. O., and W. F. Niklas, shutter image converter tube for multiple-frame photography, 2369
- Rees, J. R., *with A. E. Barrington*, 3-cm Q-meter, 562
- Rees, M. H., and G. C. Reid, aurora, radiation belt and solar wind, 4063
- *with E. K. Proctor*, scanning lens design for minimum phase error, 1101
- Reeves, R. J. D., recording and collocation of waveforms, 1650, 2357
- Rehkopf, C. H., gas evolution or sorption of anode materials, 2985
- Reich, A. B., *with H. R. Raemer*, correlation devices detect weak signals, 3099
- Reich, H. A., *with others*, transistorized crystal-controlled marginal oscillator, 1805
- Reichel, R., *with others*, resolving power of scintillation multipliers, 3081
- Reicht, R., audibility of nonlinear distortion, 3185
- Reid, G. C., electric-field theory of aurora, 1887
- and C. Collins, abnormal v.h.f. absorption, 2380
- *with H. Leinbach*, upper-atmosphere ionization by particles from solar flare, 1521
- *with R. Parthasarathy*, signal-strength recordings of satellite 1958 82, 1193
- *with M. H. Rees*, aurora, radiation belt and solar wind, 4063
- Reimer, L., investigations of thermal transformation of cathode-sputtered Ni films, 895; Hall-effect measurements in Ni films, 1280
- Reinboth, H., ferrites—in communication engineering, 4134
- Reiner, H., *with C. Heck*, storage properties of square-loop ferrites, 3397
- Reiss, H., diffusion-controlled reactions in solids, 4089 d
- *with others*, formation of donor states in heat-treated Si, 1926
- Reitan, D. K., capacitance of parallel-plate capacitors, 1794
- Reker, H., line transformer with tuned h.v. winding, 1387
- Remeika, J. P., *with others*, domain behaviour in transparent magnetic oxides, 1956
- Rempel, R. C., and H. E. Weaver, microwave reflection bridge, 1982
- *with others*, electron paramagnetic resonance in BaTiO<sub>3</sub>, 476
- Rendall, A. R. A., *with R. J. Halsey*, prospects for transatlantic television by cable, 4211
- Rennie, J. C., wide-band microwave mixer and i.f. preamplifier, 949
- Renton, C. A., *with D. F. Gibbons*, velocity of sound in Sn, 4122
- Repnev, A. I., *with others*, pressure and density measurements in high atmosphere by earth satellites, 3694
- Reshetov, W. D., radiation errors of radiosondes, 226
- Rettig, A., *with H. Bohlmann*, installation for outside sound broadcasts, 4204
- Reynolds, D. K., J. Lignac and P. A. Szenté, centipede aerial, 1333 u
- Reynolds, S. I., surface charges on insulators, 2527
- Rhoderick, E. H., nuclear magnetic resonance in InSb, 1261; superconducting computer elements, 3209
- Riblet, H. J., high-Q waveguide filter design theory, 3561
- Rice, L. P., radio transmission into buildings, 1688
- Rich, E., Jr., *with others*, tracking weather with satellites, 2715
- Richards, E. G., estimation of transmission loss in transhorizon-region, 2000 w
- *with others*, influence of ocean duct on scatter propagation beyond horizon, 578; m-λ propagation in transhorizon region, 2000 p
- Richards, J. C. S., low-capacitance input circuit, 752; apparatus for measuring dielectric constants and losses, 1305
- Richards, P. I., transients in conducting media, 2916
- Richmond, I. J., *with others*, m-λ propagation in transhorizon region, 2000 p
- Richter, H. L., Jr., and others, instrumenting Explorer I, 1547
- Ricke, F. F., L. H. DeVaux and A. J. Tuzolino, infrared detectors, 4239
- Rider, D. K., foil-clad laminates in printed circuitry, 355
- Rider, G. C., propagation measurements at 858 Mc/s, 1346; tropospheric scatter propagation measurements and aerial siting tests, 2000 s
- Ridler, P. F., transistor tube preamplifier, 387
- Ridley, B. K., lifetime measurement by photoconductive decay, 1921
- Rieck, H., aperiodic barretter probe for power measurements, 1322; low-noise h.f. preamplifier, 3236
- Riesz, R. P., *with G. L. Pearson*, switching diodes from plastically deformed Ge, 2412
- Riety, P., equipment for the absolute calibration of microphones, 2093
- Rietz, W., measurement and recording of phase characteristics for wide-band transmission, 1310
- Riggs, L. P., *with B. R. Bean*, synoptic variation of radio reflective index, 4177
- Rigrod, W. W., space-charge-wave harmonics and noise propagation in rotating electron beams, 1736
- and J. R. Pierce, space-charge-wave excitation in Brillouin beams, 1735
- Rigterink, M. D., ceramic electrical insulating materials, 4142
- Rihaczek, A., *with H. Meinke*, bandwidth compression of radar displays, 3724
- Rikitake, T., and others, effect of solar eclipse on geomagnetic field, 2561
- Ringelman, J. F., *with others*, transfer efficiency of magnetic amplifiers, 3238
- Ringwalt, D. L., W. S. Ament and F. C. MacDonald, measurements of 1250-Mc/s scatter propagation, 3096
- Rishbeth, H., radio emission from Vela-Puppis region, 2221
- Riste, T., K. Blinowski and J. Janik, spin-fluctuation scattering of neutrons in magnetite, 4127
- Ritche, G. C., and R. W. Young, design of biased-diode function generators, 2861
- Ritow, H., wire-cylinder discharges in air, 394; space-charge field-emission hypothesis, 2907
- Ritt, P. E., *with J. L. Pentecost*, lightweight ceramic materials, 839
- Rittner, E. S., theory of Peltier heat pump, 2906
- Rivier, D., Hall and Righi-Leduc effects in ferromagnetics, 758 d
- Rizzi, P. A., high-power ferrite circulators, 1079
- and J. B. Gatlin, rectangular-guide ferrite phase shifters, 1771
- Roach, F. E., night airglow, 1567
- Robbins, A., *with J. O. Thomas*, electron distribution in ionosphere over Slough, 806
- Robbrecht, G. G., and J. L. Verhaeghe, measurements of permeability tensor for 'ferrocube' at 24 kMc/s, 1293
- Robeer, A. G., *with H. E. Eckhardt*, 100-kW s.w. broadcast transmitter, 293
- Röbel, H., influence of top-end capacitance in inductive aerial couplings, 2383
- Roberson, R. E., gravitational torque on satellite vehicle, 117; air drag effect on satellite orbit, 119
- Roberts, C. R., P. H. Kirchner and D. W. Bray, radio reflections from satellite-produced ionization, 2963
- Roberts, D. H., photoconductivity in PbSe, 470
- and J. E. Baines, photoconductivity in PbSe films, 830
- and B. L. H. Wilson, effects of O<sub>2</sub> on resistivity in Si, 2294
- Roberts, G. A., *with T. W. Butler, Jr.*, ferroelectric capacitors, 3247; voltage-variable capacitor guide, 3599
- Roberts, J. A., echoes in solar corona from new type of radio burst, 102
- *with R. G. Giovanelli*, observations of solar disturbances causing type II radio bursts, 432
- *with R. Q. Twiss*, c.m. radiation from electrons in ionized medium, 408
- Roberts, M. W., stability of evaporated films, 1295
- Roberts, V., *with others*, fine structure in absorption-edge spectrum of Si, 509
- Robertshaw, R. G., *with C. H. Dix*, pulsed travelling-wave tubes in 10-Gc/s region, 2788 m
- Robillard, P. E., *with others*, diffraction of c.m. waves by ridge, 241
- Robillard, T. R., and R. W. Westberg, transistors for electronic switching, 2778
- Robin, L., harmonic distortion in f.m., 1504
- Robin-Kandare, S., and B. Vodar, reflecting power of bulk Si and Ge, 3766
- Robins, D. A., susceptibility and resistivity of transition-metal silicides, 1274
- Robinson, A. C., *with others*, properties of dilute ferromagnetic alloys, 1631
- Robinson, D. Z., methods of background description, 4010 m
- Robinson, F. N. H., current and velocity fluctuations at potential minimum, 320
- *with others*, dynamic nuclear polarization, 3412
- Robinson, K. W., *with J. Dekleva*, shunt impedance measurement, 3421
- Roch, J., electronic paramagnetic-resonance spectrometers, 3269; sensitivities of, 1172
- Roché, J. F., *with others*, measurements of bandwidth of waves propagated beyond horizon, 3459
- Rockstuhl, F., crystal-controlled 3-terminal valve oscillators, 1483
- Roddam, T., return loss, 12; bifilar-T circuit, 1122
- Rodgers, K. F., *with W. S. Boyle*, oscillations in infrared transmission of Bi, 2620
- *with others*, splitting of As donor ground state in Ge, 1615
- Rodin, V. N., electron analyser of contact circuits, 1460
- Rodot, M., properties of InSb, 3033
- *with H. Fumeron-Rodot*, properties of HgTe, 3779
- Rodrigue, G. P., and others, ferrimagnetic resonance in polycrystalline rare-earth garnets, 2690
- Rodriguez, S., cyclotron resonance in metals, 1855
- Roe, G. M., and M. R. Boyd, parametric energy conversion in distributed systems, 3240
- Roessler, E., propagation of e.m. waves, radio location and radio astronomy, 1581
- Rogal, B., *with others*, torque-operated wattmeters for 3 cin λ, 2359
- Roger, R. S., *with C. W. McLeish*, h.f. direction-finding errors caused by vertical reradiators, 1203
- Rogers, T. F., *with L. A. Ames*, 220-Mc/s reception at 700-1000 miles, 1351
- *with others*, persistent v.h.f. field strengths beyond radio horizon, 2737
- Rohan, P., radio telemetry, 3448
- Rollett, J. M., characteristic frequencies of junction transistors, 996
- Ronchi, L., *with others*, trajectory of earth satellites, 441; determination of satellite orbit, 1188
- Ronzheimer, S. P., and R. J. Farber, measurement of colour television receiver performance, 986
- Rookes, R. D., *with G. M. Clarke*, microwave reflectometer display system, (D)2703
- Root, H. G., *with others*, measurements of bandwidth of waves propagated beyond horizon, 3459
- Rose, A., and M. A. Lampert, gain-bandwidth product for photoconductors, 1900; photoconductor performance and Fermi level, 2988
- *with E. O. Johnson*, analysis of amplifier devices, 2041

- with M. A. Lambert, transient behaviour of ohmic contact, 2903
- with others, photo-properties of ZnO, 826; approach to intrinsic ZnO, 877
- Rose, A. S., metallographic aspects of alloy junctions, 187
- Rose, C., with others, long-distance single-F-hop transmission, 943
- Rose, D. C., with others, decreases in cosmic-ray intensity during period October 1956 to January 1958, 4037
- Rose, F. W. G., impact ionization in Si *p-n* junctions, 1927
- Rose, G., with others, sweep frequency oblique-incidence pulse transmissions, 2378
- Rose, M. E., electrostatic interaction of charge distributions, 760
- Rose-Innes, A. C., observation by cyclotron resonance of effect of strain on Ge and Si, 507
- with C. Hilsum, new method of measuring susceptibility, 1313
- Rosen, A., and others, ionizing radiation at 3 500–36 000 km, 3691
- Rosenberg, R., and M. Lax, free-carrier absorption in *n*-type Ge, 1249
- Rosenberger, G. B., cryogenic oscillator, 2875
- Rosson, D. D., Jr, with B. Kostyshyn, magnetic field probe, 1973
- Rosi, F. D., effect of crystal growth variables on Ge, 170
- with M. C. Steel, thermal conductivity and thermoelectric power of Ge-Si alloys, 528
- Rösner, O., propagation of e.m. waves between concentric spheres, 1338
- Rostas, E., and F. Hülster, microwave amplification by intrinsic negative resistances, 3159 *p*
- Roth, H., with V. A. J. van Lint, electron irradiation of Ge and Te, 4089 *l*
- Roth, L. M., B. Lax and S. Zwerdling, optical magneto-absorption effects in semiconductors, 3365
- with W. H. Kleiner, deformation potential in Ge, 2655
- with others, Zeeman effect of excitons in Ge, 2299; exciton- and magneto-absorption of transitions in Ge, 3364
- Roth, W. C., with J. G. White, polarity of GaAs, 3381
- Roth, W. L., multipin axis structures for antiferromagnets, 188
- Rothbart, A., torsional magnetostrictive delay line, 2881
- Rothenstein, B., and J. Hriancu, mobility of Bloch walls, 3794; influence of temperature on distribution of ferromagnetic domains, 3795
- Rothwell, P., cosmic rays in earth's magnetic field, 1524
- and C. McLwain, satellite observations of solar cosmic rays, 3692
- Rotman, W., wide-angle scanning with microwave pillboxes, 1448
- and A. A. Oliner, asymmetrical trough-waveguide antennas, 3960
- with A. A. Oliner, periodic structures in trough waveguide, 3934
- Rowden, R. A., L. F. Tagholm and J. W. Stark, tropospheric wave propagation measurements by B.B.C., 2000 *m*
- Rowe, H. E., timing in long chain of binary repeaters, 969
- Rowe, J. E., theory of crestatron, 2427
- and R. J. Martin, electron-trajectory calculator and Poisson cell, 3524 *kk*
- Rowe, R. M., with others, measurement of pulse front response of transformers, 357
- Rowland, R., printed circuits applied to microwave links, 2488
- Rowley, G. C., digital differential analysers, 1780
- Rowson, B., angular diameter measurements of radio sources at 10<sup>-7</sup> cm  $\lambda$ , 3658
- Roy, B., properties of strongly connected graph, 1964
- Royle, J. R. T., with G. Hersee, B.B.C. transparencies for testing camera channels, 984
- Rozis-Saulgeot, A. M., highly ionized regions of interstellar matter, 3272
- Rozner, F., television waveform generator using transistors, 1373
- and P. Pengelly, transistors and cores in counting circuits, 2479
- Rubbia, C., and G. Torelli, differential discrimination for fast pulses, 3990
- Ruben, S., Zn/Hg-dioxysulphate dry cell, 3866
- Rubinshtein, R. N., and V. I. Fistul', determination of surface conductivity of semiconducting crystals, 2671
- Rubissow, G. J., with E. J. Baghdaady, dynamic trap for weak f.m. signals, 1350
- Ruby, S. L., F. D. Schupp and E. D. Wolley, effect of fast neutrons on *n*-type Ge, 866
- Rücker, D., electroluminescence of SiC, 3003
- Rudd, J. B., correlation between stagger-tuned and synchronously-tuned coupled circuits, 364; double-tuned transformers, 3595
- Ruddlesden, R., with E. Fitch, aerial height for ionospheric scatter links, 2000 *c*
- Rudin, M., R. E. Shafer and B. W. Baker, dual-cavity microwave discriminator, 1487
- Rudy, W. G., with others, moulded Ni cathode, 2069
- Rüetschi, P., and R. T. Angstadt, self-discharge reactions in batteries, 2403
- Ruggles, P. C., design and performance of high-density electron guns, 3524 *u*
- Rukhadze, A. A., with V. M. Agranovich, propagation of e.m. waves in medium with spatial dispersion, 2921
- with others, Cherenkov radiation in medium with spatial dispersion, 3648
- Rumfelt, A. Y., and R. J. Como, rapid insertion device for coaxial attenuators, 3927
- Rumsey, V. H., with others, U.R.S.I. report on antennas and waveguides, 3565
- Runyan, W. R., growth of large Si and Ge crystals, 3767
- Rupp, H., network of broadcast and television transmitters in Württemberg, 1692
- Ruppel, H. M., with others, beam noise in crossed electric and magnetic fields, 313
- Ruppel, W., field effect in insulating ZnO powder, 1903
- H. J. Gerritsen and A. Rose, approach to intrinsic ZnO, 877
- with others, photo-properties of ZnO, 826
- Rupprecht, H., concentration and mobility of electrons in ZnO, 879; Hall coefficient of doped InAs, 3385
- Rupprecht, J., and C. Heck, dielectric properties of oriented Ba ferrite, 3807
- Rusch, W. V. T., with others, antenna to eliminate groundwave interference in ionospheric sounding, 710; power-line aerial, 1672; v.l.f. c.w. transmitter for ionospheric investigation, 3873
- Ruska, E., electron microscopy, 3832
- Ruske, W., magnetic properties of electrolytic Ni films, 3804
- Russell, J. T., with H. W. Lefevre, vernier chronotron, 1965, 2338
- Russo, V., with P. F. Checchacci, microwave configuration lens tests, 1450
- Ruthberg, S., double-sweep method for analysis of cavity characteristics, 926
- Ruthroff, C. L., broad-band transformers, 3593
- Rutz, R. F., and D. F. Singer, properties of experimental 1-kMc/s transistors, 3510
- Rvachev, A. L., time-lag of photoeffect and conductivity of Cu<sub>2</sub>O, 3734
- Ryabinkin, Yu. S., modern transistors, 3509
- with others, field potential and charge carriers in fused-in junctions, 3787
- Ryan, F. M., with E. W. Pugh, susceptibility of Cu-Ni and Ag-Pd alloys, 190
- Ryan, W. D., antenna switch for scintillation measurements, 2844
- Rybner, J., and E. Ungstrup, influence of auroral zone on communications, 1333 *j*
- Ryder, F. L., Lagrange equations in electrical networks, 360
- Ryer, W. H., with W. E. Sheehan, circuits for transistor receivers, 1349
- Ryerson, J. L., with others, tropospheric scatter system using angle diversity, 2751
- Ryle, M., nature of cosmic radio sources, 3274
- Rymer, T. B., with others, Ge junction cells for photoelectric control circuits, 309
- Ryter, C., 10-kMc/s paramagnetic resonance in Eu and Gd, 1629
- Rzaev, M. A., with others, temperature dependence of work function of semiconductors, 494
- Rzhanov, A. V., Yu. F. Novototski-Vlasov and I. G. Neizvestnyy, field effect and surface recombination in Ge, 1928
- Saad, T., with others, 'reactron' microwave amplifier, 1150
- Sabbatini, A., response of amplifier operating on interrupted cycle, 1138
- Saburi, A., with T. Fujii, analysis of electron beam by mechanical scanner, 3524 *l*
- Sacerdote, C. B., detecting sound fields, 2447
- Sacerdoti, G., and R. Toschi, potential of e.s. field and trajectories of charged particles, 1505
- Sachdev, D. K., study of atmospheric radio noise at Delhi, 1580
- Sack, E. A., ELF electroluminescent display, 225
- Sadashige, K., with S. L. Bendell, image retention in image orthicon, 615
- Saagar, A., piezoresistance in GaAs, 1939
- Saito, H., with others, diffraction at v.h.f. and u.h.f. by ridges, 243
- Saito, N., and J. Hori, thermodynamics of harmonic oscillator, 81
- Saito, Y., and S. Yamanaka, residual polarization of BaTiO<sub>3</sub> ceramics, 3327
- Sakaki, Y., with S. Maruse, electron-optical properties of point cathodes, 3077
- Sălceanu, C., and M. Zăgănescu, correction to velocity of sound by resonance method, 328; influence of thickness of walls of resonance tube, 1422
- Salerno, J., with C. D. Hardin, miniature X-band radar, 1584
- Salkovitz, E. I., G. C. Bailev and A. I. Schindler, effect of neutron irradiation on Curie temperature of ferrites, 898
- Salow, H., with W. v. Münch, storing and switching transistor, 2777
- Sampaio, P. M. J. C. da S., with K. W. H. Foulds, electric-field distributions in waveguide containing dielectric slab, 3940
- Sampath, S., with others, electronic and ionic devices with thermionic cathodes, 3531; cylindrical, elliptical and prismatic forms of electronic tubes, 3895
- Sampson, D. K., with H. L. Daniels, magnetic drum provides analogue time delay, 1655
- Samson, C. A., effect of atomic tests on radio noise, 4067
- Samuels, J. O., propagation of waves in rough ducts, 2919
- Sander, A., wide-band radiator with adjustable matching in range 30–70 cm  $\lambda$ , 2361
- Sander, K. F., with M. R. Barber, electron optics of e.s. electron guns, 3524 *r*
- with D. H. Davies, electron trajectories in gun of M-type carcinotron, 318
- Sanders, J. H., optical maser design, 3655
- with others, radiosonde measurement of electric field and polar conductivity, 1195
- Sanders, T. M., with others, acoustoelectric effect in *n*-type Ge, 3373
- Sandoz, O. A., E. E. Stevens and E. S. Warren, frequency prediction techniques for high latitudes, 2729
- Sandulova, A. V., and Khe-Yut-Lyan, diffusion and solubility of Ta in Ge, 4104
- Sanghi, I., electrolytic etching of Ta, 359
- Sanpei, H., with others, transmitting frequency converter, 3145
- Sansom, D. J., with L. F. Bates, magnetothermal effects in Fe and SiFe, 4129
- San Soucie, R. L., with J. H. Green, Jr, error-correcting encoder and decoder, 257
- Saporte, R., with F. Pradal, energy spectrum of reflected electron beam, 399
- Sarace, J. C., with D. R. Mason, contacts to *p*-type Si, 2296
- Sarada, K. A., cosmic-noise absorption associated with solar event, 789
- with others, radio patrol of solar flares, 3699 *p*
- Sard, E. W., with P. P. Lombardo, low-frequency travelling-wave reactance amplifier, 2524
- Sargent, D. J., with M. R. Child, accurate measurement of mutual conductance, 3059
- Sargent, J., recording microwave hygrometer, 3070
- Sarma, N. V. G., with others, radio patrol of solar flares, 3699 *p*
- Sassier, M., Si power rectifiers, 268
- Sastry, G. S., with others, abnormal ionospheric behaviour at 10 ma, 808; emission from sun at 30 Mc/s, 3699 *o*
- Sato, H., with others, dependence of sound attenuation on magnetization direction in Ni, 4125
- Sato, K., and M. Koyasu, effect of room shape on sound field, 3916
- Sato, T., with K. I. Maeda, F region during magnetic storms, 1563
- Satterthwaite, C. B., with others, evidence for energy gap in superconductors, 393
- Satyannarayana, R., K. Bakhru and S. R. Khastgir, triple splitting of F echoes, 1885
- with P. Venkateswarlu, fading of radio waves, 585
- Saubestre, E. B., electrodeless copper plating in printed circuitry, 3047
- Sauter, F., with P. S. Pütter, statistics of plasma, 1159
- Sauzade, M., transistor stabilized supply to feed electromagnet, 2758
- with H. Hahn, transistor stabilized supply at 5–9 V 800 mA, 601
- Savage, A., with R. C. Miller, observations of anti-parallel domains in BaTiO<sub>3</sub>, 2634; hysteresis loops and pyroelectric effect in BaTiO<sub>3</sub>, 3332
- Savage, F. M., analysis of impact noise, 2089
- Savornin, F., resistance of thin Co films, 162, and thermoelectric power of, 487
- Savvinykh, S., with others, nonlocal reflection in waveguides of variable cross-section, 1766
- Sawada, K., with K. A. Brueckner, magnetic susceptibility of electron gas, 759
- Sawada, S., and G. C. Danielson, electrical conduction in WO<sub>3</sub>, 2668
- with others, thermal conductivity of BaTiO<sub>3</sub> ceramics, 2628
- Saxton, J. A., and B. N. Harden, performance of directive aerials at u.h.f., 2845
- Scanlon, W. A., with R. S. Algaier, mobility in PbS, PbSe, and PbTe, 181
- Scarborough, R. J. D., K. H. Ferguson and A. W. Searis, generation of stable carrier frequencies, 3987
- Schade, O. H., measuring optical spectrum of image-display devices, 1390
- Schade, O. H., Sr, quality of colour-television images, 1391, 2404
- Schafer, G. E., and R. W. Beatty, measuring directivity of directional couplers, 3821
- Schafer, W. R., with others, polarization of Al nuclei in ruby, 3792
- Schallehn, W., with others, Telefunken traffic radar, 1898
- Schanda, J., with others, time-dependent spectra of ZnS: Cu, Pb, 4080
- Scharfman, H., with F. J. O'Hara, ferrite rodryne for microwave frequency translation, 3942
- Scharfman, W. E., with others, voltage breakdown characteristics of microwave antennas, 3581
- Schawlow, A. L., and C. H. Townes, infrared and optical masers, 1857
- Scheer, J. J., and P. Zalm, crystal structure of Na<sub>2</sub>KSB, 2995
- van der Scheer, J. W. A., portable instrument for i.f. measurements on f.m. radio links, 222
- Scheibner, E. J., with others, stabilization of Si surfaces by thermally grown oxides, 2650
- Schemel, R. E., with W. Fraser, modulator as phase detector, 2899
- Schenck, E., accuracy obtainable with transistor in p.a.m. and p.w.m., 1827
- Schenkerman, S., designing transistor d.c./a.c. converters, 267
- Scheuer, P. A. G., with others, spatial distribution of radio sources at 159 Mc/s, 103
- Schiefer, G., with K. Jost, evaluation of quadrupole and material measurements using chart, 2702
- Schiess, C., with W. F. Palmer, transistorized vertical deflection systems, 1381
- Schiffman, B. M., microwave 90° phase shifters, 2114
- Schillizzi, T. E., radar data transmission, 1586
- Schiller, M. I., television station list, 2030
- Schilling, G. F., and T. E. Sterne, densities and temperatures of upper atmosphere from satellite observations, 1871
- Schimpf, L. G., carrier transmission for closed-circuit television, 3114
- Schindler, A. I., with others, effect of neutron irradiation on Curie temperature of ferrites, 898
- Schirmer, H., and J. Friedrich, electrical conductivity of plasma, 1161
- Schlabach, T. D., and E. E. Wright, test patterns for printed-circuit materials, 2487
- Schleimann-Jensen, A., generation of submillimetre waves by avalanche semiconductor, 3875
- Schlesier, H., significance of 90° phase shift in modulation systems, 4196

- Schlesinger, K., new electron gun for picture display, 3128
- Schlesinger, S. P., and D. D. King, dielectric image lines, 2827
- Schley, U., and F. Hoffmann, noise in radiation thermocouples, 1653
- Schlichting, K., investigations on harmonic frequency dividers, 1132
- Schlier, R. E., with others, surface properties of SiC crystals, 3022
- Schlömann, E., ferromagnetic resonance in polycrystalline ferrites, 777, 906
- and J. J. Green, decline of ferromagnetic resonance absorption with increasing power level, 4139
- Schmeltzer, R. A., stabilization of transistor gain, 4231
- Schmelzer, C., with others, fixed-frequency cyclotron with one dee, 1985
- Schmerling, E. R., and C. A. Ventrice, rapid reduction of  $k_f$  records to  $N-h$  profiles, 3303
- Schmid, H., function generator for sines or cosines, 1457
- Schmid, K., with others, radio link installations for telephony and television, 1687
- Schmidt, G., plasmas in external magnetic fields, 3642
- Schmidt, L., with others, resolving power of scintillation multipliers, 3081
- Schmidt, L. W., and J. I. Davis, solar-cell power supply, 4206
- Schmidt, W., c.w. magnetron, 4244, a.c. operation of, 3161
- Schmidt-Rohr, U., with others, fixed-frequency cyclotron with one dee, 1985
- Schmidt-Tiedemann, K. J., amplifier for investigation of electron avalanches, 1136
- Schmitt, H. J., back-scattering measurements, 3843
- and W. Fullermenger, multistage resonance absorbers for cm waves, 1846
- Schmitt, R. W., with I. S. Jacobs, low-temperature behaviour of dilute alloys Mn-Cu and Co-Cu, 2673
- Schmouker, J., with others, irradiation of photoconductive single crystals of CdS, 2617
- Schmucker, G., Telefunken s.w., c.r.d.f., 2257
- Schneider, B., and M. J. O. Struth, shot noise in Si  $p-n$  junction diodes and transistors, 2413
- Schneider, H., representation of a.c. characteristics of earthed-base transistor, 2042
- with W. Hanke, scintillation counters, 3080
- Schneider, J., stimulated emission of radiation by electrons in magnetic field, 3264
- Schoen, S., transistors provide computer clock signals, 1784
- Schoenfeld, H. H., H. H. H. Green and R. E. Gossett, manufacture of waveguide parts, 3553
- Scholten, E., with G. van Gelder, radar echo box, 1590
- Scholz, M., with others, correlation measurements in s.w. range, 953
- Schorn, R. A., with others, radio reflections from satellite-produced ion columns, 121
- Schorr, M. G., and R. H. Packard, power supply for video circuits, 602
- Schouten, J. P., and A. T. De Hoop, reflection of plane e.m. wave, 1335 v
- Schröder, F. K., progress in construction of loudspeakers, 1762
- Schröder, W., pulse-width filter for television receivers, 1802
- Schroeder, C. A., C. H. Looney, Jr, and H. E. Carpenter, Jr, tracking orbits of man-made moons, 1190
- Schroeder, J. O., holding video level, 3131
- Schroeder, M. R., stereophonic effect obtained from single audio signal, 1056; measurement of diffusivity in reverberation chambers, 3919
- Schubert, J., design of input stages of i.f. amplifiers using transistors, 4001
- Schulten, G., measuring impedances on surface-wave transmission lines, 1069
- Schulz, E., with others, distribution of lightning currents in earthing system of radio mast, 1451
- Schulz, J., characteristics of cathode-coupled limiter, 1813
- Schulz-DuBois, E. O., paramagnetic spectra of substituted sapphires, 1627
- G. J. Wheeler and M. H. Sirvetz, high-power L-band resonance isolator, 3563
- with H. E. D. Scovill, 3-level masers as heat engines, 2212
- with others, paramagnetic-resonance spectrum of  $Cr^{3+}$  in emerald, 1628; 3-level solid-state travelling-wave maser, 2177; spin refrigeration and maser action at 1 500 Mc/s, 3654
- Schumann, W. O., propagation of electrical waves, along plasma layer, 1996, in magnetized plasmas, 4179
- Schünemann, R., u.s.w. propagation along rough layers, 2379
- Schuon, E., long-slot directional couplers, 2112; approximation of modulus and argument of transmission factor, 3976
- and H. J. Butterweck, linearization of f.m. characteristic of reflex klystron, 1739
- Schupp, F. D., with others, effect of fast neutrons on  $n$ -type Ge, 866
- Schusta, J., with W. Krug, electronic production of lines of equal density, 4167
- Schuster, W. D., with W. A. Dickinson, picture tubes with 110° deflection, 284
- Schutzman, E., with D. Hoffman, analysis of noise-signal amplitudes, 3826
- Schwahn, H., logarithmic wide-band amplifier, 2169
- Schwartz, E., television techniques, 1699; sound and television broadcasting, 2749
- Schwartz, J. W., high-transconductance electron gun for kinescopes, 322; annular-geometry electron gun, 652
- with R. D. Gold, drive factor and gamma of conventional kinescope guns, 1417
- Schwartz, L. S., with others, binary communication feedback systems, 2387
- Schwarz, R. F., with P. H. Brill, radiative recombination in Ge, 869
- with others, control of luminescence by charge extraction, 473
- Schwarzlander, H., intelligibility evaluation of voice communications, 2819
- Schweimler, H. C., thermal neutron capture in Si and Ge, 4089 a
- Schweizerhof, S., ferrites for magnetostriction oscillators, 1954
- Schwetke, H., absorption index of ionosphere, 2732
- Schwetman, H. D., with others, rotating-disk function generator, 2858
- Schwetsoff, V., measurements on oxidized layers of PbS, 2615; optical properties of photoelectric thin films, 4079
- Schwink, C., and H. Murrmann, field superposition for electron-optical shadow method, 3441
- Schwutke, G. H., crystal orientation of Ge and Si, 166
- Scofield, B. T., etching Ge to precise limits, 4103
- Scott, H. D., multichannel d.c. recording system, 3108
- Scott, T., with others, power transistors, 2769
- Scott, T. M., with J. H. O'Connell, measurement of transistor characteristics in 3–250 Mc/s range, 1304
- Scott, W. T., with others, Doppler satellite measurements, 1191
- Scotto, M., with others, propagation in crossed-field periodic structure, 1731
- Scovill, H. E. D., and E. O. Schulz-DuBois, 3-level masers as heat engines, 2212
- with others, 3-level solid-state travelling-wave maser, 2177; spin refrigeration and maser action at 1 500 Mc/s, 3654
- Scriven, A. K., pulse-modulated beam current in klystron operation, 1016
- Seaman, M. S., with F. A. Benson, surface structure of saturated-diode filaments, 1418
- Searls, A. W., with others, generation of stable carrier frequencies, 3987
- Sears, J., time delays in ultrasonic delay lines, 2698
- Seavey, M. H., Jr, and P. E. Tannenwald, direct observation of spin-wave resonance, 191
- Seckler, B. D., and J. B. Keller, theory of diffraction, geometric, 2538, asymptotic, 2539
- Seddon, J. C., and J. E. Jackson, ionosphere electron densities, 3714
- Seed, T. J., v.h.f. observations on aurora australis, 141
- Seeger, G., with others, theory of multiple lines, 2458
- Seeger, K., delayed electron emission and photoeffect of Fe after electron bombardment, 874; microwave-induced carrier multiplication in Ge, 2302; drift mobility in Ge, 3371
- Seeley, J. S., quarter-wave matching of dispersive materials, 2125
- and J. Brown, dispersive artificial dielectrics in beam-scanning prism, 2124
- Seemann, F. W., with D. Hahn, significance of boundary layers and polarization fields for electroluminescence, 833
- Segalin, V. G., simplified analysis of transients in linear circuits, 2148
- Ségar, N., and J. Cassette, theoretical investigation of ultrasonic field, 1423
- J. Cassette and F. Coccuzquez, crystal probe for measurement of ultrasonic power, 1752
- Seidel, G., with P. H. Keessom, specific heat of Ge and Si, 2287
- Seiden, J., theory of impurity paramagnetism, 2644
- Seiffert, K., with M. Heckl, influence of self resonances of measurement chambers on sound insulation measurements, 2090
- Sekiguchi, T., and R. C. Herndon, thermal conductivity of electron gas, 766
- Self, S. A., with others, design of high-power S-band magnetron, 2788 d
- Seljak, A., with others, frequency stepper for propagation tests, 1485
- Sellberg, F., theoretical investigation of closed relay structures, 3159 l
- Selzer, E., field of permeable alloy cylinder, 90
- Semennikov, Yu. B., electronic-acoustic converter, 679
- Semenov, A., and V. Verzunov, phase compensation methods of shaping s.s.b. signal, 588
- Sen, A. K., rhombic antenna with cylindrical helices, 19
- Sen, S. K., with S. D. Chatterjee, induced conductivity at surface of contact, 1271
- Senf, H. R., with F. E. Goodwin, volumetric scanning of radar with ferrite phase shifters, 1896
- Sengupta, D. L., radiation characteristics of zig-zag antenna, 2848
- Senior, T. B. A., currents on strip aerials, 1086; diffraction by imperfectly conducting wedge, 4028
- with J. S. Hey, e.m. scattering by thin plates, 772
- Senitzky, I. R., behaviour of 2-level solid-state maser, 73
- Senn, J. C., testing diodes for r.f. noise, 3507
- Seppen, J. M. G., and J. Verstraten, 8-mm radar, 1591
- with B. H. G. Prins, Rotterdam harbour radar system, 1589
- Sergeeva, V. M., with others, new semiconducting compounds, 3755
- Sery, R. S., with others, radiation effects in magnetic materials, 196
- Sessler, A. M., with C. E. Nielsen, space-charge effects in particle accelerators, 1984
- Sethuraman, R., rates of fading of reflected pulses at 2.6 and 4 Mc/s, 3699 h
- Sette, D., with G. Bedendo, photoconductivity and lifetime  $\tau$  of charge carriers, 3342
- with others, characteristic parameters of barrier layer in metal/semiconductor junction diodes, 2415
- Setty, P. S. V., r.f. oscillations in 'silent' discharges, 1155
- Severin, H., acoustic and e.m. boundary-value problems, 4008
- Seyler, A. J., and A. Korpel, voltage-controlled low-pass filter, 1119
- and C. R. Wilhelm, video transmission test set, 4159
- Shabanskii, V. P., non-equilibrium processes in impurity semiconductors, 2282
- Shafer, R. E., with others, dual-cavity microwave discriminator, 1487
- Shafer, Yu. G., with others, investigation of cosmic radiation, 3663
- Shafronov, V. D., propagation of e.m. field in medium with spatial dispersion, 1166
- Shain, C. A., radio emission from Centaurus-A and Fornax-A, 2222
- with M. M. Komesaroff, refraction of extra-terrestrial radio waves, 2973
- Shakeshaft, J. R., and J. E. Baldwin, radio emission from 'supergalaxy', 3660
- with others, spatial distribution of radio sources at 159 Mc/s, 103
- Shal'nikov, G. I., electron-beam high-voltage voltmeter, 560
- Shaltiel, D., with W. Low, electron paramagnetic resonance in  $BaTiO_3$ , 477; paramagnetic-resonance spectrum of Gd in  $ThO_2$ , 909
- Shand, J. A., with others, causes of geomagnetic fluctuations with 6-sec period, 2945; geographical variations in geomagnetic micropulsations, 2946
- Shanks, H. E., and R. W. Bickmore, four-dimensional e.m. radiators, 2840
- Shannon, C. E., channels with side information at transmitter, 592; probability of error for optimal codes in Gaussian channel, 2745
- Shapiro, B. S., with others, electron concentration of ionosphere from observations of first earth satellite, 3298
- Shapiro, H. S., and D. L. Slotnick, mathematical theory of error-correcting codes, 1683
- Shapiro, S., with others, cross-relaxation in spin systems, 3270
- Shapley, A. H., coordination of I.G.Y. observations, 1539
- Sharek, C. W., with I. C. Miller, designing ultrasonic delay lines, 28
- Sharma, K. P., excitation of radiation by surface waves, 2097; reactance of loss-free surface, 3557
- with J. Brown, launching of radial cylindrical surface waves by circumferential slot, 2110
- Sharp, C. E., with G. Goubau, model surface-wave transmission line, 10
- Sharpe, J., with R. Mather, tuning cavities for reflex klystrons, 3525
- Sharpe, J. S., photomultipliers for scintillation counting, 3446
- Sharpe, R. G., and D. R. Gamlen, radio communications in Ghana, 961
- Sharpless, W. M., GaAs point-contact rectifiers, 1710
- with C. B. De Loach, X-band parametric amplifier, 4006
- Shaw, A. W., A. E. Siegman and D. A. Watkins, reduction of electron-beam noise, 1728
- Shaw, H. J., with others, current distribution in modulated electron beams, 644; high-power pulsed klystrons, 1410; high-power windows at microwave frequencies, 3159 c
- Shaw, R. F., amplifiers for digital data systems, 27
- Shcheglov, P. V., with I. S. Shklovskii, optical observations of earth satellites, 3288
- Shchekin, V., solar battery, 603
- Shchelovanov, L. N., transients in phase-correcting systems for p.c.i.n., 599
- Shea, R. F., Transistor Circuit Engineering, 757
- Shearman, E. D. R., with W. C. Bain, observations on U.S.S.R. earth satellites, 2952
- Sheehan, W. E., and W. H. Ryer, circuits for transistor receivers, 1349
- Shekhtman, I., with E. Larish, production of two temperatures in ionized gas, 2536
- Shekun, L. Ya., with others, magnetic double refraction of microwaves, 776
- Shelton, J. P., with K. S. Keller, limitations of satellite antennas using spherical arrays, 1091
- Shepherd, F. M., ABN television transmitter, 3129
- Shepherdson, M., and R. Walters, stroboscopic method for frequency response measurements, 2079
- Sheridan, K. V., radio sources in Centaurus, Fornax and Puppis, 422
- G. H. Trent and J. P. Wild, extension of solar radio spectroscopy, 2933
- Sherman, A., with R. R. Palmisano, waveguide coils make compact delay lines, 339
- Sherman, C., measurement of average value of magnetic field, 3824
- Sherry, M., with C. P. Allen, measurement of magnetic flux density, 3056
- with J. C. Dix, microwave reflectometer display system, 1308, (D)2703
- Sherry, N. P. R., trochotron, 1724
- Shersby-Harvie, R. B. R., generating high-frequency waves using Doppler effect, 3159 l
- Sherwood, R. C., J. P. Remeska and H. J. Williams, domain behaviour in transparent magnetic oxides, 1956
- Shestopalov, V. P., and B. V. Kondratiev, space resonance in helix waveguide, 2464
- with B. M. Bulgakov, propagation in retarding systems with helix and dielectric, 3889
- Sheval, W. L., Jr, rotational switching in ferrites, 1634
- Shibata, H., world-wide distribution of  $f_oF_2$ , 129; 'minimum loss operation time' for s.w. communication, 258, 1359
- with others, reception of radio waves from Russian earth satellite I, 120; life tests of microphone carbon, 1758

- Shibata, T., *A. Toi and T. Saita*, e.s.-transformer-type particle accelerator, 3071
- Shibata, Y., *with others*, measurements of field patterns for comb-type slow-wave structure, 3524 n
- Shibuya, Y., *with others*, circuits for space probes, 3286
- Shields, J., breakdown in Si *p-n* junctions, 2652
- Shimazaki, T., dynamical structure of ionosphere, 2966
- Shimizu, J. K., and E. M. T. Jones, coupled-transmission-line directional couplers, 3556  
— *with E. M. T. Jones*, wide-band strip-line balun, 3931
- Shimmins, A. J., radio telemetry, 3084
- Shimoda, K., beam-type maser, 389
- Shinn, D. H., aerial requirements for ionospheric scatter communication, 2000 g; health hazards from radio transmissions, 2074
- Shipley, D. G., *with others*, 468-Mc/s tropospheric scatter propagation, 245
- Shipley, W. S., *with others*, instrumenting Explorer I satellite, 1547
- Shipman, J. S., *with others*, multiple Fourier analysis in rectifier problems, 2382
- Shiren, N. S., and E. B. Tucker, spin-phonon interaction in ruby, 2317  
— *with others*, effects of 9.2-kMc/s ultrasonics on resonances in quartz, 3816
- Shirk, W. H., Jr, *with others*, precision, guarded resistance measuring facility, 361
- Shiro, I., *with others*, temperature fluctuations accompanying solar eclipse, 2559
- Shirobokov, M. Ya., *with L. P. Kholodenko*, ferroelectric properties of polarized BaTiO<sub>3</sub> ceramics, 479
- Shkarofsky, I. P., H. E. J. Neugebauer and M. P. Bachynski, effect of mountains with smooth crests on wave propagation, 3458
- Shklovskii, I. S., and P. V. Sheglov, optical observations of earth satellites, 3288  
— *with others*, radio-astronomy investigation by earth satellites, 3292; discovery of 10-keV electrons in upper atmosphere, 3294
- Shmatov, V. T., *with G. V. Skrotskii*, thermodynamic theory of resonance and relaxation phenomena in ferromagnetics, 538
- Shmelev, I. I., *with A. N. Barkhatov*, attenuation of sound beam traversing layer of discontinuity, 669
- Shnurfer, F., aperture-coupled filters, 1112
- Shockley, W., and J. Gibbons, current build-up in semiconductor devices, 889; transient build-up in avalanche transistors, 2416  
— *with others*, avalanche-transistor pulse circuits, 2878
- Shodin, L. F., *with others*, tracking earth satellites, 123
- Shoemaker, R. F., *with others*, voltage-sensitive switch, 39
- Sholokhova, E. D., *with others*, nonferroelectric phase transitions in solid solutions, 1912
- Short, G. W., transistorized absorption wavemeter, 1979
- Shorter, D. E. L., high-quality monitoring loudspeakers, 333
- Shotov, A. P., *with B. M. Vul*, edge breakdown of *p-n* junction in Ge, 1616
- Shou-syan' Fan, *with A. A. Kolomenskii*, cyclic motion of charged particles in electric field, 3835
- Shpigel', I. S., *with M. D. Ralzer*, microwave investigation of plasma, 3262
- Shteinshleifer, Z., *with others*, absorption of compressional waves in solids, 3536
- Shtepa, N. I., graphical-analytical plotting of particle trajectories, 1832, 3630
- Shtrom, E. L., *with others*, new semiconducting compounds, 3755
- Shul'man, A. R., *and others*, secondary emission from Ni, 3789
- Shulman, R. G., Co<sup>59</sup> nuclear magnetic resonance in paramagnetic salts, 3409
- Shul'man, S. G., *with Yu. I. Ukhonov*, influence of intense electric field on Ge-diode transparency, 1931
- Shuppe, G. N., *with others*, e.s. electron emission of semiconductors, 1922
- Shutlov, V. A., *with I. G. Mikhailov*, diffraction of light by ultrasonic waves, 678
- Shvidkovskii, E. G., *with others*, pressure and density measurements in high atmosphere by earth satellites, 3694
- Sidel, T., *with R. Huzimura*, effects of impurities and temperature on electroluminescence spectra, 152
- Sideris, G., production machinery for electronics industry, 1037; insulation for electronic equipment, 1296; magnet-wire insulation, 1635; powdered magnets, 1961
- Sidorov, A. I., *with others*, distribution of non-equilibrium charge carriers in base region of *p-n* junction, 1919; lifetime of non-equilibrium charge carriers in Ge, 1929
- Sidorowicz, R. S., circuits employing cold-cathode tubes, 374; voltage-controlled swept-frequency RC oscillator, 1125
- Siegel, K. M., *with others*, U.R.S.I. report on antennas and waveguides, 3565; radar cross-section of finite cones, 4073
- Siegman, A. E., phase-distortionless limiting by parametric method, 1819  
— *and R. J. Morris*, 'staircase' maser, 2522  
— *and others*, travelling-wave solid-state masers, 2891  
— *with others*, reduction of electron-beam noise, 1728
- Siekonowicz, W. W., and F. E. Vaccaro, periodic e.s. focusing of electron beams, 2061
- Sihvonen, Y. T., *with D. R. Boyd*, growing CdS single crystals, 1905  
— *D. R. Boyd and C. D. Woelke*, properties of green and red-green luminescing CdS, 2621
- Silberstein, R., pulse-propagation experiment on 20-1 Mc/s, 240
- Silkin, B. Ia., *with V. V. Belousov*, international scientific collaboration, 3674
- Silver, P., *with others*, radar echoes from Venus, 2556
- Silverman, R. A., scattering of plane waves by dielectric noise, 415; fading of scattered radio waves, 3450
- Silverman, S. J., and J. B. Singleton, preserving lifetime in diffused Si, 2288
- Silverstein, A. N., quartz crystal testing, 1642
- Silvester, D. D., measuring techniques for backward-wave oscillators, 3524 p
- Sim, A. C., surface recombination velocity and photoconductive decays, 498
- Simhi, M., and M. Birk, sensitive single-channel pulse-height analyser, 59
- Simmons, B. D., saturable-transformer switches, 1471
- Simmons, C. D., *with C. G. Thornton*, high-current mode of transistor operation, 1004
- Simmons, R. O., lattice parameter changes in deuteron-irradiated Ge, 2307
- Simon, G., damping of h.f. elastic waves in ferromagnetic crystals, 1278
- Simon, J. C., G. Broussaud and E. Spitz, super-directivity of aerial, 3572
- Simon, J. M., network analysis of transducers, 352
- Simon, P., geomagnetic activity and eruptions, 113
- Simon, R., *with F. Pradal*, energy spectrum of secondary electrons, 1838
- Simon, Y., and J. Bok, photoconductivity of ZnTe, 3726
- Simonyi, K., accelerator with 800-kV cascade generator, 1657
- Simpson, A. W., *with others*, anomalous polarization in ferroelectrics, 1911
- Simpson, O., optical characteristics of semiconductors, 3011
- Sims, C. C., underwater sound transducers, 2445
- Sinanli, S. S., *with others*, thermoelectric properties of Bi<sub>2</sub>Te<sub>3</sub>-Bi<sub>2</sub>Se<sub>3</sub>, 3758
- Sinel'nikov, M. S., electron emission from Mo after electron bombardment, 3258
- Singer, D. F., *with R. F. Rutz*, properties of experimental 1-kMc/s transistors, 3510
- Singer, J. R., *with K. Chu*, thin-film magnetization analysis, 3394  
— *and S. D. Johnson*, transistorized nuclear-resonance magnetic-field probe, 1810  
— *with S. D. Johnson*, current regulator using transistors, 979  
— *with others*, radiation damping effects in 2-level maser, 1818
- Singer, S. F., cause of minimum in earth's radiation belt, 4038
- Singh, A., and R. A. Rao, ferrite-tuned magnetron, 3163
- Singh, C., noise spectra of probe in hot-cathode discharge, 4019
- Singh, S., *with others*, hourly median field strength of 1940-Mc/s signal, 255
- Singleton, J. B., *with S. J. Silverman*, preserving lifetime in diffused Si, 2288
- Sinno, K., hit rates of radio propagation disturbance warnings, 116; solar flare as source of geomagnetic storm, 433; characteristics of solar outbursts, 2558
- Sirs, J. A., correcting for response time delays of measuring equipment, 551; galvanometer feedback systems, 2707
- Sirvetz, M. H., *with S. L. Blum*, magnetic resonance studies in reaction of Ni-Co ferrite, 3042  
— *with others*, high-power L-band resonance isolator, 3563
- Siukola, M. S., travelling-wave television transmitting antenna, 1094
- Sivaraman, K. R., *with K. S. Raja Rao*, lunar geomagnetic tides at Kodaikanal, 1534
- Sivertsen, E., *with others*, segmentation techniques in speech synthesis, 1059
- Skanavi, G. I., *and others*, relaxation polarization and losses in nonferroelectric dielectrics, 480  
— *with A. N. Gubkin*, stability of inorganic polycrystalline dielectrics, 1603
- Skillman, T. L., and P. L. Bender, measurement of earth's magnetic field, 112
- Skinner, N. J., J. Hope and R. W. Wright, horizontal drift measurements near equator, 1557  
— *with R. W. Wright*, lunar tides in E<sub>z</sub> layer, 1880
- Sklar, B., reducing distortion in class-B amplifiers, 2883
- Skomal, E. N., and M. A. Medina, medium-power microwave limiter, 2468
- Skrotskii, G. V., and Yu. I. Alimov, ferromagnetic resonance in circularly polarized e.m. field, 3646  
— *and A. A. Kokin*, system of magnetic moments in weak variable magnetic field, 3644  
— *and L. V. Kurbatov*, anisotropy of width of ferromagnetic resonance absorption lines, 2210  
— *and V. T. Shmatov*, thermodynamic theory of resonance and relaxation phenomena in ferromagnetics, 538
- Skuridin, G. A., and L. V. Kurnosova, scientific investigations by earth satellite, 440
- Skwirzynski, J. K., and J. C. Thackray, transmission of e.m. waves through wire gratings, 3963
- Sladek, R. J., magnetically induced impurity banding in n-InSb, 1263
- Slanavi, G. I., *with A. N. Gubkin*, stability of inorganic polycrystalline dielectrics, 1603
- Slee, O. B., *with others*, radio sources between declinations +10° and -20°, 423; pencil-beam survey of galactic plane at 3.5 n, 2220
- Sletten, C. J., G. R. Forbes, Jr, and L. F. Shodin, tracking earth satellites, 123
- Sliedregt, M. van, waveguide filter theory, 53
- Slinkman, R. W., tube developments for guided-missile applications, 310
- Sliter, J. A., *with others*, multipurpose bias device of logical elements, 1461
- Sloan, D. J., *with R. W. Berry*, Ta printed capacitors, 2867
- Slotnick, D. L., *with H. S. Shapiro*, mathematical theory of error-correcting codes, 1683
- Slykhouse, T. E., and H. G. Driehamer, effect of pressure on absorption edge of Ge and Si, 1243
- Smakula, A., and J. Kabnaja, O<sub>2</sub> impurity in Si single crystals, 511
- Smale, J. A., field-strength recordings and performance of v.s.w. radio links, 2014 f
- Šmejkal, J., and L. Mollwo, measurement of u.h.f. quadrupole, 1968
- Smetana, C., first- and second-order gradient receivers, 1757; gradient receiver for intercommunication, 2094
- Smilga, V. P., and B. V. Deryagin, role of surface properties of semiconductors in adhesion, 495
- Smirnov, B. G., *with others*, e.s. electron emission of semiconductors, 1922
- Smirnov, I. A., *with E. D. Devyatkova*, thermoconductivity of Ge, 1620
- Smirnov, L. S., measurement of short lifetimes of charge carriers in Ge, 1930
- Smith, A., and D. Dutton, behaviour of PbS photocells in ultraviolet, 1407
- Smith, A. G., T. D. Carr and W. H. Perkins, night-time reception of major solar burst, 2554
- Smith, A. W., impedance, rectification and electro-luminescence of anodic oxide film on Al, 4141
- Smith, C. P., A. M. Morrell and R. C. Demmy, 21-in glass colour picture tube, 280
- Smith, D. L. A., incremental frequency control of RC oscillators, 1126
- Smith, D. O., thin magnetic films for digital computer memories, 3212
- Smith, E. K., *with J. A. Thomas*, survey of knowledge of E<sub>o</sub>, 1879  
— *with others*, sporadic E at v.h.f. in U.S.A., 2587; I.G.Y. observations of F-layer scatter in Far East, 2733
- Smith, F., *with others*, synchronous and exalted-carrier detection, 1378
- Smith, J. E., *with D. J. Collins*, regulated power supplies, 2401
- Smith, M. S., *with R. Parker*, dispersion phenomena in inhomogeneous dielectrics, 837
- Smith, N. W. W., response of nonlinear devices to band-limited h.f. signals and noise, 1674; noise in backward-wave oscillators, 3159 e
- Smith, P., and D. O. Sproule, experiments on the acousto-electric effect, 4009
- Smith, P. G., *with others*, radio observations of hypersonic shock waves, 1658
- Smith, R. W., properties of deep traps, 1901  
— *and F. J. Hyde*, transistor current gain, 3426
- Smith, S. T., *with others*, beam noise in crossed electric and magnetic fields, 313
- Smith, W. B., *with others*, reciprocity of ionospheric transmission, 1667; radar echoes from Venus, 2556
- Smith, W. V., J. Overmeyer and B. A. Calhoun, microwave resonance in Gd-Fe garnet crystals, 3043  
— *with others*, multiple quantum transitions in paramagnetic resonance, 1856
- Smith-Rose, R. L., electron-density profiles in ionosphere, 438; international radio organizations, 1036; position finding by radio, 2978 a
- Smits, F. M., *with R. L. Balford*, diffusion of impurities into evaporating Si, 1925
- Smolenskii, G. A., A. I. Agranovskaya and S. N. Popov, effect of polarization on Pb<sub>2</sub>NiNb<sub>2</sub>O<sub>6</sub>-Pb<sub>2</sub>MgNb<sub>2</sub>O<sub>6</sub>, 2631  
— *V. A. Isupov and A. I. Agranovskaya*, new ferroelectric, 2632  
— *and others*, nonferroelectric phase transitions in solid solutions, 1912
- Smyth, H. R., *with others*, distress beacon for crash position indicator, 1891
- Snitko, O. V., influence of adsorption on photoconductivity of Cu<sub>2</sub>O, 3733
- Snow, W. B., impedance—matched or optimum, 37
- Snyder, C. W., upper boundary of Van Allen radiation belts, 4039
- Snyder, D. D., and C. E. Bleil, mechanism for carrier excitation in CdS, 3004
- Snyder, R. H., video time-delay systems, 3867
- Sobey, A. E., Jr, *with C. W. Horton*, near fields of acoustic sources, 3537
- Soble, A. B., thermistor compensation of resistance and conductance, 721; thermistors for linear temperature readings, 2489
- Sodha, M. S., and D. B. Agrawal, low-field mobility of carriers in nondegenerate semiconductors, 164  
— *and P. C. Eastman*, Hall mobility in nondegenerate semiconductors, 856; mobility of electrons in nondegenerate semiconductors, 1225; drift and Hall mobility of electrons, 3340  
— *and Y. P. Varshni*, fully ionized gas, transport phenomena in, 402, electron mobility in, 3643; nondegenerate semiconductors, transport phenomena in, 3753, transport properties of, 3754
- Solomon, A. H., and F. Stierer, *mus* microwave ferrite modulator, 1107
- Solomon, B. D., and C. S. Broneer, constant-S equalizers, 3226
- Solomon, I., relaxation in magnetic resonance, 2542
- Solt, I. H., Jr, *with others*, magnetostatic modes of ferrimagnetic spheres, 3813
- Solymar, L., stepped transmission-line transformers, 3594  
— *with P. Foldes*, lens-aerial design, 1100
- Somayajulu, Y. V., and N. N. Rao, galactic radiation at 30 Mc/s, 3699 i
- Somerville, M. J., *with E. M. Dunstan*, i.f. noise reduction in feedback integrators, 369
- Sommers, H. S., Jr, tunnel diodes as h.f. devices, 3505
- Sonder, E., properties of reactor-irradiated Si, 4100
- Sondheimer, E. H., *with J. E. Hebborn*, diamagnetism of conduction electrons in metals, 2194
- Sonett, C. P., *with others*, ionizing radiation at 3 500-36 000 km, 3691



- Sonkin, S., with others, high-power windows at microwave frequencies, 3159 c
- Sonnenfeldt, R. W., with T. Murakami, detection of asymmetric-sideband signals in presence of noise, 248
- Sorensen, H. O., with others, magnetostrictive delay line for video signals, 1134
- Sorenson, J., with others, earth's gravitational potential from satellite orbit, 1867
- Sorokin, O. V., with G. E. Pikus, measuring magnetic field intensity, 1972
- with others, determination of surface recombination velocity, 500
- Sorokin, P. P., I. L. Gelles and W. V. Smith, multiple quantum transitions in paramagnetic resonance, 1856
- Sosin, B. M., with V. O. Stokes, wide-band amplification at h.f., 3234
- Sotnikov, S., frame aerials for television reception, 3200
- Soule, D. E., magnetic-field dependence of Hall effect and magnetoresistance in graphite, 1239; analysis of galvanomagnetic oscillations in graphite, 1240
- Sowton, C. W., and G. A. C. R. Britton, radio interference, 954
- Spaepen, J. B. M., with others, diffusion capacitance in transistors, 3148
- Sparkes, J. J., measurement of transistor equivalent-circuit parameters, 1646
- Spear, W. E., surface effects in electron-irradiated Ge, 873
- Spears, R. A., thermally compensated crystal oscillators, 370
- Spector, J. O., with T. Tamir, swept-frequency klystron operation, 3524 h
- Speight, C. S., Miller sweep circuit, 743
- Spellmire, R. J., with L. L. Bailin, radiation fields from slots in circular cylinders, 1093
- Spence, R. D., and R. D. Ewing, antiferromagnetism in  $\text{Cu}_2(\text{CO}_3)_2(\text{OH})_2$ , 1947
- Spencer, D. G., with P. Moon, solution of integral equations, 209
- Spencer, E. G., and R. C. LeCraw, magnetoacoustic resonance in Y-Fe garnet, 201
- R. C. LeCraw and A. M. Cleegston, low-temperature line-width maximum in Y-Fe garnet, 3812
- with others, microwave semiconductor switching techniques, 3597
- Spencer, H. E., spectral response of PbS thin films, 2994; photoconductance and time constant in PbS films, 3323
- Spenske, E., induction behaviour of p-n rectifiers, 2036
- Spetner, L. M., model for forward scattering off rough surface, 1518
- Speyer, N. B., with others, diffusion capacitance in transistors, 3148
- Spicer, W. E., studies of alkali-antimony compounds, 825; influence of defect levels on photoemission, 1206
- Spiegel, E. F., applications of industrial television, 1395
- Spiehl, W., and W. J. Trittipoe, threshold elevation produced by noises, 682; noise exposure and temporary threshold shifts, 1053
- Spinrad, R., core-saturation blocking oscillator control, 3989
- Spirin, G. S., with others, e.s. electron emission of semiconductors, 1922
- Spitz, E., with others, superdirectivity of aerial, 3572
- Spitzer, C. F., lunistors, 3884
- Spitzer, W. G., and J. M. Whelan, infrared absorption and effective mass in n-type GaAs, 3383
- D. A. Kleinman and C. J. Frosch, infrared properties of SiC film, 2298
- D. Kleinman and D. Walsh, infrared properties of SiC, 2297
- Spivak, G. V., F. Igras and I. S. Zhelevdey, domain structure of ferroelectrics, 158
- Spooner, D. J., checking crystal oscillators, 372
- Spracklen, J. G., W. Stroh and G. C. Wood, noise-gated a.g.c. and sync system, 1382
- Sprenger, K., ionospheric drift measurements in long-wave range, 1198
- with E. Lauter, detecting solar flare effects in ionosphere, 1181
- Springer, A. M., regulator of speed and pitch for recordings, 2825
- Springer, H., with others, detail recognition on television screen, 3135
- Sproule, D. O., with P. Smith, experiments on the acousto-electric effect, 4009
- Sprung, H. B., with M. von Ardenne, ingestible intestinal transmitter, 1327, 3834
- Squires, R. K., with others, Vanguard measurements of earth's figure, 2236
- Srikantaswamy, M. N., and K. K. Nair, matrix analysis of valve circuits, 2497
- Srivastava, G. P., with S. Swarup, directivity pattern of 3-cm parabolic reflector, 2474
- Srivastava, R. S., with B. A. P. Tantry, polarization of atmosphere by successive reflections, 143; waveforms of atmospherics, 459, with superimposed pulses, 815
- Ståblein, H. G., with others, theory of multiple lines, 2458
- Stacey, F. D., fluctuating-field ferromagnet at low temperatures, 536; thermal activation of ferromagnetic domains, 1275
- Stadler, H. L., ferroelectric switching time of  $\text{BaTiO}_3$  crystals, 478
- Stafeev, V. I., current multiplication in nonideal p-n junction, 1626
- Staffin, T., with L. Huld, infrared absorption of photogenerated carriers in Ge, 176; valence-band structure of Si, 508
- Stagg, J. M., and B. Hultqvist, auroral isochasms, (D)4062
- Stahl, F. A., and G. Dermitt, Ge photo-tetrode, 308
- Stampfl, R., with others, current amplification of junction transistor, 631; tracking weather with satellites, 2715
- Stankowski, J., with Z. Pajak, polarization changes during aging of  $\text{BaTiO}_3$ -type ferroelectrics, 844
- Staras, H., antenna-to-medium coupling loss, 235
- and A. D. Wheelon, theoretical research on tropospheric scatter propagation, 3846
- Stark, J. W., with others, tropospheric wave propagation measurements by B.B.C., 2000 m
- Stark, R., coupling between vibrations of AT-cut crystal plates, 3975
- Starke, B. J., and others, atmospheric discontinuity layer effects on propagation, 2000 o
- Stata, R., microwave power detectors, 3830
- Statz, H., with G. F. Koster, Zeeman splittings of paramagnetic ions, 2549
- Stauss, H. E., form effect in magnetostriction, 2930
- Stavik, O., alloyed Ge transistor has symmetrical characteristics, 2419
- Stavitskaya, T. S., with others, thermoelectric properties of PbTe, 1941
- Stearman, G. H., use of dekatrons for pulse distribution, 1130
- Stecker, A., microphony in electron tubes, 1013
- Steele, M. C., electrical breakdown in n-InP, 4116
- and F. D. Rost, thermal conductivity and thermoelectric power of Ge-Si alloys, 528
- L. Pensak and R. D. Gold, pulse amplification using impact ionization in Ge, 2882
- with M. Glucksmann, plasma pinch effects in InSb, 3388
- with others, single phonon emission in breakdown of semiconductors, 3013
- Stein, F., N. G. Einspruch and R. Truell, temperature dependence of fractional volume changes in Si, 3355
- Steinberg, J. L., with M. Pick-Gutmann, 16-aerial array at 9300 Mc/s, 3659
- Steinboch, K., automatic character recognition, 1991; automatic speech recognition, 3913
- Steinemann, A., and H. Gränicher, dielectric properties of ice crystals, 1600
- Steiner, F., and H. Stittgen, reduction of bearing errors in long-base-line systems, 3720
- Steinert, L. A., geometrical anisotropy of magnetic materials in waveguides, 3809
- Stepanov, K. N., kinetic theory of magnetohydrodynamic waves, 767; damping of e.m. waves in plasma, 2201; low-frequency oscillations of plasma, 3639
- Stephen, J. H., with R. C. M. Barnes, operating experience with transistor digital computer, 2132
- Stephen, M. J., and A. B. Lidiari, Faraday effect in semiconductors, 4088
- Stephenson, I. M., with A. L. Cullen, experimental investigation of velocity-modulated electron beams, 3524 g
- Stephenson, L. M., and H. E. M. Barlow, power measurement at 4 Gc/s by Hall effect, 1312
- Stephenson, M., with M. Mark, air-cooled chassis for electronic equipment, 353
- Stephenson, W. L., transistor d.c. converter circuit, 1698
- Stern, E., and R. S. Mangiaracina, ferrite high-power effects in waveguides, 3937
- Stern, F., and J. R. Dixon, narrowing energy gap in semiconductors by compensation, 1917
- Sternberger, R. L., J. S. Shipman and S. R. Zohn, multiple Fourier analysis in rectifier problems, 2382
- Sterne, T. E., motion of satellite around unsymmetrical central body, 1866
- with G. F. Schilling, densities and temperatures of upper atmosphere from satellite observations, 1871
- Sterrett, J. E., and H. Heffner, periodic magnetic focusing structures, 1021
- Sterzer, F., pulse amplifier with sub- $\mu\text{s}$  rise time, 1135; random-number generator, 2476; parametric oscillators for digital computing, 3590
- with D. J. Blattner, backward-wave oscillator tubes for 29-74-kMc/s range, 1740; voltage-tunable mm-wave oscillators, 3529
- with A. H. Solomon,  $\mu\text{s}$  microwave ferrite modulator, 1107
- Stevens, E. E., with others, frequency prediction techniques for high latitudes, 2729
- Stevens, E. J., with A. C. Hudson, data on ferrite core materials, 897
- with T. D. Northwood, acoustical design of Alberta Jubilee Auditoria, 688
- Stevens, K. W. H., wave-mechanical damped harmonic oscillator, 739; microwave physics, 1171
- Stevenson, A., with S. Prussin, infrared strain-optic coefficient of Si, 2295
- Stevenson, M. H., ATN television centre, 3130
- Stevenson, M. J., with D. C. Mattis, theory of negative-mass cyclotron resonance, 3760
- Stewart, J. L., and E. C. Westerfield, active sonar detection, 2596
- Stickler, D. C., e.m. diffraction by dielectric strips, 1516
- Stiegler, J. O., with T. S. Noggle, electron-microscope studies on etching of irradiated Ge, 4089 g
- Stieler, W., X-band spectrometer for demonstration of paramagnetic resonance, 1854
- Stigmark, L., with L. Minnhagen, excitation of ionic spectra by 100-kV h.f. pulses, 376
- Stilbans, L. S., with others, temperature dependence of work function of semiconductors, 494; thermo-electric properties of PbTe, 1941
- Stille, V., with H. H. Brämer, electron recombination in afterglowing active nitrogen, 1510
- Stinson, D. C., ferrite line width measurements in cross-guide coupler, 3810
- with others, oriented ferrites with cubic anisotropy, 3399
- Stinton, H., monostable circuit using transistor, 1128
- Stittgen, H., with F. Steiner, reduction of bearing errors in long-base-line system, 3720
- Stockford, M. T., with B. H. L. James, microwave frequency standard, 1300
- Stöckmann, F., and others, photoconduction of Ge after bombardment, 3027
- Stoddart, H. F., nucleonics instrumentation—scalers, 3446
- Stoekert, A. J., with others, moulded Ni cathode, 2069
- Stoffregen, W., i.f. radio reflections during intense aurora, 812
- Stokes, V. O., and B. M. Sosin, wide-band amplification at h.f., 3234
- Stolz, H., depolarization in small conducting bodies, 3631
- and H. W. Streitwolf, secondary electron emission of metals, 3257
- Stone, G. M. C., I.G.Y. progress report, 114
- with C. E. Newton, I.G.Y. v.h.f. programme, 115
- Stone, H. A. Jr, field-effect tetrodes, 3152
- with others, semiconductor current limiter, 1368
- Stone, M. L., with others, u.h.f. signals reflected from moon, 1525
- Stone, R. E., microwave multiplexing circuits, 2465
- Storey, L. R. O., and J. K. Grierson, time-symmetric filters, 365
- with C. O. Hines, time constants in geomagnetic storm effect, 1535
- Stow, R. L., Ti as getter, 4074
- Stoyko, A., apparent velocity of s.w., 1333 k
- and N. Stoyko, random variation in speed of rotation of earth, 1301
- Stoyko, N., with A. Stoyko, random variation in speed of rotation of earth, 1301
- Stracca, G. B., i.f. circuits with 3 coupled resonators, 1803
- Strachan, C., and A. M. Murray, spin-orbit coupling and extraordinary Hall effect, 1952
- Strack, W., systems engineering of personal radio signalling systems, 3478
- Strafford, F. R. W., second band-III program, 1775; band-III aerial problem, 2122
- Straiton, A. W., with C. W. Tolbert, absorption of mm waves over extended ranges, 246
- with others, phantom radar targets at mm  $\lambda$ , 3315
- Stram, O. B., with T. C. Chen, digital memory system, 2129
- Strandberg, M. W. P., with M. Peter, efficiency of frequency measurements with atomic clock, 1311
- with others, electron spin-lattice relaxation times, 417; maser amplifier with large bandwidth, 1144
- Stratton, A., combination of inertial navigation and radio aids, 2259 g
- Stratton, R., hot-electron effect in n-type Ge, 175
- Straub, A., with D. Eber, design of Südwestfunk studio building, 3182
- Straube, G. F., voltage-variable capacitor, 46
- Straubel, H., with H. Oswald, photoelectric amplifier, 1405
- Strauss, A. J., distribution coefficients and carrier mobilities in InSb, 3386
- with H. H. Harada, preparation of InAs, 1624
- Streitwolf, H. W., with H. Stolz, secondary electron emission of metals, 3257
- Strickland, P. R., transistor thermal equivalent circuit, 1720
- Strikha, V. I., with others, lifetime of injected current carriers in Sb-doped Ge, 1932
- Strocchi, G., radio-link equipment for 60-120 channels, 2013
- Stroh, W., with others, noise-gated a.g.c. and sync system, 1382
- Strong, C. E., aspects of short-range rho-theta systems, 2259 h
- Strotzer, G., electrical absorption of gases, 2986
- Strull, G., with H. W. Henkels, very-high-power transistors, 1001
- Struthers, J. D., with G. Bemski, Au in Si, 2290
- Strutt, M. J. O., Hall effect in semiconductor compounds, 855
- with A. H. Frei, analogue-computer measurements on diodes and transistors, 3508
- with B. Schneider, shot noise in Si p-n junction diodes and transistors, 2413
- Stuart, A., with M. G. Kendall, The Advanced Theory of Statistics, Vol. 1, (B)1639
- Stuart, G. A., and B. Meltzer, effect of anode aperture on dense beam, 3524 v
- Stuart, G. W., satellite-measured radiations, 2958
- Stuart, P. R., with others, c.r. tube for monochrome and colour television, 619
- Stuart, R. D., transient response of d.c. amplifier systems, 3994
- Stubbe, L., and B. Gossick, Dember-potential measurements in Ge, 3359
- Stuetzer, O. M., ion-drag pressure generation, 3637
- Stuijts, A. L., and H. P. J. Wijn, crystal-oriented ferroplana, 2687
- Stumpers, F. L. H. M., spectrum of limited Gaussian noise, 1681
- Stupp, E., with H. Honig, electron spin-lattice relaxation in P-doped Si, 512
- Sturge, M. D., theory of diffusion of Cu in Ge, 1611; diffusion of B in Ge, 1612; resistance of superconducting Sn and In, 2314
- Sturrock, P. A., kinematics of growing waves, 1849; variation principle for disturbances of electron beams, 3159 g; production and focusing of sheet beams, 3524 ll
- Sucher, M., and others, calorimeters for measurement of microwave power, 2358
- Suchkov, B. A., sound amplitude fluctuations in turbulent medium, 667
- Suchy, K., and P. Vila, magnetic field in  $F_2$  layer at Dakar, 133
- with K. Rawer, 'fourth reflection condition' of e.m. waves in plasma, 1164; equivalent theorems of wave absorption in plasma, 1669; dispersion formula of Lorentz plasma, 3641

- Sucksmith, W., with others, ferromagnetic alloys, properties of, 1631, magnetization of, 3392
- Sugai, I., numerical solution of Laplace's equation, 3050
- Suhl, H., and B. T. Matthias, impurity scattering in superconductors, 3633
- Suhrmann, R., contrast filters for television sets, 2765
- G. Wedler and E. A. Dierk, temperature dependence of electron emission of Bi films, 2619
- Suita, T., with others, e.s.-transformer-type particle accelerator, 3071
- Sulanke, H., with others, equalization in television transmission by cable, 3488
- Sumi, M., excitation of oscillations in plasma layer, 1513; theory of excited plasma waves, 2534
- Sumner, F. H., with others, automatic recognition of patterns, 2372
- Suozi, J. J., with L. A. Finzi, feedback in magnetic amplifiers, 2172, 3998
- Surplice, N. A., reversible poisoning of oxide-coated cathodes, 4249
- Süsskind, C., with others, design of transition region of beam valves, 1017
- Sutcliffe, H., digital voltmeter, 2355
- and D. J. Mathews, transistor junction temperature, 1974
- Sutherland, J. W., microwave links for radar networks, 976; waveguide switches and branching networks, 1080
- Suwerkrop, B., with others, capabilities of coaxial cable, 2457
- Suzuki, H., with H. Tubota, Se photocells with artificial intermediate layers, 3158
- Suzuki, M., with T. Hayasaka, errors of electro-acoustic standards, 3186
- Svechnikov, S. V., photoconductive properties of CdSe, 469; parameters of AgS barrier-layer photocells, 638; conductivity of CdSe under X-ray excitation, 1906
- and V. T. Aleksandrov, photoelectric properties of CdSe and SdTe, 468
- Svetitskii, E. M., with others, discovery of 10-keV electrons in upper atmosphere, 3294
- Svirskii, M. S., with S. V. Vonsovskii, absence of superconductivity in ferromagnetics, 195
- Swanekamp, F. W., with others, line width in Y-F garnet, 2330
- Swarup, G., and R. Parthasarathy, solar brightness distribution at 60 cm, 430
- Swarup, S., and G. P. Srivastava, directivity pattern of 3-cm parabolic reflector, 2474
- Sweeney, H. E., compatible stereo radio, 3105
- Sweet, L. O., with others, calorimeters for measurement of microwave power, 2358
- Swenson, G. W., Jr, with others, radio reflections from satellite-produced ion columns, 121
- Swift, A. F. J., quartz delay lines for radar systems, 2511
- Swift, J., wide-band thermistor mounts, 564
- Swift, J. W., application of analogue calculation to flight simulators, 1466
- Swift-Hook, D. T., dispersion curves for helix, 3159 w
- Sydnor, R. L., with T. R. O'Meara, balun transformer for v.h.f. and u.h.f., 338
- Sykes, M. F., with M. E. Fisher, Ising model of ferromagnetism, 3263
- Sylvan, T. P., bistable circuits using unijunction transistors, 744; transistor d.c.-a.c. beta tester, 1647; 2-terminal solid-state switches, 2040; solid-state thyristors, 2046
- Symmons, H. F., with G. S. Bogle, paramagnetic resonance of Fe<sup>3+</sup> in sapphire, 1949; zero-field masers, 2889
- Sze, T. W., with P. E. Lego, obtaining transient response using digital computer, 2130
- Szente, P. A., with others, centipede aerial, 1333 u
- Szöke, A., and S. Meiboom, radiation damping, 2543
- Szulkin, P., reflection of e.m. waves in ionosphere, 2728
- Tabuchi, S., with others, radio observation of satellite 1957a, 446
- Taft, E. A., H. Philipp and L. Apher, exciton-induced photoemission from BaO, 2264
- with H. R. Philipp, optical constants of Ge, 2659
- Tagholm, L. F., with others, tropospheric wave propagation measurements by B.B.C., 2000 m
- Taguchi, Y., with others, radio observation of satellite 1957a, 446
- Tait, D. A. G., with M. D. Johnson, filter attenuation characteristics, 731
- Takahashi, H., with others, electron and ion density distributions in F region, 2579
- Takahashi, S., with others, oxide-coated cathode, 3078
- Takahashi, T., with others, mutually coupled CR-type directional coupler, 9
- Takahashi, Y., with others, microwave power standard, 3433
- Takahira, A., with others, microwave propagation over sea beyond line of sight, 2734
- Takashima, K., and T. Misugi, measurement of input impedance of u.h.f. triodes, 2788 aa
- Takeda, S., and E. H. Holt, microwave propagation method of studying decaying gas plasmas, 4021
- Takenoshita, Y., with Y. Hakura, s.w. transmission disturbance of 11th Feb. 1958, 573
- Takeuchi, K., with S. Okamoto, dielectric loss of oxidized high-density polyethylene, 3414
- Taluts, G. G., with P. S. Zyrjanov, acoustic-electrical phenomena in degenerate plasma, 3638
- Tamir, T., and J. O. Spector, swept-frequency klystron operation, 3524 hh
- Tamor, S., with others, theory of cathode sheath in discharge, 82
- Tanabe, Y., with others, preparation of ZnS single crystals, 2625
- Tanaoka, I., with others, effect of solar eclipse on geomagnetic field, 2561
- Taniguchi, S., with others, ferromagnetic domain structure in Co-Ni crystal, 192
- Tannenbaum, E., with others, stabilization of Si surfaces by thermally grown oxides, 2650
- Tannenwald, P. E., with M. H. Seavey, Jr, direct observation of spin-wave resonance, 191
- Tanner, W. P., Jr, what is masking?, 3541
- and T. G. Birdsall, definitions of  $d'$  and  $\eta$ , 3854
- Tantilla, W. H., with D. A. Jennings, frequency modulator for marginal oscillator, 1626
- Tantry, B. A. P., and R. S. Srivastava, polarization of atmospherics by successive reflections, 143; waveforms of atmospherics, 459, with superimposed pulses, 815
- Tanzman, H. D., high-accuracy time-interval measurements, 3418
- G. A. MacLeod and W. T. Scott, Doppler satellite measurements, 1191
- Tao, K., radio scattering in terms of ionosphere turbulence, 236
- Taratynova, G. P., motion of artificial satellite, 3682
- with others, determination of lifetime of artificial earth satellite, 3681
- Tartaglia, A. A., with F. A. Trumbore, resistivities and hole mobilities in Ge, 519
- Tartakovskii, B. D., ultrasonic interference filters, 677; diffraction of sound waves in converging beams, 2813
- with B. F. Potoshevnikov, attenuation of plane sound waves, 2809
- Tarui, Y., measurement of transistor cut-off frequency, 2705
- Tasteny, R., development of s.w. telegraphy systems, 1686
- Tattersall, R. L. O., frequency meter for 3975–4275 Mc/s, 4161
- Taylor, D. F., alloy junctions in semiconducting devices, 888
- Taylor, J. G., electrostatics as distribution theory, 404
- Taylor, R. J., thermal structures in lower atmosphere, 136
- Taylor, R. V., Sonobuoy receiver, 254
- Taylor, S., with others, processing Ni-matrix cathodes, 4250
- Taylor, W. E., with P. E. Cane, cooling high-power valves by vaporization, 654
- Taylor, W. K., pattern recognition by automatic analogue apparatus, 2371
- Tchoubar, G., with A. Oberlin, shadow-casting carbon films for electron microscopy, 938
- Teal, R. H., with others, versatile stimulator, 229
- Teaney, D., with A. M. Portis, microwave Faraday rotation, 770
- Teboul, M., and N. Nifontoff, flicker effect in photovoltaic diodes, 639
- Teeter, W. L., and K. R. Bushore, microwave power divider and multiplexer, 1078
- Teitler, S., generation-recombination noise in semiconductor, 493
- Telford, M., tropospheric scatter system evaluation, 595
- Temko, K. V., with E. I. Adirovich, transition frequency and phase characteristics of transistor, 634
- with others, field potential and charge carriers in fused-in junctions, 3787
- Teodorescu, I., investigation of r.f. properties of ferrites, 3815
- Terhune, R. W., with others, ruby as maser material, 3793
- Terpugov, N. V., resolving power of automatic frequency analysers, 1969
- Tertian, L., with J. J. Trillat, electron-microscope images without photographic emulsion, 1331
- Teunissen, H. A., television transmitter design, 3492
- Thackeray, D. P. C., constant-current/constant-voltage stabilizer, 605; selecting matched components, 659
- Thackray, J. C., with J. K. Skwirzynski, transmission of e.m. waves through wire gratings, 3963
- Thain, R. S., with others, engineering of i.f. communication systems, 2750
- Tharma, P., public-address amplifiers using transistors, 68
- with J. F. Pamling, 4.5-W sliding-bias amplifier using OC16, 384
- Thayer, G. D., with B. R. Bean, models of atmospheric radio refractive index, 2725
- Thelle, R., operation of image orthicon, 3497
- and F. Pils, television transmission of non-transparent still pictures, 1374
- Thels, M. E., digital storage on punched tape, 1785
- Thelssing, H. H., F. A. Dieter and P. J. Caplan, analysis of emissive phase of pulsed maser, 756
- Theriault, G. E., and H. M. Wasson, transistor performance characteristics at v.h.f., 1115
- Thiele, A. N., television i.f. amplifiers with linear phase response, 3117
- Thiele, A. P., magnetostrictive filters, 52
- Thiele, R., design of Südwestfunk studio building, 3183
- Thies, H., with H. Ehlers, synchronizing transmitter frequencies, 4224
- Thomas, D. E., and J. M. Klein, automatic transistor a measuring set, 3427
- with others, surface barrier height changes on transistors, 633
- Thomas, D. G., diffusion and precipitation of In in ZnO, 4111
- Thomas, E. L., analogue computation, 31
- Thomas, J. A., and F. H. Hibberd, satellite Doppler measurements and ionosphere, 1874
- and E. K. Smith, survey of knowledge of E<sub>s</sub>, 1879
- Thomas, J. B., with T. R. Williams, current noise and nonlinearity in carbon films, 3596
- Thomas, J. J., with others, evidence for carriers with negative mass, 875
- Thomas, J. O., distribution of electrons in ionosphere, 1552
- and A. Robbins, electron distribution in ionosphere over Slough, 806
- Thomas, L., measurements of horizontal movements in region F, 2243
- Thomas, L. G., Tacañ system, 461
- Thomas, S., with others, observations of detonation by interferometer, 3068
- Thompson, A. M., cylindrical cross-capacitor as standard, 3051
- and R. W. Archer, comparator for 100-kc/s frequency standards, 1299
- Thompson, B. J., intensity distribution near focus of diffracted waves, 3256
- Thompson, F. G., factors affecting life of magnetrons, 2788 f
- Thompson, G. T., with P. C. Butson, effect of flanges on radiation patterns, 3582
- with others, propagation measurements at 3 480 Mc/s, 2000 r
- Thompson, J. E., with others, magnetization of ferromagnetic alloys, 3392
- Thompson, M. C., Jr, and H. B. Jones, phase stability over low-level tropospheric path, 4176
- and M. J. Vetter, microwave refractometer for aircraft, 1321
- and D. M. Waters, studying ionospheric structure using earth satellites, 799
- F. E. Freethey and D. M. Waters, ceramic X-band cavity resonators, 363
- Thompson, P. M., with others, lightweight airborne navigation system, 2599
- Thompson, W. J., application of phase-measuring techniques, 1895
- Thomson, J. D., r.f. powers and noise levels in multichannel R/T systems, 598
- with B. W. G. Penhall, signalling for single-channel and mobile radio-telephone systems, 4200
- Thomson, J. H., rotation of first Russian satellite, 1187
- with others, radar observations of 1957b, 3290; ionospheric information from observations of satellite 1957  $\alpha$ 2, 3297
- Thomson, M. M., with others, Canadian standard of frequency, 2700
- Thorne, T. G., and J. A. Billings, Doppler navigation systems, 2608
- with G. E. Beck, airborne Doppler navigation equipment, 2259 e
- with J. E. Clegg, Doppler navigation, 2259 d
- Thornton, G. G., and C. D. Simmons, high-current mode of transistor operation, 1004
- Thornton, W. A., electroluminescent thin films, 1598; a.c.-d.c. electroluminescence, 3000
- Thun, R., electron-diffraction apparatus for continuous recording, 3442
- Thureau, P., with J. P. Leroux, photoluminescence of ZnS-Cu, 1908
- Thurlow, E. W., with others, microwave model for study of s.w. aerials, 709
- Tibbals, M. L., with others, v.l.f. propagation measurements for Radux-Omega system, 2736
- Tiberio, S., with others, characteristic parameters of barrier layer in metal/semiconductor junction diodes, 2415
- Tiberio, U., echo filtering in radar, 2602
- Tichý, J., equivalent circuit of oscillating piezoelectric rods, 1475
- Tiemann, J. J., with others, observation of phonons during tunnelling in junction diodes, 4226
- Tien, P. K., parametric amplification and frequency mixing in propagating circuits, 76
- Tikhonov, A. N., propagation of variable e.m. field in stratified medium, 2920
- Tillman, J. R., transistors in line communications, 594
- Timmins, E. W., with others, apparatus for measuring electrical resistivity of Si, 214
- Tingley, G. R., with J. H. Haines, Vitascan flying-spot colour scanner, 279
- Tipnis, C. B., with S. Parthasarathy, diffraction of light by ultrasonic waves, 1049, 1751
- Tischer, F. J., resonant properties of nonreciprocal ring circuits, 2462
- Tisner, W., with L. Keibs, measuring acoustic impedance of air spaces, 3180
- Titheridge, J. E., variations in direction of arrival of h.f. waves, 941; ray paths in ionosphere, 2377
- Tkalich, L. G., with E. K. Jordaniskikh, semiconductor thermostat for self-oscillators, 609
- Toback, P. L., Zener diodes stabilize heater voltages, 2759
- Tobin, M., video differential planimeter, 3067
- Toedter, H., with others, Telefunken traffic radar, 1898
- Toi, A., with others, e.s.-transformer-type particle accelerator, 3071
- Tokunaga, K., with G. S. Verma, antiferromagnetism of CuF<sub>2</sub>, 2H<sub>2</sub>O, 1946
- Tolansky, S., and A. F. B. Wood, interferometric studies on oscillating quartz crystals, 2335
- Tolbert, C. W., and A. W. Straton, absorption of mm waves over extended ranges, 246
- A. W. Straton and C. O. Britti, phantom radar targets at mm  $\lambda$ , 3315
- Toll, J. S., with M. Lutzky, formation of discontinuities in nonlinear electrostatics, 2914
- Tolmie, R. W., zeroing of d.c. amplifiers, 2342
- Tolpygo, K. B., emission capacity of p-n junction, 496
- with E. I. Kaplanova, temperature dependence of Hall coefficient in semiconductors, 1621
- Toman, K., geometrical properties for ionospheric propagation, 3848
- Tomishima, H., with others, lattice scattering mobility in CdS, 2990
- Tomita, K., theory of magnetic resonance saturation, 95; theory of magnetic double resonance, 2922
- Tomlin, D. H., with others, Ge junction cells for photoelectric control circuits, 309
- Tompkins, R. D., with P. J. Allen, instantaneous microwave polarimeter, 3432

- Topchiev, A. V., and others, producing polymers with semiconductor properties, 4121
- Torelli, G., with C. Rubbia, differential discrimination for fast pulses, 3990
- Toschi, R., with G. Sacerdoti, potential of e.s. field and trajectories of charged particles, 1505
- Towle, A., with others, frequency stepper for propagation tests, 1485
- Towle, L. C., and J. A. Lockwood, cosmic-ray increases associated with solar flares, 2557
- Townes, C. H., with A. I. Schawlow, infrared and optical masers, 1857
- with others, maser amplifier for radio astronomy, 2892
- Townsend, J. W., Jr, rocket and satellite symposium, 1870
- Toyoda, H., with others, life tests of microphone carbon, 1758
- Traube, M. J., with others, split reflector for microwave antennas, 712
- Tredgold, R. H., with others, anomalous polarization in ferroelectrics, 1911
- Treharne, R. F., analogous transistor system design, 1796
- Trenea, S. N., electron guns for cone-type beams, 2430
- Trent, G. H., with others, extension of solar radio spectroscopy, 2933
- Trevena, D. H., space-charge waves, 2058
- with J. R. Pichin, new development of monotron oscillator, 3524 aa
- Triebwasser, S., ferroelectric transition in triglycine sulphate, 157; ferroelectric transitions of  $\text{KNbO}_3$ - $\text{KTaO}_3$ , 3330
- Trigubenko, V. A., with others, relaxation polarization and losses in nonferroelectric dielectrics, 480
- Trillat, J. J., and L. Terrian, electron-microscope images without photographic emulsion, 1331
- Trinkaus, J. W., pulse-forming networks, 375
- Trittipee, W. J., residual effects of low noise levels on temporary threshold shift, 1054
- with W. Spieth, threshold elevation produced by noises, 682; noise exposure and temporary threshold shifts, 1053
- Trivelpiece, A. V., with R. W. Gould, electro-mechanical modes in plasma waveguides, 2800 f
- Trodden, W. G., with others, evaporation of Ba from impregnated cathodes, 2792
- Trofimov, K., anti-aircraft radiolocation techniques, 2984
- Tröim, J., with L. Harang, angle of arrival of auroral echoes, 2254
- Troitskii, V. N., fading in u.s.w. radio links, 586
- Troleas, L. G., and L. J. Anderson, foreground terrain effects, 3457
- Troost, A., s.w. cathode-ray direction finders, 2256
- Troude, J., elimination of noise and interference on radar, 3319
- de Troye, N. C., classification and minimization of switching functions, 3048
- with H. J. Heijn, fast method of reading magnetic-core memories, 3587
- True, T. T., with R. H. Rausch, reference generator for colour TV receivers, 1324
- Truell, R., with others, temperature dependence of fractional velocity changes in Si, 3355
- Trumbore, F. A., and A. A. Tartaglia, resistivities and hole mobilities in Ge, 519
- C. R. Isenberg and E. M. Porbansky, solubilities of Sn in Si and Ge, 4094
- Trzeba, E., null-point band filters, 736
- Tsarev, B. M., development of thermionic cathodes, 2068
- Tseftlin, M. Z., frequency dividers using transistors, 378
- Tseplyaev, V. I., with M. I. Kiselev, oblique shock waves in plasma, 1163
- Tsevech, V. P., brightness fluctuations of second earth satellite, 2956
- Tsintsadze, N. L., with P. V. Polovin, longitudinal vibrations of electron-ion beams, 1835
- Tsuda, T., with others, ionospheric scattering, under influences of ion production and recombination, 4059, in electro-dynamically controlled turbulence, 4060
- Tsukernik, V. M., with M. I. Kaganov, theory of kinetic processes in ferromagnetic dielectrics, 1285
- Tubota, H., and H. Suzuki, Se photocells with artificial intermediate layers, 3158
- Tucker, D. G., signal/noise performance, of electro-acoustic strip arrays, 2, of super-directive arrays, 329
- with V. G. Welsby, multiplicative receiving arrays, 3953
- Tucker, E. B., with N. S. Shiren, spin-phonon interaction in ruby, 2317
- with others, effects of 9.2-kMc/s ultrasonics on resonances in quartz, 3816
- Tukizi, O., diffraction of e.m. waves by earth's curvature, 3092
- Tulchin, H., u.h.f. transistor data, 2044
- Tunis, C. J., with others, automatic recognition of patterns, 2372
- Tunkelo, E., with others, lattice vibrations in Si by neutron scattering, 2291
- Tunmer, H., galactic radio emission, 1176
- Turf, J., with others, multipactor effect, 3836
- Turin, G. L., improvement of range determination with noise radar, 148
- Turk, S., response of CR divider, 47
- Turner, D. R., electropolishing Si in HF solutions, 1245
- Turner, E. H., fast ferrite switch for 70 kMc/s, 2834
- Turner, R. J., and P. Hermann, transistor design for picture i.f. stages, 1385
- Turner, R. W., submarine antenna systems, 2469
- Turner, W. R., with others, atmospheric discontinuity layer effects on propagation, 2000 o
- Tutovan, V., magnetic permeability in circular and longitudinal fields, 3645
- Tuttle, W. N., Zobel filters for Tchebycheff insertion loss, 1118
- Tuzzolino, A. J., piezoresistance constants of InAs, 884
- with others, infrared detectors, 4239
- Tvanenko, I. P., with others, mechanism of terrestrial corpuscular radiation, 2216
- Tveten, L. H., with others, I.G.V. observations of F-layer scatter in Far East, 2733
- Tweet, A. G., vacancy clusters in dislocation-free Ge, 522; precipitation in semiconductors, 4089 n
- and W. W. Tyler, enhanced Cu concentration in Ge containing Ni, 521
- Twersky, V., calculation of reflection coefficients, 1333 w
- Twiddy, N. D., with R. L. F. Boyd, electron energy distributions in plasmas, 3260
- Twisleton, J. R. G., transformation of admittance through matching section, 2111
- Twiss, R. Q., radiation transfer and possibility of negative absorption in radio astronomy, 2218; growth of electron space-charge and radio waves in moving ion streams, 4030
- and J. A. Roberts, e.m. radiation from electrons in ionized medium, 408
- Tychinskii, V. P., conductance of space-charge cloud in magnetron, 2425
- Tyler, W. W., with A. G. Tweet, enhanced Cu concentration in Ge containing Ni, 521
- Tyrrell, A. J., with K. G. Beauchamp, image converter equipment for observation of discharges, 3522
- Uberol, M. S., and E. G. Gilbert, measurement of cross-spectral density of random functions, 2349
- Uda, H., with others, measurement of attenuation by rain, 4187
- Uda, S., with others, hourly median field strength of 1940-Mc/s signal, 255
- Uebele, G. S., ferrite microwave limiters, 3943
- Uehling, E. A., with J. L. Bjorkstam, magnetic resonance and relaxation in  $\text{KD}_2\text{PO}_4$ , 3743
- Ueno, K., with S. Kanaya, h.f. propagation related to annular eclipse, 2730
- Uenohara, M., with others, Barkhausen-Kurz oscillator at cm  $\lambda$ , 1486
- Uhlir, A., junction diodes in microwave circuits, 3159 n
- Uijtens, A. G. W., with others, temperature-stable transistor circuit, 71; protection device for stabilized line timebase circuit, 282; transistor circuits based on half-supply-voltage principle, 755; stabilization, of line output circuit, 989, of line and frame output circuits, 3123
- Ukhanov, Yu. I., frequency characteristic of Ge infrared diode modulator, 1721
- and S. G. Shul'man, influence of intense electric field on Ge-diode transparency, 1931
- Ulinich, F., with others, nonlocal reflection in waveguides of variable cross-section, 1766
- Unger, H. G., helix waveguide theory and application, 703
- Unger, S. H., computer oriented toward spatial problems, 30
- Ungstrup, E., with J. Rybner, influence of auroral zone on communications, 1333 j
- Unterberger, R. R., microwave spectrometer tests electron resonance, 2211
- Unwin, R. S., geometry of auroral ionization, 137; movement of auroral echoes, 2593
- Uny, C., variation of resistance and noise in Au, Ag and Cu films, 3350
- Unz, H., current distribution over cone surface, 2841
- Upadhyay, C. S., with others, electronic and ionic devices with thermionic cathodes, 3531; cylindrical, elliptical and prismatic forms of electronic tubes, 3895
- Ure, R. W., with others, InAs and InSb as thermoelectric materials, 3384
- Urkowitz, H., using cascading charts, 2513
- Usher, T., Jr, performance of class-B audio amplifiers with random noise signals, 2168
- Ussachevsky, V., with A. Moles, use of acoustic spectrograph, 1425
- Uyeda, H., and others, reception of radio waves from Russian earth satellite I, 120
- Uyeda, R., with others, oxide-coated cathode, 3078
- Uyeda, S., with others, effect of solar eclipse on geomagnetic field, 2561
- Vaccaro, F. E., with D. J. Blattner, electrostatically focused travelling-wave tube, 1414
- with W. W. Siekanowicz, periodic e.s. focusing of electron beams, 2061
- Vaina Bappu, M. K., optical tracking of satellites, 3699 q
- Vainshtein, L. A., electron waves in periodic structures, 1738; group velocity of damped waves, 1848; electron waves in retarding systems, 2062; nonlinear theory of travelling-wave valve, 2426
- Vakulov, P. V., with others, cosmic rays and terrestrial corpuscular radiation by cosmic rocket, 2231
- Valdes, L. B., circuit conditions for parametric amplification, 75; microwave mixer diode of improved conversion efficiency, 2414
- Valeev, Kh. S., N. G. Drodov and A. L. Frumkin, investigations on Li-Zn ferrites, 1957
- Valiev, K. A., and Sh. Sh. Bashkurov, stimulated r.f. paramagnetic amplifiers, 2181
- Valkó, I. P., theory of cardioid microphone, 2092
- with F. Fisher, new mechanism for generation of flicker noise, 1028
- Vallese, L. M., properties of hook transistors, 753; transistor bias design, 1140
- Van Allen, J. A., Scientific Uses of Earth Satellites, (B)2595
- and L. A. Frank, radiation around the earth, 2553; radiation measurements with Pioneer IV, 4041
- C. E. McIlwain and G. H. Ludwig, radio observations with satellite 1958e, 2238
- Van Bueren, H. G., plastic creep of Ge single crystals, 2654
- Van Cakenberghe, J., with J. M. Gilles, photo-conductivity and crystal size in evaporated CdS, 828
- with G. Offergeld, stoichiometry of  $\text{Bi}_2\text{Te}_3$ , 3785
- Van Dang, Nguyen. See Nguyen Van Dang.
- Vandeland, R. N., with others, remote-control carrier systems in two-way closed-circuit television, 285
- Van der Houven van Oordt, A. J., with G. Diemer, nature of blue edge emission in CdS, 2269
- Van der Ziel, A. See van der Ziel, A.
- Van Dong, N., and others, influence of high-energy electron bombardment on Ge, 3773
- Van Duzer, T., and G. R. Brewer, space-charge simulation in electrolytic tank, 2356
- Vanhuyse, V. J., anomalous attenuation in linear accelerators, 1329
- J. L. Verhaeghe and J. Turf, multipactor effect, 3836
- Vantine, H., Jr, and E. C. Johnson, transceivers compute distance, 146
- Van Uitert, L. G., F. W. Swanekamp and S. E. Hassko, line width in Y-Fe garnet, 2330
- Van Valkenburg, A., with others, infrared studies on  $\text{SiO}_2$  and  $\text{GeO}_2$ , 205
- Van Vliet, K. M. See van Vliet, K. M.
- Van Zanten, P. G., with F. H. R. Almer, transistor pyrometer, 3424
- Varnerin, L. J., transistor base transit analysis, 2417
- Varshni, Y. P., with M. S. Sodha, fully ionized gas, transport phenomena in, 402, electron mobility in, 3643; nondegenerate semiconductors, transport phenomena in, 3753, transport properties of, 3754
- Vartanian, P. H., with J. L. Melchor, temperature effects in microwave ferrite devices, 3938
- Vassy, E., propagation and radio navigation systems, 1333 l
- with others, rocket measurements of absorption in lower ionosphere, 2972
- Vatter, M. J., with M. C. Thompson, Jr, microwave refractometer for aircraft, 1321
- Vaughan, W. C., power in angle-modulated wave, 3851
- Vautey, R., with L. J. Milosevic, travelling-wave resonators, 2144
- Vautier, C., with others, measurement of very slight variations of resistance, 555; properties of Sb films, 2693
- Vautier, R., and A. J. Berteaud, Y-Fe garnet with substituted Cr, g-factor of, 2328, width of absorption curve of, 2329; direct measurement of width of resonance curves, 3814
- and A. Marais, switching time of square-loop ferrite, 3404
- Vavilov, V. S., and K. I. Britsyn, quantum yield of photoionization in Si, 863
- A. A. Gippins and M. M. Gorshkov, reflection coefficients of Ge and Si, 3765
- and others, Si solar batteries for earth satellites, 3862
- Veazie, C. E., transistorized radar sweep circuits, 3317
- Vedam, K., with R. Pepinsky, room-temperature ferroelectric, 4084
- with others,  $(\text{NH}_4)_2\text{SO}_4$  and  $(\text{NH}_4)_3\text{BeF}_6$  transitions, 836; ferroelectricity in  $\text{Li}(\text{N}_2\text{H}_5)_2\text{SO}_4$ , 840;  $(\text{NH}_4)\text{HSO}_4$  ferroelectric with low coercive field, 841
- Vellex, R., with J. Bok, semiconductivity experiments on hot electrons in InSb, 3781
- Veith, F. S., TV camera tubes, 616
- Veith, W., calculation of electron-beam contours, 3524 w
- with K. Pöschl, focal length of diaphragm for electron beams, 1416
- Veksler, V. I., and L. M. Kovrizhnykh, cyclic acceleration of particles in h.f. fields, 3440
- Velizhanina, K. A., with Z. N. Baranova, acoustic properties of sound-absorbing material, 686
- Veloric, H. S., with J. H. Forster, effect of surface potential on junction characteristics, 3390
- Venables, J. D., and R. M. Brody, photoanodization of InSb, 3782
- Venema, A., and others, dispenser cathodes, 2791
- Vengel', T. N., and B. T. Kolonets, vitreous semiconductors, 1920
- Venlar, F. A., signal detection as function of frequency ensemble, 1052, 3539
- Venkatesan, D., solar activity and cosmic-ray intensity, 2942
- Venkateswarlu, P., and R. Satyanarayana, fading of radio waves, 585
- Venkiteshwaran, S. P., radiosonde techniques for measuring potential gradient, 3699 b
- Ventrice, C. A., with E. R. Scherling, rapid reduction of  $h\nu$  records to  $N$ -h profiles, 3303
- Venugopalan, M., potential variation of Joshi effect, 2530
- Vergne, R., orientational superstructure from deformation of Fe-Ni, 1276
- Verhaeghe, J. L., with G. G. Robbrecht, measurements of permeability tensor for 'ferroxcube' at 24 kMc/s, 1293
- with others, multipactor effect, 3836
- Verma, G. S., and K. Tokunaga, antiferromagnetism of  $\text{CuF}_2 \cdot 2\text{H}_2\text{O}$ , 1946
- Vermeulen, R., stereo-reverberation, 1065
- Vernov, S. N., and others, mechanism of terrestrial corpuscular radiation, 2216; cosmic rays and terrestrial corpuscular radiation by cosmic rocket, 2231; investigation of cosmic radiation, 3663
- Verstelle, J. C., G. W. J. Drewes and C. J. Gorter, h.f., susceptibilities of paramagnetic alums, 2332

- Verstraten, J., frequency stability of r.f. heating generators, 933  
 — with J. M. G. Seppen, 8-mm radar, 1591
- Verzeano, M., R. C. Webb, Jr., and M. Kelly, radio control of ventricular contraction, 929
- Verzunov, V., with A. Semenov, phase compensation methods of shaping s.s.b. signal, 588
- Veter, V. V., with L. V. Kirenskiĭ, measurement of boundary layer width between domains, 2676
- Victorov, I. A., Rayleigh-type waves on cylindrical surfaces, 670
- Vidal, D., and G. Blet, influence of annealing time on thermoelectric power of Se, 2648
- Vierhout, R. R., models for transmission lines, 1067
- Vikramasingh, R., and others, hourly median field strength of 1940-Mc/s signal, 255
- Vila, P., with K. Suchy, magnetic field in  $F_2$  layer at Dakar, 133
- Vilbig, F., long-distance telecommunications by means of satellites, 964
- Villard, O. G., Jr., with K. C. Yeh, new type of fading on path crossing equator, 945
- Ville, J. A., application of information theory to amplitude compression, 3466  
 — and J. Bouzlat, finite-duration signals with maximum filtered energy, 2390
- Villeneuve, A. T., with R. F. Harrington, reciprocity relations of gyrotropic media, 3044
- Villers, G., and J. Lories, properties of mixed Dy-Y, Dy-Gd and Dy-Er garnets, 2331  
 — J. Lories and C. Claudel, properties of mixed Gd-Er and Gd-Y garnet, 1633  
 — J. Lories and R. Pauthenet, magnetic properties of Er garnet, 1290
- de Villiers, P., diffraction of ultrasonic waves by arrays of rods, 1048
- Vilms, J., with M. M. Fortini, solid-state generator for microwave power, 3991
- Vink, H. J., with F. A. Kröger, concentrations of imperfections in solids, 1175
- Vinogradova, M. B., with others, large inhomogeneities in  $F_2$  layer, 2581
- Vinti, J. P., satellite orbits, effect of drag on, 3287, theory of, 3687
- Vishniievsky, A. I., grades of vacuum in electronic tubes, 2262  
 — S. Sampath and C. S. Upadhyay, electronic and ionic devices with thermionic cathodes, 3531; cylindrical, elliptical and prismatic forms of electronic tubes, 3895
- Visocekas, R., with J. Nalot, anomalous behaviour in M-type carcinotron, 2788 t
- Visser, S. W., present sunspot cycle, 107
- Vitkevich, V. V., outer corona of sun, 426  
 — and Yu. L. Kokurin, irregularities in ionospheric refraction, 2251
- Vitousek, M. J., with R. G. Mason, geomagnetic phenomena associated with nuclear explosions, 3672
- Vlaardingerbroek, M. T., active admittances of triode at 4 Gc/s, 2788 x
- van Vliet, K. M., and A. van der Ziel, noise generated by diffusion mechanisms, 2422  
 — with J. E. Hill, carrier-density fluctuation in Ge, 1617
- van Vlodrop, P. H. C., with H. L. van der Horst, induction-heating generator using hydrogen thyristors, 3439
- Vocoides, J., with others, conductance of dipoles, 1089
- Vodar, B., with S. Robin-Kandare, reflecting power of bulk Si and Ge, 3766
- Vogel, J., travelling-wave tubes, 1019
- Vogelman, J. H., high-power microwave filters, 3562  
 — J. L. Ryerson and M. H. Bickelhaupt, tropospheric scatter system using angle diversity, 2751
- Vogt, K., with R. Heiderster, diversity reception by aerial selection method, 2741  
 — with others, correlation measurements in s.w. range, 953
- Voigt, F., dispersion in transverse susceptibility of Li ferrite, 1288
- Voigt, J., with others, evaluation of conductivity glow curves, 3321
- Vojnović, M. M., increased sensitivity of trigger circuits, 57; series-diode multivibrator, 2502
- Vojtašek, S., measurement of capacitance of junction transistors, 3425
- Vokes, J. C., with others, high-power 400-Mc/s klystron, 3524 t
- Volkenshtein, N. V., G. V. Fedorov and S. V. Vonsovskiĭ, Hall effect in pure Ni at He temperatures, 2322  
 — with others, change of sign of Hall constant in alloys, 2675
- Volkov, Yu. D., with V. I. Chechernikov, temperature dependence of paramagnetic susceptibility of Ni-Zn ferrites, 3041
- Vollmerer, N. F., and M. I. Karnovskii, concentration coefficient of directional acoustic systems, 3905
- Volosok, V. I., and B. V. Chirikov, compensation of space charge in electron beam, 1836
- Völz, H., frequency-diversity method, 2385
- Vonbun, F. O., method for tuning maser cavity, 74
- Vonnegut, B., C. B. Moore and A. T. Botka, organized electrification and precipitation in thunderstorms, 2253
- Vonsovskii, S. V., and M. S. Svirskii, absence of superconductivity in ferromagnetics, 195  
 — with others, Hall effect in pure Ni at He temperatures, 2322
- Vook, F. L., and R. W. Balluffi, deuterium-irradiated Ge, length and resistivity changes in, 2306, structure of, 2308
- Vore, M. P., of random-noise transformers, 3214
- van der Vorm Lucardie, J. A., automatic supervision of f.m. transmitters, 292; vestigial-sideband filters and duplexers, 3494
- Vose, A. W., and F. V. Wilson, airborne weather radar, 147
- Voss, W. G., 2-hole directional coupler, 705
- Votaw, M. J., with R. L. Easton, Vanguard I, 1868
- de Vrijer, F. W., with T. Poorter, projection of colour-television pictures, 3119
- Vul, B. M., and A. P. Shoutov, edge breakdown of p-n junction in Ge, 1616
- Vyatkin, A. P., and V. A. Elchin, origin of fluctuation of crystal triode parameters, 628
- Vysokovskii, D. M., geometric characteristics of scattering of radio waves in troposphere, 571; multiple dispersion in u.s.w. scatter propagation, 1995
- Wachtel, A., ZnS-Sn, Li phosphors, 1212
- Wächtler, M., with H. Gabler, component determination in d.f. for coherent waves, 816
- Waddington, C. J., with P. H. Fowler, artificial aurora, 1888  
 — with others, cosmic-ray  $\alpha$  particles during solar maximum, 3279
- Wade, C. M., radio emission of hydrogen nebulae, 421
- Wade, G., and R. Adler, method for pumping fast space-charge wave, 1412  
 — and H. Heffner, gain, bandwidth and noise in cavity-type parametric amplifier, 2066; microwave parametric amplifiers and converters, 2896  
 — with H. Heffner, characteristics of variable-parameter amplifiers, 77  
 — with others, parametric devices tested for phase-distortionless limiting, 2182; parametric amplifiers as superregenerative detectors, 3245
- Wadley, T. L., principles of tellurometer, 1980
- Waechter, D., measurement of random fluctuations in television, 2031
- Wagner, R. S., production of dislocations in Ge by thermal shock, 865
- Wagner, T. C. G., with J. W. Caldwell, boosting power-transistor efficiency, 978
- Wahl, A. J., analysis of base resistance for alloy-junction transistor, 1714
- Wait, J. R., transient behaviour of e.m. ground wave over spherical earth, 239; transmission and reflection of e.m. waves in stratified media, 939; propagation of v.l.f. pulses to great distances, 948; downcoming radio waves, 1664; transmission of power in radio propagation, 1999; deduction of diurnal change of ionospheric heights, 2735; field in conductor with wavy interface, 2904; earth currents near monopole antenna, 3947; radiation from loop in conducting medium, 3957  
 — and A. M. Conda, pattern of antenna on curved lossy surface, 3195  
 — and A. Murphy, influence of ridge on l.f. ground wave, 233  
 — with others, ionospheric reflection coefficients from series, 2589; U.R.S.I. report on antennas and waveguides, 3565
- Waite, T. R., with others, annealing of radiation defects in semiconductors, 4089 o
- Wakefield, J., with others, diffusion across semiconductor/vapour interface, 165; precipitation on a dislocation, 2289
- Waldron, R. A., propagation in cylindrical waveguides containing gyromagnetic media, 341; resonant-cavity methods of measuring ferrite properties, 545; helical coordinate system and e.m. theory, 773; e.m. fields in ferrite ellipsoids, 1286; coupling coefficient of ladder networks, 1478; mode spectra of cylindrical waveguides, 2838
- Waldron, R. D., with M. Balkanski, internal photo-effect and exciton diffusion in CdS and ZnS, 824
- Walk, K., with H. Zemanek, Tchebycheff approximations for Cauer filters, 2498
- Walker, D. F., improvement in detecting power of iron-cored search coils, 2351
- Walker, D. M. C., with D. G. King-Hele, last minutes of satellite 1957B, 447; irregularity in atmospheric drag effects, 797; predicting orbits of near earth satellites, 2232; irregularities in density of upper atmosphere, 2571
- Walker, G. B., dielectric loading for u.h.f. valves, 3159 q
- Walker, J. S., with J. T. Kendall, h.f. tetrode transistors, 3516
- Walker, R. M., with others, spin resonance in electron-irradiated Si, 4089 h
- Wallis, G., surface states on Ge, 171  
 — with S. Wang, recombination centres on ion-bombarded Ge surfaces, 2303
- Wallis, R. F., and H. J. Bowlden, impurity photo-ionization spectrum of semiconductors in magnetic fields, 1232  
 — with others, Zeeman-type magneto-optical studies of interband transitions, 2283
- Wallmark, J. T., and S. M. Marcus, semiconductor devices for microminiaturization, 3213
- Walsh, D., improving microwave tube efficiency, 3887  
 — with others, infrared properties of SiC, 2297
- Walter, J. L., and others, cube-oriented magnetic sheet, 896
- Walters, L. C., with J. R. Jöhler, mean absolute value and standard deviation of phase, 3416; propagation of ground-wave pulse, 3842
- Walters, R., with M. Shepherson, stroboscopic method for frequency response measurements, 2079
- Walther, K., reflection factor of absorbers for cm waves, 2915
- Walton, A. K., and T. S. Moss, magneto-photoelectric theory for three carriers, 1923; photoelectromagnetic effect in Ge, 2660; free-carrier Faraday effect in n-type Ge, 3375  
 — with T. S. Moss, effective electron mass in GaAs, 4113
- Walton, J., pickup for low record wear, 1764
- Wang, C. C., large-signal linear-beam tube theory, 3159 f
- Wang, C. P., with others, parametric devices tested for phase-distortionless limiting, 2182
- Wang, S., and G. Wallis, recombination centres on ion-bombarded Ge surfaces, 2303
- Wang, W. S., and G. E. Peterson, segment inventory for speech synthesis, 1060  
 — with others, segmentation techniques in speech synthesis, 1059
- Wangness, R. K., ferrimagnetic-resonance parameters, 91, 2545
- Wanlass, L. K., and L. O. Hill, digital-analogue conversion with cryotrons, 1103
- Ward, A. L., effect of space charge in cold-cathode gas discharges, 1833
- Warekols, E. P., and P. H. Metzger, X-ray method for  $A^{111}\text{In}$  compounds, 3786
- Waring, J., reflexed transistor receiver design, 3100
- Waring, R. K., with H. S. Jarrett, ferrimagnetic resonance in NiMnO<sub>3</sub>, 543
- van Warmerdam, J. C., with E. G. Dorgelo, intermittent use of valves in r.f. heating generators, 2071
- Warnecke, M., with H. Huber, Ti pump, 1205
- Warnecke, R., O. Doehler and B. Epsstein, electron velocities and pass band in travelling-wave amplifiers, 316  
 — with J. Arnaud, increase of bandwidth in O-type travelling-wave valves, 317
- Warner, R. M., Jr., and others, semiconductor current limiter, 1368
- Warnick, G. W., with others, remote-control carrier systems in two-way closed-circuit television, 285
- Warren, E., with others, reciprocity of ionospheric transmission, 1667; spiral occurrence of E<sub>s</sub>, 3304
- Warren, E. S., with others, frequency prediction techniques for high latitudes, 2729
- Warringa, J. J. M., and H. Piepers, open rectangular waveguides in r.f. oscillators, 3984
- Warschauer, D. M., with W. Paul, optical properties of semiconductors under hydrostatic pressure, 506
- Warwick, C., green coronal line intensity and geomagnetism, 2949
- Warwick, C. S., and R. T. Hansen, geomagnetic activity following large solar flares, 3284
- Warwick, J. W., interaction of solar plasma and geomagnetic field, 2560  
 — with A. Boischot, radio emission following flare, 3276
- Wasilik, J. H., and R. B. Flippen, piezoelectric effect in InSb, 180
- Wasserman, R., and P. Hurnev, tones find data in high-speed tape systems, 932
- Wasson, H. M., with G. E. Theriault, transistor performance characteristics at v.h.f., 1115  
 — with H. B. Yin, r.f. amplifier for v.h.f. television receivers, 1384
- Watanabe, T., with Y. Kato, geomagnetic storm in relation to geomagnetic pulsation, 1537
- Waterman, A. T., Jr., transhorizon propagation, scattering relationships in, 570, rapid beam-switching in, 3198  
 — N. H. Bryant and R. E. Miller, antenna-beam distortion in transhorizon propagation, 1347
- Waters, D. M., with M. C. Thompson, Jr., studying ionospheric structure using earth satellites, 799  
 — with others, ceramic X-band cavity resonators, 363
- Waters, W. E., azimuthal electron flow in spherical diode, 2433; aberrations in electron sheet beams, 2908
- Watkins, C. D., with D. P. Harrison, radio echoes from aurora australis and aurora borealis, 140
- Watkins, D. A., helitron oscillator, 319  
 — with others, reduction of electron-beam noise, 1728
- Watkins, G. D., J. W. Corbett and R. M. Walker, spin resonance in electron-irradiated Si, 4089 h
- Watkins, T. B., 1/f noise in Ge devices, 1256  
 — with others, surface-barrier height changes on transistors, 633
- Watt, A. D., and R. W. Plush, worldwide standard-frequency broadcasting system, 4201  
 — E. L. Maxwell and E. H. Whelan, l.f. propagation paths in arctic areas, 4182  
 — and others, radio system performance in noise, 963
- Watters, B. G., with G. Kurtze, wall design for high transmission loss, 3917
- Watts, J. M., interpretation of night-time l.f. ionograms, 1558  
 — with others, I.G.Y. observations of F-layer scatter in Far East, 2733
- Way Dong Woo, tape recording system for data processing, 1464
- Waynick, A. H., with J. J. Gibbons, D region of ionosphere, 1553
- Weaver, C. S., with R. S. Davies, minimum transmitter weight for space communications, 3141
- Weaver, H. E., with R. C. Kempel, microwave reflection bridge, 1982  
 — with others, electron paramagnetic resonance in BaTiO<sub>3</sub>, 476
- Weaver, L. E., measurement of random noise in television, 2345; impairment of television pictures, 2408
- Webb, R. C., Jr., with others, radio control of ventricular contraction, 929
- Webber, S. E., ballistic analysis of 2-cavity klystron, 1729
- Webber, W. R., with J. J. Quenby, cosmic-ray cut-off rigidities, 3280
- Weber, L. A., f.m. digital subset for data transmission, 2392
- Weber, R., with L. Gensel, theory of interference modulation, 2191; spectroscopy in far infrared, 2192
- Weber, S., mavar: low-noise microwave amplifier, 79; transistor for cryogenic temperatures, 1712  
 — with others, '59 I.R.E. Show, 2801
- Webley, R. S., thin magnetic films, 2682
- Webster, H. C., spread-F echoes at night at Brisbane, 454

- Webster, H. F., performance of thermionic energy converter, 3438
- Webster, J. C., R. G. Klumpp and A. L. Witchey, evaluation of modulated-air-flow loudspeaker, 3922
- Wedler, G., with others, temperature dependence of electron emission of Bi films, 2619
- Wedlock, B. D., stability of transistor amplifiers, 4000
- Weekes, K., with G. J. Aitchison, ionospheric information from observations of satellite 1957  $\alpha 2$ , 3296
- with others, ionospheric information from observations of satellite 1957  $\alpha 2$ , 3297
- Weeks, R. R., with W. G. Long, quadruple-diversity tropospheric scatter systems, 972
- van Weel, A., analysis of diode detector for asymmetric-sideband signals, 249; detector stages for symmetrical or asymmetrical sidebands, 580
- Weger, M., and W. Low, paramagnetic-resonance spectrum of Gd in  $\text{LaCl}_3 \cdot 7\text{H}_2\text{O}$ , 780
- Weglein, R. D., with R. C. Knechtli, low-noise parametric amplifier, 2185
- Weibel, E. S., confinement of plasma by r.f. fields, 1511; orbits of charged particles in c.m. field, 3250
- Weibel, G. E., masers and quantum-mechanical devices, 72
- Weide, F., with others, equalization in television transmission by cable, 3488
- Weithe, W. K., classification and analysis of image-forming systems, 4237
- Weinberg, L., tables for optimum ladder networks, 49
- Weingartner, A., a.f. equipment in Südwestfunk studios, 3188
- Weinreich, G., T. M. Sanders, Jr, and H. G. White, acoustoelectric effect in n-type Ge, 3373
- and others, splitting of As donor ground state in Ge, 1615
- Weinreich, O. A., H. Matari and B. Reed, grain-boundary amplifier, 3241
- with others, conductivity of grain boundaries in Ge bicrystals, 2657
- Weir, C. E., with others, infrared studies on  $\text{SiO}_2$  and  $\text{GeO}_2$ , 205
- Weisberg, L. R., J. R. Woolston and M. Glicksman, electron mobilities in GaAs, 529
- Weisbrod, S., and L. Colin, refraction of v.h.f. signals, 3698
- Weiser, K., distribution coefficients of impurities in Ge and Si, 1242
- with M. Glicksman, electron mobility in InP, 415
- Weisman, L., telemetry demodulator, 1992
- Weiss, A. A., meteor trails, electron density in, 2224, electron density of echoing points in, 2941; radio detection of weak meteor showers, 2227; theory of radio-echo meteor height distribution, 2940
- with others, c.w. technique for measurement of meteor velocities, 105
- Weiss, G. T., with others, extended-range distributed-amplifier design, 1492
- Weiss, H., with H. Welker, semiconductor compounds of homopolar character, 1227
- Weiss, J. A., Faraday-rotation switch for TH system, 2835; theory of Reggia-Spencer phase shifter, 2837
- Weiss, M. T., microwave and i.f. oscillations due to resonance instabilities in ferrites, 198
- Weiszburp, J., J. Schanda and Z. Bođi, time-dependent spectra of ZnS: Cu, Pb, 4080
- Weitsch, W., compensation of chromatic dependence in electron microscope, 3076
- Weitzsch, F., thermal stability of transistors, 1713
- Welker, H., and H. Weiss, semiconductor compounds of homopolar character, 1227
- Wells, C. P., prolate spheroidal antenna, 1445
- Wells, H. W., with H. J. A. Chivers, new ionospheric phenomenon, 2582
- Wells, R. P., timing-signal transmission at Canaveral, 2722
- Wells, R. W., colour television, display system for, 621, Faraday cell in, 1705
- Welsby, V. G., improving aerial directivity, 3574
- and D. G. Tucker, multiplicative receiving arrays, 3953
- Welsh, J., production testing equipment for microwave components and systems, 221
- with E. Laverick, automatic standing-wave indicator, 2711
- Weltzien, J. W., with others, multipurpose bias device of logical elements, 1461
- Wendt, P. H., with others, automatic input equipment for data processing, 3586
- Wentworth, J. W., technical standards for colour television, 278
- Wereb, J. A., Jr, zero-crossing technique for wave-train outputs, 3064
- Werner, E., with F. Bopp, theory of spin waves, 2214
- Werner, P., surface enlargement of Al for electrolytic capacitors, 2868
- Werner, P. H., standardization of disk recording, 2454
- Wernick, J. H., S. Geller and K. E. Benson, constitution of  $\text{AgSbSe}_2\text{-AgSbTe}_2\text{-AgBiSe}_2\text{-AgBiTe}_2$  system, 1270
- with S. Geller, ternary semiconducting compounds:  $\text{AgSbSe}_2$ ,  $\text{AgSbTe}_2$ ,  $\text{AgBiSe}_2$ ,  $\text{AgBiTe}_2$ , 1269
- with others, magnetic moments of Fe and Co with rare-earth metal additions, 2321
- Wertheim, G. K., neutron-bombardment damage in Si, 861; recombination properties of bombardment defects in semiconductors, 4090
- and D. N. E. Buchanan, electron-bombardment damage in oxygen-free Si, 4089 k
- Wescott, E. M., with V. P. Hessler, correlation between earth-current and geomagnetic disturbance, 4044
- Wesemeyer, H., and J. M. Daniels, influence of saturation of paramagnetic resonance absorption on Faraday effect, 2547
- Wessel, G. K., u.h.f. ruby maser, 2178
- West, J. C., with J. L. Douce, magnetic-drum store for analogue computing, 348
- West, R. E., high-speed read-out for data processing, 3086
- Westberg, R. G., ionizing-potential space waves in glow-to-arc transitions, 3254
- Westberg, R. W., with T. R. Robillard, transistors for electronic switching, 2778
- Westerfield, E. C., with J. L. Stewart, active sonar detection, 2596
- Westerhof, T. J., with others, cathodothermoluminescence, 2624
- Westoby, P. J., ring counter, 2506
- Weston, D. E., guided propagation in slowly varying medium, 2204
- Weston, M. A., breakdown of Si power rectifiers, 3863
- Weston, V. H., with others, radar cross-section of finite cones, 4073
- Wexler, G., with others, high-power 400-Mc/s klystron, 3524 j
- Weys, N., class-C operation of transmitter valves, 1033
- Whale, A. V., with W. F. Gibbons, ceramic wave-guide window for X-band valves, 3159 a
- Whale, H. A., effects of ionospheric irregularities on bearings of s.w. signals, 1998
- and L. M. Delves, relations between bearing and amplitude of fading radio wave, 947
- Wheatley, G. H., with J. M. Whelan, preparation and properties of GaAs, 881
- Wheaton, R. N., techniques of transistor production, 2049
- Wheeldon, A. J., tropospheric scatter tests, 260
- Wheeler, G. J., with others, high-power L-band resonance isolator, 3563
- Wheeler, H. A., radiansphere around small antenna, 3566
- Wheeler, L. K., with P. R. Keller, automatic error correction, 966
- Wheeler, M. S., beam steering by scattering from ferrites, 2472
- Wheeler, R. G., multiplet structure of excitons in CdS, 3324
- Wheeler, A. D., spectrum of passive scalar mixed by turbulence, 1660
- with H. Staras, theoretical research on tropospheric scatter propagation, 3846
- with others, aperture-to-medium coupling on line-of-sight paths, 4183
- Whelan, E. H., with others, l.f. propagation paths in arctic areas, 4182
- Whelan, J. M., and G. H. Wheatley, preparation and properties of GaAs, 881
- with C. S. Fuller, behaviour of Cu in GaAs, 882
- with W. G. Spitzer, infrared absorption and effective mass in n-type GaAs, 3383
- with others, elastic moduli of GaAs, 3380
- Whetstone, A., mas light source, 3435
- Whetten, N. R., and A. B. Lapovsky, secondary emission from MgO thin films, 2316
- Whipple, F. L., and J. A. Hynes, I.G.Y. optical satellite tracking program, 2566
- Whirry, W. L., and C. E. Nelson, microwave cavity filters, 2467
- with others, relaxation phenomena in diode parametric amplifiers, 3626
- White, A. D., gas-diode switch, 724; hollow-cathode glow discharge, 2909
- White, B. H., with H. C. Lin, single-ended amplifiers for class-B operation, 2885
- White, D. L.,  $\beta$ -quartz as high-temperature piezoelectric material, 3009
- White, E. L. C., frequency modulator for broadcast transmitters, 3872
- White, G. K., and S. B. Woods, resistivity of Bi and Sb at low temperatures, 1222
- White, H. G., with others, splitting of As donor ground state in Ge, 1615; acoustoelectric effect in n-type Ge, 3373
- White, J. G., and W. C. Roth, polarity of GaAs, 3381
- White, L. G., with J. F. Golding, linear amplifier for decimicrosecond pulses, 3993
- White, N. P., with S. T. Cap, guidance systems in space flight, 3839
- White, R. B., with others, radiation observations with satellite 1958  $\delta$ , 4042
- White, R. L., line widths and g-factors in ferrites, 3402
- White, R. M., C. K. Birdsall and R. W. Grow, multiple ladder circuits for mm-wave tubes, 3159 v
- Whitehead, C. C., 'variable- $\mu$ ' magnetic amplifier, 2170
- Whiteway, F. E., pre-pulse techniques in high-speed oscillography, 3827
- Whitfield, G. D., theory of electron-phonon interactions, 2215
- Whitfield, H. R., and C. M. Cade, analysis of collision-course prediction, 2259 r
- Whitham, K., relation between secular change and non-dipole fields, 790
- Wickersham, A. F., Jr, anomalous dispersion in artificial dielectrics, 482; Stokes' equations and refractivity of thin films, 1154
- Wickizer, G. S., with others, 468-Mc/s tropospheric scatter propagation, 245
- Widdowson, A. E., D. C. Gore and C. H. Butcher, new method for fine-wire grids, 2788 y
- Wieder, H. H., ferroelectric properties of colemanite, 3741
- Wiekhorst, F., absorption of e.m. waves by lossy resonant slots, 2205
- Wienczek, Z., automatic controls for colour television, 3118
- Wiener, F. M., and D. N. Keast, propagation of sound over ground, 3900
- K. W. Goff and D. N. Keast, instrumentation for study of sound propagation, 2081
- Wiener, G. W., and K. Delert, cube-oriented magnetic sheet, 896
- van Wieringen, J. S., paramagnetic resonance, 778
- Wiessner, W., with G. Zickner, influence of leads on capacitors, 1316
- Wigan, E. R., unpleasantness of distorted sound, 2817
- Wigington, R. L., new concept in computing, 2126
- Wijn, H. P. J., with A. L. Stuijts, crystal-oriented ferroplasma, 2687
- Wilcox, C. H., with R. B. Barrar, Fresnel approximation, 1442
- Wild, J. P., with others, extension of solar radio spectroscopy, 2933
- Wilhelm, C. R., with A. J. Seyler, video transmission test set, 4159
- Wilkinson, E. J., slot-antenna array for missiles and aircraft, 1774
- Wilkinson, J. H., and D. W. Davies, automatic computing engine at N.P.L., 2128
- Will, R., with F. Duclaux, lunar-diurnal variation of geomagnetic field, 2228
- Willardson, R. K., transport properties in Si and GaAs, 4089 f
- with others, transverse magnetoresistance and Hall effect in n-type InSb, 4119
- Willhite, C. C., and J. W. McIntyre, analogue computer for evaluating radar performance, 1465
- Williams, A. D., and D. C. Gore, low-noise triode for use up to 1 kMc/s, 1419
- Williams, C., review of radio aids to navigation, 2259 a; radio aids and aeronautical navigation, 2978 c
- Williams, D., structure of h.f. ionospheric scatter signals, 2000 d
- with P. H. Culler, scatter-signal analyser, 2000 b
- Williams, H. J., with others, domain behaviour in transparent magnetic oxides, 1956
- Williams, I., with others, search for new Heusler alloys, 1950
- Williams, R., with others, microwave frequency standard, 4150
- Williams, R. G., with others, evidence for carriers with negative mass, 875
- Williams, R. L., properties of CdS photoconductive cells, 1010
- Williams, R. W., and H. Marchant, resistance potentiometers as function generators, 35
- Williams, T. R., and J. B. Thomas, current noise and nonlinearity in carbon films, 3596
- Williams, W., adiabatic and isothermal effects in  $\text{Bi}_2\text{Te}_3$ , 2670
- with R. Mansfield, electrical properties of  $\text{Bi}_2\text{Te}_3$ , 532
- Williams, W. E., step discontinuities in waveguides, 14
- Williamson, D. T. N., e.s. loudspeakers, 8
- Williamson, J. B. P., with others, electrical conduction in solids, 485
- Williamson, L. A., cooling airborne electronic equipment, 1420
- Willis, D. W., data storage and processing on magnetic tape, 1786
- Willis, J. B., with others, precipitation on a dislocation, 2289
- Willmore, A. P., new method of tracking earth satellites, 1189
- Willoughby, E. O., and E. Heider, omnidirectional paraboloid aerial, 1447
- Willrodt, M., with others, precision generator for radar range calibration, 2352
- Wilmotte, R. M., with M. Greenspan, distributed transducer, 673
- Wilson, A. C., with H. V. Coltony, gains of corner-reflector antennas, 3205
- Wilson, F. G., with others, decreases in cosmic-ray intensity during period October 1956-January 1958, 4037
- Wilson, B. L. H., with D. H. Roberts, effects of  $\text{O}_2$  on resistivity in Si, 2294
- Wilson, D. K., with others, electron-spin-resonance experiments on Ge, 3775
- Wilson, E. F., divider vernier to synchronize pulses, 3232
- Wilson, F. V., with A. W. Vose, airborne weather radar, 147
- Wilson, J. M., large-scale preparation of Ge, 2653
- Wilson, V. C., conversion of heat to electricity by thermionic emission, 3436
- Wilson, W. P., group delay and group velocity, 1798
- Wiltse, J. C., characteristics of dielectric image lines at mm  $\lambda$ , 3930
- Wimmel, H. K., with W. Maier, quantum theory of dielectric polarization of gases, 2901
- Wimpffen, J., with W. F. Niklas, oscilloscope tube with travelling-wave deflection, 927
- Winckel, F., acoustic criteria for concert halls, 1063
- Winckler, J. E., with others, balloon gear monitors cosmic radiation, 437
- Winckler, J. R., and others, auroral phenomena during storm, 3309
- with L. Peterson,  $\gamma$ -ray burst from solar flare, 104
- with others, geophysical effects associated with high-altitude explosions, 2575; protons from sun 12th May 1959, 4040
- Windsor, E., oxide cathodes for travelling-wave tubes, 3159 ff
- Winer, T., with J. C. Anderson, temperature-stabilized photo-transistor relay circuit, 1109
- te Winkel, J., drift transistors, 3879, transmission-line analogue of, 3153
- with others, junction transistor as network element, 1719, 2781, 3518
- Winkel, P., and D. G. de Groot, impedance of dielectric layers, 2271
- Winkler, G. M. R., with others, comparison of Cs frequency standards, 212
- Winslow, D. K., with others, current distribution in modulated electron beams, 644

- Wintenberger, M., measurement of Hall effect in anisotropic media, 213
- Winwood, J. M., magnetic forces and relativistic speeds in stationary electron beams, 85
- Wisch, W., instrument for measurement of  $Q$ -factor, 2709
- Wiseman, R. S., and M. W. Klein, photoemissive image-forming systems, 4238
- Wisotzky, W., constant-frequency oscillators without stabilized supplies, 1482
- Witchey, A. L., with others, evaluation of modulated-air-flow loudspeaker, 3922
- Wither, E. L., c.r. tube adds third dimension, 1747
- Wittke, H., image distortion by RC quadrupoles of c.r.o., 1318
- Wittke, J. P., with others, structure and relaxation times of  $Cr^{3+}$  in  $TiO_2$ , 2333
- Woelke, C. D., with others, properties of green and red-green luminescing  $CdS$ , 2621
- Wolf, M., with M. B. Prince, Si photovoltaic devices, 640
- Wolf, W. P., with others, ferromagnetic resonance in polycrystalline rare-earth garnets, 2690
- Wolfe, J. L., satellite tracking by h.f. d.f., 798
- Wolfe, P. G., with others, colour purity adjustment for 'apple' c.r. tube, 1386
- Wolfe, W. L., with M. R. Holler, optical-mechanical scanning techniques, 4010 k
- Wolff, G. A. I., Adams and J. W. Mellichamp, electroluminescence of AlN, 4082
- Wolff, H. G., frequency-shift keying of i.f. and v.l.f. radio circuits, 965
- Wolff, P. A., plasma resonance in solids, 781
- Wolfstirn, K., and C. S. Fuller, comparison of radio-copper and hole concentrations in Ge, 1250
- Wolk, B., breakdown of cathode coatings, 1029
- Wolkstein, H. J., effect of collector potential on efficiency of travelling-wave tubes, 314
- Woll, H. J., with J. E. Lindsay, design of transistor d.c. amplifiers, 65
- Wolley, E. D., with others, effect of fast neutrons on  $n$ -type Ge, 866
- Wolter, H., reactance theorem, 1797; theorems of information theory, 3852
- Woltjer, L., theorem on force-free magnetic fields, 784
- Wong, J. Y., scattering of plane e.m. wave, 2540
- and S. C. Loh, radiation resistance of elliptic loop, 1776; radiation field of elliptic helical antenna, 3577
- with S. C. Loh, radiation field of elliptic loop, 20
- Wong, P. K., with others, use of d.c. amplifier and recorder to balance resistance bridge, 3061
- Woo, Way Dong. See Way Dong Woo.
- Wood, A. F. B., with S. Tolansky, interferometric studies on oscillating quartz crystals, 2335
- Wood, G. C., with others, noise-gated a.g.c. and sync system, 1382
- Wood, P. W., transistorized f.m. oscillator, 1489
- Woodbridge, D. D., N. J. Macdonald and T. W. Pohrite, geomagnetic disturbances and changes in atmospheric circulation at 300 mb, 2229
- Woodbury, H. H., with G. W. Ludwig, electron spin resonance in Ni-doped Ge, 2661
- Woodland, N. J., with W. E. Goetz, data reduction of spot diagram information, 1105
- Woods, J., photochemical effects and effect of  $O_2$  on  $CdS$ , 1593
- Woods, S. B., with G. K. White, resistivity of Bi and Sb at low temperatures, 1222
- Woodward, O. M., Jr, circularly polarized corner-reflector antenna, 1098
- Woodyard, O. G., with others, U.R.S.I. report on antennas and waveguides, 3565
- Woolley, R. v. d. R., Royal Greenwich Observatory, 2550
- Woolston, J. R., with others, electron mobilities in GaAs, 529
- Wootton, D. J., J. A. Lucken and R. C. Bannerman, experimental annular reflex klystron, 3524 bb
- with others, design of gridless low-voltage reflex klystron, 3524 dd
- Worcester, J. A., one-transistor push-pull, 2887
- Wormser, E. M., with R. De Waard, thermal detectors, 4010 g
- Worst, E. C., Jr, with others, high-sensitivity infrared detectors, 1012
- Woschni, E. C., permissible circuit impedance of i.f. filters for f.m., 732; distortion factor in v.h.f. f.m. receivers, 4190
- Woyk (Chvojková), E., signals from earth satellites, 1549; antipodal reception of Sputnik III, 2957
- Wray, D., frequency compensator for stepped waveguide transforming sections, 1077
- Wray, F., with others, c.w. power travelling-wave tube, 2787
- Wright, C., temperature stabilization of transistor circuits, 2052
- Wright, C. S., with others, causes of geomagnetic fluctuations with 6-sec period, 2945; geographical variations in geomagnetic micropulsations, 2946
- Wright, D. A., thermoelectric properties of semiconductors, 3347
- with others, thermoelectric power of semiconducting diamond, 1924
- Wright, E. E., with T. D. Schlabach, test patterns for printed-circuit materials, 2487
- Wright, G. T., space-charge-limited currents in insulating materials, 1622
- Wright, H. C., and J. C. Brice, indium monotelluride, 2312
- Wright, R. W., and N. J. Skinner, lunar tides in E<sub>1</sub> layer, 1880
- with others, horizontal drift measurements near equator, 1557
- Wright, S. B., with F. C. Champion, diamond conduction counters with small electrode separations, 1990
- Wu, T. T., and R. W. P. King, driving point and input admittance of linear antennas, 1440
- Wucher, J., with others, magnetic properties of (Ni,Li)<sub>2</sub>O, 3799
- Wulf, O. R., with S. B. Nicholson, diurnal variation of geomagnetic fluctuations, 1533
- Wunderlin, W., with W. Guggenbühl, equivalent circuit of h.f. transistors, 2433
- Wunsch, G., practical design of 2-phase networks, 2158; general network theorem, 2495
- Wyatt, S. P., so ar effects on motion of Vanguard, 4050
- Wyeth, F. H., J. B. Higley and W. H. Shirr, Jr, precision guarded resistance measuring facility, 561
- Wynne, C. G., lens designing by digital computer, 2483
- Yabroff, I., with R. L. Leadabrand, geometry of auroral communications, 1671
- Yabumoto, T., Hall effect in oxide cathodes, 3166
- Yadavalli, S. V., broad-band operation of multi-cavity klystrons, 1015
- Yaffee, P., with others, electronic subsystem development problems in naval ordnance, 2803
- Yajima, T., and L. Esaki, excess noise in narrow Ge  $p$ - $n$  junctions, 1257
- Yakobson, M. A., with others, line spectra of absorption edge of  $CdS$ , 471
- Yamada, K., with T. Kasuya, electrical and thermal conductivity of monovalent metals, 4015
- Yamaguchi, J., and Y. Hamakawa, Ge  $p$ - $n$  junction, high-electric-field effects in, 3023, barrier temperature at turnover in, 3024
- Yamaguchi, K., with B. Oguchi, centre-excited mode transducer, 2831
- Yamaguchi, S., measurement of residual magnetism of thin film, 1314; magnetic analysis with electron beams, 2199; magnetic perturbation of cathode rays, 3636; magnetic and crystallographic analysis by electron diffraction, 3801
- Yamaguchi, Y., and others, effect of solar eclipse on geomagnetic field, 2562
- Yamaka, E., with others, band structure of InSb, 1940
- Yamamoto, M., S. Taniguchi and K. Aoyagi, ferromagnetic domain structure in Co-Ni crystal, 192
- Yamanaka, S., with Y. Saito, residual polarization of  $BaTiO_3$  ceramics, 3327
- Yanagi, A., with others, 4-kMc/s-band v.s.w.r. scanner, 1975
- Yanaoka, I., with others, helix-type travelling-wave amplifier, 1415
- Yankov, V. V., behaviour of conducting gaseous sphere: i) quasi-stationary e.m. field, 3640
- Yariv, A., coupling coefficients in 'coupled-mode' theory, 1014
- and F. D. Clapp, determination of cavity parameters, 4154
- J. R. Singer and J. Kemp, radiation damping effects in 2-level maser, 1818
- Yasuda, S., with M. Kenmoku, package-type travelling-wave amplifier, 2788 p
- Yatani, M., with others, band structure of InSb, 1940
- Yates, B., conductivity and Hall coefficient of  $Bi_2Te_3$ , 1942
- Yatsvi, S., double-quantum transitions in masers, 2890; multiple-quantum transitions in magnetic resonance, 2923
- Yatsunskii, I. M., effect of geophysical factors on satellite motion, 3683
- Yavich, L. R., wave matrices of quadrupole, 2149
- Yee, R., and others, avalanche breakdown in  $n$ - $p$  Ge diffused junctions, 3378
- Yeh, K. C., and O. G. Villard, Jr, new type of fading on path crossing equator, 945
- Yeh, L. P., tropospheric-scatter system design, 1360; loop control of scatter power to offset fading, 1694; communications in space, 3469
- Yerg, D. C., analysis of drifts of signal pattern, 1884
- Yin, H. B., and H. M. Wasson, r.f. amplifier for v.h.f. television receivers, 1384
- Yonezawa, T., influence of electron-ion diffusion on formation of F<sub>2</sub> layer, 128
- and Y. Arima, F<sub>1</sub> layer, semidiurnal lunar variations of, 1196; variations in electron density of, 4055
- H. Takahashi and Y. Arima, electron and ion density distributions in F region, 2579
- Yoshida, I., S. Nomura and S. Sawada, thermal conductivity of  $BaTiO_3$  ceramics, 2628
- Yoshida, M., with others, magnetic properties of  $TiFe_2O_7$ - $Fe_2O_3$  system, 542
- Yoshida, S., X circulator, 2832
- Young, J. F., alternatives to Wien bridge, 1124; simple v.l.f. oscillator, 2160; transistor characteristic curve tracer, 3060
- Young, J. W., pagemaster receiver and modulation equipment, 3476
- Young, L., predicting accurate radar ranges, 2606
- Young, M. E., W. M. Alexander and H. D. Schwenman, rotating-disk function generator, 2858
- Young, R. D., energy distribution of field-emitted electrons, 2197
- and E. W. Miller, energy distribution of field-emitted electrons, 2198
- Young, R. W., with C. C. Ritchie, design of biased-diode function generators, 2861
- Young, S. G., h.f. exponential-line transformers, 1070
- Younger, J. J., and others, parametric amplifiers as, superregenerative detectors, 3245
- Yousef, Y. L., and H. Mikhail, electrodynamic magnetic field gradiometer, 218
- Yu, Y. P., coincident slicer measures phase directly, 217
- Yueh-Ying Hu, back-scattering cross-section of cylindrical antenna, 1444
- Yukutake, T., with others, effect of solar eclipse on geomagnetic field, 2561
- Zăgănescu, M., with C. Sălceanu, correction to velocity of sound by resonance method, 328; influence of thickness of walls of resonance tube, 1422
- Zakharchenya, B. P., with E. F. Gross, Zeeman effect and exciton structure in  $Cu_2O$ , 1623
- with others, influence of magnetic field on fluorescence of pure  $CdS$ , 2622
- Zakirova, I. R., with others, secondary emission from Ni, 3789
- Zaim, P., with J. J. Scheer, crystal structure of  $Na_2KSb$ , 2995
- with others, electroluminescence and image intensification, 1597
- Zankel, K. L., and E. A. Hiedemann, amplitude distortion of ultrasonic waves, 2814
- Zavadskii, E. A., with I. G. Fakhidov, oscillation of resistance of  $n$ -type Ge in pulsed magnetic fields, 872
- Zawels, J., wide-band bridge for transistor parameters, 1003
- Zettler, E., and G. F. Bahr, quantitative electron microscopy, 3444
- Zelikman, M. Kh., with K. I. Gringauz, measurement of ion concentration along satellite orbit, 3696
- Zemanek, H., solution of equations in switching algebra, 1297
- and K. Walk, Techebycheff approximations for Cauer filters, 2498
- Zemel, J. N., surface transport theory, 1233
- Zerbst, G., with others, image converters for quantity production, 1404
- Zheleznyakov, V. V., radio emission of sun and planets, 3275
- Zheleztsov, N. A., and M. I. Felgin, operating conditions of symmetrical multivibrator, 1806
- Zheludev, I. S., with others, domain structure of ferroelectrics, 158
- Zhidkov, V. A., and V. E. Lashkarev, diffusion and electric state of thermal excitons in Ge, 520
- Zhirnov, V. A., theory of domain walls in ferroelectrics, 3740
- Zhuze, V. P., G. E. Pikus and O. V. Sorokin, determination of surface recombination velocity, 500
- V. M. Sergeeva and E. L. Shtrum, new semiconducting compounds, 3755
- Zickner, G., and W. Wiessner, influence of leads on capacitors, 1316
- Ziegler, E., with E. Huster, spreading of discharge in counter tubes, 1332
- Ziehm, G., true-phase capacitive goniometers, 4068
- with K. Baur, ferromagnetic transmitter aerial for distress at sea, 4223
- van der Ziel, A., with H. J. Hannam, noise in oxide cathodes, 1027
- with K. M. van Vliet, noise generated by diffusion mechanisms, 2422
- Zielasek, G., growth phenomena in Ge crystals, 3358; semiconductor component for electronic circuits, 4225
- with G. Pröpsch, Sb distribution in Ge-Sb alloys, 3026
- Ziman, J. M., galvanomagnetic properties of Fermi surfaces, 3271
- Zimmermann, A., thermal expansion coefficient of ferrites, 4128
- Zinke, O., with K. L. Lenz, absorption of e.m. waves in absorbers and lines, 1068
- Zito, G., measurement of phase difference on power transmission lines, 1971
- Zitter, R. N., role of traps in photoelectromagnetic and photoconductive effects, 1229
- Zlotykamin, C., high-density electron gun, 3524 x
- Zmuda, A. J., analysing values of scalar magnetic intensity, 109
- Zneimer, J. E., with others, grain growth in Ni ferrites, 544
- Zohn, S. R., with others, multiple Fourier analysis in rectifier problems, 2382
- Zoldan, G., with G. C. Corazza, physical realizability of microwave junction, 2139
- Zozulya, Yu. I., with M. I. Klinger, theory of semiconductors with excited impurity zone, 1604
- Zschechel, H., automatic data processing, 1454
- Zschörner, H., with H. K. Paetzold, radio observations at 20 Mc/s of first Russian earth satellites, 2237; density of outer atmosphere from satellite observations, 3695
- Zucker, I. J., with others, frequency pushing in crossed-field oscillators, 2788 q
- Zucker, N., with others, markerless pulse trains for communications, 956
- Zuhrt, H., addition of distortion voltages in long-distance a.m. systems, 3856
- Zuleeg, R., effective collector capacitance in transistors, 632
- and J. Lindmayer, sweep equipment displays transistor  $\beta$ , 928
- with J. Lindmayer, determining transistor high-frequency limits, 4232
- Zverev, A., and H. Blinichhoff, network transformations for wave filter design, 3222
- Zverev, G. M., and others, chromium corundum paramagnetic amplifier, 1145
- Zwerdling, S., and others, exciton- and magneto-absorption of transitions in Ge, 3364
- with others, Zeeman effect of excitons in Ge, 2299
- with others, optical magneto-absorption effects in semiconductors, 3365
- Zwicker, E., psychological and systematic bases of loudness, 3544
- Zwobada, R., 220-kW Q-band magnetron, 2788 e
- Zyazev, V. L., and O. A. Esin, influence of short-range order on type of conductivity, 3750
- Zyryanov, P. S., and G. G. Taluts, acoustic-electrical phenomena in degenerate plasma, 3638

# SUBJECT INDEX

- Absorption**, (See also Resonance; Wave Propagation)  
 acoustic, calculation of statistical coefficient from impedance-tube measurements, 3920  
 of fibrous materials, coefficients for, 3549  
 of hollow cylinders, 3547  
 in lined ducts, 683  
 low-frequency, slit-resonators for, 687  
 reciprocity violation in, 332  
 resonant plywood panels for, 2821  
 in reverberant field, calculation of coefficient from impedance value, 3921  
 in sea, reverberation tank for measurements, 1043  
 of sound-insulation materials, 686  
 in transition layer between homogeneous media, 669  
 waveform distortion effects in, 668  
 of e.m. waves, by resonant slots, 2205  
 structures for, 1068  
 microwave, in artificially anisotropic media, 1847  
 by grid of lossy dipoles, 1846  
 in  $NH_3$  at 6 mm  $\lambda$ , 2213  
 polarization and angle dependence of reflection of absorbers, 2915  
 Zeeman spectrum of atomic oxygen, 4032  
 ultrasonic, in metals, 3336  
 collision-drag effect, 2444  
 in quartz, at 1-4 kMc/s, 2636  
 in seawater, at 50-500 kc/s, 2082  
 in solids, at 100-1000 Mc/s, 3536  
 in viscous liquids, 671
- Acoustics**, (See also Absorption; Diffraction; Sound; Ultrasonics)  
 architectural, automatic evaluation of sound reflections, 3545  
 design of Alberta auditoria, 688  
 design of talk studios, 2822  
 distribution of normal modes in rooms, 684  
 'echo parameter' criterion in, testing of, 685  
 effect of room shape on sound field, 3916  
 features of auditoria and concert halls, 1063  
 iteration method applied to speech and music, 1428  
 reverberation-curve characteristics, 3546  
 sound pressure fluctuations when receiver position is varied, 3915  
 studio design for exclusion of traffic noise in Karlsruhe, 1756  
 wall design for high transmission loss, 3917  
 artificial ear for insert earphones, 3  
 diffusion measurements, in reverberation chambers, 3919  
 using rotating microphone, 3918  
 insulation measurements, influence of resonances on, 2090  
 measurement of impedance of closed air spaces, 3180  
 research in China, 2808  
 reverberation plates with electrodynamic excitation, 1755  
 spectrograms of experimental music, 1425  
 stereo-reverberation effect in, loudspeaker system for, 1065
- Acousto-electric effect**, experiments on Cu and Al, 4009  
 in metals and semiconductors, 2189
- Aerials**, (See also Lenses, microwave)  
 aircraft, automatic switching circuit for, 3568  
 aperture- and horn-type, effect of flanges on radiation patterns of, 3582  
 aperture-type, using helix waveguide, optimum dimensions for, 3958  
 using open waveguide, radiation characteristics of, 3959  
 using trough waveguide, 3960  
 arrays, broadside, directivity of, 3955  
 dipole, directivity factors, method of plotting, 2470  
 horizontal radiation patterns around support mast, 343  
 directivity control by servo system, 1092  
 directivity improvement for pulsed signals, 3574  
 multiplicative, for reception, 3953  
 rhombic, design of, 3576  
 with rotating radiation field, 2120  
 scanned electrically, effective aperture of, 2847  
 sidelobe suppression for m.f., 3575  
 slot, for missiles and aircraft, 1774  
 slotted, nonresonant, 3202  
 strip, signal/noise performance, 2  
 superdirective, signal/noise performance, 329  
 slotted, 3572  
 beam-swinging, for transhorizon propagation measurements, 3198  
 cone-type, surface current distribution for required radiation pattern, 2841  
 cylindrical, back-scattering cross-section of, 1444  
 current distribution and input impedance of, 1085  
 first-order solution by generalized circuit, 23  
 theory of, 3945  
 dielectric, control of radiation from, 1095  
 verification of theory using perspex rod, 2118  
 wax models for design of, 3204  
 dipoles, resonant-ring, for forward-scatter systems, 3196  
 dipole, circuit theory based on variational method, 1090  
 conductance of, 1089  
 conical, characteristic-impedance calculations, 2843  
 electric and magnetic field of, 17
- Aerials**, dipole, folded, bandwidth of, 2842  
 radiation over surface of given impedance, 3950  
 transient ground wave radiated from, 239  
 Yagi concentric feed for, 344  
 directive, aperture field distribution for high-gain beam, 3952  
 u.h.f., performance in complex fields, 2845  
 for earth satellites, spherical-array problems, 1091  
 efficiency calculations, 3944  
 ferromagnetic, for sea-rescue transmitter, 4223  
 helical, elliptic, radiation field of, 3577  
 theory of, 3570  
 hemi-isotropic, using dielectric element in waveguide aperture, 2850  
 horn-type, beam-width reduction by plexiglass plates, 3961  
 with parabolic reflectors, for radio links, 1777  
 linear, asymmetrically fed, radiation diagram of, 3567  
 driving point and input admittance of, 1440  
 loop, elliptic, radiation field of, 20  
 radiation resistance of, 1776  
 radiation in conducting medium, 3957  
 rectangular, as dipole, 3579  
 mast-type, lightning-current distribution in earthing system for, 1451  
 microwave, combining network for 4, 6 and 11 kMc/s, 3954  
 Fraunhofer radiation pattern of, simulation in Fresnel zone of, 1096  
 radiation from ring-source excited cone, 3965  
 sawtooth, 3578  
 scanning, Foster-type, 2121  
 split reflector for reducing mismatch, 712  
 with wire-grid reflector, transmission-loss data, 3963, 3964  
 modulation of parameters for multipattern operation, etc., 2840  
 monopole, top-loaded, earth currents near, 3947, 3948  
 paraboloid, omnidirectional, vertically polarized, 1447  
 as passive relay system, using Hertzian mirror, 2852  
 for television, 2851  
 pillbox-type, with wide-angle scanning, 1448  
 with plane reflector, radiation patterns as function of spacing, 1097  
 prolate-spheroid, current distribution and impedance of, 1445  
 'radiosphere' around, 3566  
 radiation fields of, Fresnel approximation for, Sommerfeld expansion in, 1442  
 for radio-astronomy, high-resolution 2-element interferometer, 2936  
 'optimum' design, 2471  
 16-element array for 9300 Mc/s, 3659  
 using 360-ft parabola and plane reflector, 3962  
 receiving, influence of top-end capacitance on inductive coupling of, 2383  
 long-wire, delta-type, 3199  
 reflector-type, attenuation in radio links of, 1778  
 corner, with arbitrary dipole orientation and apex angle, 1099  
 circularly polarized, 1098  
 gain of, 3205  
 log-periodic, for 105-430 Mc/s, 2853  
 parabolic, with feed displaced from focus, 2474  
 rhombic, with cylindrical helices as arms, 19  
 design methods, 3956  
 scanning system, using ferrite-loaded aperture, 2472, 2473  
 short, bandwidth and efficiency of, 3946  
 slot, annular, design data, 2849  
 conical radiation field of, 3580  
 in filled and unfilled waveguide, radiation from, 21, 22  
 in parallel-plate transmission line, 3203  
 voltage breakdown characteristics, 3581  
 slotted-cylinder, for four simultaneous transmissions, 1443  
 radiation patterns of, 1093  
 slotted-waveguide, for marine radar, 711  
 on smooth curved surface, radiation pattern of, 3195  
 spiral, equiangular, 3949  
 strip-type, current distribution with normally incident plane wave, 1086  
 for submarines, design of, 2469  
 surface-wave, corrugated and dielectric-clad, for beacon applications, 1449  
 scanning-type, using corrugated conductor, 3201  
 s.w., for ionospheric sounding, 710  
 microwave model for studying directivity characteristics, 709  
 switches, phase-shift type, for radio-astronomy interferometer, 2844  
 television, receiving, adaptation problems, 1775  
 frame-type, 3200  
 wide-band, for band III, 2122  
 transmitting, quadruplexer for, 2119  
 slotted-cylinder, for v.h.f., 1094  
 Süddeutscher Rundfunk, 1773  
 u.h.f., post-installation tests of, 1088  
 in U.K., 3571  
 transmitting, automatic tuning systems, 3197  
 performance data for, 1087  
 for simultaneous transmission of broadcast programs, 16  
 travelling-wave, design method for, 3569  
 for determination of end-fire echo area of long thin bodies, 1446  
 U.R.S.I. report on, 3565  
 v.h.f., 3-band combining network for, 733
- Aerials**, v.l.f., using power transmission line, 1672  
 zig-zag, radiation characteristics of, 2848  
 Alloys, Mn-Cu and Co-Cu, dilute, low-temperature electrical and magnetic properties of, 2673  
 of transition metals, electron structure of, 418
- Amplification**, parametric, circuit conditions for, 75, (C)2897  
 and frequency mixing in propagating circuits, 76  
 of space-charge waves, 1025  
 wide-band, at h.f. using artificial transmission lines, 3234  
 techniques for, 1490
- Amplifiers**, (See also Circuits; Valves)  
 a.f., using auxiliary ultrasonic signal, 2814  
 class-B, distortion reduction in, 2883  
 performance with random noise signals, 2168  
 ultralinear, using cathode followers in place of tapped transformer, 1493  
 3-valve, 63  
 band-pass, design formulae for, 2512  
 cathode-follower, design data, 3235  
 maximum amplitude as function of output time-constant, 751  
 class-C, response of, 1138  
 d.c., compensation for changes in heater supply voltage, 750  
 for control systems, 748  
 using magnetic modulators, 2165  
 for measurements, zero adjustment of, 2342  
 using semiconductor, 3233  
 transient response of, 3994  
 with transistor chopper, 2519  
 with whole-loop feedback, 1137  
 d.c. and chopper-type, using transistors, 1498  
 differential, for reducing effects of power-supply variations, 3615  
 distributed, using straight-wire transmission line, 1492  
 v.h.f., for coupling receivers to aerial, 749  
 wide-band, for short pulses, 747  
 for 200-Mc/s pulses, 2166  
 feedback, matrix analysis of equivalent quadrupoles, 2497  
 h.f., low-noise, using disk-seal triode, 3236  
 input circuits for, low-capacitance, 752  
 linear, for negative pulses, 62  
 logarithmic, voltage-operated, 3996  
 wide-band, 50 c/s-100 kc/s, 2169  
 lumistor, using coupled electroluminescent cell and photocell, 3884
- magnetic**, a.c.-controlled, 382  
 analysis of, 3237  
 applications of, 2516  
 with combined magnetic and electrical feedback, 3998  
 design for maximum power, 381  
 with dynistor and transistor semiconductor switching devices, 2174  
 fast-response, transfer efficiency of, 3238  
 feedback in, 2172  
 half-wave, theory of, 1495  
 operating characteristic of, graphical determination of, 3617  
 for servo systems, 2173  
 shunt-coupled, using gate voltage as output, 3997  
 'variable- $\mu$ ', 2170  
 volt-second transfer efficiency in, 2171
- maser**, Bloembergen-type, materials for, 3242  
 dual system with lossless power-dividing network, 388  
 based on hyperfine levels of Cu ions, 2181  
 for infrared and optical wavelengths, 1857  
 method for tuning cavity, 74  
 molecular-beam, sub-mm- $\lambda$ , 1146  
 multiple-level, pulsed-field, 3623  
 $NH_3$ -beam, as frequency standard, 389  
 noise-figure measurement, 2343  
 paramagnetic, theory of, 2894  
 3-kMc/s, using  $Al_2O_3 \cdot Cr_2O_3$  crystal, 1145  
 principles of, 1500  
 pulsed, analysis of emission conditions, 756  
 ruby, 2178  
 L-band, tunable, 2523  
 low-field, 3624  
 wide-band, tunable, 1144  
 3-level, 1143, calculation of resonance conditions in, 3622  
 ruby as material for, 3793  
 small-signal analysis of, 1501  
 solid-state, travelling-wave, 2891, 3-level, 2177  
 2-level, behaviour of, 73, materials for, 3037  
 3-level, 1502  
 300-500-Mc/s, 4002  
 'staircase'-type, proposal for, 2522  
 weak-field, for nuclear-magnetic-resonance investigations, 2548  
 self-oscillator, 2521  
 X-band, for radio astronomy, 2892  
 zero-field, 2889  
 2-level, radiation damping effects in, 1818  
 3-level, double-quantum process for, 2890  
 as heat engine, 2212  
 maser action at 1500 Mc/s by 3-level excitation, 3654  
 masers and quantum-mechanical devices, theory of, 72  
 microwave, using negative-conductance 'tunnel' diode, 3246  
 negative-mass, using semiconductors, principles of, 1824  
 solid-state, 4004  
 molecular-beam and paramagnetic-crystal types, 2888  
 nonlinear, effect of reaction on gain of, 2167

- Amplifiers, operational, without stabilized supply, 1494  
 parametric, 2896  
 cancellation of ferromagnetic hysteresis by orthogonal polarization, 3244  
 cavity-type, with variable coupling, 2185  
 electron-beam, 321  
 cavity-type, 2066  
 design of travelling-wave couplers for, 2067  
 pumping of fast space-charge wave for, 1412  
 with transverse modulation, 4247  
 3-frequency, analysis for, 2065  
 ferromagnetic, pulsed, gain measurements on, 2184  
 using grain boundary in Ge, 3241  
 as limiter without phase distortion, 1819  
 'navar' operation, 79  
 nonlinear-capacitance, 1820  
 performance of, 77  
 for reception of space signals, 2895  
 using Si-diode, for 900-Mc/s scatter link, 390  
 solid-state, low-noise, 1503  
 superregenerative, 3243  
 as superregenerative detectors, 3245  
 surface-wave, ferroelectric, 3625  
 travelling-wave, analysis of, 3240  
 4.5-Mc/s, 2524  
 using variable-reactance diodes, with directional bridge system, 2183  
 as phase-distortionless limiter, 2182  
 relaxation phenomena in, 3626  
 X-band, using GaAs diodes, 4006  
 4-terminal, using Ge diodes, 1148, analysis of, 4005  
 2900-Mc/s, 'reactatron', using junction diodes, 1150  
 4-kMc/s, using Ge diodes, 1149  
 power, grounded-grid, using disk-seal valve, design data for, 2884  
 pulse, based on impact ionization in Ge, 2882  
 with sub-nus rise time, 1135  
 0.1- $\mu$ s, using auxiliary boost circuit, 3993  
 r.f., asymmetric, sideband currents with a.m. in, 3992  
 80-kW, 6-27-Mc/s, 290  
 semiconductor, avalanche-controlled, theory of, 3620  
 transistor, a.f., 67  
 for acoustic measurements, 1499  
 preamplifier for magnetic-tape playback, 387  
 push-pull, single-ended, 2885, 2887  
 RC-coupled, design of, 1816  
 4.5-W, sliding-bias, 384  
 25-W, 2886  
 bias-network design using thermal parameters, 1140  
 class-A, common-emitter, nonlinearity of, 1817  
 common-base and common-emitter, gain stability and frequency response of, 1139  
 d.c., design considerations for, 65  
 differential circuit for reducing drift in, 1496  
 for servo system, 2176  
 feedback, design of, 3239, equations for, 3619  
 i.f., emitter-current-controlled, 2517  
 l.f. design procedure, 3999  
 low-noise input stages for, 4001  
 low-noise stages with negative feedback, 1142  
 for magnetic tape and drum playback, 2175  
 matrix method of circuit analysis for, 1141  
 narrow-band, nomographs for, 1497  
 negative-resistance, for Q-multiplication, 3618  
 pulse, 2518  
 with nonlinear feedback, 386  
 stability of, 4000  
 tetrode, for 30-Mc/s i.f. stages, 70  
 thermal stabilization using half-supply-voltage principle, 71, 755  
 video-frequency, design of, 385  
 stagger-tuned, 754  
 with 80-V output, 69  
 2-stage, high-gain circuit, 66  
 15-W, for public-address system, 68  
 tuned-transformer-coupled, design charts for, 2513  
 u.h.f., power-type, using travelling-wave valves, 380  
 video-frequency, with cathode compensation, 1814, 2515  
 using valve Type PCL84 with anode compensation, 379  
 wide-band, design data for, 1491  
 for investigation of electron avalanches, 1136  
 400-450-Mc/s, for radar and scatter, 64
- Analysers**, amplitude, with variable-width output pulse, 1976  
 frequency, wide-range, using 2 reference signals, 2712  
 pulse-height, using beam-deflection valve, 3990  
 multichannel, using distributed circuits, 377  
 single-channel, 59  
 10-Mc/s, 2505  
 spectrum, for testing quartz crystals for spurious response, 1642  
 time-interval, encoder for, 2339  
 vernier chronotron, 2338  
 for nuclear particles, 1965  
 waveform, for frequency characteristics of filters, 1969  
 for sorting of circuit components, 1645  
 for spectrum of random-noise generator, 1309  
 uniform transient error in power-level measurements by, 216
- Antiferromagnetic materials**, Curie-point phenomena in, 3391  
 nonmagnetic ions in, 189  
 rock-salt-type, multipin axis structures in, 188
- Antiferromagnetism**, in  $\text{Cu}_2(\text{CO}_3)_2(\text{OH})_2$ , 1947  
 of  $\text{Cu}_2\text{Fe}_2\text{H}_2\text{O}$ , 1946
- Astrophysics**, highly ionized regions in interstellar medium, 3272  
 interplanetary magnetic field and effect on cosmic-ray variations, 783  
 theorem on force-free magnetic fields, 784
- Atmosphere**, (See also Ionosphere; Troposphere)  
 electrical properties of, radiosonde measurements of, 1195  
 lower, thermal structure of, 136  
 upper, in auroral zone, 3704  
 composition of, 1551  
 density variations due to hydromagnetic heating, 4057  
 geophysical effects of high-altitude explosions, 2575  
 investigation of ionization by rockets and satellites, 3702  
 night airglow in, phenomenological description of, 1567  
 pressure measurements at 50-100 km, 3701  
 rocket-borne ion-spectrometer measurements, 3703  
 rocket investigations of composition of, 3700  
 temperature distribution in, 1876  
 temperature of regions of nightglow, 1877  
 turbulence measurements at 80-100 km, 4058  
 wind determination using artificially generated Na cloud, 3302  
 100-800 km, model based on rocket and satellite data, 3300
- Atmospheric electricity**, charge distribution in clouds, 456  
 thunderstorms, electrification and precipitation in, 2253
- Atmospherics**, average power of impulsive noise, 1354  
 effect of atomic explosions on, 4067  
 l.f., simultaneous recordings on 4 frequencies, 813  
 noise measurements at h.f. in India, 2743  
 polarization by successive reflections from ionosphere, 143  
 recording of, integrating circuit for, 2870  
 related to lightning discharges, 814  
 with superimposed pulses, recording of waveforms of, 815  
 v.l.f., emissions from exosphere, 1575, 3311  
 propagation-mode measurements, 3094  
 spectra of, 3313  
 theory of travelling-wave amplification for, 4066  
 waveform of lightning impulses producing whistlers, 142  
 waveforms of, classification and interpretation of, 459, 3312  
 'whistler-mode' echoes remote from conjugate point, 2731  
 whistlers, 1576  
 correlation with lightning flashes, 458  
 cyclonic disturbances as cause of, 3719  
 dispersion and solar activity, 144  
 path combinations for observed echo groups, 1577  
 propagation in regions of low electron density, 1578  
 27-kc/s, sudden enhancement of, solar-flare anomaly in, 1579  
 at 27 and 100 kc/s, observations at Delhi, 1580
- Attenuators**, coaxial, alignment aid, 3927  
 microwave, calibration by absolute bridge method, 1123
- Aurora**, and airglow, photoelectric measurements of H, emissions in, 3310  
 artificial, due to nuclear explosion, 1569, 1888  
 australis, radar echoes at 60 Mc/s, 141  
 australis and borealis, comparison of radar echoes from, 140  
 displacement of radiant point during disturbance, 138  
 disturbances, scattering of radio waves during, 2001  
 drift effects related to radiation belt and solar wind, 4063  
 electric-field theory of, 1887  
 equal-frequency lines (isochasms), theoretical and observed, 2975, (D)4062  
 formation of, 1568  
 intense, l.f. reflections from 75-90 km during, 812  
 ionization geometry from v.h.f. echo data, 137  
 ionization and magnetic disturbances, 1570  
 at low latitudes, spectroscopic observations, 2592  
 phenomena during storm, 3309  
 radar echoes from, horizontal motion observed at Saskatoon, 2255  
 movement related to magnetic-disturbance current system, 2593  
 polarization of, 4064  
 u.h.f. observations of, 1573  
 at 400 Mc/s, 4065  
 radiation at 500 Mc/s, 139  
 radio reflections from, angle-of-arrival measurements at Kjeller, 2254  
 geometry of, 1671  
 on ionograms obtained in minauroral region, 457  
 at low latitudes, 1670  
 subvisual, and simultaneous occurrence of noise bursts on 4.6 kc/s, 2974  
 v.h.f. radar for research on, 1574
- Barretters**, low-voltage, theory for, 270
- Batteries**, (See also Power supplies)  
 dry, using C-nitroso compounds, 2402  
 internal resistance, pulse measurement of, 2760  
 lead-acid, self-discharge reactions in, 2403
- Book notices and reviews**, The Advanced Theory of Statistics, Vol. 1: Distribution Theory, 1639  
 Advances in Electronics and Electron Physics, Vol. 9, 327  
 Atmospheric Electricity, 1201  
 Handbuch der Physik, Vol. 18, 3657  
 The Ionosphere, 1200  
 Light Scattering by Small Particles, 1519  
 Radio Research, 1957, 2077  
 Russian-English Electronics and Physics Glossary, 660  
 Scientific Uses of Earth Satellites, 2595  
 Semiconductor Thermoelements and Thermo-electric Cooling, 207  
 Transistor Circuit Engineering, 757
- Breakdown**, of air at high altitudes, for frequency range 100 Mc/s-35 kMc/s, 1834  
 of air and other gases at 9.6 Mc/s, 395  
 in solid dielectrics, electron bombardment as cause of, 2336
- Bridges**, a.c., for measurement of p-n junction characteristics, 1648  
 capacitance, balanced unsymmetrical parallel-T network as, 3062  
 coaxial displacement dielectric cell for liquids, 3063  
 double-T, for dielectric constant of ferrites, 4158  
 microwave, with ferrite isolator for paramagnetic resonance detection, 1982  
 Mueller, use of d.c. amplifier and recorder for balancing, 3061  
 Wheatstone, screened, for precision measurement of resistance, 561
- Broadcasting**, a.m., interference protection ratios for, 3464  
 measurement of program level, 3187  
 shared-channel, subjective tests of interference in, 3479  
 sound and television, progress review, 2749  
 stereophonic, systems for, 2397  
 studios, Karlsruhe, equipment of, 2016  
 Südwestfunk, design of, 3182, 3183  
 equipment of, 3188  
 s.w., in Netherlands, 30-year survey, 265  
 Netherlands World Centre at Lopik-Radio, 266
- Cables**, coaxial, eccentric, inductance of, 3191  
 response calculations for transient waveform in, 3125  
 solderless technique for splicing and earthing, 336  
 solid-dielectric, attenuation above 3 kMc/s, 337  
 supporting-disk data, 3926  
 test results under extreme conditions, 2457  
 theory, construction and testing, 335
- Capacitance**, bridge measurements of, errors due to leads in, 1316  
 measurement for two infinite cones, 3820  
 standards, laboratory determination of absolute unit, 2699
- Capacitors**, Al and Ta, dielectric films in, 725  
 ceramic, temperature-sensitive, using  $\text{CeO}_2$ , 45  
 electrolytic, Al, methods of increasing electrode surface area, 2868  
 solid-state, advances in, 1111  
 Ta, increase of capacitance by etching, 359  
 solid-electrolyte, 2137  
 ferrite-cored, 726  
 ferroelectric, for f.m. of v.f.o., 3247  
 as tuning elements, 1472  
 hydromagnetic, 1843  
 impedance of, as function of frequency, 2136  
 paper, d.c. breakdown of, 1473  
 impregnants for, comparison of wool wax and petroleum jelly, 1474  
 probable life of, 3219  
 parallel-plate, subarea method for calculating capacitance of, 1794  
 printed, Ta, 2867  
 pulse-loaded, dielectric losses in, 2493  
 standard, cylindrical, sectioned, 3051  
 variable, giving linear frequency variation, 3973  
 voltage-variable, selection guide, 3599  
 Si-junction, 46, 3974
- Cathode-ray oscillographs**, with accelerating voltage in form of long-tailed pulse, 1317  
 amplitude/frequency display using ratio method, 219  
 camera for automatic recording from, 1978  
 for character writing, using combination of l.f. waveforms, 467  
 image distortion by RC networks in, 1318  
 for phase characteristics of transmission systems in range 0.1-10 Mc/s, 1310  
 pre-pulse techniques for extending range of, 3827  
 pulse system for high-accuracy  $V/I$  characteristics, 4160  
 sample method for displaying  $\mu$ s pulses, 3828  
 survey of types available in U.K., 1977  
 with travelling-wave deflection system and large field of view, 927
- Cathode-ray tubes**, (See also under Television)  
 automatic electrical welding of, 2799  
 energy losses at binder films of phosphor screens in, 3173  
 low-voltage, development of, 2713  
 inagnetic-deflection, errors in and coil design for, 3125  
 'peritron', with moving screen for 3-dimensional display, 1747  
 phosphors for low-scanning-speed displays, 4254  
 screens for, aluminized, surface phenomena associated with organic barrier film in, 2438  
 effect of temperature on persistence of, 2440  
 storage-type, for direct viewing, survey of, 1744  
 half-tone, survey of, 1745  
 iatron, 1746  
 thin, rectangular, 3171  
 for 'writing' directly on current-sensitive paper, 1748
- Cathodes**, (See also Electron emission; Photocathodes)  
 activated, Ni-base, research on, 2069  
 breakdown of coatings on, 1029  
 carbonization techniques for high-power magnetrons, 3530  
 Cs-Sb, energy distribution of electrons from, 2070  
 development of, 2068  
 discharge modes with, 2441  
 dispenser-type, pressed and impregnated, 2791  
 for high current densities, 3893  
 impregnated with Ba-Ca aluminate, evaporation of Ba from, 2792  
 Ni-matrix, processing technique for, 4250  
 oxide, conduction mechanism of, 1026  
 conductivity in magnetic field, 2428  
 Hall effect in, 3166



- Cathodes, oxide, noise in, 1027  
 preconversion technique for, 3891  
 processing of, servo system for, 651  
 reversible poisoning of, 4249  
 SrO, dissociation by electron impact, 3892  
 oxide-cored, for electron microscopy, 3078  
 point-type, for electron microscopes, 3077
- Cells, (See also Batteries; Photocells)  
 dry, Mg-BiO, 3865  
 Zn/Hg-dioxysulphate type, 3866
- Circuits, (See also Networks)  
 amplitude-comparison, 3600  
 cathode-follower, for d.c. reference level, 2164  
 clamping or d.c. restoration, 2138  
 construction using thin-film components, 354  
 counter, coincidence, using transistors and diodes, 3230  
 decade, 1-Mc/s, using transistors, 1131  
 dekatron, for addition and subtraction, 1110, 1812  
 multiphase-output, from d.c. to 500 kc/s, 58  
 ring-type 2506, 2507  
 transistor, 3231  
 coupled, double-tuned, response of, 1815  
 stagger-tuned and synchronously tuned, correlation between, 364  
 wide-band, design data for, 3995  
 differentiating, 1795  
 diode and triode, with short time-constant, 3221  
 ferrésonant, 2140  
 with square-loop reactor, 2141  
 gating, neon-bulb, for digital computers, 358  
 phase-selective, rejecting quadrature component, 719  
 integrating, compensation for waveform distortion due to valve capacitances, 1479  
 feedback, l.f. noise reduction in, 369  
 long-time-constant, pulse response of, 2870  
 limiter, 2494  
 cathode-coupled, characteristics of, 1813  
 microcircuits with distributed resistance and capacitance, 3972  
 microminiaturization, micromodule system, 2485, 2486  
 program at D.O.F.L., 2484  
 microwave, using low-noise devices, 3971  
 theory and techniques of, 3175  
 miniaturization of, using integrated semiconductor devices, 3213  
 modular, integrated micromodules, 2863  
 potted and printed, 2862  
 printed, electroless copper plating for, 3047  
 foil-clad laminates for, 355  
 manufacture and assembly of, 1788  
 for microwave links, 2488  
 test patterns for, 2487  
 through-connections for, 38  
 pulse, using cold-cathode valves, 374  
 time/height converter, 2879  
 transistor, 3228, 3229  
 avalanche-type, 2878  
 20- $\mu$ s linear gate, 2880  
 pulse-forming, for radar, 375, 742  
 regenerative, using 'hybrid' valve-transistor arrangements, 2877  
 sequential, using transistors, 3613  
 switching, coincidence-diode, for radar displays, 1792  
 using crystal diodes, 2866  
 using electroluminescent cells and photoconductors, 1108  
 ferroelectric, 'transpolarizer' with stored setting, 2864  
 using gas-filled diode, 724  
 using magnetic cores, 2492  
 performance of, 3217  
 phototransistor, temperature-stabilized, 1109  
 representation by binary-decision programs, 3215  
 ring-type, for high-speed multiplexing, 3218  
 using saturable transformers, 1471  
 using semiconductor, current build-up in, 889  
 microwave, 3597  
 ternary, 1789  
 transistor, 43  
 delayed switch-off effect in, 722  
 for missile count-down, 3598  
 parameters of various types, 723  
 with voltage-controlled delay, 2865  
 transistor, nodal construction method for, 1796  
 trigger, bistable, using unijunction transistors, 744  
 increased sensitivity using crystal diode in feedback loop, 57  
 with series valve connection, 2163
- Colls, ferrite-cored, for a.f., 1790  
 inductance, calibration at power and audio frequencies, 2346
- Colour, vision, characteristics and two-coordinate system for, 3629
- Committees, C.C.I.R. and U.R.S.I., work of, 1036
- Communication circuits, h.f., effect of echo on operation of, 3471  
 maritime, signal strength measurements at Cadiz, 3859  
 'minimum-loss operation time' for, 258, 1359  
 U.K.-Commonwealth, performance index for, 261
- Communication systems, (See also Phototelegraphy; Radiolinks)  
 a.m., long-distance, addition of distortion voltages in, 3856  
 binary channels in cascade, 2388  
 binary-code, decision feedback systems, 591  
 decoding techniques in, 2747  
 error probability in, 2389  
 feedback, 2387  
 keying systems, error probability in, 2746  
 in Brazil, 3176  
 in buildings, field-strength measurements at v.h.f., 1688  
 compandor for speech transmission, 2395
- Communication systems, for data transmission over telephone lines, 1684  
 f.m. digital subset for, 2392  
 using earth satellites, 964, 2012  
 'Frena' and 'Frenac', nonlinear system for transmissions at high noise levels, 2753  
 in Ghana, 961  
 l.f., design of, 2750  
 line, transistor applications in, 594  
 meteor-burst-type, choice of frequencies for, 597  
 JANET, 4198  
 microwave, network for Pacific coast, 2398  
 tropospheric-scatter, using angle diversity, 2751  
 mobile, with 920 channels between 30 and 76 Mc/s, 262  
 multichannel, using angular modulation, r.f. powers and noise levels in, 598  
 carrier telephony on power lines, 2748  
 f.m., measurement of degree of intermodulation due to mismatch, 2396  
 frequency-diversity, two-tone, 2011  
 11-kMc/s, T.J., 3106  
 p.c.m., digital, regenerative statistics of, 957  
 timing of regenerative repeaters for, 967, 968, 969  
 for telephone service, 8-kMc/s, 2393  
 multichannel relays, C.C.I.T.T. recommendations and white noise, 4199  
 multiplex, f.m., Canadian TD-2 transcontinental microwave network, 973  
 echo distortion in, 3472  
 for studio-transmitter links, 3107  
 h.f. error-correcting system for REM, 3104  
 review of, 1686  
 paging systems, design of, 3478  
 receiver and modulation equipment, 3476  
 selective, at Allentown-Bethlehem, Pa, 3477  
 f.m., microminiature decoder for, 2018  
 performance in presence of thermal and atmospheric noise, 963  
 planning of, evaluation method for comparison of radio and cable systems in, 1355  
 pulse, frequency-shift method for, 3470  
 'Rake', for multipath channels, using correlation technique, (D)596  
 R/T, carrier-frequency-shift signalling for, 4200  
 intelligibility of speech with restricted frequency characteristics, 2755  
 multichannel, high-frequency bridging, branching and interconnecting of, 1362  
 SAGE data signalling method, 259  
 in space, infrared receiver for space vehicles, 4197  
 minimum transmitter weight for, 3141  
 problems of, 3469  
 telemetry system analysis, 3860  
 s.s.b., compatible, 971  
 'third method' for, 970  
 s.s.b. and d.s.b., suppressed-carrier, for aeronautical services, 2752  
 s.s.b. and independent-sideband, for ground/air communication, 263  
 stereophonic, compatible, using a.m./f.m. multiplex, 3105  
 using f.m. multiplex, 1363  
 using precedence effect, 3474  
 f.m. multiplex, adapter for, 2754  
 interference in, 3857  
 telegraphy, class-A1, bandwidth determination for, 962  
 code speed comparison, 593  
 error-correcting 'autoplex' system for, 966  
 l.f. and v.l.f., frequency-shift keying for, 965  
 p.c.m., phase correcting systems for, 599  
 teleprinting, coder and decoder for, 1685  
 over long-distance radio links, 960  
 telephony, carrier-current, bridge negative-feedback amplifiers for, 974  
 tropospheric-scatter, description of Canadian equipment, 975  
 design of, 1360  
 evaluation of, 595  
 multichannel, f.m., system parameters for, 1361  
 quadruple-diversity method, 972  
 tests, Start Point-Chelmsford, 260  
 in U.S. army, 2744  
 v.h.f., for port and harbour control, 3480  
 vocoder, time-division, 2394  
 waveguide transmission with h.f. carrier, pulse distortion in, 3473
- Communication theory, application to amplitude compression, 3466  
 capacity of asymmetric information channels, 3103  
 channels with side information at transmitter, 592  
 coding law, 4195  
 coding systems, binary, burst-correcting, 3468  
 variable-length, 3467  
 binary and Gaussian, merits and methods of detection of, 2010  
 definitions of  $d'$  and  $\eta$  in signal detection, 3854  
 demodulation and detection processes in, 959  
 discrimination of signals in noise, 1357, 2008  
 error-correcting codes, with constant bit-rate of transmission, efficiency of, 1358  
 mathematical theory of, 1683  
 using regenerative shift-register sequences, 257  
 error probability for optimum codes in Gaussian channel, 2745  
 for infinite alphabets, 958  
 physical interpretation of Shannon's ambiguity, 3853  
 sampling of signals without d.c. components, 1356  
 speech transmission, threshold levels for quantization, 3855  
 in telecommunications, 3852
- Components, (See also Circuits, printed; Electronic equipment)  
 electroforming technique for complex shapes, 4143  
 microwave, production testing equipment for, 221  
 selection from random samples, 659
- Computers, analogue, analysis of British models, 31  
 using capacitor storage unit, 32
- Computers, analogue d.c., negative-resistance circuit for, 3605  
 differential analyser, Fourier analysis by, 33  
 for evaluating radar performance, 1465  
 function generators, biased-diode, design of, 2861  
 rotating-disk type, 2858  
 for sines or cosines, 1457  
 tapped-potentiometer, 35, quadratic interpolation by, 2133  
 using loaded potentiometers, error reduction technique, 3969  
 matrix programming of, 347  
 multiplier, using Hall effect in semiconductors, 349, 350, 2131  
 multiplier-divider, using thyrite resistors, 1458  
 for prediction of sound propagation, 3207  
 ratio calculator, 1102  
 resistance-network, design principle for, 2480  
 use of, 2481  
 for simulation of aircraft performance, 1466, 2477  
 storage systems for, magnetic-drum, 348  
 analyser for relay-circuit contacts, 1460  
 control systems with 'intelligence', 716  
 data reduction system using scanned photocathode and image dissector, 1105  
 digital, ACE, 2128  
 ADDAM II differential analyser, 1780  
 adders, controlled by magnetic cores, 3210  
 applications, for lens designing, 2483  
 for transient response of linear control systems, 2130  
 for verification of logic structure of switching system, 2134  
 for automatic graph plotting, 2859  
 binary multiplication in, 2856  
 capacitive sensing system for punched cards or continuous foil, 1455  
 character display system for output of, 3968  
 counting circuits for, using transistors and magnetic cores, 2479  
 C.S.C.E. Pisa, using parametric cells, 3966  
 data-processing, automatic failure recovery system, 1453  
 automatic magnetic 'reading' equipment for, 3586  
 information handling in, 1454  
 magnetic-tape recording system for, 1464  
 tape amplifiers for, 27  
 efficiency of logical elements as multipurpose bias devices, 1461  
 electromechanical input-output equipment, 26  
 high-speed, using ferrite cores and transistors, 2127  
 test generator for, 3585  
 with inductive control of switching, 3967  
 'laddic' ferrite device for switching in logic circuitry, 1463  
 logic synthesis of high-speed comparators, 1456  
 logic systems, using magnetic elements, 1104  
 based on signal phase in nonlinear reactances, 2126  
 using transistors and square-loop ferrite cores, 351  
 magnetic-core matrices for logical functions, 2860  
 magnetic materials for storage and switching, 1782  
 operation of, 25  
 parametric subharmonic oscillators for, 3590  
 'parametron' reactance element for, 3588  
 pulse generator using transistor blocking oscillator with saturable transformer, 3970  
 rectifier networks for, 29  
 sequence transducers, network analysis of, 352  
 for simple algebraic functions, 1452  
 sin  $N$ , cos  $N$  and  $N^{1/m}$  computations by, 2857  
 for spatial problems, operating on information in planar form, 30  
 standard block design using transistors, 2855  
 storage systems, ferrite-core, using transistors, 1783  
 ferrite plates for end-fired type, 36  
 ferroelectric, 1717, 1781  
 magnetic, using coated glass rod, 1462  
 magnetic-core, using core-threading technique, 3587, noise problem in, 1787  
 magnetic-disk, 2129  
 magnetic-drum, control apparatus, 346, track switching system for, 718  
 magnetic-film and ferrite-core characteristics, 3212  
 matrix-type, using ferrites, 2482  
 punched-tape, 1785  
 storage and processing of data using magnetic tape, 1786  
 switching circuits using transistors for, 1784  
 switching elements for, 'cryosar', 3211  
 superconducting, 3209  
 tabulated reference to 27 models, 1779  
 test generator for, variable-frequency, 3591  
 transistor, operating experience with, 2132  
 1-Mc/s, transistor circuits for, 3229  
 digital/analogue conversion, using bistable multi-vibrator, 3206  
 using cryotrons, 1103  
 for storage-tube deflection, 2135  
 printing of pulse-code data using shaped-beam c.r. tube, 34  
 random-number generator using subharmonic oscillators, 2476  
 reliability of computation in presence of noise, 345
- Conduction, in solids, theory of, 485  
 surface, of insulating solids, criterion for, 3252  
 theory of electron transport in magnetic fields, 4014  
 in ThO<sub>2</sub> crystals, polarization effects in, 3335
- Conductivity, h.f., of metals, quantum theory of, 762  
 quantum theory of surface impedance in magnetic field, 763  
 induced by radiation in CdS and polyethylene, 2672  
 of metals, evaluation of, 1507  
 of monovalent metals, 4015
- Conductors, charge penetration in, 3251

- Conductors, penetration of transient e.m. field in, 2905  
 solution of Bloch's equation for electrons in, 1914  
 with wavy interface, e.m. field distribution in, 2904
- Conferences and conventions, acoustics, Moscow, June 1957, 661**  
 British Association Meeting, Glasgow, Sept. 1958, 1171, 1202  
 3 papers on radio navigation aids, 2978  
 cosmic rays, Varenna, June 1957, 1861  
 cosmical gas dynamics, Cambridge, Mass., June 1957, 100  
 electrical discharges, Physical Society, Swansea, Sept. 1958, 2196  
 electronic standards and measurements, Boulder, Aug. 1958, 1303  
 electronics reliability symposium, Philadelphia, Jan. 1959, 2805  
 fluctuation phenomena and stochastic processes, Physical Society, London, March 1959, 4007  
 I.E.E. Radio and Telecommunications Section, Chairman's address, 1421  
 I.G.Y. Special Committee, 5th Assembly, Moscow, Aug. 1958, 3674  
 information processing, Paris, June 1959, 3208  
 I.R.E. National Convention, New York, 1959, 2801  
 long-distance propagation above 30 Mc/s, I.E.E., London, Jan. 1958, 2000  
 long-distance transmission by waveguide, I.E.E., London, Jan. 1959, 1437  
 luminescence, Estonia, June 1956, 2997  
 microwave valves, I.E.E., London, May 1958, 2788, 2800, 3159, 3524  
 physics of magnetic phenomena, Moscow, May 1956, 3035  
 propagation of radio waves, Paris, Sept. 1956, 1333  
 radiation effects in semiconductors, Tennessee, May 1959, 4089  
 radio aids to aeronautical and marine navigation, I.E.E., London, March, 1958, 2259  
 radio links, Rome, June 1957, 2014  
 rockets and satellites, Moscow, July/Aug. 1958, 1870  
 semiconducting SiC, Boston, April 1959, 3771  
 solid-state memory and switching devices, London, Sept. 1958, 2478  
 solid-state physics, Brussels, 1958, 497  
 space vehicles, satellites and missiles, Buffalo, N.Y., June 1958, 2239  
 stereophony, I.E.E., London, March 1959, 2086  
 Swiss Physical Society meeting, Neuchâtel, Sept. 1957, 758  
 transistors, I.E.E., London, May 1959, 3511
- Connectors, coaxial, hybrid-ring, analysis of, 3552**  
 as microwave filter, 3551
- Control systems, (See also Electronic applications; Frequency control; Servomechanisms)**  
 digital, for positioning shafts, using telephone-line carrier system, 1656  
 feedback, test equipment for, 1651  
 review of techniques for, 3861
- Converters, (See also Frequency, converters)**  
 d.c., high-power, using transistors, 1470  
 d.c./a.c., using transistors, 3483  
 design data, 267  
 for driving induction motor, 1983  
 for 3-phase 115-V output, 3482  
 using 4 transistors in bridge circuit, 1698  
 20-kc/s, using power transistors, 2021  
 d.c./d.c., using transistors, 4207  
 parametric, microwave, 2896
- Cooling, air, chassis design for, 353**  
 forced-convection, prediction of temperatures in, 1750  
 liquid, for airborne equipment, 1420  
 of semiconductor devices, nomograms for, 3146
- Cores, (See also Coils)**  
 ferrite, for television receivers, test methods, 3057  
 powder, Fe, properties of, 2323
- Cosmic radiation, (See also Radio astronomy)**  
 balloon equipment for monitoring, 437  
 corpuscular, low-energy, at high latitudes, 2551  
 cosmic-rocket data on, 2231  
 cut-off rigidity and geomagnetic field, 3280  
 effect of magnetic anomalies on belt of trapped particles, 3662  
 energy spectrum of, 419  
 flux and energy spectrum of  $\alpha$  particles during solar maximum, 3279  
 increases in, interplanetary magnetic-field model for explanation of, 783  
 related to solar flares, 2557  
 intensity of, cause of inaccuracies in prediction of, 1524  
 decreases in, 27-day, latitude variation of, 1862  
 1958-1958, 4037  
 fluctuations, at southern stations, 1860  
 measurements in stratosphere, 3277  
 variations, review of, 4036  
 at solar maximum, 3278  
 during two solar cycles, 1523  
 in interplanetary space, rocket and satellite investigations of, 3718  
 investigations by earth satellite, 3663  
 measurements of, at distances up to 107 400 km from earth, 2553  
 with Pioneer IV, 4041  
 nature of sources, 3274  
 observations, before intense solar activity, 1179  
 of 1958  $\delta$  over Australia, 4042  
 proton, during solar flare 12th May 1959, 4040  
 r.f., absorption associated with solar event, 789, 1521  
 trapping beneath ionosphere of, 788  
 terrestrial corpuscular radiation due to, 2216  
 theory of cosmic-ray equator, 3661  
 Van Allen belt, cause of minimum between zones, 4038  
 origin of, 2217, 2552  
 upper boundary of, 4039
- Cosmic rays. See Cosmic radiation.**
- Counters, (See also Circuits, counter)**  
 diamond, with small electrode spacings, 1990  
 G-M, end-window, improved design of, 3079  
 for nucleonics, 3446  
 radiation, with magnetic recording of pulse-amplitude data, 1989  
 self-quenching mechanism of spreading discharge in, 1332  
 scintillation, photomultiplier-type, resolving power of, 3081  
 review of, 232, 3080
- Couplers, (See also Waveguides)**  
 directional, CR-type, mutually coupled, 9  
 measurement of directivity of, 3821
- Crystals, (See also Molecular systems; Piezoelectric materials; Quartz; Resonators)**  
 growth of, floating-zone technique for, 2337  
 SiO<sub>2</sub> and GeO<sub>2</sub>, infrared studies on polymorphs of, 205  
 with zinc blende structure, calculation of lattice oscillations in, 3413
- Delay lines, (See also Computers, storage systems)**  
 magnetostrictive, for pulsed video signals, 1134  
 torsional, 2881  
 quartz, for radar systems, 2511  
 ultrasonic, design of, 28  
 Hg, characteristics of, 361  
 measurement method for, 2698
- Detection, of asymmetric-sideband signals in noise, 248**  
 of co-channel f.m. signals, by correlation method, 581  
 microwave, tests on coaxial diodes for, 2794  
 power-law, with 3 input signals, multiple Fourier analysis for, 2382  
 of pulsed signals in noise, optimum filter functions, 247  
 response of nonlinear devices to band-limited h.f. signals and noise, 1674  
 step system for multiplex systems, 590
- Detectors, correlation devices for weak signals, 3099**  
 correlation function of output noise with biasing and limiting effects, 2005  
 diode, analysis for asymmetric-sideband signals, 249  
 optimum, with log  $I_0$  characteristic, for weak signals in noise, 2004  
 phase, diode, push-pull, theory and design curves for, 1152  
 product-type, using pentagrid converter, 2898  
 for symmetric- or asymmetric-sideband signals, 580
- Dielectric constant, contribution of exciton to, 1831**  
 of conducting liquids, l.f. measurements, 215  
 measurement, at microwave frequencies, bridge method using coaxial cable, 921  
 method based on Weissfloch transformation theorem, 4153  
 static, molecular theory of, 761
- Dielectric properties, of glacier ice, 1994**  
 of ice crystals, 1600  
 of low-loss materials, free-space mm- $\lambda$  technique for measuring, 2348  
 measurement bridge for 10 c/s-50 kc/s, 1305  
 measurement technique for liquids, using H<sub>21</sub> resonator, 922  
 Onsager's theory of, 392  
 polarization of gases, quantum theory for, 2901  
 of polycrystalline stannates and cerates, 2626
- Dielectrics, (See also Insulating Materials)**  
 artificial, anomalous dispersion in, 482  
 dispersive, for beam scanning, 2124  
 $\lambda/4$  matching of, 2125  
 formed by array of thin films, 1154  
 rod-type, reflections from, 2123
- BaTiO<sub>3</sub>, breakdown field of, temperature dependence of, 2627**  
 ceramic, effect of compression on permittivity, 481  
 thermal conductivity of, 2628  
 low-temperature properties at 9.1 kMc/s, 1601  
 thermal expansion coefficient of, 2629
- Ba(Ti,Sn)O<sub>3</sub> and Ba(Ti,Zr)O<sub>3</sub> ternary systems, 838**  
 ceramic, after-effect in, 3328  
 light-weight, 839  
 gaseous, C<sub>2</sub>F<sub>6</sub>, properties of, 3415  
 inhomogeneous dielectric dispersion phenomena in, 837  
 (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and (NH<sub>4</sub>)<sub>2</sub>BeF<sub>4</sub>, transitions in, 836  
 nonferroelectric, relaxation polarization and losses in, 480  
 solid, impedance of layers of, 2271
- Diffraction, acoustic, of converging beams, 2813**  
 of acoustic and e.m. waves, asymptotic solution of problems in, 1850  
 effect of fluctuations on intensity distribution near focus of lens, 2917  
 by smooth object, geometrical theory for, 3265  
 by wedges or corners, for plane, cylindrical or spherical wave, 1167  
 of e.m. waves, by circular hole in plane screen, comparison with optical microscope, 2206  
 by dielectric strips, 1516  
 at ideally conducting flat screens, 1515  
 by imperfectly conducting wedge, 4028  
 Kirchhoff-Young theory of, 2918  
 by perfectly conducting half-plane, 1168  
 by perfectly conducting solid, 774  
 polarized, by wide slit and complementary strip, 411  
 skew-plane, by absorbing wedge, 3266  
 by slit, approximation for, 1851  
 by slit and rectangular apertures, intensity distribution near focus 3256  
 in inhomogeneous media, asymptotic theory of, 2539  
 geometric theory of, 2538  
 of light, by ultrasonic waves, intensity distribution for, 1051  
 at oblique incidence, 1049  
 of ultrasonic waves, by arrays of rods, 1048
- Direction finders, c.r.o.-type, s.w., comparison of, 2256**  
 Direction finders, c.r.o.-type, s.w., Telefunken, 2257  
 2-channel, integration method for improving bearing evaluation in, 2258  
 h.f., with averaging system and automatic read-out, 2600  
 interferometers for tracking airborne vehicles, 1583  
 long-base-line, error reduction in, 3720  
 v.h.f., automatic, using rotating Adcock aerial, 817  
 true-phase capacitive goniometers for, 4068
- Direction finding, coherent-wave, component determination using 2-channel c.r. d.f., 816**  
 h.f., errors caused by nearby vertical radiators, 1203  
 3-dimensional, using spaced aeriels, 3314
- Discharge tubes. See Valves, gas-filled.**
- Discharges, (See also Breakdown; Plasma)**  
 cold-cathode, space-charge effects in, 1833  
 effect of coupling oscillator coil to discharge tube, 1156  
 electrodeless, in air at reduced pressure, effect of magnetic field on, 83  
 glow-to-arc transitions, ionizing-potential space waves in, 3254  
 glow-type, hollow-cathode, 2909  
 h.f., torch-type, electron temperature and noise in, 3253  
 Hg-vapour, noise spectra measurements in, 4019  
 Joshi effect, potential variation in, 2530  
 low-density, theory of cathode sheath in, 82  
 propagation of non-ionizing shock waves in, 4016  
 pulse, gas recovery after, method of studying, 2531  
 'silent' r.f. oscillations in light and darkness in, 1155  
 space-charge field-emission hypothesis applied to, 2907  
 thermal noise in, 1158  
 wire-cylinder, in air, in relation to space-charge field-emission hypothesis, 394
- Discriminators, frequency, linear, wide-band, using transmission lines, 2526**  
 microwave, for stabilizing klystron oscillators, 1487
- Distortion, of a.m. and f.m. signals, 2007**  
 harmonic, in f.m. system, 1504  
 of signal on h.f. carrier in circular waveguide, 3473
- Earth, conductivity, mapping by radio technique in U.S.S.R., 434**  
 measurement of, 3420
- Earth satellites, applications, for transoceanic communication system, 2012**  
 for verification of theory of relativity, 3684  
 atmospheric density determination, lifetime data for, 3686  
 from orbital data, 3689, 3695  
 irregularities in, 2571  
 at 200-400 km, 2955  
 atmospheric pressure and density measurements by, 1871, 3694  
 instrumentation for, 439  
 cosmic-radiation investigations by, 3690  
 analysis of, 2958  
 instrumentation for, 3663  
 Doppler measurements on, 1191, 3697  
 velocity determination from, 442  
 electron energy levels at 470-1E80 km recorded by, 3294  
 errors in tracking, due to refraction at ionospheric heights, 3698  
 Explorer series, firing system, instrumentation and tracking of, 1546  
 flight principles and velocity data, 2950  
 geodetic information from, 1185  
 geomagnetic field measurements by, 3693  
 gravitational torque on, 117  
 ion-concentration measurements by, 3696  
 ionization trails, radio reflections from, 121, 2963  
 ionosphere investigation by, 1873, 3295  
 launching problems, 3680  
 lifetime determination and orbit perturbations, 3681  
 optical observation, over polar regions, 793  
 tracking program for I.G.Y., 2566  
 in U.S.S.R., 3288  
 orbital acceleration of, atmospheric effects in, 2564  
 orbital data, calculations, 3682  
 and geophysical factors, 3683  
 value for earth's flattening obtained from, 2567  
 orbits of, air-drag effect on, 3287  
 allowing for earth's oblateness, 1184  
 described by difference equations, 119  
 irregularity in, 797, 1543, atmospheric tides as cause of, 2565  
 cause of air resistance changes in, 1186  
 coordinate system for, 3687  
 determination from tracking data, computer program for, 2568  
 Doppler method for determination of, 1188  
 effect of earth's oblateness on, 2233, 2234  
 prediction of, 2232  
 around unsymmetric central body, 1541, (D)1866  
 polyhedral, for accurate orbital data, 794  
 radar scattering from, effect of Faraday rotation on, 1345  
 radio-astronomy investigations by, 3292  
 radio observations of, comparison of methods of studying ionospheric structure by, 799  
 derivation of ionosphere data from, 1548  
 ionospheric effects on, 1549  
 in Italy, 1192  
 signals from, Faraday fading of, deduction of ionospheric electron content from, 2572, correction for, 450  
 Faraday rotation of, 796  
 magneto-ionic effects up to 2 000 km in, 2961  
 recording of, 2573  
 solar corpuscular radiation investigated by, 3293  
 time-dilation measurement method, 3688  
 tracking, methods for, 122, 4047  
 'minitrack' system for, 1190  
 photoelectric optical method for, 1189

- Earth satellites, tracking, 108-Mc/s interferometer system for, 123  
trajectory determination, ground equipment for, 441  
U.S. and U.S.S.R., tabulated data on, 3679  
telemetry data for, 124  
U.S.S.R., observations related to ionospheric propagation, 2952  
tracking by Doppler measurements, 443  
weather observation by, 2360  
instrumentation for picture transmission in, 2715  
1957  $\alpha$  (Sputnik I), determination of orbit and regions of reception, 120  
Doppler measurements at Johannesburg, 445  
electron density determinations in outer ionosphere by, 3298  
ionospheric information from, 3296, 3297  
ionospheric investigation by simultaneous Doppler shift measurements of, 1874  
radio observations of, in Japan, 446  
results from, 1869  
in southern hemisphere, 444  
rotation of, 795, 1187  
1957  $\alpha$  and  $\beta$ , radio observations, in Germany, 2237, 3289  
Royal Society discussion, 2951  
tracking of, using h.f. d.f., 798  
1957  $\beta$  (Sputnik II), brightness fluctuations of, 2956  
change of inclination of orbit of, 1542  
cosmic-ray intensity variations recorded by, 2959  
field-strength recordings at 40 Mc/s in West Germany, 3291  
gravitational-field investigations by, 792, 4048  
instrumentation of, 440  
last minutes of, 447  
orbit of, changes in inclination to equator, 2235  
motion of nodal line in, 118  
radar observations of, 3290  
solar-flare effect on period of, 449  
1958  $\alpha$  (Explorer I), cosmic-ray information from, analysis in Japan, 448  
instrumentation for, 2964  
instrumentation of, 1547  
1958  $\beta$  (Vanguard I), instrumentation, orbital data and applications of, 1868  
orbit of, determination of coefficient  $J$  of gravitational potential from, 1867  
variations related to gravitational field, 2236  
solar effects on motion of, 4050  
1958  $\beta$  and  $\delta$ , effect of corpuscular radiation on acceleration of, 2960  
1958  $\delta$  (Sputnik III), antipodal reception conditions, 2957  
auroral ionosphere investigation using, 4052  
diurnal lapse of signals from, 2954, 4049  
instrumentation and results of observations, 1550  
ionized tracks as cause of signal strength fluctuations, 2953  
orbital data for, 1545, 3685  
radio observations of, 2569  
signal-strength recordings, in Alaska, 1193  
in Ohio, 2570  
upper-atmosphere investigation by, 1872  
1958  $\epsilon$  (Explorer IV), cosmic radiation increases detected by, 3692  
observations of radiation belt by, 2238
- Electrets,  $\text{CaTiO}_3$ , anomalous stability of, 1603  
phenomenological theory of, 1602
- Electroacoustics, standards, calibration and errors of, 3186
- Electrodynamics, classical, as distribution theory, 404  
nonlinear, formation of discontinuities in, 2914
- Electroluminescence, (See also Phosphors)  
in  $\text{Cu}_2\text{O}$ , and current creep effects in rectifiers, 3005  
display panels, for automatic displays, 3434  
for character generation and storage, 1654  
transfluxor-controlled, 568  
display systems, E.L.F., 225  
'sylvatron', 224  
in GaP and InP, bimolecular transitions at rectifying junctions, 3737  
of insulated particles, 1215  
mechanism of, 1597  
'memory' effect in enhancement of, 1213  
modulation of photoluminescent emission by alternating field, 831  
processes and application to picture tubes, 1909  
screens for television display, problems of, 566  
in SiC, 3003  
in SiC  $p$ - $n$  junctions, 1910
- Electrolyte tank, anisotropic field plotting in, 3825  
servo system for automatic tracing of equipotential curves, 3428  
space-charge simulation by current injection, 2356, 2708
- Electromagnetic field, in stratified medium, excited by dipole in surface, 2920
- Electromagnetic theory, electron wave functions, consistency condition for, 2537  
e.m. waves in crystal with exciton absorption, 409  
helical coordinate system for, 773  
of induction, 407  
Maxwell's equations, in general relativity theory, 1514  
solution in terms of spinor notation, 2900  
uniqueness criterion for solutions of, 3628  
Maxwell's and Helmholtz's equations, application of distribution theory to, 405  
of 'singular' induction, 406
- Electron beams, axially symmetric, with uniform velocity profile, 3526  
distribution of particles with multiple scattering, 1837  
effect of inclination of focusing electrodes on formation of, 2060  
homogeneous, plasma heat-exchange technique for producing, 397  
influence of angle of diffusion on energy spectrum in thin films, 3255  
magnetic analysis based on Lorentz effect in, 2199
- Electron beams, magnetically focused, anomalous noise in, 2789  
characteristics of, 3888  
periodic permanent-magnet structures for, 1021  
parallel-flow, periodic e.s. focusing of, 2061  
partially neutralized, pervance and Bennett pinch relation in, 84  
relativistic, intense, behaviour of, 4017  
rotating, space-charge-wave harmonics and noise in, 1736  
sheet-type, aberrations in, 2908  
space-charge in, compensation of, 1836  
space-charge flow in, solution of equations for, 764  
splitting effect on penetrating magnet, 3636  
stationary, magnetic forces and relativistic speeds in, 85  
theory of formation and trajectory in magnetic field, 2059
- Electron emission, (See also Cathodes; Photoelectric emission)  
field-type, total-energy distribution for, 2197  
measurement of, 2198  
from Hg films in discharge tube, 1157  
from Mo, after electron bombardment, 3258  
secondary, due to ion beam, energy spectrum analysis, 1838  
of metals, theory of, 3257  
from MgO films, 2316  
from Ni, 3789  
thermionic, from Mo, effect of magnetic field on, 1945  
wave-mechanics correction of Richardson-Dushman equation, 2912
- Electron gas, dielectric formulation of many-body problem for, 1830  
high-density, magnetic susceptibility of, 759
- Electron guns, for kinescope, annular, 652  
high-transconductance, 322  
electrode requirements for prescribed field distribution, 323  
magnetically shielded, electron-beam dynamics of, 1031  
magnetically shielded and immersed, perturbations in beams from, (D)2429  
Pierce-type, design theory for, (D)653  
'ramp'-type, space-charge-limited crossed-field, theory of, 3894  
for solid and hollow cone-type beams, 2430  
toroidal, for dense hollow beams, 3527
- Electron lenses, asymmetric, stigmatic image in, 3075  
unipotential design of, 937  
e.s., correction of aperture error by space charge, 4171  
ion-focusing properties of quadrupole pair, 2721  
magnetic, induction along axis of, measurement of, 2704  
weakly convergent, spherical aberration in, 3838
- Electron microscopes, cathodes for, oxide-cored, 3078  
point-type, 3077  
remote-focus, 936  
emission-type, using secondary electrons, 1330  
using ultraviolet radiation, 1987  
e.s. charging of photosensitive material in, 1988  
chromatic variation of magnification in, compensation of, 3076  
field of series of cylindrical magnetic lenses, 3445  
with highly biased electron gun, 3443  
image contrast analysis, 3444  
space-charge aberration and resolving power of, 3074
- Electron microscopy, image in, e.s. method for obtaining, 1331  
obtained by negative-ion bombardment, 567  
review of developments since 1957, 3832  
shadow casting, use of carbon films in, 938
- Electron optics, diffractograph for continuous recording, 3442  
energy spectrum of electron beam reflected by metallic object, 399  
e.s. immersion objectives, computation methods, 3073  
shadow technique, field superposition for increasing sensitivity, 3441
- Electronic applications, automatic character recognition systems, 1991  
automatic pattern recognition, by analogue apparatus, 2371  
using flying-spot scanner, 2372  
catapult end-speed recorder, 924  
electron-bombardment processing of materials, 4168  
e.s. teletypewriter for data processing, 3086  
hygrometer, microwave-refractometer, recording-type, 3070  
in inertial guidance system for space flight, 3839  
manometer, microwave, for pressures  $>0.1$  mm Hg, 565  
in medicine, control of ventricular contraction in experimental heart block, 929  
ingestible radio capsule, 1326, 1327, 3834  
microwave radiator for heat therapy, 2361  
pulse generator for electrocardiograph, 4169  
sensitivity of v.l.f. amplifiers for electromyography, 230  
variable-pulse stimulator, 229  
microwave model of human eye, 1325  
 $\mu$ s light source using Si  $p$ - $n$  junction containing P, 3435  
observation of confined detonation processes using microwave interferometer, 3068  
photoelectric apparatus with mechanical scanning for photometry, 4167  
plasma engine, 3833  
radar meter for vehicle speed measurement, 1898, 1981  
radar technique, for detection of shock waves, 3447  
for shock-wave velocity determination, 1658  
in railway industry, 2717  
seismic transducer for visual recording, 3069
- Electronic applications, 'tellurometer', for measurement of distance, 1980  
video differential planimeter, 3067
- Electronic equipment, in Brazil, 3176  
in naval ordnance, design problems, 2803  
production and assembly techniques for, 1037  
reliability of, calculations on, 2806  
design factors for, 2076  
'interaction' in, 1038  
numerical approach for, 2804  
Soviet, review of, 3899  
transistorized, data on, 3592
- Electrons, collision probability in gas, microwave measurement method, 768  
relativistic flow in straight lines with no external magnetic field, 396  
slow excitation of molecular vibration and rotation by, 3259  
spin kinematics in uniform field, 99
- Electrostatics, generation of static charge on high polymers, 4013  
interaction of two charge distributions, 760  
potential and capacitance of torus, 4012  
potential distribution near  $p$ - $n$  junction, 1506  
simple method of calculating capacitance, 2193  
surface charges on insulators, 2527
- Equalizers, constant-S, 3226  
Laguerre-function, using passive elements, 1481
- Ether, deflection of light waves by movement of, 3248
- Exhibitions, Audio Fair, London, April 1959, 2095  
electronic computers, London, 1958, 715  
German Radio, Frankfurt, 1959, 3898  
National Radio, London, Sept. 1959, 3897, 4255  
Physical Society, London, 1959, 1749  
R.E.C.M.F., London, April 1959, 2802  
S.B.A.C., Farnborough, Sept. 1959, 4256
- Faraday effect. See Magnetic effects.
- Ferrimagnetic materials. See Ferrites.
- Ferrites, with anomalous magnetization loops, hysteresis losses of, 3400  
Ba, anomalous characteristics of samples containing  $\text{CaO}$ , 2685  
dielectric properties of, anisotropy in, 3807  
magnetization curve analysis, 3806  
substitution of cations in, 540, 541  
 $\text{BaO} \cdot 6\text{Fe}_2\text{O}_3$ , magnetization and structure of, 899  
containing Co, perminvar effect in, 1284, 2324  
semiconducting properties of, 4135  
dielectric-constant measurement bridge for, 4158  
Dy-Y, Dy-Gd and Dy-Er mixed garnets, properties of, 2331  
e.m. fields in ellipsoidal samples, 1286  
Er garnet, Al- and Cr-substituted, interpretation of properties of, 1290  
 $\text{Fe}_2\text{O}_3$  and  $(\text{NiO})_{0.15}(\text{FeO})_{0.85}\text{Fe}_2\text{O}_3$ , Hall-effect measurements on, 3403  
'ferrocube', permeability tensor of, at 24 kMc/s, 1293  
'ferroxplana', crystal-oriented, 2687  
flux reversal in, modified rotational model for, 900  
frequency characteristics of, 3398  
garnets, domain observation by transmitted light, 200  
growth of single crystals of, 1289  
Gd-Er and Gd-Y mixed garnets, properties of, 1633  
Gd-Fe garnet, microwave resonance in, two-sublattice model for, 3043  
as gyrotropic media, reciprocity relations for, 3044  
hysteresis loop evaluation by computer, 2326  
kinetic processes in, phenomenological theory of, 1285  
Li, susceptibility of, transverse, dispersion in range 10-1000 Mc/s, 1288  
Li-Zn, magnetic properties of, 1957  
for magnetostriction oscillators in filter circuits, 1954  
measurements by resonance-cavity methods on, formulae for, 545  
Mg, effect of Mn and firing conditions on, 903  
effect of oxygen pressure on, 1287  
solubility of MgO in, 2688  
Mg-Mn, magnetic viscosity in hysteresis loop tracings, 2325  
microstructure and properties of, 4133  
microwave Faraday effect and birefringence in, 1632
- Mn, domain-wall motion and resonance in, 1958  
magnetic properties and disaccommodation of, 2327
- $\text{Na}_2\text{O} \cdot \text{SnO} \cdot \text{Fe}_2\text{O}_3$ , 904  
neutron irradiation effects on Curie temperature of, 898
- Ni, effect of divalent-ion substitutions on magneto-mechanical properties of, 1292  
grain growth in, 544
- Ni-Co, magnetic resonance studies during reaction, 3042  
and Ni ferrite-aluminates, resonance measurements on, 2689
- Ni-Fe, magnetic anisotropy in, low temperature transition of, 902
- $\text{NiMnO}_3$ , resonance in, 543  
 $\text{NiMnO}_3$  and  $\text{CoMnO}_3$ , crystal structure of, 199  
Ni-Zn, effect of Co on magnetic dispersion, 3808  
hysteresis reduction by transverse field, 3244  
paramagnetic susceptibility of, temperature dependence of, 3041  
permeability variation with time in, 4136  
oriented, with cubic anisotropy, 3399  
permeability and loss data for cores, 897  
polycrystalline, resonance in, spin-wave analysis of, 777  
power-gain relations for 3- and 4-frequency excitation, 3045  
preparation of, by continuous electrolytic co-precipitation, 1959  
properties and applications of, 4134  
rare-earth garnets, resonance in, 2690  
rare-earth orthoferrites, weak ferromagnetism in, 905

- Ferrites, resonance in, magnetostatic modes of, 3813  
properties and microwave applications of, 4140  
theory of, 906  
resonance line widths, and  $g$ -factors in, 3402  
measurements in cross-guide coupler, 3810  
resonance in spheres, magnetostatic modes in, 908  
reversal of temperature coefficient by d.c. field,  
2686  
r.f. properties of, weak-field measurements of, 3815  
single-crystal, domain configurations on, 1283  
square-loop, rings, test equipment for, 4155  
storage properties of, test methods for, 3397  
switching-time investigation using asymmetrical  
pulses, 3404  
storage-type, magnetic reversal in, 4137  
susceptibility of ellipsoid in uniform field, 3809  
switching in, rotational, mechanisms of, 1634  
thermal expansion coefficient of, 4128  
TiFe<sub>2</sub>O<sub>7</sub>-Fe<sub>3</sub>O<sub>4</sub> system, properties of, 542  
transparent, domain observations in, 1956  
Y-Fe garnet, effective exchange constant in, 3401  
magnetic anisotropy constant of, 901  
magnetoacoustic resonance in, 201  
permeability spectra of, 1291  
resonance in, 4138  
effect of rare-earth impurities on, 3811  
resonance instabilities causing microwave and  
l.f. oscillations, 198  
resonance line widths, 2330  
at liquid-He temperatures, 907  
maximum at low temperature, 3812  
with substituted Cr, absorption curve, variation  
in width of, 2329  
 $g$ -factor of, 2328  
Y and Gd garnet, resonance absorption with  
increasing power level, 4139
- Ferroelectric materials.** (See also Piezoelectric  
materials)  
anomalous polarization in, 1911  
(Ba,Sr)TiO<sub>3</sub>, thin films, vapour-deposited in electric  
field, 4083  
Ba(Ti,Sn)O<sub>3</sub> and Ba(Ti,Zr)O<sub>3</sub>, polarization variation  
with temperature, 3745  
BaTiO<sub>3</sub>, ceramics, anomalous residual polarization  
in, 3327  
polarized properties of, 479  
primary pyroelectric effect on, 156  
crystals, triangular, growth of, 1599  
domain structure observed by electron micro-  
scope, 158  
domains in, antiparallel, during polarization  
reversal, 2634  
effect of space-charge fields on, 2274  
electron paramagnetic resonance in, 476, 477  
hysteresis loops and pyroelectric effect in, 3332  
irradiation effects on coercive field of, 1913  
motion of 180° domain walls in, 155  
polarizability increase during switching, 3744  
polarization changes during aging of, 844  
polarization reversal in, 159, 3007  
spontaneous polarization in, ultra-low-velocity  
component of, 160  
switching current in, domain model for, 2635  
switching time at high voltages, 478  
switching velocity in, pulse-width dependence of,  
2275  
transition to ferroelectric state in, 843  
CaSr(Ti,Zr)O<sub>3</sub> and Na(Nb,Ta)O<sub>3</sub> solid solutions,  
nonferroelectric phase transitions in, 1912  
Cd,Nb<sub>2</sub>O<sub>7</sub>, preparation of, by anodic spark reaction,  
2276  
ceramics, charge release for different temperature  
and stress conditions, 2630  
energy loss processes in, 1217  
ceramics and crystals, review of, 153  
colemanite, properties of, 3741  
domain structures of, powder-pattern techniques  
for delineating, 4085  
domain wall theory for, 3740  
hysteresis loops of, growth of, 3329  
K<sub>2</sub>PO<sub>4</sub>, magnetic resonance spectrum and  
relaxation in, 3743  
KH<sub>2</sub>PO<sub>4</sub>, properties of, 3331  
KNbO<sub>3</sub>-KTaO<sub>3</sub> system, transitions in, 3330  
LiH<sub>2</sub>(SeO<sub>3</sub>)<sub>2</sub>, crystallography, dielectric and  
thermal measurements on, 4084  
Li(N<sub>2</sub>H<sub>4</sub>)<sub>2</sub>SO<sub>4</sub>, 840  
metaniobate and metatantalate ceramics, prop-  
erties of, 3326  
(NH<sub>4</sub>)HSO<sub>4</sub>, with low coercive field, behaviour in  
range -3° to -119° C, 841  
PbNi and PbMg niobates, temperature dependence  
of permittivity and loss angle, 2631  
Pb<sub>2</sub>ScNbO<sub>7</sub> and Pb<sub>2</sub>ScTaO<sub>7</sub>, temperature depen-  
dence of permittivity and loss angle, 2632  
properties and selection of, 154  
Rochelle salt, Curie temperature and domain  
structure of, 1218  
hysteresis and after-effects in, 3008  
local-field theory of clamped crystal, 484  
SrTiO<sub>3</sub>, electron paramagnetic resonance of Mn  
ions in, 2633  
stability of, 483  
thermal fluctuations of electric polarization in, 842  
triglycine sulphate, polarization reversal by  
sideways expansion of domains, 3742  
radiation damage in, 2273  
second-order transition in, 157
- Ferromagnetic materials.** (See also Ferrites;  
Magnetic properties)  
 $\alpha$ -Fe<sub>2</sub>O<sub>3</sub>, magnetostatic energy and magnetic  
anisotropy of, 893  
alloys, Co- and Fe-rich, magnetization of, 3392  
Co-Gd, magnetic moments of, 2321  
Co-Ni, domain-structure changes after quenching,  
192  
CrTe, Hall effect in, 2681  
crystal anisotropy and magnetostriction of, 3393  
dilute, experimental investigation of, 1631  
Fe-Al, Hall effect at Curie point in, 2680  
Fe-Co, Hall effects in, 1953
- Ferromagnetic materials, alloys, Fe-Si, temperature  
dependence of magnetic properties, 193  
Fe-Si-Al, sintered flake, for l.f. applications, 894  
Heusler-type, Ag and Au, 1950  
Mn-Al, metallographical investigation of, 2679  
Mn-Bi, films, magnetic writing on, 539  
Ni-Cu and Ni-Cr, temperature dependence of  
resistance of, 3805  
Ni-Fe, films, magnetization reversal by rotation  
and wall motion in, 1955  
orientational superlattices arising from  
mechanical deformation, 1276  
Ni<sub>2</sub>Fe, antiferromagnetic orientation in, 537  
Ni<sub>2</sub>Mn, change of sign of Hall constant in, 2675  
permalloy, direct observation of spin-wave  
resonances in thin film, 191  
perminvar, influence of magnetic annealing on,  
3396  
magnetic annealing in, 3797, 3798  
measurement of domain-boundary propagation  
velocity by Kerr effect, 194  
Co, films, resistivity of, 162  
resistivity and thermoelectric power of, 487  
leakage-field determination using divergent  
electron beam, 202  
nuclear resonance in, 4126  
polycrystalline, magnetic resonance of, 3802  
creep of asymmetric hysteresis cycles in, 204  
cube-oriented sheet, 896  
Curie-point phenomena in, 3391  
cyclic remagnetization of, noise measurements on,  
3796  
domain boundary configuration during magnetiza-  
tion reversals in, 2319  
domains in, observation by magneto-optical Kerr  
rotation, 1281  
thermal activation of, 1275  
width of boundary layer between, 2676  
elastic-wave damping in, high-frequency, 1278  
electron diffraction method of analysis of, 3801  
electron mirror microscopy of stray fields in, 3800  
Fe, amco iron, ultrasonic investigation of deformation  
in, 4124  
domain distribution between two phases in  
single-crystal disk, 3038  
domain structure, influence of demagnetizing  
field on, 2677  
eddy-current losses in, 4130  
films, evaporated, chemisorption of O<sub>2</sub> in, 1295  
magnetic anisotropy in, 2683  
influence of carbon inclusions on mobility of  
Bloch walls, 3794  
Fe and Ni films, magnetization vectors determined  
from magnetoresistance effect, 3040  
Fe and SiFe, magnetothermal effects in, 4129  
films, energy relations for magnetization analysis,  
3394  
monitoring hysteresis loop during and after  
deposition, 2682  
Hall effect in, measurements on, effect of crystal  
anisotropy and magnetostriction in, 3803  
theory of, 1277  
hysteresis in, calculation of, 197  
hysteresis cycles in, creep of, 547  
interatomic distances in, 891  
irradiation effects on, 2646  
magnetite, spin-fluctuation scattering of neutrons  
in, 4127  
magnetization of, change with hydrostatic pres-  
sure, 892  
model for interpreting domain effects on electron  
beam, 3407  
mu-metal, 'after-effect' in, 2320  
Ni, domain distribution in, influence of tempera-  
ture on, 3795  
Hall effect at low temperatures in, 2322  
resonance in, 2684  
ultrasonic velocity and attenuation changes with  
magnetization direction, 4125  
ultrasonic wave propagation in, 1951  
Ni, films, cathode-sputtered, thermal transforma-  
tion of, 895  
electrolytically produced, properties of, 3804  
Hall effect in, 1279, 1280  
magnetic properties of, 3039  
magnetoresistance of, 1944, 3395  
Ni and Pd films, temperature dependence of  
resistance of, 3805  
particles in paramagnetic alloy, variation of  
spontaneous magnetization with tempera-  
ture, 2678  
powder-core, temperature coefficient of initial  
permeability of, 1282  
radiation effects in, 196  
resonance and relaxation phenomena in, thermo-  
dynamic theory of, 538  
soft, flux reversal mechanism in, 3405  
spin-orbit coupling and extraordinary Hall effect  
in, 1952  
structure of, instability of Bloch walls due to  
interstitial atoms, 535  
superconductivity conditions for, 195**
- Ferromagnetism, coupling of elementary domains  
in, 546  
effect of coupling between grains on hysteresis,  
203  
excluded-volume problem and Ising model of, 3263  
fluctuating-field theory and low-temperature  
ordering, 536  
granular structures in, analysis of, 2318  
Heisenberg model for, equivalence of Bose-Einstein  
lattice gases to, 2913  
Field strength. (See also Reception; Wave propaga-  
tion, e.m.)  
measurements, recording and evaluation of, 3419**
- Flms, thin, absorption of e.m. wave by, optimum  
thickness for, 3268  
absorption/field-strength curves for, determina-  
tion of width of, 3814**
- Films, thin, Au, effect of Se film on conductivity of, 488  
Au and Cu, resistance variation and noise in,  
3350  
magnetoresistance measurement circuit, 555  
microwave refractivity of, 1154  
oxide, on Al, impedance, rectification and  
electroluminescence of, 4141  
Sb, resistivity and magnetoresistance measure-  
ments on, 2693
- Filters.** (See also Networks; Waveguides)  
active, band-pass, 16-175-c/s, multirange, 3977  
using transistors and twin-T networks, 2156  
all-pass, for delay equalization in television  
transmission, 737  
attenuation characteristics, formulae for, 731  
band, normalized admittance curves and mis-  
match circles for, 734  
null-point, 736  
2-stage, with feedback amplification for band-  
width control, 735  
branched, 2151  
constant- $k$ , stagger-tuned, for servo systems, 368  
crystal, lattice-type, symmetrical transfer charac-  
teristics of, 1121  
wide-band, design of, 1120  
development of technique in France since 1947,  
2153  
elliptic-function, design curves for, 367  
i.f., permissible circuit impedances for f.m., 732  
triple-tuned, operational and design data for,  
1803  
image-parameter, Tchebycheff approximations for,  
2498  
ladder, band-pass, half-sections formulae for, 3223  
coupling coefficients for maximally flat ampli-  
tude response, 1478  
interchange of infinite-attenuation elements in,  
2150  
LC, design curves for, 366  
low-pass/band-pass transformation of, 2152  
mismatch conditions for improving character-  
istics of, 1116  
optimum, design tables for, 49  
Zobel-type, simplified design method for, 3224  
linear, transfer-function relation for, 3607  
low-pass, RC, with optimum response, design data,  
51  
response to finite-duration signals, 2390  
voltage-controlled, continuously variable, 1119  
magnetostrictive, narrow-band, 52  
mechanical, for communication equipment, 2155  
flexural vibrations in, 2154  
theory and technique of, 3225  
microwave, cavity-type, aperture-coupled, 1112  
for minimum insertion loss, 1117  
pulse-width, for television receivers, 1802  
rejector, bifilar-T, analysis of, 1122  
Tchebycheff-type, symmetrical, estimation of  
dissipative effects in, 50  
synthesis of, 3608  
time-symmetric, for gliding-tone analysis, 365  
wave, design of, network transformations for, 3222  
Zobel-type, for Tchebycheff insertion loss, 1118
- Frequency, control, automatic, using junction diode,  
for f.m. receivers, 951  
converters, ferrite 'serrordyne' for X band, 3942  
u.h.f., using nonlinear-capacitance diode, 3145  
dividers, harmonic-type, investigations on, 1132  
for pulse synchronization, 3232  
regenerative-modulator-type, process related to  
Mathieu functions, 2509  
using transistors, 378, 1133  
wide-band, 2508  
measurement equipment for transmissions from  
aircraft in flight, 3423  
measurements, using atomic clock, 1311  
pulse beat method for, 1643  
of response of electromechanical devices, 2079  
meter, microwave, H<sub>2</sub>, mode, 4161  
multiplication, using counter circuits, 3614  
stabilization, using double mixing circuit, 738  
standards, Canadian, 2700  
using Cs beam, 2701  
Cs, 'atomichron', 550, comparison of, 212, drift in,  
4148  
comparison with NH<sub>3</sub>-beam maser, 915  
correction for earth's ellipticity, 4147  
N.P.L., circuits of, 2340  
portable, 3053  
microwave, using crystal oscillator, 1300  
using Na vapour, 4150  
for microwave spectrometers, 3054  
molecular, theory of cavity microwave spectro-  
meter used with, 1641  
based on molecular-beam electric resonance in  
LiF, 4149  
NH<sub>3</sub>, in terms of astronomical time, 914  
portable 15-Mc/s, 3052  
100-kc/s, comparator for, 1299**
- Galvanomagnetic effects.** See Magnetic effects.  
**Galvanometers.** See Meters, galvanometer.  
**Gases, ionized.** (See also Plasma)  
auroral afterglow of nitrogen, 1510  
dependence of electron mobility on magnetic  
field, 3643  
electron and ion temperature difference in  
magnetic field, 2536  
irreversible processes in, 4020  
in strong fields, as hydromagnetic capacitor, 1843  
thermal diffusion in, 89  
transport phenomena in, considering electron-  
electron scattering, 402  
oxygen, attachment of slow electrons in, 2533
- Generators.** (See also Oscillators; Signal generators)  
frequency-sweep, using voltage-variable  $p$ - $n$ -  
junction capacitor, 3986  
wide-band, with 100 kc/s-300 Mc/s sweeps, 558  
harmonic, efficiency with ideal rectifiers, 60  
microwave, using capacitive-mode crystal  
diode, 3991

- Generators, harmonic, using nonlinear reactances, 61  
pulse,  $\mu$ s, calibrated, using coaxial line, 2706  
using half-cycle delay principle, 2501  
using vibrating-reed Hg switch, 2500  
using nonlinear amplifiers to shorten rise time, 1488  
for radar range calibration, 2352  
using transistors, 2161  
variable, using pulse transformer and transistor, 1128  
80- $\mu$ s, 100-kW, for spectroscopy, 376  
pulse and square-wave, commercial, 2710  
random-function, with constant peak-to-peak amplitude, 373  
sine-wave, l.f., commercial, 552
- Geomagnetic storms**, activity following large solar flares, 3284  
correlation with sudden disappearance of solar filaments, 2948  
recurrent, 1917-1944, related to solar prominences, 1865  
in relation to geomagnetic pulsation, 1537  
ring-current theory of, inadequacy of, 1536  
sudden commencements, observations at Tamar-rasset, 1183  
propagation of, 3285  
time constants for, 1535
- Geomagnetism**, activity, in polar regions, from report of French expeditions, S IV 2, 111  
related to green coronal-line intensity, 2949  
relation with solar flares, 113  
dynamo theory of, 108  
far-field discrepancies in cosmic-ray and surface data, 435  
field disturbances, correlation with earth currents, 4044  
due to nuclear explosions, 3669, 3670, 3671, 3672, 3709  
related to atmospheric circulation at 300 mb, 2229  
as relaxation variations, 2944  
due to solar plasma, 2560  
field fluctuations, irregular, diurnal variations of, 1533  
in 0.1-30-c/s range, 1532  
with 6-sec period, causes of, 2945  
field geometry at ionospheric heights, 3849  
field intensity, scalar, method for analysis, 109  
solar-eclipse effect on, 2561, 2562  
field measurement, using weak-field maser, 3823  
field micropulsations, in Alaska and California, 4045  
geographic variations, 2946  
field pulsations, auroral origin of, 2947  
related to oscillations of outer atmosphere, 3673  
field reversal calculations, 436  
field variations, e.m. fields induced by, 3668  
lunar tides at Kodaikanal, 1534  
lunar-diurnal, at Tamar-rasset, 2228  
secular, relation to non-dipole fields, 790  
hydromagnetic waves above ionosphere, 110  
measurement with Rb vapour magnetometer, 112
- Hall effect**, (See also under Semiconductors)  
devices based on, 2692  
generators, semiconducting thin films for, 3349  
measurement apparatus, a.c., for ferromagnetic and semiconductor materials, 918
- Hearing**, binaural fusion in, mechanism of, 1055  
definitions of  $d'$  and  $\eta$  in signal detection, 3854  
detection of signals in noise, 3540  
as function of frequency ensemble, 1052, 3539  
masking in, definition and index for, 3541  
stereophonic effect obtained with single signal, 1056  
threshold, and duration of tone pulses, 3909  
threshold shift, due to noise, 682, 1053, 1054  
relation with masking, 681
- Heating**, eddy-current system using gas-filled triodes, 2716  
induction, generator using hydrogen thytrons, 3439  
r.f., frequency stability of generators for, 933
- Hysteresis**. See Magnetic properties.
- Image converters**, electron-acoustic, using piezo-electric plate scanned by electron beam, 679, 2084  
for military and scientific use, 2783  
pulsed, for observation of luminous discharges, 3522  
for quantity production, and definition of gain characteristic, 1404  
shutter-type, for multiple-frame photography, 2369
- Image intensifiers**, cascade, fluctuations in, 3521  
with optical feedback, for picture storage, 1408  
solid-state, application of electroluminescence in, 1597
- Impedance**, matched or optimum, assessment of, 37  
measurements, by differential bridge, between 10 kc/s and 10 Mc/s, 3429  
in waveguide, automatic frequency-sweep c.r.o. method, 220  
100 c/s-50 Mc/s, 3-branch phase-opposition circuit for, 554  
shunt, of resonant cavity, measurement method, 3421  
surface, measurement technique for v.h.f., using disk-terminated coaxial line, 1306  
quantum theory of, 1221
- Inductors**. See Coils.
- Information theory**. See Communication theory.
- Infrared**, (See also Photocells)  
physics and technology, 4010
- Insulating materials**, (See also Dielectric properties; Ferroelectric materials)  
ceramic, structure and properties of, 4142  
for magnet wires, 1635  
plastics, epoxy resins, properties of, 911  
polyethylene, oxidized, dielectric loss of, 3414  
polymers, dielectric losses and permittivity at cm  $\lambda$ , 3818
- Insulating materials, silicone, tabulated data on, 2694  
tape- and film-type, for electronic equipment, 1296
- Interference**, (See also Noise; Reception)  
from fluorescent lamps, 3463  
from industrial, scientific and medical apparatus and radiating receivers, 954  
from radar, in microwave communication services, 1353  
in shared-channel broadcasting, subjective tests, 3479  
suppression equipment for lifts and screened rooms, 4193  
from television receivers, reduction of, 955  
u.s.w., measurement equipment for, 2386
- Interferometry**, double-beam, coherence requirements for, 398
- International Geophysical Year**, coordination of observational program for, 1539  
Indian program, 3299  
Indian work during, texts of papers covering, 3699  
N.B.S. radio and ionospheric observations during, 4046  
organization and data-collection arrangements for, 1538  
program of atmospheric research, 1540  
R.S.G.B. progress report, 114  
for v.h.f. program, 115  
S.W.I. and disturbance warnings, improvement of, 116  
World Data Centre for rockets and satellites, 1194
- Inverters**. See Converters, d.c./a.c.
- Ionization**, in homogeneous field, extension of Townsend's approximation formula, 2200
- Ionosphere**, (See also Atmosphere; Earth satellites; Wave propagation, e.m.)  
abnormal effects on cosmic noise at 10 m  $\lambda$ , 808  
absorption in, interpretation of variations in, 3716  
'riometer' cosmic-noise equipment for measurement of, 1566  
at 5 Mc/s over Delhi, 810  
in arctic, measurements from drifting observatory, 3717  
in auroral zone, rocket measurements 100-210 km, 1560  
D region, absorption in, explanation of daytime constancy of, 809  
rocket measurements of, 2972  
arctic, electron-collision frequencies in, 1886  
 $f_{min}$  and sudden disturbances of, 2588  
low-frequency sounding and reaction-rate investigation of, 1553  
disturbances in, effects on communication circuits, 573  
sudden, effect on 2.28-Mc/s pulse reflections, 2971  
travelling, night-time, 2580  
drift in, evaluation by method of 'similar fades', 801  
measurements at l.f., 1198  
signal-pattern analysis for, 1884
- E region, effect of ion production and recombination on wave scattering in, 4059  
geomagnetic distortion of, 2246  
lower, horizontal drifts and temperature in, 804  
measurements during solar eclipse, 3306  
size of irregularities in, 4054  
structure and variations of, 1554  
turbulence due to e.m. forces and wave scattering in, 4060
- E and F regions, drift observations at Ibadan, 1557  
E<sub>2</sub> layer, long-term variations in Japan, 127  
lunar influence at Huancayo, 3305  
lunar-tide observations at Ibadan, 1880  
polar, analysis of ionosonde data, 1561  
spiral, occurrence of, 3304  
spread-F and radio-star scintillation, causes of, 2970  
survey of data, 1879  
v.h.f. observations in U.S., 2587
- E<sub>1</sub> and F<sub>2</sub> layers, comparison of data on, 2578  
E<sub>2</sub> layer, lunar tides observed at Brisbane, 132  
effects of nuclear explosions on, 3709, 3712, 4056  
radio observations of, 2969  
in recordings of atmospherics and solar r.f. bursts, 3711  
in vertical-incidence absorption measurements, 3710  
effects on radio reflections from moon and solar corona, revised formula for, 2583  
effects related to cosmic noise level variations around 80 Mc/s, 2582  
effects of strong gyro-waves in, 3308  
electron density of, computations of, 126  
daytime decay variations with height, 3708  
investigations by rocket in U.S.S.R., 2965  
measurements using rocket-to-ground c.w. transmission, 3714  
profiles, during I.G.Y., 791  
preparation from ionograms for I.G.Y., 438  
electron distribution in, derivation of  $N(h)$  profiles for, 1552  
over Slough, 806  
electron energy levels recorded at 470-1880 km, 3294  
electron-ion recombination measurements on nitrogen, 125  
equatorial, electric-current measurements by rocket magnetometer in, 2968  
e.s. field measurements by rocket or satellite, 3713  
F region, bifurcations in, at Baguio, 1952-1957, 802  
drifts in, horizontal, at Waltair, 2242  
electron and ion density distributions in, 2579  
height gradient of electron loss in, 805  
 $k'f$  records at Macquarie Island, 2241  
inhomogeneous structure of, 2244  
magnetic-storm effects on, 1563  
physical conditions and effects of, 1555  
solar-activity effects on, 2245  
spread-echo observations at Brisbane, 454  
triple-splitting measurements at low latitudes, 1885
- Ionosphere**, F<sub>1</sub> layer, critical frequency, derived from quality figures of WWV transmissions, 135  
variation near auroral zone during magnetic disturbances, 803  
world-wide distribution, 129  
drifts in, effect of magnetic activity on, 2586  
electron-density variations from critical-frequency data, 4055  
electron production rate in, 800  
equatorial, diurnal development of, 3707  
horizontal movements in, vertical-incidence recordings of, 2243  
influence of electron-ion diffusion on formation of, 128  
ionization, relation of magnetic dip to, 2584  
lunar variations of, semidiurnal, 1196  
magnetic field calculations at Dakar, 133  
model for, 3705  
observations at Halley Bay, 1881  
polar, critical frequency, diurnal and annual variations of, 1882  
structure and movement of large inhomogeneities in, 2581  
world-wide electron density distribution, anomalies in, 3706  
geomagnetic tides in, origin of L, currents causing, 2247  
heating by hydromagnetic waves, 2585  
height, changes deduced from v.l.f. phase velocity measurements, 2735  
virtual, measurement of, 3715  
 $k'f$  records, coefficients for  $N(h)$  profiles from, 3303  
inhomogeneities, irregularities of refraction due to, 2251  
ionograms, accurate virtual height from, method of obtaining, 2249  
lower, abnormal ionization associated with cosmic-ray enhancements, 1562  
'Chapman behaviour' in, 3301  
nocturnal ionization of, effect of vertical drifts on, 1878  
solar-cycle influence on, 130  
magnetic-storm effects on, 134  
measurements on, instrument effects in, 807  
motions in, interpretation of observational data on, 1556  
night-time variation, interpretation of l.f. ionograms for, 1558  
outer, electron density distribution from whistler data, 3307  
electron density and neutral particles in, 2967  
reflection coefficient at v.l.f. from measurements of atmospheres, 2589  
refraction of extraterrestrial waves by, 2973  
research in Hungary 1954-1956, 452  
review for 1958, 1199  
rocket observations of, 1559  
self-demodulation and self-distortion of radio waves in, 2252  
solar-eclipse effects on, observations at Freiburg, 131  
observations at Singapore, Dec. 1955, 1883  
solar-flare effects on, detection of, 1181  
sounders, automatic frequency-sweep, Type C-4 equipment for I.G.Y., 1564  
back-scatter, 3-frequency, for I.G.Y., 1565  
sounding of, aerial to eliminate ground-wave interference in, 710  
echoes obtained in minaural region, 457  
experiments using back-scatter technique, 1197  
storms, morphology of, 2248  
stratified, with weak irregularities, reflection from, 2250  
structure of, dynamic model for, 2966  
temperature and electron-density determinations by vertical-incidence scatter measurements, 4061  
turbulence in, 2577  
winds in, and S<sub>2</sub> variations, 453
- Ions**, emission, secondary, from metal surfaces, 1508  
pressure generation by ion-drag, 3637  
sources, high-current, 1986
- Lenses**, (See also Aerials; Electron lenses)  
microwave, axial phase anomaly in, 713  
'confection'-type, tests on, 1450  
design of, 1100  
dielectric sphere as, 714  
Luneberg-type, general solution for refractive index of, 24  
properties of slotted dielectric interface for, 3584  
scanning, design for minimum phase error, 1101  
spherically symmetric, design method for, 3583  
stepped-index, 2854
- Lightning**. See Atmospherics.
- Limiters**. See Circuits, limiter.
- Loudspeakers**, (See also Acoustics; Sound; Transducers)  
acoustic testing of, 1761  
with bass-reflex cabinet, acoustic interactions in, 2456  
analogue network for performance calculations, 1763  
column-type, for public-address systems, 2824  
design methods for improved performance, 1762  
diaphragms, rigidity of 'sandwich' construction, 334  
e.s., development and constant-charge operation of, 8  
generating high-intensity noise for component testing, 692  
impedance and phase measurements on, 2823  
ionic, design and performance of, 1759  
with modulated air flow, for high-intensity sound, 3922  
monitoring, performance criteria and design of, 333  
permanent magnets for, 1760  
response of, theoretical study near principal resonance, 1433
- Luminescence**, (See also Electroluminescence; Phosphors)  
control by charge extraction, 473

- Luminescence, and exo-electron emission of inorganic crystals, 3002
- Magnetic effects**, (See also Hall effect)  
Faraday rotation, design of bimodal cavity for experiments on, 770  
galvanomagnetic properties of Fermi surfaces, 3271  
magnetoresistance of metals in high fields, 3337  
magnetostriction, linear, form effect in, 2930
- Magnetic fields**, amplification by high-current discharge, 401  
cosmic, force-free, 784  
of ferrite ellipsoid, 403  
flux density measurement by paramagnetic resonance, 3056  
flux function and induction calculations, 4023  
improvement in detecting power of search coils for measuring, 2351  
interplanetary, and cosmic-ray variations, 783  
measurement, electrodynamic gradiometer using microvibration technique, 218  
by nuclear-resonance technique, 1644, 3824  
using semiconductor, 1972  
probe, Bi, miniature, based on Hall effect, 1973  
uniform, effect of permeable alloy cylinder in, 90
- Magnetic properties**, hysteresis, creep characteristics, influence of temperature on, 1294  
from susceptibility measurements, 4024  
of (Ni, Li)O, 3799  
permeability of iron wire under action of circular alternating field and d.c. longitudinal field, 3645  
of perovskite-type mixed crystals LaSrCoO<sub>3</sub>, 890  
renaissance, measurement in thin films, 1314  
susceptibility, of Cu-Ni and Ag-Pd alloys at low temperatures, 190  
measurement, by analogue of Wheatstone bridge, 1313  
on Pd mixed crystals, 3790  
of transition-metal silicides, 1274
- Magnetization**, of Au<sub>2</sub>Mn, influence of pressure on, 1273  
theory of, system of magnetic moments in, 3644
- Magnetohydrodynamics**, spherical vortices in, 92
- Magnetometers**, influence of self-inductance of core winding in, 3058
- Magnetoresistance**. See Magnetic effects.
- Magnetostriction**. See Magnetic effects.
- Magnets**, permanent, stability of, factors influencing, 1960  
powder, properties of, 1961
- Mathematics**, characteristic functions of  $\Delta u + k^2 u = 0$ , asymptotic nature of, 2696  
elliptic integrals, numerical evaluation method, 549  
flow-diagram analyses, 1964  
forced-oscillator equation, simple-subharmonic solutions for, 4146  
Fourier analysis, template method for evaluation, 1298  
generalized Rayleigh processes, 210  
geometric-analytical theory of transition, 3049  
integral equations, approximate solutions of, 209  
Lagrange equations in electrical networks, 360  
Laplace equation, numerical solution for Cauchy conditions, 3050  
Laplace expansion, modification for network analysis, 548  
Laplace transformation, for summation of weakly convergent series, 2695  
Mathieu and related functions, regenerative modulation process as analogue for, 2509  
parametric solutions of nonlinear differential equations, 1963  
sampling theorems, 3417  
smoothing of data, 208  
statistics, analysis of errors in determination of mean value, 1638  
switching algebra, solution of equations in, 1297  
ternary, 1636  
switching functions, classification and minimization of, 3048  
toroidal functions, theory and numerical tables, 4145  
vectors, probability distribution of phase with Rayleigh-distributed component, 3416  
Weber's equation, approximation method of solving, 913  
Liouville method applied to, 912
- Z transforms**, derivation and applications, 1637
- Measurements**, (See also individual subjects)  
calibration centre at Boulder, Colorado, 1302  
of characteristics of u.h.f. quadrupoles, 1968  
of cross-spectral density of random functions, 2349  
microwave, interferometer and grating-spectrometer techniques for, 563  
of polarization, with instantaneous display, 3432  
of phase and amplitude, 0.01 c/s-10 kc/s, for testing control systems, 1651  
of phase and time delay, video transmission test set, 4159  
response-time delays in equipment, correction formulae for, 551  
r.f., reciprocity in, 917  
of r.f. radiation, survey of techniques, 2714  
slotted-line, logarithmic chart for evaluation of, 2702  
of valve temperatures, using phototransistor pyrometer, 3424
- Metals**, (See also Alloys; Conduction; Ferromagnetic materials)  
Al, surface finishes for, 1962  
alkali and noble, band structures of, 910  
Bi, infrared transmission of, de Haas-van Alphen-type oscillations in, 2620  
diamagnetism of conduction electrons in, 2194  
electron structure of, 418  
high-purity, 486  
isotropic, galvanomagnetic, thermomagnetic and thermoelectric effects in, 161  
surface impedance of, h.f., quantum theory of, 1221  
ultrasonic absorption in, collision-drag effect for, 2444
- Metals**, ultrasonic attenuation by electrons in, 3336
- Meteors**, magnetic effects from, absence of, 106  
radio-echo height distribution, theory of, 2940  
radio search method for weak showers, 2227  
reflection of radio waves from, Booker's theory for, 1527  
trails, drift of reflection point along, 2226  
echoing points, height and electron density from c.w. measurements at 27 Mc/s, 2941  
electron density in, approximations for, 2224  
over-dense, oblique echoes from, 2225  
reflection of radio waves from, research applications of, 1526  
velocity of, c.w. technique for measurement, improvement to, 105
- Meters**, galvanometer, feedback systems for, 2707  
mirror-type, improved performance using photoelectric compensating circuits, 2354  
ohmmeter, accuracy of, 1649  
phasemeter, for 1-100 c/s, 1319  
voltmeter, digital, 2355  
high-voltage, using electron beam, 560  
wattmeter, double-vane torque-operated for 7 kMc/s, 223  
thermoelectric, for 50 c/s-30 kc/s, 1320  
torque-operated, for 3 cm  $\lambda$ , 2359
- Microphones**, (See also Transducers)  
carbon, powder for, deterioration of, 3189  
preparation of, 1758  
cardioid, theory of, 2092  
concentration coefficient and directivity factor in surrounding noise, 691  
condenser-type, for airborne ultrasonic applications, 2448  
differential-type, characteristics of, 1757  
dynamic, acoustic-front damping in, 2455  
effect of mechanical vibrations on, 690  
c.s., uniaxial, 1432  
gradient-type, for intercommunication systems, 2094  
magnetic, miniature, construction of, 1431  
probe-type, design for, 1429  
standard, calibration of, absolute methods for, 1430, 2093
- Missiles**, guided, miss-distance indicator based on space-coupled oscillatory system, 2601
- Mixers**, microwave, design for minimum noise figure, 2874
- Modulation**, amplitude, microwave, by ferrocube, 1151  
amplitude and frequency, transient response of networks and transmission lines for, 2186  
asymmetrical, distortion calculations, 3465  
frequency, negative-feedback method for broadcasting transmitter, 3872  
phase, mathematical treatment of power in, 3851  
phase-shift circuits for s.s.b. and quadrature, 4196  
pulse, accuracy obtainable with transistors, 1827  
markerless systems for communications, 956  
pulse-code, with amplitude keying, channel capacity, 3103  
signal/noise ratio in, 2009  
pulse-width, effect of carrier f.m. on, 4194  
single-sideband, multiphase, suppression of unwanted sideband in, 589  
phase compensation method for, 588  
system for, 587
- Modulators**, ferrite, microwave, 1825  
frequency, diode reactance-type, 2187  
using ferroelectric capacitor, 3247  
for 'marginal' oscillator, 1826  
portable unit for television link, 2034  
pulse-code, magnetic-amplifier circuit for, 2188  
shunt-type, as phase detector, error in, 2899
- Molecular systems**, effective radius of electron in, 1858  
elastic model of lattice defects, 1173  
electron-phonon interactions in, and impurities in metals, 1859  
theory of, 2215  
energy-loss spectrum of electron interaction in solids, 2931  
energy potentials in crystals, Fourier coefficients of, 782  
energy states of one-dimensional crystal, 1174  
imperfections in solids, relations between, 1175  
negative-mass charge carriers in, energy absorption by, 3747  
nuclear polarization by means of 'hot' electrons, 4011  
plasma resonance in solids, theory of, 781  
spin-wave theory for, validity of equations in, 2214  
Zeeman splitting of paramagnetic ions in, 2549
- Moon**, radio echoes at 412.85 Mc/s, rapid fading rate of, 1525  
radio observations of surface of, 1863
- Navigation aids**, (See also Direction finders; Radar)  
airborne, Doppler systems, characteristics of, 2979  
review of performance of military equipment, 2608  
self-contained, with automatic computer system, 2599  
for aircraft, automatic blind-landing system, B.L.E.U., 464, 1892, 3723  
collision detection without range data, 3722  
for distress beacon, operating on 243 Mc/s, 1891  
Doppler omnirange system, 2610  
VOR, design considerations, 1897  
'Vorac', rotating aerial array for, 2120  
flight testing of, 460  
radio equipment for B.O.A.C.'s Comet, 1890  
TACAN, general description of, 461  
beacons, metallic reflectors for, 1582  
Decca, Doppler sensor, description of, 820  
Mk. 10 receiver, air trials of, 462  
Dextra, interim report on field trials of, 463  
d.m.e. system, Australian, 208-Mc/s receiver for, 145
- Navigation aids**, d.m.e. system, using common-frequency transceivers, 146  
infrared, search-system range performance, 4070  
simulation techniques for system evaluation, 4071  
marine, electronic clock coder for radio beacons, 4069  
v.l.f., radux-omega system, phase stability measurements for, 2736
- Networks**, (See also Circuits; Filters)  
active, RC, synthesis of, 3978  
combining, 3-band, 733  
linear, transfer properties based on growth of spectral energy, 3220  
matching, 'immittance' chart design method for transistor measurements, 1115  
multipole, analysis of multitapped potentiometers with loaded output, 2159  
RLC, topological analysis for, 2157  
'traditor', nonenergetic nonlinear elements in, 2872  
2-phase, design of, 2158  
quadrupole, analysis based on determinant technique, 48  
CR divider, response of, 47  
general theorem for synthesis of, 2495  
group delay and group velocity related to transfer function, 1798  
using gyrators, as nonreciprocal systems, 2145  
for impedance conversion, 1480  
LC, synthesis of, 2147  
linear, asymmetric, iterative analysis for, 2869  
passivity condition for, 1800  
transient analysis with f.m. input, 2148  
lossy, geometric representation of, 1477  
microwave, matrix analysis for, 2149  
voltage-node displacement for definition of, 1114  
Minkowski model of Lorentz space in analysis of, 1799  
non-Euclidean geometry in, 3606  
symmetrical, analysis by voltage-node displacement method, 1801  
synthesis of, using symmetrical lattice structure, 2146  
transfer-function approximation by polynomial, 3976  
transformation theorem for, 2496  
twin-T, response time of, 730  
u.h.f., 3-point measuring method for, 1968  
RC, asymmetrical, synthesis of, 1113  
transients in, analysis using Laplace transformation, 728  
2-terminal, negative-resistance, 1476  
reactance theorem for, 1797  
3-terminal, nonreciprocal element for topological analysis, 2871
- Noise**, (See also Atmospheric; Solar radiation; Sound)  
in communication and servo systems, 1682  
contact, theory of, 2422  
current, in film-type resistors and semiconductor diodes, 3506  
extension of Nyquist's theory to field-excited 'hot' electrons, 2902  
Gaussian, limited, spectrum of, 1681  
simultaneous variation of amplitude and phase, 583  
measurements on noise-thermometer amplifier, 3055  
random, measurement of, in presence of television signal, 2345  
sources, diode for u.h.f., 3533  
discharge-tube, for 1 700-2 300-Mc/s band, 559  
standard, filament-type for 3 kMc/s, 2344  
statistical analysis using digital technique, 3826
- Observatories**, Melbourne-Toolangi, 1531  
Royal Greenwich, 2550
- Oscillations**, microwave, 30-3 000-kMc/s, methods of generating, 1845  
strongly nonlinear, analysis for, 80
- Oscillators**, Barkhausen-Kurz, cm- $\lambda$ , 1486  
blocking, with transformer-core saturation for control of pulse duration, 3989  
using transistors, analysis and design of, 2504  
waveform control methods, 56  
constant-frequency, controlled by thermistor bridge, 1482  
cryogenic, based on relaxation process in Pb film, 2875  
crystal-controlled, for equally spaced frequencies in given band, 741  
Hartley-type, theory of, 1804  
'marginal', using transistors, for nuclear magnetic resonance observations, 1805  
with servo control, 371  
testing of, 372  
thermally compensated, using thermistor, 370  
3-terminal, design of, 1483  
1-Mc/s, using transistors, 1484  
with cubic nonlinearity, ultraharmonic and subharmonic resonance in, 3611  
f.m., using transistors, 1489  
harmonic, damped, wave-mechanics treatment of, 739  
thermodynamics of, 81  
microwave, based on ferrimagnetically coupled electrons in transient fields, 4026  
mm- $\lambda$ , using ferrites, 3983  
review of techniques, 3982  
multivibrator, analysis of, phase-space method for, 1806  
low-impedance, using transistors, 2503  
magnetically coupled, frequency control of, 3612  
with negative feedback, 1807  
negatively biased, 55  
using series diode for increased sensitivity, 2502  
using single triode with no filament current, 3988  
nonlinear, analysis of, 2499  
parametric, subharmonic, for digital computing, 3590

- Oscillators, parametric, semiconductor-diode, 3981  
 RC, frequency-sweep, voltage-controlled, 1125  
 incremental frequency control of, 1126  
 wide-range, 54  
 4 c/s-350 kc/s, using bridged-T circuit, 1808  
 for stable carrier frequencies of 8 800-4 200 Mc/s, 3987  
 stepped-frequency, for propagation tests, 1485  
 sub-mm  $\lambda$ , using avalanche effect in semiconductor, 3875  
 synchronized, transfer function of, 3979  
 transistor, condition for self-oscillation in, 1809  
 crystal-controlled, 1129  
 graphical design method, 746  
 'marginal', as magnetic-field probe, 1810  
 Meacham-bridge circuit for carrier-frequency techniques, 1811  
 phase-locked, 2162  
 20-kc/s with 50-mW output, design of, 745  
 with two degrees of freedom, stability study by differential analyser, 3980  
 v.l.f., based on triangular-wave/sine-wave transformation, 2876  
 using Zener-diode limiter and harmonic filter, 2160  
 Wien bridge, modified, for improved characteristics, 1124  
 2-valve, with feedback via  $\pi$ -network, 3985  
 500-Mc/s, using open rectangular waveguide, 3984
- Particle accelerators**, betatron, electron capture and limiting current in, 2718  
 cyclic, controlled by h.f. field, 3440  
 cyclotron, fixed-frequency, with one dee, 1985  
 microtron, maximum energy and intensity in, 3837  
 with star-shaped field, 2370  
 linear, electron, anomalous attenuation in, 1329  
 multiplier effect in, 3836  
 22-MeV, 2719  
 r.f. aspects of design of, 1328  
 space-charge effects in, longitudinal, 1984  
 tandem Van de Graaff, at Chalk River, 935  
 10-MeV, design of, 934  
 150-kV generator using rotating ferroelectric disks (ferrostaic), 3071  
 with 800-kV cascade generator, Budapest model, 1657
- Particles**, charged, correlation function for, 1829  
 cyclic motion in electric field, 3835  
 in e.m. field, stable orbits of, 3250  
 energy losses in gyrotropic medium, 3635  
 e.s. field and trajectories of, 1505  
 longitudinal vibrations of electron-ion beams, 1835  
 in magnetic fields, trajectory plotting methods, 1832  
 moving through dielectric, radiation from, 3634  
 trajectory plotting, graphical-analytic method for, 3630
- Phase**, measurement, using coincident slicer, 217  
 using heptode mixer, 1970  
 and locking of frequency changer, pulse-beat method for, 1643  
 for power supply systems, 1971  
 splitter, concertina-type, performance analysis, 3616
- Phosphors**, AlN, electroluminescence of, 4082  
 cathodoluminescence of, 2624  
 CdI<sub>2</sub> and PbI<sub>2</sub>, luminescent complexes in, 149  
 CdS, blue edge emission in, mechanism of, 2269  
 carrier excitation due to electron bombardment in, 3004  
 edge luminescence anisotropy in, 474  
 emission spectra and absorption edge of S in, 1216  
 energy transfer mechanism in, 827  
 excitation by ionizing radiation, 3325  
 with green and red-green luminescence, 2621  
 influence of magnetic field on blue fluorescence or luminous absorption of, 2622  
 multiplet structure of excitons in, 3324  
 pure fluorescent emission lines and luminous absorption lines at 4.2°K, 2618  
 CdS and ZnS, polarization of fluorescence in, 2267, 2268  
 electroluminescence characteristics and applications of, 151  
 luminophore, measurement of short afterglows of, 2350  
 review of, 1595  
 SrO, (Ba,Sr)O and MgO, cathodoluminescence of, 150  
 SrS:Pr, with fluorescence larger than energy gap, 2623  
 sulphide, Ag luminescence centres in, energy levels of, 2998  
 two-stage optical excitation of, 2996  
 transient response of, 1211  
 ZnO.CdO.B<sub>2</sub>O<sub>3</sub> system, phase relations and fluorescence, 3735  
 ZnS, cathodo-electroluminescence phenomena in, 834  
 cathodoluminescence efficiency of, 472  
 electroluminescence in, with a.c.-d.c. excitation, 3000  
 effects of impurities and temperature on, 152  
 based on equilibrium conditions, 832  
 particle size and efficiency of, 2266  
 under pulse excitation, 833  
 significance of particle size in, 3738  
 of single crystals with cathode barriers, 835  
 electron traps in, 1596  
 excitation spectra and temperature dependence of luminescence of, 2999  
 films, preparation from electroluminescent powder, 1598  
 preparation of single crystals by gas reaction and sublimation methods, 2625  
 short-persistence, luminescence of, 3001  
 ZnS and ZnCdS, activation by Au and other elements, 3736
- Phosphors, ZnS-Cu, chromatic effects in photoluminescence of, 1908  
 electroluminescence brightness and brightness waveform of, 1214  
 ZnS-Cu,In, energy transfer in, 4081  
 ZnS-Cu,Pb, electroluminescent, time-dependent spectra of, 4080  
 ZnS-Sn,Li, excitation and emission spectra of, 1212
- Photocathodes**, interference-type, with increased yield and variable response, 2053
- Photocells**, AgS, barrier-layer, determination of parameters, 638  
 amplifier, using divided crystal in bridge circuit, 1405  
 Bi-Te, photovoltaic 'sandwich'  $p$ - $n$  barrier type, 2055  
 CdS, noise power and time constants of, 1010  
 classification and analysis of image-forming systems, 4237  
 classification of photoconductive materials for, 3520  
 compensating, for mirror-galvanometer measurements, 2354  
 electron-multiplier, characteristics of different types, 3155  
 linearization of response for light-intensity measurements, 2054  
 manufacture of, 3156  
 for scintillation counting, 3081  
 for stroboscopic analysis of low-intensity light flashes, 1722
- Ge, junction-type, for control circuits, 309  
 $p$ - $n$ - $p$  tetrode-type, response of, 308  
 for infrared detection, 1012  
 with beam-scanning read-out, 4242  
 InSb, preamplifier design, 4241  
 based on intrinsic absorption, 4239  
 performance measurements, 4240  
 photoelectromagnetic InSb detector, 2987  
 infrared modulator, Ge diode, 1721  
 for light sensing, based on transient response of grain boundaries, 3788  
 operating with electroluminescent cells as 'lumistor' amplifier, 3884  
 PbS, ultraviolet response of, 1407  
 photoemissive, properties of image-forming systems, 4238  
 photovoltaic, Ge, grain-boundary-type, 1723  
 $p$ - $n$  junction, flicker effect in, 639  
 multi-electrode, analogous to retina, 231  
 Si,  $p$ - $n$  junction, 640  
 sandwich-type, CdS, conduction mechanism of, 1406  
 Se, with artificial intermediate layers, 3158  
 influence of microstructure on characteristics of, 2056  
 open-circuit e.m.f. at low temperature, 3157  
 surface-barrier diode, as photocapacitor, 3885  
 transistor, equivalent-circuit analysis of, 4233
- Photoconductive materials**, (See also Semiconductors)  
 CdS, absorption and reflection spectrum of, 1208  
 anisotropy in galvanomagnetic effects, 2992  
 conductivity glow curves of, 3321  
 crystal growth, at high pressure and temperature, 4077  
 by vaporization method, 1905  
 diffusion of Cu in, 3732  
 displacement of absorption edge by pressure, 3729  
 effect of deformation on spectrum of, 3730  
 effects of proton irradiation on, 2617  
 elastic constants of, 3728  
 e.s. charging in strong fields, 3731  
 evaporated layers, effect of heating, 828  
 exciton diffusion in, 2265  
 irradiation effects on, 1594  
 laminar structure of, 3727  
 lattice scattering mobility of electrons in, 2990  
 lifetime measurements using Kerr cell, 3322  
 photochemical effects and effects of O<sub>2</sub> on, 1593  
 polarization and wavelength of incident light for maximum conductivity, 2991  
 review of development of, 829  
 space-charge-limited currents in, 1622  
 spectral distribution of, 1904  
 spectral structure near absorption edge, 471  
 thin films, breakdown field-strengths, 2993  
 CdS and CdSe, films, bombarded by slow electrons, 2616  
 photistors, characteristics of, 1011  
 powders, response and trap distributions in, 1902  
 CdS and ZnS, internal photoeffect and exciton diffusion in, 824  
 CdSe, conductivity anomalies in, 469  
 conductivity increase under X-ray excitation, 1906  
 CdSe and CdTe, properties of, 468  
 Cu<sub>2</sub>O, influence of adsorption on conductivity of, 3733  
 time-lag of photoeffect in, 3734  
 film-type, infrared, properties of, 4076  
 gain-bandwidth product for, 1900  
 evaluation from current measurements, 1901  
 PbS, films, effect of thickness on spectral response, 2994  
 optical properties, 4079  
 oxidized, measurements on, 2615  
 photoconductivity/time-constant relation, 3323  
 PbSe, films, chemically deposited, 830  
 investigations on films and filaments of, 470  
 performance analysis based on Fermi level, 2988  
 photoconduction and luminescence of, intensity dependence of, 1207  
 $p$ - $n$  junction, lateral photoeffect in, theoretical study of, 2614  
 Sb<sub>2</sub>S<sub>3</sub>, films, optical properties of, 1209  
 photoelectric properties of, 1210  
 semiconductor, test equipment for, 4078
- Photoconductive materials, ZnO, with ohmic and blocking contacts, photocurrent measurements, 826  
 powder, field-effect measurements on, 1903  
 ZnS, anomalous photovoltaic effect in, 2989  
 ZnTe, conductivity at high field strengths, 3726
- Photoconductivity**, as function of optical absorption, 1828  
 quenching of, model for, 2263
- Photoelectric effect**, photovoltaic, in CdTe films, 1907
- Photoelectric emission**, (See also Electron emission)  
 influence of defect levels on, 1206
- Photoemissive materials**, alkali-antimony compounds, 825  
 alkali metals, peak-emission wavelengths, 4075  
 BaO, exciton-induced, 2264  
 Bi films, temperature dependence of spectral emission, 2619  
 Na<sub>2</sub>K<sub>2</sub>Sb, crystal structure of, 2995
- Phototelegraphy**, delay distortion correction by time-reversal techniques for, 981  
 narrow-band system using flying-spot scanner and photomultiplier, 276  
 'stop-go' scanning system for reducing bandwidth, 277
- Physics**, optical and optical-electronic devices, development of, 391
- Pickups**, crystal, with low effective mass, 1764  
 moving-magnet type, 2818
- Piezoelectric materials**, (See also Quartz)  
 (Ba-Pb)(Ti-Zr)O<sub>3</sub> system, properties of, 3006  
 (Ba,Sr)TiO<sub>3</sub>, Ba(Ti,Sn)O<sub>3</sub> and Ba(Ti,Zr)O<sub>3</sub>, properties of, 845  
 BaTiO<sub>3</sub>, ceramic, internal friction in, 475  
 electromechanical properties of, 3333, 3334  
 CdS, hexagonal, elastic properties of, 2278  
 influence of activator and irradiation on, 3746  
 ceramic, properties of, 4086  
 Pb(ZrTi)O<sub>3</sub>, with substituted Ca and Sr, increased dielectric constant of, 3739  
 ZnS-type, theory of, 846
- Plasma**, a.c. conductivity and Langevin equation for, 3261  
 charge density of, 87  
 conductivity of, 1161  
 confinement by r.f. fields, 1511  
 in electric and magnetic fields, transport phenomena in, 400  
 electron energy distributions in, 3260  
 electron oscillations, in Hg-vapour discharge with oxide cathode, 2910  
 transit-time relation for, 1840  
 electron temperature in variable electric field, 2532  
 e.m. waves in, 'fourth reflection condition' for, 1164  
 energy spectrum of electrons in, 765  
 equilibrium properties of, 86  
 gaseous, thermal conductivity of electron gas in, 766  
 high-temperature, microwave emission from, 1512  
 ion fields, calculation of, 1160  
 $I/V$  relation for planar diode, 1509  
 Lorentz-type, dispersion formula for, derivation of, 3641  
 in magnetic field, 3642  
 damping of e.m. waves, 2201  
 low-frequency oscillations, 3639  
 oscillations, 'hydromagnetic' wave structure of, 1162  
 magnetohydrodynamic waves in, kinetic theory of, 767  
 microwave conductivity of, 1842, 2202  
 along magnetic field, 1841  
 microwave investigation, 3262, 4021  
 of afterglow in, 2203  
 microwave scattering by, 769  
 oblique shock waves in, 1163  
 oscillations in, electron-beam excitation of, 1513, 2534  
 Lagrangian formulation for, 2911  
 nonlinear, 2535  
 oscillations and waves in, nonlinear theory of, 88  
 stability in quasistationary e.m. field, 3640  
 statistics of, 1159  
 travelling-wave focusing for containment of, 4022  
 ultrasonic absorption by, 3638
- Potentiometers**, calibration of, 4157
- Power**, measurement of, (See also Bolometers; Meters, wattmeter)  
 density-meter design for high-intensity microwave fields, 3831  
 based on Hall effect in semiconductor, 556  
 microwave, detector characteristics, 3830  
 resistive-film calorimeters for, 4162  
 standard, bolometer-type instrument for, 3433  
 wide-band calorimeters for, 2358  
 using wide-band thermistor mounts, 564  
 at 4 kMc/s, by Hall effect in semiconductor, 1312  
 at 30-1500 Mc/s, aperiodic barretter probe for, 1322  
 pulse measurement at m $\lambda$ , 3829  
 standards, microwave, international comparison of, 4163
- Power supplies**, (See also Batteries; Generators)  
 constant-voltage, 40-1 000 V, for time-controlled unit function, 4205  
 nuclear, miniature generator Snap III for space-rocket telemetry system, 2757  
 solar battery, Si, 603  
 for earth satellites, 3862  
 effect of radiation on, 1366  
 for infrared detector, 4206  
 for space vehicles, 2399  
 stabilized, 2401  
 thermionic energy converter, 3436  
 diode, 324, 325  
 efficiency of, 3437  
 performance of, 3438

- Power supplies, thermoelectron engine, diode configuration for, 2434, (D)2435  
 transistor, rectifier giving d.c. of either polarity, 3481  
 for video circuits, 602  
 transistor-stabilized, for an electromagnet, 2758  
 5-9-V 800-mA, 601  
 for valve heaters, high-stability, using tuned amplifier and thermistor bridge, 1697  
 variable-frequency, stabilized, for instrument calibration, 1696
- Public-address systems**, acoustic feedback system for increased stability, 693  
 at Brussels Exhibition, 1691
- Pulses**, (See also Amplifiers; Circuits; Generators) distribution system using dekatrons, 1130  
 $\mu$ s, analysis of transmission through uniform systems, 362  
 synchronization, using divider vernier, 3232
- Q-factor**, measurement method for inductances, 2709  
 microwave measurements of, 3819
- Quartz**, (See also Resonators, crystal) anelasticity at low temperatures, 2334  
 $\beta$ -type, for high temperatures, 3009  
 mechanical resonance dispersion at a.f., 1219  
 production of microwave phonons in, 2277  
 sands, dielectric properties in range 3 cm-800 m, 2272  
 visualization of ultrasonic beam in, 674
- Radar**, airborne, for weather observations, 147  
 altimeters, Marconi Type S 244, 2612  
 miniature, X-band, 1584  
 anti-aircraft techniques, 2984  
 beam-scanning system, use of f.m., and artificial dielectric for, 2124  
 cavity resonator for artificial echoes, unwanted modes in, 740  
 cross-sections, of circular cones, 3320  
 of finite cones, 4073  
 delay lines, quartz, 2511  
 for detection of shock waves, 3447  
 determination of velocity of shock wave by, 1658  
 DEW-line warning system, 1592  
 digital counter techniques for, 2981  
 displays, bandwidth compression for transmission over telephone channel, 3724  
 distance-measurement systems, noise-modulated, 2611  
 Doppler systems, frequency stability criteria, 2607  
 echo box, remotely controlled, 1590  
 echoes, from atmospheric inhomogeneities, 819  
 filtering of, 2602  
 mesosystems associated with, 2604  
 due to meteorological effects, 2603  
 ranging systems, p.m. and f.m., comparison of, 1893  
 effect of surface reflections on rain echo cancellation, 4072  
 high-altitude, correction of slant-range distortion, 821  
 interference, mutual, reduction of, 3318  
 suppression methods, 465  
 marine, 'Escort', 2983  
 system for Rotterdam Harbour, 1589  
 3-D system for *H.M.S. Victorious*, 467  
 microwave links for remote presentation, 976  
 modulators, Si diodes as, 3110  
 moving-target system, monitor for automatic indication of jitter, 3725  
 noise in, elimination using storage system, 3319  
 noise-based, improvement in range determination by, 148  
 phantom targets at mm  $\lambda$ , 3315  
 phase-measurement techniques for angle and distance measurements, 1895  
 pulse, effects of a.g.c. on accuracy of, 1894  
 magnetic circuits for, 3316  
 maximum-range data, 2606  
 range calibration in, precision pulse generator for, 2352  
 receivers, dynamic compression for, 1588  
 remote presentation of data, by radio link, 1586  
 review of developments in, 1581  
 ring angles over south-east England, 2982  
 scan-converter storage tube for phone-line relay, 2605  
 scanning systems, using electronic sector scanning, 818  
 'volumetric', by ferrite phase shifters, 1896  
 simulators, marine, 466  
 sweep circuit, low-power, using transistors, 3317  
 tracking systems, scintillation noise effects, 2609  
 traffic, Doppler system for vehicle-speed measurement, 1981  
 Telefunken, 1898  
 v.h.f. low-power, for auroral research, 1574  
 8-mm high-definition equipment, description of, 1591
- Radiation**, (See also Aerials) detectors, noise in, 4166  
 properties and efficiency of, 4164  
 spatial filtering technique for, 4165  
 e.m., from atomic explosion, 3649  
 Cherenkov, from dipole, 3647  
 in medium with spatial dispersion, 3648  
 from detonations, 3650  
 of electrons in ionized medium in uniform magnetic field, 408  
 health hazards from, 2074, 2075  
 microwave, coherent, from pulse-excited  $\text{NH}_3$  molecules, 1165  
 stimulated emission by electrons in magnetic field, 3264  
 transition-type, from protons entering metal surfaces, 4018  
 infrared, measurement of, thermocouples and bolometers for, 1652
- Radio astronomy**, (See also Cosmic radiation; Solar radiation) interferometer, array at Nançay for solar r.f. radiation at 9 300 Mc/s, 3659  
 high-resolution, for solar studies, 2936  
 phase-sensitive, for measurement of brightness distributions, 1177  
 interferometry using sea surface, 2219  
 Jodrell Bank observations, of Andromeda nebula at 408 Mc/s, 2937  
 of Coma Cluster at 408 Mc/s, 2938  
 principles and results of, 3273  
 radar echoes from Venus, 2556  
 radiation transfer and negative absorption in, 2218  
 review of developments in, 1581  
 r.f. emission, galactic, intensity distribution, 1176, (D)4034  
 pencil-beam survey at 3.5 m  $\lambda$ , 2220  
 mechanism in hydrogen nebulae, 421  
 following solar flare, 3276  
 from solar outbursts, origin of harmonics, 4035  
 from sun and planets, 3275  
 from 'supergalaxy', at 1.9 m  $\lambda$ , 3660  
 at 8.5 m  $\lambda$ , 2223  
 in Vela-Puppis region, 2221  
 r.f. sources, catalogue for declinations  $+10^\circ$  to  $-20^\circ$ , 423  
 in Centaurus, Fornax and Puppis, 422  
 Centaurus-A and Fornax-A, at 19.7 Mc/s, 2222  
 Cygnus and Cassiopeia, angular diameter measurements at 10.7 cm  $\lambda$ , 3658  
 improved measurements of position with Cambridge radio telescope, 2932  
 on Jupiter, observations of, 1522  
 scintillation measurements, 427  
 survey at 159 Mc/s, 103  
 Russian developments in, 420  
 scattering of radio waves from Crab nebula by solar corona, 2939  
 telescopes, Ohio State University, 3962
- Radio links**, for control of aircraft communication equipment, 1689  
 correlation function and power spectra of signals, 4203  
 f.m., portable instrument for measurement of i.f. level in, 222  
 microwave, fading in, 3475  
 for radar networks, 976  
 multichannel, scatter, in telecommunication networks, 600  
 telephony, and C.C.I.F. recommendations for cable systems, 264  
 for 60-120 channels, Italian equipment for, 2013  
 planning of, 1364  
 statistics of fading-dependent noise power in, 3858  
 for telephony and television in 2- and 4-kMc/s bands, 1687  
 u.h.f., multichannel, Oslo-Karlstad, 2756  
 215-mile, 4202
- Radiosondes**, radiation errors of, 226
- Radiotelegraphy**. See Communication systems.
- Radiotelephony**. See Communication systems.
- Radomes**, rigid, design of, 2475
- Receivers**, (See also Television) broadcast, analysis of repairs, 253  
 car, design of, 252  
 codan unit for a.f. suppression, 3101  
 f.m., a.f.c. system using junction diode, 951  
 converter unit for reception of multiplex-type stereophonic transmission, 1679  
 using diffused-base mesa transistors, 4188  
 tuner, using transistors, 251  
 v.h.f., distortion due to incomplete limiting in, 4190  
 'sonobuov', modification for broadcast reception, 254, 582  
 frequency-sweep, using low-pass video amplifier in place of i.f. stage, 1677  
 h.f., dual space-diversity, Type-RX.5C, 3462  
 input circuit design, 2383  
 instability in, 250  
 manufacture of, statistical methods in, 1676  
 microwave, wide-band mixer and i.f. preamplifier for, 949  
 transistor, a.v.c. circuit using diode for, 2742  
 portable, design data summary, 1349  
 reflex-type, design of, 3100  
 30 Mc/s-75 kMc/s, using carcinotron local oscillator, 2006
- Reception**, (See also Television; Wave propagation, e.m.) analysis of field-strength records for radio-link assessment, 584  
 correlation function and power spectra of signals in random dielectric noise, 4203  
 diversity, by aerial selection method, 2741  
 dependence of gain on signal-level distribution, 4191  
 frequency, simplified method of, 2385  
 frequency-shift telegraphy system using, 1675  
 linear combining techniques for, 3102  
 s.w., correlation measurements in, 953  
 double-diversity, tests on methods for, 952  
 fading effects, on A1-telegraphy signals, 1352  
 at m.f., 585  
 in u.s.w. radio links, 586  
 at v.h.f., diurnal variation of, 256  
 f.m., high-Q trap for capture of weaker signal, 1350  
 signal at output of limiter under noise conditions, 4189  
 v.h.f., r.f. protection ratios for, 1348  
 multipath pulse delay, automatic recorder for, 4192  
 phase-measurement system using spaced aerials, 2384  
 selectivity and stability in multiplex systems, 1686  
 u.h.f., diurnal variation of field strength in India and meteorological data, 255  
 v.h.f., distributed amplifiers, for common-aerial system, 749  
 220 Mc/s, over 700-1 000 miles, 1351
- Recording**, (See also Sound recording) digital, using ferrite-core storage system, 2365  
 film, video, using ultrasonic light modulation, 931  
 magnetic-tape, braking action in, 694  
 method for extraction of selected data, 932  
 multichannel, 0-10-c/s, on single-track system, 3108  
 for pen recording of h.f. signals, 2020  
 for sampling discriminators in data reduction, 2366  
 storage system and equipment for evaluating field-strength records, 3419  
 for television, 'Ampex' system, 1702  
 transistor amplifier for playback in, 2175  
 for ultrasonic frequencies, 2085  
 pen, circuit for converting to rectilinear output, 1695
- Rectifiers**, (See also Semiconductors; Valves, crystal) controlled, principles and applications of, 2421  
 Cu/Cu<sub>2</sub>O and Au/Ge junctions, methods of determining parameters of, 2415  
 electrolytic, current/time relation for, 3112  
 Ge, heavy-current, thermal effects in, 3109  
 p-n junctions for, 3485  
 Ge and Si, for industrial use, 269  
 p-n junctions, temperature limits for, 295  
 Se, with artificial selenide layers, 3111  
 semiconductor, forward-current-surge failure in, 1367  
 testing and establishing rating under dynamic conditions, 2341  
 Si, breakdown with h.v. high-frequency supply, 3863  
 construction of alloy-junction type, 268  
 controlled, switching characteristics and rating of, 4227  
 2-impurity diffusion process for, 2418  
 with current rating 1A, 2022  
 measurement of load characteristics of, 3484  
 p-n junction, design of, 604  
 as radar modulators, 3110
- Reflectometers**, for bands I and II, 923  
 coaxial, m- $\lambda$ , 3431  
 microwave, display system for, (D) 2703  
 with reflection-coefficient/frequency display, for 7.5-11 kMc/s, 1308  
 rotating-loop, for waveguide, 2117
- Refractometers**, microwave, for aircraft use, 1321  
 recording-type, N.B.S., 3070
- Regulators**, (See also Control systems; Stabilizers) constant-current/constant-voltage, 605  
 current, using high-gain d.c. amplifier in control loop, 3113  
 using transistors, for electromagnets, 979  
 current-balancing reactors for semiconductor rectifiers, 606  
 current-limiting, semiconductor, 1368  
 for electromagnet, using integrating circuit and feedback, 1365  
 thermostat, semiconductor, for oscillators, 609  
 valve, with grid compensation, delay network for, 3864  
 voltage, design of, 607  
 using transistors, 980
- Relay systems**. See Radiolinks; Television.
- Relays**, ball-contact type, 3487  
 reliability in, improvement of, 610
- Resistance**, contact, between K and Al, influence of electric stress on, 1271  
 measurement, using ion chamber as current source, 4152  
 on semiconductors at low temperature, cryostat for, 1967  
 of slight variations, in thin films, 555  
 negative, variable, for d.c. computer, 3605  
 of ohmic injecting contact, transient properties of, 2903
- Resistivity**, of Bi and Sb, electrical and thermal, at low temperatures, 1222  
 of compounds with ordered spin arrangements, 1220  
 of transition-metal silicides, 1274
- Resistors**, carbon, derating methods for, 2491  
 film-type, noise and nonlinearity in, 3596  
 nonlinear characteristics of, measurement of, 41  
 pyrolytic, performance of, 2490  
 cracked-carbon, nonlinearity measurements on, 1106  
 design for guaranteed tolerance range, 3216  
 nonlinear, positive and negative, power relationships for, 729  
 varistors, construction, specification and performance, 42  
 wire, measurement of inductance of, 2347
- Resonance**, absorption, paramagnetic, influence of saturation on Faraday effect, 2547  
 antiferromagnetic, in MnF<sub>2</sub>, 3791  
 indirect coupling of nuclear spins in, 3036  
 cross-relaxation in spin systems, 3270  
 cyclotron, in metals, theory of, 1855  
 electron, applications in microwave physics, 779  
 electron-spin, in quartz, effect of 9.2 kMc/s ultrasonics on, 3816  
 excitation of atomic levels in discharges for maser action, 3656  
 excitation by electron impact for optical maser, 3655  
 excitation of spin waves in antiferromagnet by r.f. field, 2925  
 ferrimagnetic, effective parameters in, 91, 2545  
 in spheres, magnetostatic solutions for, 2928  
 ferromagnetic, absorption line width in, theory of, 2210  
 in circularly polarized e.m. field, 3646  
 exchange effects in, 2926  
 in Ni film on quartz, ultrasonic excitation by, 3817  
 magnetic, applications and techniques in solid-state electronics, 2924



- Resonance, magnetic, double, theory of, 2922  
in Li and  $\text{CaF}_2$ , saturation line shapes, 1948  
nuclear, of  $\text{Co}^{2+}$  ions in paramagnetic salts, 3409  
free-precession observation technique for, 1853  
multiple-quantum transitions in, 2923  
radiation damping in, 2543  
spectrometer for, r.f. unit for, 2544  
weak-field maser for investigation of, 2548  
relaxation investigation by 'forced transient precession', 2542  
saturation in, theory of, 95  
maser devices for infrared and optical wavelengths, 1857  
microwave, applications of, 1171  
spin refrigeration and maser action at 1 500 Mc/s, 3654  
nuclear polarization due to saturation of resonance of impurities, 3412  
paramagnetic, absorption and dispersion in salts at 1 325 Mc/s, 2674  
of Al nuclei in ruby, 3792  
asymmetry of curve for organic radicals, 1170  
in copper propionate monohydrate, 98  
in Cr and Fe alums at low temperature, 2332  
of Cr ions in  $\text{TiO}_2$ , 2333  
electron free precession in, 3408  
electron spin-lattice relaxation time measurements in, 417  
in Eu and Gd, theory of, 1630  
at 10 kMc/s, 1629  
of  $\text{Fe}^{2+}$  in sapphire, 1949  
of impure  $\text{MgO}$ , 3410  
of impurities in  $\text{CaF}_2$ , 3411  
induced emission in  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ , 2927  
in ionic crystals for solid-state masers, 3037  
microwave spectrometer technique for, 2211  
multiple quantum transitions in, 1856  
in nonmetals, stationary nuclear polarization by saturation, 3653  
Overhauser effect in propane in diphenyl picrylhydrazyl, 2546  
quantum-mechanics theory of, 778  
relaxation phenomena at low temperatures, 3652  
in ruby, for maser applications, 3793  
sensitivity of spectrometer equipment for, 1172  
spectrum of Cr ions, in emerald, 1628  
in ruby, 1627  
spectrum of Gd in  $\text{LaCl}_3 \cdot 7\text{H}_2\text{O}$ , 780  
spin-level inversion and mixing in ruby, 4123  
spin-phonon interaction in ruby, 2317  
of S-state impurity in  $\text{MgWO}_4$ , 2691  
 $\text{ThO}_2$  single crystals with Gd impurity, spectrum of, 909  
r.f. absorption spectra of hydrogen deuteride in strong magnetic field, 1852
- Resonators**, acoustic, excitation of, theoretical treatment of, 3907  
Helmholtz-type, nonlinearity of absorption coefficient of, 1424  
cavity, bimodal, design for Faraday rotation experiments, 770  
electron interaction with h.f. fields in, quantum effects in, 1844  
expansions of e.m. fields in, 2143  
measurement of parameters of, 4154  
time-dependent characteristics of, microwave double-sweep method for analysis of, 926  
unwanted modes in, suppression of, 740  
X-band, ceramic, fabrication of, 363  
cavity and waveguide, dielectric constant of gaseous medium in, 72  
coaxial, miniature designs for, 3604  
coupled, multiple, as filters, dissipation loss in, 3603  
crystal, AT-cut, coupling between vibrations of, 3975  
manufacture and performance of, 2142  
piezoelectric,  $\text{BaTiO}_3$ , disks, vibration distributions on surface of, 2446  
for generation of very short ultrasonic pulse, 2078  
quartz, high-quality, construction of, 1127  
multiple-beam interferometer studies of, 2335  
test equipment for detecting spurious response in, 1642  
thermoelastic loss in, 206  
rods, equivalent circuit for, 1475  
standard measurements of parameters, theory for, 211  
travelling-wave, 2144
- Scattering**, (See also Diffraction; Sound; Wave propagation, e.m.)  
of acoustic and e.m. waves, by random refractive-index fluctuations, 415  
over sea or uneven ground, 775  
of e.m. waves, by anisotropic ellipsoid, 413  
end-fire echo area of long thin bodies, 1446  
by large conducting bodies, 4029  
microwave, by positive column of Hg discharge, 769  
by obstacles, variation principles for, 412  
plane, by cylindrical dielectric tube, 2540  
scalar, by periodic medium, 93  
from rough surface, statistical model for, 1518  
by thin conducting plates, 772  
by thin dielectric rings, 1517  
by turbulent inhomogeneities, 1335  
of ultrasonic wave, by periodic surface, 1047
- Semiconductors**, (See also Photocells; Photoconductive materials; Transistors; Valves, crystal)  
absorption edge in, effect of magnetic field on, 501  
AlSb, formation of  $p$ - $n$  junction in, 3030  
preparation and properties of, 2311  
anisotropic, Faraday effect in, 3018  
Auger effect as recombination mechanism, 3341  
Bi-Te solid solutions, properties of, 4120  
Bi $_2$ Te $_3$ , adiabatic and isothermal effects in, 2670  
conductivity and Hall coefficient of, 1942  
galvanomagnetic effects in, 183  
magnetothermoelectric effects in, 182  
model for chemical bonding in, 531
- Semiconductors, Bi $_2$ Te $_3$ , optical properties of, 533  
properties of, 532  
stoichiometry of, 3785  
Bi $_2$ Te $_3$ -Bi $_2$ Se $_3$ , thermoelectric properties of, 3758  
bombardment damage effects in, 4091  
bombardment defects in, recombination properties of, 4090  
breakdown of, low-field, single phonon emission in, 3013  
carrier-life-time measurement, optical method for, 1230  
phase-shift method for, 515  
charge carriers, in perturbed lattices, 2528  
 $A^{III}B^V$ , behaviour of impurities in, 2641  
K-edge structures of elements of, 853  
magnetic properties of, 2645  
surface differentiation by X-ray method, 3786  
Ag, ternary, with NaCl-type structure, 1269,  
solid solutions of, 1270  
energy losses in, 4092  
Hall effect in, and applications of, 855  
of homopolar character, 1227  
intermetallic, preparation, properties and applications of, 163  
vitreous, photoelectric and thermoelectric properties of, 1920  
compounds and elements of Groups VB-VIIB, properties of, 1226  
conductivity at high frequencies, depolarization effects in, 3631  
contacts on, adhesive forces developed in, 495  
CoSb $_3$ , thermoelectric properties, effect of alloyed impurities on, 2667  
CuFeS $_2$ , CuFeTe $_2$ , AgFeS $_2$  and AgFeTe $_2$ , 3755  
CuFeS $_2$ , measurement of Hall effect in, 213  
Cu $_2$ O, diamagnetic Zeeman effect and exciton structure in, 1623  
current build-up during switching in, 889  
current density calculation using drift velocity, 3751  
cyclotron resonance in, 2647  
development and future application of, 489  
diamond, rectification and photo-effects in, 504  
Si and Ge, electronic structure of, 1238  
thermoelectric power of, 1924  
diamond-type, vibration spectra and specific heats of, 2284  
diffusion techniques and theory with application to Si solar battery, 184  
diffusion across vapour interface, 165  
dislocation planes in, 3338  
doped, compensation, technique for narrowing energy gap, 1917  
drift mobilities in, measurement technique for, 2313  
electron-electron scattering in, 492  
electron-hole pairs in, effect of lattice vibrations on, 850  
energy-band interpolation based on pseudo-potentials, 1236  
equilibrium charge density in bipolar diffusion in, 2637  
excess carriers in, decay of, 1915  
time-dependent changes in presence of surface recombination, 1228  
with excited impurity band, theory of, 3752  
Faraday effect in, 4088  
FeSe $_2$ , preparation and measurement results, 885  
field effect at high frequency in, 2640  
field-effect theory, 2639, 3749  
field-emission investigations, 3016  
films for use as Hall generators, 3349  
GaAs, crystal growth rates, 3382  
diffusion and electrical behaviour of Cu in, 882  
diffusion of Zn in, at 1 000°C, 1259  
effective electron mass determined by infrared Faraday effect, 4113  
elastic moduli of single crystals, 3380  
electron mobilities in, 529  
 $n$ -type, infrared absorption and electron effective mass in, 3383  
piezoresistance of, 1939  
single crystals, polarity of, 3381  
preparation and properties of, 881  
galvanomagnetic, thermomagnetic and thermoelectric effects in, 161  
galvanomagnetic effects in, surface transport theory for, 1233  
Ga $_2$ Te $_3$ , doped with Cu, crystal structure changes, 3031  
Ge, Bi as donor in, 4105  
bicrystals, grain-boundary conduction in, 2657  
carrier mobility in, effects of temperature and field on, 4101  
carrier multiplication in, microwave-induced, 2302  
contact-potential measurements on cleaned surfaces, 3360  
crystal pulling from floating crucible, 3029  
crystals, with dislocation array, minority carriers in, 1618, transport properties in, 1619  
dislocation-free, vacancy clusters in, 522  
dislocations in, 1247, produced by thermal shock, 865, produced by thermal stresses, 3028  
growth effects on properties of, 170  
growth phenomena, 3358  
melted-layer growth of, 1251  
X-ray integrated intensities for, effect of impurities on, 177, 3376  
X-ray measurement of microstrains in, 3377  
X-ray transmission anomalies, 2309  
deformation potential from optical absorption lines, 2655  
Dember potential measurements in, 3359  
diffusion of B in, 1612  
diffusion of Cu in, theory of, 1611  
diffusion and solubility of Ta in, 4104  
diffusion of thermal acceptors in, 520  
doped, with Au or Zn, photoconductivity response, 4106  
crystal growth from molten metals, 4102
- Semiconductors, Ge, doped with Fe, charge-carrier lifetime in, 1933, effect of annealing on, 1934  
with Ga and As, changes of carrier concentration with introduction of Cu, 1250  
with group III impurities, optical and magneto-optical absorption effects of, 3366  
heavily, resistivity and hole mobilities in, 519  
with In, impurity conduction in, 3368  
influence of group III and V elements on recombination velocity in, 1614  
with Ni, electron-spin resonance in, 2661,  
enhanced Cu concentration in, 521  
with Sb, charge-carrier lifetime in, 1932,  
resistivity and Hall coefficient of, 526  
with Zn, properties of, 1613  
drift mobility in, microwave field dependence of, 3371  
in electrolyte, with  $p$ - $n$  junction electrode, 527  
electron-bombardment effects, anomaly in electron-voltaic effect at 100°K, 3773  
delayed electron emission and external photo-effect, 874  
surface effects in, 873  
electron-bombardment-induced recombination centres in, 4108  
electron-spin-resonance experiments on shallow donors in, 3775  
electron temperature in strong fields, 518  
field effect and surface recombination in, 1928  
Hall effect in, temperature dependence of, 1621  
hot-electron behaviour in magnetic field, 3777  
infrared absorption, by conduction electrons, theory for, 871  
of photogenerated carriers, 176  
injection and extraction of minority carriers as electrochemical processes, 3025  
irradiated, energy levels in, 2664, 4109  
irradiated by deuterons, lattice parameter changes in, 2307  
length and sensitivity changes in, 2306  
structure of, 2308  
irradiation effects, of  $\alpha$ -particles at 4.2°K, 1254  
annealing of, 2305  
of  $\gamma$ -rays on surface recombination velocity of, 3372  
on recombination in, 4107  
junctions, alloy, In, reverse breakdown in, 534,  
Si, formation of, 3379  
barrier temperature at turnover, 3024  
diffused, avalanche breakdown in, 3378  
edge breakdown, 1616  
high-electric-field effects, 3023  
infrared transparency with pulsed field, 1931  
narrow, excess noise in, 1257  
noise correlation in, 1255  
1/f noise in, theory for, 1256  
L-absorption spectrum of, 3772  
lattice constant in, precision measurement of, 1936  
lattice vibrations in, theory of, 3367  
by neutron scattering, 2304  
lifetime of non-equilibrium charge carriers in, 1929  
liquid surfaces, electrical phenomena on, 2656  
magnetic susceptibility of photogenerated carriers in, 2300  
microwave absorption techniques for measurement of lifetime, 3774  
negative-mass carriers revealed by cyclotron-resonance experiments, 875  
noise spectrum in near intrinsic crystals, at high field strengths, 1617  
normal-mode determination by neutron spectrometry, 173  
 $n$ -type, acoustoelectric effect in, 3373  
doped heavily, piezoresistance in, 174  
effect of edge dislocations on mobility in, 3362  
effect of monoenergetic fast neutrons on, 866  
free-carrier absorption in, 1249  
free-carrier Faraday effect in, 3375  
hot-electron effect in, 175  
irradiation of, defect formation by, 4110  
magnetoresistance at low temperatures, 870  
manufacture of thin base layers, etching method for, 2665  
oscillation of resistance in pulsed magnetic field, 872  
pressure dependence of Hall effect in, 2663  
strain-induced changes in Seebeck coefficient, 3374  
optical constants of, 2659  
orientation control for wafers of, 1935  
Peltier effect in, 3776  
photoconductive response of films prepared from Ge $_2$ , 867  
photoconductivity after electron bombardment, 3027  
photoelectromagnetic effect in, influence of fast holes on, 2660  
quadratic, 1253  
plastic creep of single crystals, 2654  
plasticity in, light induced, 1938  
preparation of, large-scale, 2653  
 $p$ -type, drift velocity measurements in, ohmic, noninjecting contact for, 3361  
effect of minority impurities on conduction in, 2658  
radiation due to recombination of impurities in, 3369  
radiation-induced recombination centres in, 868  
radiative recombination in, 869  
reaction with  $\text{HNO}_3$ , 2310  
recombination centres in, 516  
Seebeck-effect fluctuations in, 178  
short lifetimes of charge carriers in, 1930  
splitting of As donor ground state in, 1615  
surface influence on 1/f noise in, 172  
surface radiation effect in, 523  
surface recombination velocity in, high-vacuum studies of, 1248

- Semiconductors, surface states on, 171  
surfaces, effects of chemical action and oxidation, 3370  
etching and polishing, 1252  
etching to precise limits, 4103  
influence of H<sup>+</sup> on conductivity of, 2301  
recombination centres after ion bombardment, 2303  
thermal conductivity of, 1620  
thermally induced glide of dislocations in, 3363  
thermo-e.m.f. measurements on, 524  
thermomagnetic effects and phonon drag in, 2662  
transitions in, exciton- and magneto-absorption of, 3364  
theory of optical magneto-absorption for, 3365  
vibrational spectrum and specific heat of, 517  
Zeeman effect of excitons in, 2299  
Zeeman splitting of donor states in, 525
- Ge and Si, band structure during strain, observation by cyclotron resonance, 507  
contacts on, metal, preparation of, 491  
crystals, large, growth by Teal-Little method, 3767  
orientation by optical technique, 166  
distribution coefficients of impurities in, calculation of, 1242  
as electrodes in electrolyte, saturation-current investigation, 4093  
heat capacity and vibrational frequency spectra of, 3353  
infrared antireflection coatings for, 864  
lattice vibrational spectra of, 857  
lattice vibrations in, 2286  
metallurgy of, 3020  
negative-mass cyclotron resonance effects in, 3760  
optical absorption edge of, effect of pressure on, 1243  
*p*-type, effect of deformation on properties of, 2649  
recombination centres and trapping levels in, distinction between, 3764  
reflection coefficients of, 3765, 3766  
slow capture of holes and electrons by surface states, 3352  
solubility of Sn in, 4094  
specific heat at low temperatures, 2287  
surface-conductivity and space-charge data, 858  
surface distribution of slow traps in, 3768  
surface mobility in, 505  
surface states on, 3019  
theory and properties of, 3351
- Ge-In junctions, X-ray investigations of, 1937  
generation-recombination noise in, 493  
Ge-Sb alloys, distribution of Sb in, 3026  
GeSe, crystal structure of, 876  
GeSe and SnSe, Hall-effect anomalies in, 2669  
Ge-Si alloys, thermal conductivity and thermo-electric power of, 528  
grain boundaries, capacitance and barrier height in, 3339  
graphite, galvanomagnetic data for, analysis of, 1241  
galvanomagnetic oscillations in, 1240  
Hall effect and magnetoresistance of, field dependence of, 1239  
Hall effect, in high electric fields, 1235  
measurement of, 503  
theory and applications of, 502  
Hall effect and magnetoresistance effect, influence of geometry on, 1234  
heat flow in, RC-network analogue for, 4087  
HgTe, Hall coefficient and resistivity of, 4112  
thermomagnetic properties of, 3779  
high-purity, 486  
impurity-band conduction in, simple model for, 3010  
theory of, 1223, 1224  
impurity paramagnetism at low temperatures, 2644  
impurity photo-ionization spectrum in magnetic field, theory of, 1232  
with impurity zone, magnetic susceptibility of, 499  
non-equilibrium processes in, 2282  
In monotelluride, properties of, 2312  
InAs, doped, with Cu, 2666  
with *p*-type material, anomalous temperature characteristic of Hall coefficient of, 3385  
effect of heat treatment on, 3032  
*n*-type, piezoresistance constants of, 884  
preparation of, 1624  
InAs and InSb, as thermoelectric materials, 3384  
vapour-deposited films, preparation and properties of, 3761  
InAs<sub>1-x</sub>P<sub>x</sub>, thermoelectric properties of, 3759  
infrared absorption of, effect of pressure on, 3014  
inhomogeneities made visible by micrography, 3757  
inorganic compounds, prediction of semiconducting properties in, 847  
InP, breakdown in low field, 4116  
electron mobility in, 4115  
*n*-type, optical properties of, 883  
preparation and properties of, 4114  
InSb, band structure of, 1940  
distribution coefficients and carrier mobilities in, 3386  
intrinsic, electron transport in, 4117  
*n*-type, conduction in, 1625  
conductivity in strong field, 530  
magnetically induced impurity banding in, 1263  
magnetoresistance and Hall effect in, 4119  
oscillatory transverse magnetoresistance effect in, 1264  
nuclear magnetic resonance in, 1261, 1262  
oscillator based on field effect in, 3781  
photoionization of, 3782  
piezoelectric effect in, 180  
plasma pinch effects in, 3388  
plastic flow of, delay time in, 3387  
properties of, 3033  
*p*-type, conduction in, 1260
- Semiconductors, InSb, *p*-type, conductivity in strong field, 179  
photoelectric properties and lifetimes, in 4118  
transverse magnetoresistance at liquid-nitrogen temperature, 1265  
thin layers of variable composition, 3780  
irradiation effects on, 2646  
junctions, capacitance with graded impurity density, 852  
effect of surface potential variations on characteristics, 3390  
metallographic aspects of, 187  
non-ideal, increase of minority-carrier current by, 1626  
*p*-*n*, charge-carrier distribution in base region, 1919  
injection efficiency of, 496  
*p*-*n* and *p*-*i*, analysis of field distribution and carrier concentration in, 3787  
preparation of, theory for, 888  
lapping machine for thin slices of, 1943  
lifetime measurement by photoconductive decay, 1921  
magnetic susceptibility of trapped electrons and holes in, 3017  
magnetoresistance and photoelectric effects due to electrons and slow and fast holes in, 1923  
MgTe, preparation and properties of, 1258  
minority-carrier lifetime, dependence on majority-carrier density, 849  
MnO<sub>2</sub>, influence of foreign ions on semiconductivity of, 3783  
mobility and effective mass in, correlation of, 2279  
negative effective mass related to negative resistance, 3632  
nondegenerate, electron mobility in, 1225  
Hall mobility in, 856  
low-field carrier mobility in, 164  
*n*-type, impure, drift and Hall mobility of electrons in, 3340  
thermal effects in, 1604  
transient response of grain boundaries in, light sensor based on, 3788  
transport phenomena in, integration method for, 3754  
in magnetic field, 3753  
optical characteristics of, 3011  
optical properties under hydrostatic pressure, 506  
PbO, conductivity measurements with impurity additions, 3784  
PbS, PbSe and PbTe, magnetoresistance in, 1267  
mobility of electrons and holes in, 181  
PbTe, thermoelectric properties of, 1941  
photoconductivity of, influence of surface recombination on, 2643  
photoconductivity and lifetime measurements, 3342  
photoelectromagnetic and photoconductive effects in, 1229  
piezoresistance of, electric-field dependence of, 3345  
polar, binary, interdiffusion in, 3343  
lattice screening in, 3344  
theoretical transport coefficients for, 2642  
polymeric, acrylnitril, 4121  
pyrolusite, properties of, 1266  
research at N.B.S., 3748  
Sb<sub>2</sub>Te<sub>3</sub> and Sb<sub>2</sub>Te<sub>3</sub>-Bi<sub>2</sub>Te<sub>3</sub>, thermoelectric effects in, 1268  
Se, dielectric behaviour at dm  $\lambda$ , 2285  
diffusion of impurities in, 1605  
polycrystalline, influence of annealing time on thermoelectric power, 2648  
secondary-emission measurements as function of doping, 3762  
thermal conductivity of, effect of Br additions on, 1606  
Si, absorption bands in, 1608  
absorption-edge spectrum of, 509  
avalanche breakdown in, statistical theory of, 4095  
compressional waves at 10-170 Mc/s in, temperature dependence of velocity of, 3355  
crystal growth, effects of seed rotation on, 3021  
free from dislocations, 3354  
by pulling technique, furnace for, 168  
density change on melting, 2292  
diffusion control technique, 4096  
diffusion of Ga in, 513  
diffusion of impurities in vapour phase, 1925  
diffusion of P in, 2651  
doped, with Al, precipitation on dislocation in, 2289  
with As, absorption spectrum of, 1244  
with Au, measurement of lifetimes and capture cross-sections, 3769  
with P, electron spin-lattice relaxation in, 512  
electron-spin-resonance experiments on donors in, 4098, 4099  
electropolishing in HF solutions, 1245  
formation of donor states in, mechanism of, 1926  
heat-treated, change of characteristics due to introduction of Au, 2290  
impurities in, O<sub>2</sub>, 511  
impurity-carrier concentration in, variation with temperature, 510  
impurity compensation and magnetoresistance in, 2293  
infrared spectra of heat-treatment centres in, 167  
infrared strain-optic coefficient for, 2295  
irradiated by neutrons, magnetic and electrical properties of, 4100  
junctions, breakdown in, 2652, effect of heat treatment on, 1609  
*p*-*n*, delineation of, 514, impact ionization in, 1927, photomagnetomechanical effect in, 3357  
lattice vibrations by neutron scattering, 2291  
lifetime preservation by getter action, 2288  
measurement of resistivity using 4-point probe method, 214
- Semiconductors, Si microplasma fluctuations in, 3770,  
microwave spin echoes from donors in, 860  
neutron-bombardment damage in, comparison with electron-bombardment effects, 861  
*n*-type, ohmic Al contact on, 3356  
photoionization quantum yield, 863  
*p*-type, bonding materials for, 2296  
recombination properties of Au in, 862  
resistivity of, effects of O<sub>2</sub> on, 2294  
surface properties of, effects of treatment and atmosphere on, 4097  
surface recombination velocity, measurement of, 859, by steady-state photoconductance, 1246  
surface stabilization by thermally grown oxides, 2650  
valence-band structure of, 508  
SiC, films, cubic, infrared properties of, 2298  
infrared properties of, 2297  
junctions, electron emission from breakdown regions in, 1610  
report of conference on, 3771  
surface properties of crystals, 3022  
SnS, synthetic crystals, properties of, 886  
SnSe, electrical properties of, 3389  
space-charge distribution due to low-level injection, 3012  
Stark effect for study of valence bands, 3346  
surface conductivity measurements, by 'wedge' method, 2671  
surface potential from field-induced changes in surface recombination, 851  
surface recombination velocity, determination from photoconductive decay, correction formulae for, 498  
determined by change of resistance in magnetic field, 500  
effects of carrier injection on, 1916  
surfaces, properties determined from drift-mobility experiment, 2281  
shape and extent of space-charge regions in, 848  
transport phenomena on, theory of, 2280  
Te, anomalous Hall-coefficient reversal in, effect of hydrostatic pressure on, 1237  
band structure of, 3763  
magnetic susceptibility in, 1607  
theory of, revision of, 490  
thermodynamics of irreversible processes applied to conduction phenomena in, 2638  
thermoelectric effects in, power limits of, 1231  
thermoelectric properties of, 3347  
effect of strain on, 854  
thermoelements, determination of heat conductivity, 3348  
Ti and V oxides, conductivity measurements on, 3756  
TiO<sub>2</sub>, infrared absorption of, 3034  
piezoresistivity in, 887  
transitions in, interband, Zeeman-type, magneto-optical studies of, 2283  
two-band, theory of thermoelectricity in, 3015  
variation of properties with fusion, 1918  
V<sub>2</sub>O<sub>5</sub> binary mixtures, conductivity mechanism, 3750  
W.C. field-emission characteristic of, 1922  
WO<sub>3</sub>, conduction in, 2668  
work function of, temperature dependence of, 494  
ZnO, conductivity of powder form, 877  
diffusion and precipitation of In in, 4111  
doped, conductivity and Hall effect in, 879  
field effect and photoconductivity in, 880  
preparation of single crystals with defined impurity content, 878  
surface potential, field-effect mobility and conductivity of, 3778
- Servomechanisms, (See also Control Systems)  
digital, using c.r. tube beam in photographic storage system, 1459  
for temperature control of transistors, 1693  
for u.h.f. scatter-link transmitter, 1694
- Signal generators, (See also Generators; Oscillators)  
microwave, amplitude stabilization of, 2353  
timed-pulse, portable, 1966
- Signals, finite-duration, maximum efficiency for transmission through low-pass filter, 2390  
flow graphs, 3601, 3602  
interpolation and prediction of, optimum filter for, 2391
- Solar activity, causing transient decreases in cosmic-ray intensity, 2942  
eruptions, possible mechanism for nonstable processes, 3666  
flares, as cause of geomagnetic storm of 11th Feb. 1953, 433  
and intense long-duration ionization below 50 km, 2576  
magnetic field associated with, 4043  
radiation and particle precipitation from, 1530  
associated with r.f. noise at 200 Mc/s, 1180  
25th-27th Sept. 1957, observations at 4.3 mm  $\lambda$ , 786  
indices based on ionospheric and r.f. noise data, 3281
- Solar eclipses, temperature fluctuations during, 2559
- Solar radiation, (See also Radio astronomy)  
nonthermal, gyro theory of, 408  
outbursts causing geomagnetic storms, 2558  
proton streams, laboratory model using 'Störmertron' tube, 1864  
r.f., brightness distribution at 60 cm  $\lambda$ , 430  
bursts of, anomalous night-time reception of, 2554  
m- $\lambda$  and 3-cm- $\lambda$ , time relations of, 2555  
power spectrum and relation to s.w. fades and geomagnetic storms, 1178  
type-II, observations of solar disturbances causing, 432

- Solar radiation, r.f., bursts of type-III, flare-puffs as cause of, 431
- type-IV, and relation with storm centres, 3283
  - 3-cm- $\lambda$ , dimensions of sources of, 425
  - dm- $\lambda$ , as index for ionospheric studies, 787
  - echoes in solar corona, 102
  - ionizing radiation associated with noise storm, 429
  - polarization measurements of, 101
  - spectroscopy at 24-40 Mc/s, 2933
  - at 3 and 27 cm  $\lambda$ , during  $\gamma$ -ray burst from solar flare, 104
  - at 3.2 cm  $\lambda$ , distribution and brightness of sources, 424
  - at 200 Mc/s, fine structure and drift in frequency, 2935
  - during noise storms, short-period variations in, 2934
  - ultraviolet, investigation of, 3664
- Solders**, for nuclear and space environments, 4144
- Sound**, (See also Absorption; Acoustics; Diffraction; Transducers; Ultrasonics)
- attenuation in gases, 2809
  - audibility of nonlinear distortion, 3185
  - build-up of oscillations in enclosed spaces, 3184
  - constant-pressure source, using microphone and feedback system, 2447
  - distorted, criterion for, 2817
  - field of vibrating source on ribbon plate, 1044
  - frequency spectrum of power-law double tones, 3908
  - interference and coherence of reiterated signals, 3910
  - 'lateral-wave' field of point source, 1040
  - loudness, evaluation, 3544
  - influence of peak content in noise, 1754
  - meter, 1427
  - scale, discrimination criterion, 1062
  - sensation for rhythmic sounds, 1426
  - tests with periodic sounds, 3911
  - noise, from data processing machines, measurement and evaluation of, 6
  - impact, instrument for measuring peak intensity of, 2089
  - measurement methods, 2453
  - spectra evaluation, 3914
  - pitch fluctuations, measurement of, 3179
  - propagation of, amplitude and phase fluctuations of spherical wave in, 662
  - amplitude fluctuations in turbulent medium, 667
  - correlation of field with amplitude and phase fluctuations in, 663
  - diffraction and radiation in liquids and gases, 664
  - over ground, experimental study of, 3900, instrumentation for, 2081
  - in inhomogeneous media, 'effective' parameters for, 1041
  - in medium with negative velocity gradient and homogeneous surface layer, 666
  - in sea-water, velocity calculations, 3903
  - underwater, analysis for different pulse shapes, 3901
  - waveguide mode in stratified medium, 665
  - propagation of Rayleigh-type waves on cylindrical surfaces, 670
  - radiators, concentration coefficient of focusing systems, 3905
  - distance determination from near-field measurements, 3537
  - superdirective arrays, signal/noise performance, 329
  - reflected from sphere under pulse conditions, 1046
  - reflections from gradual-transition absorbers, 3548
  - scattering, on inhomogeneous surfaces, 675
  - by thin rod, 676
  - in irregular waveguides, 1042
  - at layer of discontinuity in sea, 3902
  - in turbulent atmosphere, 2083
  - stereophonic, compatible system based on 'precedence effect', 3474
  - velocity of, in liquids, influence of wall thickness of resonance tube, 1422
  - viscosity correction, 328
  - in pure and salt water, using ultrasonic pulse technique, 2810
- Sound ranging**, active sonar detection, theory of, 2596
- direction finder for location of noise sources, 2091
  - multiple-receiver correlation system, 1066
  - underwater missile tracking instrumentation, 2597
- Sound recording**, disk, standardization of, 2454
- magnetic, for delaying reproduced sound, 3924
  - multiple-track recording techniques, 3190
  - multitrack and stereo head design, 3550
  - speed and pitch regulator for, 2825
  - theory of, 3923
- stereophonic, cutting head for single-groove disk, 2096
- velocity-type microphones in, 7
  - stereophonic reproduction system for, two-track, three-channel, 1064
- Space research**, communication, navigation and guidance systems in, 2807
- cosmic rockets, instrumentation of Pioneer vehicle and tracking stations, 3286
  - interferometer for tracking, 1544
  - launching problems, 3677
  - Lunik I, 2230, 2563, 3678
  - cosmic-ray data from, 2231
  - progress of, 3676
  - Lunik II, observations at Jodrell Bank, 4051
  - Pioneer I, cosmic radiation measurements by, 3691
  - Pioneer IV, signal reception using parametric amplifier, 2895
  - dynamic problems of flight to moon, 3675
  - radar technique based on back-scatter from free electrons, 451
- Spectrographs**, magnetic, current and field stabilization of 9-kW electromagnet for, 3072
- Spectrographs, mass, magnet stabilization by atomic-beam resonance, 4170
- Spectrometers**, mass, ion source for, strong-focusing, 2720
- microwave, high-Q Stark absorption cell for, 2209
  - for paramagnetic-resonance measurements, 1172
  - influence of modulation amplitude on line shape, 3269
  - source-modulated, criteria for, 416
  - X-band, for paramagnetic-resonance observations, 1854
  - for X and K bands, 96
- Spectroscopy**, infrared, theory of interference modulation for, 2191
- application of, 2192
- Speech**, acoustic studies of, instruments and methods for, 1058
- analysis and synthesis of, 2450
  - characteristics, theoretical analysis of, 4
  - compandor, for transmission circuits, 2395
  - intelligibility of, evaluation of, 2819
  - at high noise levels, prediction of, 3543
  - subjective masking of delayed echoes, 5
  - masking by prolonged vowel sounds, 680
  - pitch distribution in German language, 2088
  - recognition systems, automatic, 3913
  - mechanical, 2451
  - system for telephony, 331
  - theory of, 2452
  - phonetic-pattern vocoder, 1057
  - for voice dialling, 1061
  - reinforcement systems, factors affecting intelligibility, 3912
  - sampling, pulse gating circuit for, 2820
  - synthesis of, segment inventory for, 1060
  - segmentation techniques in, 1059
  - synthetic, vocoder development and intelligibility of, 1753
  - vocoder transmission system for, 2394
- Stabilizers**, of anode-current fluctuations due to heater-current changes, 1369
- thyatron circuit for h.v. supplies, 4208
  - voltage, routine testing of, 608
  - Zener-diode, 271
  - for valve heater supplies, 2759
- Standard-frequency transmissions**, J.J.V., frequency variation of received signal, 916
- MSF, correction with reference to Ephemeris time, 1640
  - power requirements and optimum frequency for world-wide system, 4201
- Standards**, on navigation aids, 59 I.R.E. 12.S1, 3721
- on recording and reproducing, calibration of mechanically-recorded lateral frequency records, 58 I.R.E. 19.S1, 689
  - on terminology, of audio techniques, 58 I.R.E. 3.S1, 727
  - for magnetic amplifiers, A.I.E.E. Committee report, 383
  - of static magnetic storage, 59 I.R.E. 8.S1, 2019
  - on waveguides and waveguide component measurements, 59 I.R.E. 2.S1, 2105
- Standing-wave indicators**, automatic, for 3-cm band, 2711
- for production testing of microwave components, 221
  - for 4-kMc/s band, using c.r.o., 1975
- Stations**, (See also Broadcasting; Television; Transmitters)
- Olifantsfontein and Derdepoort, South Africa, 2015
  - WWI, for v.h.f. research, 977
- Storage systems**, (See also under Computers)
- magnetic-drum, 1655
  - flying-spot, beam-positioning servo system for, 2364
  - design factors of, 2362
  - optics and photography in, 2363
- Sun**, (See also Solar activity; Solar radiation)
- brightness of disk, comparison of results obtained during 1944 and 1954 eclipses, 785
  - corona, intensity, polarization and electron density of, 1182
  - investigations using r.f. emission from Crab Nebula, 426
  - new theory of, 2943
- Sunspots**, numbers, mean values and data for 1700-1957, 1529
- for 1944-1959, 107
  - for 1959-1968, 3282
  - structure and mechanism of, 3665
- Superconductors**, energy gap in, evidence for, 393
- in h.f. field, impedance of, 2195
  - impurity scattering in, 3633
  - Sn, change in sound velocity from normal state, 4122
  - Sn and In, frequency variation of resistance of, 2314
- Switches**, (See also Circuits, switching)
- coaxial, using Si diodes, for v.h.f. aircraft aerials, 3486
  - microwave, using ferrite ring inside helix, 1107
  - t.r., electronic, 44
  - voltage-sensitive, using dielectric breakdown of oxide film, 39
- Switching**, functions, classification and minimization of, 3048
- solution of equations for, 1297
  - systems, ternary, algebra for, 1636
- Telecontrol systems**, h.f. characteristics, in terms of parameter  $f_1$ , 4236
- timing-signal transmission at Canaveral test range, 2722
- Telemetry**, balloon-borne units using transistors, 2373
- miniature system for electroencephalograph, 3085
  - p.p.m., demodulator system for, 1992
  - for rotational displacements, 2374
  - systems, comparison, 4172
  - performance analysis, 3084
  - techniques for guided missiles, 3448
- Telemetry, transmission system, using magnetic-modulator/multiplier circuit, 1659
- u.h.f., 6-channel, 4173
- Television**, (See also Aerials; Interference)
- applications, in astronomy, 3082, 3083
  - for determining rocket orientation, using single-line-scan vidicon, 2033
  - for recording eye fixations on changing visual scenes, 930
- camera tubes, image-orthicon, image retention in, 615
- operation of, 3497
  - quantum efficiency of detection, 4216
  - recent developments in, 616
  - sensitivity of, 4215
  - vidicon-type, inertia effects, 985
  - lenses for, 1375, 1376
  - target materials in, 1703
- cameras, measurements on preamplifiers for, 3115
- portable, for outside broadcasts, 2026
  - single-lens reflex, 3496
  - zoom lenses for closed-circuit systems, 1370
- cameras and film scanners, video amplifier using transistors, 4214
- centre, ATN, Sydney, 1330
- colour, automatic hue and chroma controls for, 3118
- camera tubes, vidicon, for industrial service, 2025
- 'chroma-key' technique for simulating optical effects, 612
  - compatible 819-line system for, 1700
  - film, lenticular system for, 1371
  - flying-spot scanning system, 279
  - magnetic demodulators for, 1379
  - N.T.S.C. system, adaptation to European 625-line standard, 4212
  - modulator for C.C.I.R. standard, 2762
  - phase and amplitude fluctuations in subcarrier transmission, 993
  - picture quality in, 2404
  - and perception of colour detail in N.T.S.C. system, 1391
  - picture tubes, afterglow in, 2407
  - deflection coil design for, 3125
  - mask-type, error correction in, 990
  - screen-persistence test equipment, 4218
  - 21-in. Type-21CV22, glass, 280
- projection systems, 3119
- display with controlled filters, 621, 2029
  - picture tube using Faraday cell, 1705
  - receivers, 'apple' system, colour-purity adjustment techniques, 1386
  - performance measurement, 986
  - signal-distortion in envelope-type second detectors, 1392
  - standards, F.C.C., 278
  - test equipment, for investigating interference of subcarrier with monochrome reproduction, 2032
  - for N.T.S.C. system, 1372
  - signal generator for, 1324
  - transmitters, correction of phase distortion in, 614
  - use of dichroic mirrors in, 1701
  - echo phenomena in, methods of eliminating, 3134
  - industrial, equipment for, 1394, 1395
  - interference reduction in co-channel systems by precise carrier frequency control, 4221
  - links, cable, interconnection at carrier-frequency stage, 992
  - long-distance, 4210
  - for switching and control centres, 275
  - transatlantic, 4211
  - using trunk coaxial cable, fluctuation interference in, 611
  - delay equalization method, 3132
  - waveform distortion testing, 4209
- networks, European, survey of, 1707
- Eurovision, German standards converter equipment, 4213
- optimum design for bands IV and V, 3501
  - in Württemberg, 1692
- picture quality, assessment of, 4222
- test pattern for, 1393
  - comparison method for measurement of random fluctuations in, 2031
  - detail perception test, 3135, 3136, 3138
  - impairment by noise, tests on, 2408
  - use of bifilar-T trap for improving, 988
- picture tubes, contrast filters for, tests with, 2765
- current characteristic of, 1704
  - electroluminescent, problems of, 566
  - flat-type, for monochrome and colour, 619
  - guns for, drive factor and gamma of, 1417
  - kinescope, high-transconductance electron gun for, 322
  - measurement of resolution characteristics, 1390
  - with luminous surround, subjective tests on, 2764
  - new electron gun with transistor drive, 3128
  - sealing of, 1035
  - short, using TFF gun, 3127
  - thin, rectangular, 3171
  - 110°-deflection, development problems, 284
  - projection, eidophor system, 620
- random-noise measurement in presence of signal, 2345
- receivers, deflection circuits, using transistors, peak flyback voltage in, 4220
- dual-standard, for French and C.C.I.R. systems, 4217
  - effects of valve faults in, 311
  - frame multi-vibrator and diode separator circuit, 3499
  - i.f. amplifiers with linear phase response, 3117
  - line-deflection transformer, magnetic measurements on ferrite U-cores for, 3057
  - with tuned h.v. winding, 1387
  - line and frame output stabilization, 3123, 3124
  - line output circuit stabilization, 3871

- Television, receivers, line output circuit stabilization, using voltage-dependent resistance, 989
- line timebase circuit, stabilized, protection devices for, 282
- manufacture, statistical methods in, 16
- multitriode flywheel synchronizing circuit, 3500
- noise-gated a.g.c. and sync system for, 1382
- pin triode for bands IV and V, 2796
- r.f. amplifier, constant-impedance, 1384
- scanning oscillators and synchronization, 3121
- sound-channel, 'delta' f.m. system with a.m. compression, 2027
- detector using drift transistor, 2028
- synchronization, characteristics in presence of noise, 1388
- noise-limiting circuits and a.g.c. for, 3120
- separator using remote-cut-off pentode, 3122
- synchronous and exalted-carrier detection in, 1378
- synchrophase, for phase-distortion correction, 3116
- transistor circuits, 987
- for i.f. stages, 1385
- for line deflection, 3126
- for vertical-deflection system, 1381
- for 90° deflection, 3870
- u.h.f. tuner using r.f. amplifier, 1383
- video output stage with wire resistor, 2347
- X radiation from, 4219
- for 625-line C.C.I.R. standard, 617
- reception, effects of random noise, 3139, 3140
- field-strength measurements and propagation curves, 288
- measurement of service area, 287
- vertical-polarization tests at u.h.f., 289
- recording, film, methods and equipment in Germany, 2024
- magnetic-tape, 'Ampex' system, 1702
- systems for international program exchange, 3867
- relay systems, passive, aerial calculations for, 2851
- research work at Turin study centre, 2761
- review of developments, 1699
- standards converter, using vidicon, 2405
- stations, in N. America, list of, 2030
- studio equipment, improved design of tungsten filament lamps, 286
- maintenance of, 622
- systems, cable, equalization in, 3488
- closed-circuit, coaxial-cable, using transistors, 3114
- for industrial applications, 272
- two-way, remote-control carrier system for, 285
- coding method based on 'edge' detection, 3489
- optical performance criteria, 3498
- vestigial-sideband, phase distortion in, 3137
- for 50-kc/s bandwidth, 982
- test equipment, B.B.C. transparencies for testing camera channels, 984
- waveform generator using transistors, 1373
- test patterns, for monochrome installations, 3502
- testing techniques for monochrome and colour transmissions, 613
- transmission, bilingual, multichannel sound by single transmitter for, 983
- black-level monitoring, 1377
- cable circuits for, 273
- correction equipment, 3495
- delay equalization in, filters for, 737
- limiter circuit technique, 3491
- monitoring installations, 3869
- in Germany, 2763
- residual-sideband, delay equalization, 3490
- of still pictures, using flying-spot scanning system, 1374
- over telephone lines, experiments using 250-kc/s bandwidth, 274
- video level control during studio switching, 3131
- transmitters, automatic frequency translation for improving local reception, 991
- band-I, ABN, Gore Hill, Australia, 3129
- design of, 3492
- Isle of Wight I.T.A. Station, and associated radio links, 1706
- vestigial-sideband filters and diplexers, 3494
- 5- and 10-kW, 3493
- Thermistors**, circuits using, design for, 40
- for compensation of resistance and conductance, 721
- for deriving linear temperature-control voltage, 2489
- for u.h.f. power measurements, design of mounts for, 564
- Thermocouples**, radiation, noise in, 1653
- Thermoelectric effects**, (See also Semiconductors) in Bi, Sb, Te and Bi-Te, effect of oxide impurities on, 2315
- in grey Se, 1272
- Peltier heat pump, theory of, 2906
- for refrigeration, theory of, 3449
- at very low temperatures, 2529
- Time**, (See also Clocks)
- interval measurement, by vernier technique, 3418
- standards, atomic and astronomical, variation in speed of earth's rotation in terms of Cs resonance, 1301
- Timebases**, linear, using Miller integrator and Puckle flyback circuits, 743
- Transducers**, differential-transformer, 557
- electroacoustic, calibration for operation under increased pressure, 330
- distributed-type, 673
- equivalent circuits for transient vibrations, 3904
- frequency-sensitivity characteristics by spectral analysis of thermal noise, 3906
- signal/noise performance of strip arrays, 2
- for underwater use, 2445
- electrochemical, 'solion', current integration with, 2023
- Transducers, electromechanical, stroboscopic method for frequency response of, 2079
- piezoelectric, piston-type, operating in water, 1045
- theory of, 672
- Transducers**, (See also Amplifiers, magnetic) auto self-excited, analysis of, 1791
- Transformers**, balun, for v.h.f. and u.h.f., 338
- double-tuned, general analysis of, 3595
- equivalent 2-terminal networks for, 1467
- hybrid, design and applications of, 1468
- mains, lamination data and design procedure, 356
- pulse, with premagnetization of core, 1469
- pulse-front response of, measurement of parameters of, 357
- for random-noise voltages, 3214
- transmission-line, stepped, design of, 3594
- twisted-pair, wide-band, 3593
- with zero phase shift, design of, 720
- Transistors**, (See also Photocells; Semiconductors; Valves, crystal)
- with  $\alpha > 1$ , current multiplication in, 1626
- alloy-junction, base resistance for, 1714
- Ge, dependence of current gain on emitter current and frequency, 3878
- with symmetrical characteristics, 2419
- alloy-junction and grown-junction types, Si, comparison of, 300
- analogue-computer determination of design data, 3508
- analysis of quadripole networks containing, 48
- applications, in 'hybrid' regenerative valve circuits, 2877
- for i.f. amplifier, 305
- in line communication systems, 594
- review of, 4228
- in television receivers, 987
- avalanche-type, 2772
- theory of, 186, 998
- transient build-up in, 2416
- characteristic frequencies of, 996
- characteristics, a.c., representation of, 2042
- curve tracer, 3060
- frequency and phase, for common-emitter operation, 634
- based on insertion-type measurements, 2048
- present limits in, 629
- charge storage during turn-off in, 2773
- current amplification of, 631
- diffused-base, evaporation alloying technique for, 307
- manufacture of, 4229
- mesa, in f.m. receiver, 4188
- for range 10-20 000 Mc/s, 635
- diffusion capacitance in, 3148
- drift-type, current gain to 105 Mc/s, 3880
- diffused-base, for 1-kMc/s, properties of, 3510
- equivalent circuits for, 3879
- h.f. power gain of, 3881
- internal current gain of, 999
- transmission-line analogue of, 3153
- effective collector capacitance in, 632
- emitter efficiency of, 2043
- equivalent circuits for, 1009, 1718
- model-based derivation of, 2770
- and operation at i.f., 2781
- T-parameters at a.f., 2782
- fluctuation of parameters in, origin of, 628
- Ge, breakdown voltage of, 3519
- current amplification factor with carrier injection and extraction at high temperature, 3882
- diffused microwires, 637
- grain-boundary, for low-temperature operation, 1712
- grown-junction, n-p-n, Si, construction of, 301
- h.f., equivalent-circuit analysis and characteristics of, 2423, 2768
- Ge, design theory and production of, 1000
- Ge and Si, 3509
- production techniques for, 2049
- progress in development of, 1399
- h.f. phenomena in, model for, 3154
- high-current mode of operation of, 1004
- hook, properties of, in switching and amplifying circuits, 753
- interchangeability chart for 500 types, 3517
- lattice defects in, influence and creation of, 2771
- life expectation of, in earth satellites, 2780
- mechanisms affecting, 1715
- limiting-frequency determination up to 1 kMc/s, 4232
- measurements, of  $\alpha$  cut-off frequency, 2705
- apparatus and techniques for characteristics in 3-250-Mc/s range, 1304
- using bridge techniques, 3430
- of capacitances, 3425
- of current gain, 3426
- automatic equipment for, 3427
- d.c.-a.c. beta tester, 1647
- of equivalent-circuit parameters, 1646
- simulator for, 4156
- sweep generator for c.r.o. display of  $\beta/I_e$  characteristic, 928
- of temperature-dependent base leakage current, 1974
- of v.h.f. characteristics, design of matching networks for, 1115
- wide-band bridge for, 1002
- as network element at i.f., 1719, 3518
- noise figure of, influence of inductive source on, 2047
- parameter conversion, using Jacobians, 2775
- point-contact, effect of magnetic field on, 630
- power-type, cooling system for, 636
- Ge, with Al electrodes, 1001
- applications and performance limits, 302
- for horizontal-deflection stage, 306
- increasing efficiency of, 978
- techniques for improving, 2769
- selective etching of, 1402
- shot noise in, 2413
- Si, manufacture of, 1007
- Transistors, Si, temperature dependence of mobility and lifetime in, 3150
- small-signal parameters for, variation of, 995
- stabilization, calculations for, 2051
- of gain over wide temperature range, 4231
- using negative-temperature-coefficient resistors, 2052
- surface-barrier height changes in, method of studying, 633
- surface-effect immunity in, structure giving, 4230
- structure-determined gain-band product of, 997
- switching parameters, 723
- switching-type 'deplistor', 2420
- Si, p-n-p-n, 3883
- for telephone service, 2778
- theory of, 1401
- with thyatron characteristics, and related devices, 1006
- 'thyristor', high-speed, 1005
- with tungsten point in collector, 2777
- 3-terminal, 2046
- tecnetron, 303
- temperature distribution in, 3149
- terminology and notation, revision of, 1008
- tetrode-type, characteristics, applications and construction of, 3152
- field-effect, 2779
- h.f., grown-junction, Si, theory, characteristics and applications of, 3516
- thermal effects in, evaluation of, 299
- thermal equivalent circuit for, 1720
- thermal stability criteria, 1713
- transconductance as parameter for, 1403
- transient response of, calculations for, 2774
- unified representation for, 2050
- transit-time analysis of, stored-charge method for, 2417
- u.h.f., characteristics of, 2044
- Transmission Lines**, (See also Cables; Waveguides)
- coil-loaded, phase and group delay in, 698, (D)3193
- delay, interdigital, dispersion in, 1022
- lumped-parameter, linear, construction technique for, 697
- surface-wave propagation conditions along, 696
- with distributed conductance, for e.m. wave absorption, 1068
- equivalent circuits for, magnitude of errors in, 1067
- exponential, for impedance matching, 1070
- helical, theory of, 2459
- inhomogeneous, for absorption of e.m. waves, 1765
- lossy, applications of, 3192
- laminated, Clogston-type, experimental, 2102
- nonuniformities in, 2101
- matching, circle diagram for, 2460
- measurements, logarithmic chart for evaluation of, 2702
- multiple, theory of, 2458
- pulse,  $\mu$ s, propagation constants of, 362
- return loss of, 12
- surface-wave, cylindrical, power radiated from, 2098
- excitation of radiation by discontinuity on, 2097
- Goubau-type, tests on, 10
- impedance measurement method, 1069
- surface-wave-propagation theory for stratified medium, 939
- 2-wire, balanced, screened, characteristic impedance of, 3928
- Transmitter-receivers**, for outside broadcasts, f.m., 80-W, 4204
- Transmitters**, (See also Television) a.m., class-C output stage for, 624
- broadcast, automatic monitoring system for, 1397
- combined operation of, using bridged-T network, 623
- common-channel operation of, synchronization techniques for, 4224
- m.f., common-channel common-program operation of, 1690
- network in Würtemberg, 1692
- s.w., 100-kW, Type-SOZ 294/00, 293
- f.m., remote control and change-over equipment for, 292
- h.f., 60-kW r.f. power amplifier for, 290
- linear-amplifier, for independent-sideband operation, 291
- sea-rescue, 2-Mc/s, with ferromagnetic aerial, 4223
- s.s.b. and i.s.b., rating of, 3503
- telegraphy, Post Office, at Ongar, 3142
- v.l.f., c.w., for ionospheric investigation, using power-line aerial, 3873
- W/T, below 50 Mc/s, I.R.E. Technical Committee report on test methods, 1396
- 500-kc/s, 4-W, using transistors, with automatic keying, 3504
- Troposphere**, (See also Atmosphere; Wave propagation, e.m.)
- climatology of radio ducts, 4053
- radio echoes from invisible objects in, 2240
- refractive index of, models for, 2725
- Tuners**, permeability, 1678
- Tuning indicators**, electron-beam, Type-EM84, for voltage indication, 2073
- Ultrasonics**, (See also Absorption; Scattering; Transducers)
- applications, to high-fidelity video recording on film, 931
- diffraction of light by, 678, 1751
- distortion of small-amplitude waves in liquids, 2814
- field due to piston-type resonator in liquids, 1423
- generators, electrostrictive, electrode deformation in liquids, 2812
- interference filters, variable-frequency, 677
- interferometer design for measurements in liquids, 2816
- measurement of field, quartz probe for, 1752
- measurement of velocity, pulse technique for metals with low attenuation, 2449

- Ultrasonics, measurement of velocity and elastic moduli at high temperature, 2815  
 research at N.P.L. of India, 3177  
 velocity, in liquids under pressure, pulse measurement of, 1  
 in water near freezing point, 2811  
 waveform determination by light refraction, 1050, 3538  
 wave-train synchronizing technique for equipment testing, 3064
- Vacuum technique, 'clean-up' effect, hypotheses for, 2986  
 getter-ion pumps, theory and design data for, 1899  
 Ti, 1204, 1205  
 getters, Ba film, 2613  
 Ti, 4074  
 grades of vacuum in electron and ion tubes, 2262  
 measurements of gas evolution or sorption of anode materials, 2985
- Valves, (See also Cathode-ray tubes; Electron beams; Rectifiers; Transistors)  
 amplifier, general analysis for transistor, triode and beam-deflection types, 2041  
 for wide-band operation, data for, 1032  
 construction of, trends in, 2793  
 cooling techniques, 4252  
 'vapotron', 654  
 crystal, and associated equipment, data on, 3592  
 diffusion techniques for, 184  
 production techniques, development of, 294  
 review and characteristics of, 3147  
 crystal-diode, analogue-computer determination of design data, 3508  
 avalanche effect for generation of sub-mm waves, 3875  
 circuit representation and pulse method of voltage division for, 2035  
 d.c. characteristics of, 2410  
 Ge, annealing of radiation-induced  $1/f$  noise in, 298  
 manufacture of, 1709  
 as mixers, noise at low temperatures, 3876  
 new types and applications of, 994  
 noise temperature ratio variation with temperature, 627  
 Russian GD-Ts type, blocking junction process in, 1708  
 time-lag in, 2767  
 Ge and Si, tests for r.f. noise in, 3507  
 Ge-In-Sb, diffusion-type, for  $m\mu s$  switching, 3144  
 hole storage in, 'turn-on' and 'turn-off' times for, 626  
 inductive behaviour under high loads, 2036  
 influence of adjacent connections on characteristics of, 1398  
 logarithmic characteristic of, test method for, 2038  
 microwave, mixer-type, with improved conversion efficiency, 2414  
 recent developments, 3877  
 nonlinear-capacitance, for frequency conversion, 3145  
 PbS,  $I/V$  characteristics of  $n-p$  contacts on galena, 3874  
 $p-n-p-n$  and  $p-n-p-m$ , as 2-terminal switches, 2040  
 point-contact, d.c. and a.c. characteristics of, 3143  
 effect of geometrical factors on characteristic of, 2411  
 electron-hole transition in, 185  
 GaAs, for u.h.f. applications, 1710  
 Ge, current noise of, 3506  
 Ge and Si, characteristics and manufacture of, 296  
 semiconductor-semiconductor 'point contact', 2037  
 shot noise in, 2413  
 Si, construction and properties of, 297  
 as voltage-reference devices, 2039  
 switching-type, from plastically deformed Ge, 2412  
 tunnel-type, for h.f. applications, 3505  
 phonon processes in, 4226  
 'variode', for gating and control circuits, 4225  
 $V/I$  characteristics of, 625  
 Zener-type, list of manufacturers and applications of, 1711
- diode, coaxial-type, for microwave detection, 2794  
 as noise generator for u.h.f., 3533  
 planar, reference-type, for test purposes, 4253  
 saturated, surface structure of filaments in, 1418  
 space-charge neutralization by ions in, 2432  
 spherical, azimuthal electron flow in, 2433  
 as thermionic energy converters, 324, 325, 2434, (D)2435
- diode and triode, space-charge, shot noise in, 2436  
 double-triode, Type-PCC88, characteristics and application for cascade circuit, 655
- electron-beam, amplifier, noise due to cathode in, 1023  
 using beam of flat elliptical cross-section, 3887  
 crossed-field, noise in, 313  
 current and velocity fluctuations at potential minimum, 320  
 defocusing system for microwave detection, 1413  
 design of transition region for, 1017  
 energy relations in, 4245  
 equations of space-charge flow, 3886  
 focal length of diaphragm for, 1416  
 'helitron' oscillator, 319  
 interception noise in, 3165  
 magnetically focused, current distribution in, 644  
 noise in, effect of electron lenses on, 1726  
 mechanism of reduction of, 1727  
 reduction by low-potential drift region, 1728  
 for parametric amplification, 1025  
 by pumping of fast space-charge wave, 1412  
 parametric-amplifier, 321
- Valves, electron-beam, parametric-amplifier, cavity-type, 2066  
 design of couplers for, 2067  
 with transverse modulation, 4247  
 as parametric amplifier and frequency converter, 2065  
 propagation of perturbations in, 4246  
 retarding system with helix in dielectric, analysis of, 3889  
 space-charge-wave excitation for Brillouin flow, 1735  
 space-charge waves in, 2058  
 surface-wave electron velocities in magnetic field, 2786  
 v.m., generation of second harmonic in, 1409  
 electron oscillations due to transit-time effects in, 4251  
 flicker noise in, effect of cathode porosity on, 1028  
 gas-filled, cold-cathode, tetrode, effect of trigger pulse polarity on anode breakdown time, 3174  
 triodes for switching, 2443  
 as noise source, for  $em\lambda$  measurements on, 658  
 u.h.f., helix-coupled, 559  
 stabilizer, neon-argon-type, effect of argon content on, 2442  
 'Störmertron', for simulating solar proton streams, 1864  
 thyatron, ceramic, for high-power radar, 3535  
 grid emission in, properties of Ti for preventing, 1030  
 for guided missiles, development of, 310  
 klystron, energy distribution of electrons in, 2424  
 frequency control by magnetic amplifiers and transistors, 1737  
 high-power, pulsed, design of, 1410  
 low-power, water cooling system for, 312  
 multicavity, effect of beam coupling coefficient on wide-band operation of, 1015  
 multigap, 2785  
 pulse-modulated beam current for mixer operation, 1016  
 reflex, linearization of f.m. characteristic of, 1739  
 Type-TK7, 1730  
 wide-range tuning cavities for, 3525  
 as 11-kMc/s negative-resistance-type amplifier, 1741  
 resonant-cavity design theory, 3890  
 2-cavity, ballistic analysis of, 1729
- magnetron, a.c.-operated, advantages of, 3161  
 current limitation by inductance, 3162  
 cut-off characteristics of, 2057  
 c.w., 2.5-kW, Type-7091, 4244  
 diffusion theory of, 645  
 ferrite-tuned, 3163  
 $mm-\lambda$ , development of, 4248  
 planar-diode, space-charge-limited current in, 1018  
 pulser design for, 648  
 reflex-type, with voltage control of frequency, 3528  
 single-anode, diffusion theory for, 646  
 space-charge theory, considering electron scattering, 3160  
 electronic conductance in, 2425  
 split-anode, diffusion theory for, 647  
 manufacturing techniques, 3523  
 measurement method for mutual conductance, 3059  
 microminiature, heaterless, for modular circuit construction, 2863  
 microphony in, analysis of, 1013  
 effects of, 3896
- microwave, output window, design of broadband matching for, 643  
 review of construction techniques, 4243  
 survey of, 2784  
 wide-band, new developments in, 642  
 receiving-type, circuit effects of faults in, 311  
 formula for  $\mu u$  of, 3170  
 with rectangular envelopes, theoretical comparison with cylindrical forms, 3531  
 shape, comparative study of different forms, 3895  
 subminiature, vibration tests for guided-missile applications, 2431  
 switching, trochotron, 1724  
 transit-time, strophotron-type, for u.h.f., 1725  
 travelling-wave, amplifier, C- and L-band, design and characteristics of, 2063  
 backward-wave, using helical electron beam in unloaded waveguide, 3164  
 minimum-noise conditions in, 1734  
 as  $mm-\lambda$  voltage-tuned oscillator, 3529  
 M-type carcinotron, electron trajectories in gun of, 318  
 oscillator, 20-40 kMc/s, 1742, 29-74 kMc/s, 1740  
 with ridge-loaded ladder circuit, 2790  
 'coupled-mode' theory of, coupling coefficients in, 1014  
 coupled-resonator slow-wave structures for, 650  
 crestatron, 2427  
 with crossed-field periodic structure, field theory for, 1731  
 dispersion of interdigital delay line in, 1022  
 efficiency of, effect of collector potential on, 314  
 electrostatically focused, 1414  
 experimental c.w. power-type, 2787  
 exponential electron gun for, 2064  
 gain and stability of, effect of attenuator surface on, 1411  
 helix design data, 649  
 helix-type, for 48 kMc/s, 1415  
 hybrid-type, for pulsed amplification, 1733  
 leakage flux around focusing magnet for, analysis of, 315  
 nonlinear theory of, 2426  
 O-type, effect of double beams in, 317  
 O-type and M-type, spread of electron velocities and bandwidth of, 316  
 with periodic circuits, characteristics of, 1732  
 periodically loaded, wave matrix treatment of oscillations in, 1020
- Valves, travelling-wave, slow-wave structures for  $mm$  and sub- $mm\lambda$ , 1743  
 survey of, 1019  
 theory of electron waves in periodic structures for, 1738  
 theory of electron waves in retarding systems of, 2062  
 v.h.f., amplifier and oscillator, 1024  
 triode, disk-seal, transmitting-type, for frequencies up to 900 Mc/s, 2797  
 Type-2040, influence of penetration factor fluctuations on conductance of, 2437  
 for 4-kMc/s amplifier, 2798  
 pin-type, Type-PC88, for bands IV and V, 2796  
 for r.f. heating, class-C operation of, 1033  
 intermittent use of, 2071  
 as oscillator with variable load, 2795  
 output power as function of load resistance, 2072  
 Type-A2521, for low-noise operation up to 1 kMc/s, 1419  
 u.h.f., thimble, Type-7077 and 'Nuvistor', 3534  
 v.h.f. and u.h.f., 20 years' development of, 641
- Vibrations, measurement of, reciprocity method for, 3178  
 of membranes and resonators, variation of natural frequency with load, 1039
- Voltage, peak, measurement for h.v. pulses, 920
- Wave propagation, acoustic and e.m., analogous effects in, 3249  
 analogy of boundary-value problems in, 4008  
 fluctuation distribution near focus of lens, 4027  
 guided, in slowly varying medium, 2204  
 in rough ducts, 2919
- Wave propagation, e.m., (See also Diffraction; Reception; Scattering; Television; Transmission lines; Waveguides; Waves)  
 in air-earth-ionosphere cavity, 1338  
 angle-of-arrival measurements in, crossed-loop method for, 1664  
 attenuation and velocity of transients and triangular pulses in conducting media, 2916  
 back-scatter measurements by space-separation method, 3843  
 echoes observed on sea swell at Casablanca ionospheric sounding station, 2724  
 fading in, relations between bearing and amplitude, 947  
 ground-wave, comparison of Millington's method and equivalent-numerical-distance method with theory of, 2375  
 of pulse from damped current source, 3842  
 transient, over spherical earth, 239  
 group velocity of damped waves, 1848  
 in inhomogeneous media, 771  
 ionospheric, absorption, index from analysis of field-strength recordings, 2732  
 of sky wave, graphical determination of, 1341  
 validity of theorems for, 1669  
 analysis of signal-pattern drift in, 1884  
 during annular eclipse, 2730  
 between Australia and Europe, analysis of observation in relation to predictions, 2727  
 back-scatter sounding for skip-distance determination, 1340  
 disturbance warnings, improvement of, 116  
 during disturbance 11th Feb. 1958, 573  
 F-layer scatter observations in Far East, 2733  
 F<sub>2</sub>-layer multiple reflections, focusing effects as cause of, 1342  
 forecasts for, comparison of, 1339  
 prediction techniques for high latitudes, 2729  
 frequency variation of JYJ transmissions, 916  
 geomagnetic field geometry for, 3849  
 geometrical properties applied to, 3848  
 importance of F<sub>1</sub> layer in oblique-incidence transmissions, 2378  
 l.f., analysis for, 4179  
 mode expansion for, 4178  
 numerical solutions of equations for, 3455  
 over long distances, possible explanation for, 942  
 pulse experiment at 20.1 Mc/s, 240  
 via single F hop, 943  
 magneto-ionic fading in vertical-incidence pulsed transmissions, 944  
 magneto-ionic theory for calculation of parameters in, 572  
 new type of fading on paths crossing magnetic equator, 945  
 nonlinear interaction effects in, 3847  
 considering plasma layer bounded by dielectric, 1996  
 polarization fading over oblique-incidence path, 1668  
 ray path calculations for, 2377  
 reciprocity tests, 1667  
 reflection conditions for vertical sounding, 2728  
 reflection in stratified medium with weak irregularities, 2250  
 refraction of extraterrestrial waves, 2973  
 refraction irregularities at 4 m  $\lambda$ , 2251  
 round-the-world echoes, 1343  
 by scatter, amplitude and phase characteristics related to Gaussian noise, 583  
 during auroral disturbance, 2001  
 due to electro-dynamically controlled turbulence in, 4060  
 due to equatorial sunset effect, 3461  
 importance of meteor activity in, 1344  
 under influence of ion production, 4059  
 scattering cross-section for turbulent fluctuations, 236  
 self-demodulation and self-distortion in, 2252  
 signal bearing variations due to irregularities and aurora, 1998  
 test between Ascension Island and Slough, 2376  
 u.h.f., during annular eclipse, 2739  
 between U.K. and Japan, 3453  
 variations in direction of arrival, 941  
 v.h.f., refraction effects in satellite tracking, 3698

- Wave propagation, e.m. ionospheric, v.h.f. scatter, solar-cycle influence on, 130
- v.l.f., mode theory confirmation from spectra of atmospherics, 3094, 3313
- phase stability deduced from waveguide mode theory, 2735
- using power-line aerial, 1672
- 17-kc/s, 'whistler-mode' echoes remote from conjugate point, 2731
- over irregular terrain, 2723
- in isotropic and crystalline media with spatial dispersion, 1169
- l.f., in arctic areas, 4182
- in glaciers, 1994
- influence of ridge on, 233
- in medium with random inhomogeneities, effect of receiver focusing system on field fluctuations, 4031
- in medium with spatial dispersion, 2921
- nonreciprocal, in ionized gas, 2541
- in plasma in magnetic field, with spatial dispersion, 1166
- pulse, around earth, 1662
- in medium with dielectric losses, 2208
- and radiation problems, physical description and analogies for, 4025
- reflected wave from moving object, characteristics of, 410
- reflection, from auroral ionization, 1670
- geometry of, 1671
- from satellite-produced ionization, 2963
- by scatter, aerial-to-medium coupling loss, 235
- from low-density meteor trails, 1665
- from meteor trails, direction of arrival of long-duration echoes, 1993
- from random inhomogeneities, 414
- role of turbulent mixing in, 3088
- scattering, by free electrons in and above atmosphere, 451
- of surface wave by reactance discontinuity, 3844
- by turbulence, theory of, 1660, 1661
- scattering matrix for echoes through intervening ionosphere, 1345
- statistical theory for medium with random fluctuations over conducting plane, 3840
- surface-type, Sommerfeld treatment of, 1334
- over stratified ground, 939
- system loss, 4174
- theory for inhomogeneous path, 3841
- transmission loss due to aerial environment, 1999
- tropospheric, airborne research work on, 2726
- climatology of ground-based ducts, 4053
- diffraction by earth's curvature in, 3092
- diffraction measurements in mountainous region, 241
- diffraction by mountain ridges, 243
- diurnal influences for path near Persian Gulf, 1337
- fading due to scattering by dielectric turbulence, 3450
- at great heights, theory for nonstandard atmosphere, 1336
- mechanism for different scattering surfaces in atmosphere, 2379
- polarization rotation in, 3451
- refractive-index, models for, 2725
- synoptic variation, 4177
- by scatter, Australian tests, 3452
- calculation of multiple dispersion in, 1995
- geometric characteristics, 571
- theoretical research in U.S., 3846
- transhorizon, 1663, field-strength relations for, 570
- tests in U.S.A., 234
- u.h.f., aperture-to-medium coupling on line-of-sight paths, 4183
- through array of parallel metallic plates, 94
- attenuation by rain at 8.6 mm  $\lambda$ , 4187
- attenuation and rainfall data for 11-kMc/s relay, 1673, 2381
- diffraction by mountains, 3458
- effect of cloud layers on field strength, 4186
- foreground terrain effects in, 3457
- in Italy over 196-km path, 2002
- long-distance, path loss over 864 km, 244
- over Mediterranean at 10 cm  $\lambda$ , 940
- mm- $\lambda$ , absorption over extended ranges, 246
- optical techniques for, 2099
- phase stability measurements, 4176
- over rough terrain and sea surfaces, 4184
- by scatter, over English Channel, 578
- measurements at 858 Mc/s over paths up to 585 km, 1346
- measurements at 1250 Mc/s related to meteorological data, 3096
- transhorizon, wavelength-dependence in, 1666
- at 468 Mc/s over 289-mile path, 245
- Wave propagation, over sea, in Denmark, 579
- over sea surface, 242
- phase fluctuations in, 2738
- transhorizon, aerial-beam distortion in, 1347
- bandwidth measurements, 3459
- distance dependence, fading and distortion of, 3090
- rapid-beam-swinging measurements, 3198
- over sea path, 2734
- over 171-mile land path, 4185
- 490-Mc/s, transmission loss related to tropopause height, 3097
- 1.3-kMc/s, analysis of field-strength recordings, 3095
- 2-kMc/s, prolonged fade-out on short path, 3098
- 2800-Mc/s, disturbances on 'just-below-horizon' path, 3091
- velocity measurements, 2190
- velocity modulation in dielectric medium, 2207
- v.h.f., abnormal absorption of cosmic noise at 30 Mc/s, 2380
- back-scatter from sea in anomalous television reception, 577
- field-strength measurements, near Berlin, 2740
- e.m., v.h.f., field-strength measurements, over nonuniform terrain in East Germany, 3456
- influence of moisture, temperature and terrain on, 3089
- long-distance, due to E<sub>s</sub> and F layers and troposphere, 2003
- role of turbulent scattering in, 575
- long-range reception of television signals, 574
- by scatter from overdense meteor trail, 576
- in towns, 3850
- transhorizon, field-strength measurements of, 2737
- v.l.f., long-distance, waveguide-mode analysis of, 948
- phase stability measurements for radux-omega system, 2736
- Waveform, recording, using homodyne detector, 3065
- by stroboscopic methods, 1650, 2357
- sampling comparator, 919
- Waveguides, (See also Transmission Lines)
- assemblies, integrally constructed, design and testing of, 2826
- attenuators, ferrite-type, medium-power, 2468
- bends in, propagation around, 2106
- circular, with absorbing walls, attenuation of, 3194
- containing ferrite rod, propagation constants, 341
- containing gyromagnetic media, mode spectra, 2838
- effect of diaphragms and corrugations in, 1075
- ferrite-loaded, as delay device, 2116
- perturbation method for propagation coefficient, 2836
- loaded with paramagnetic salt, rotation of plane of polarization in, 776
- for long-distance transmission, 2107
- circular and elliptic, attenuation measurements, 2829
- circulators, ferrite, low-loss, L-band, 1769
- 1-kW, X-band, 1079
- using semiconductor Hall effect, 15
- 3-port, using Hall effect, 2113
- 4-port, 2832
- coaxial, low-reflection junctions for, 1073
- coiled, as delay-line, 339
- couplers, directional, comparison of, 3936
- end sections for matching, 1083
- long-slot, 2112
- measurement of directivity of, 3821
- wide-band, interference-type, 705
- and multimode measurement techniques, 3935
- multiple-branch, 3559
- hybrid ring as, 2465
- variable-ratio power divider and multiplexer, 1078
- curved, fundamental modes in, 3929
- dielectric, image-type, 2827
- characteristics at mm  $\lambda$ , 3930
- dielectric-loaded, field distribution in, 3940
- propagation of orthogonal dominant modes in, 1081
- elliptic, characteristic impedances of, 702
- ferrite-loaded, analysis for, 3933
- ferrite-loaded, high-power effects in, 3937
- as microwave limiters, 3943
- phase-shift calculations for, 2115
- for phase shifting, 1771
- propagation in, 707, 1770
- thermal effects in, 3938
- filters, band-pass, design of, 3939
- cavity-type, ferrite-loaded, 2467
- ferrite-type, 2466
- Waveguides, high power, 3562
- high-Q, design theory, 3561
- multistage, formulae for, 53
- theory of wire-grid transmission loss for, 3963
- helix-type, curved, attenuation of TE<sub>01</sub> wave in, 704
- influence of dielectric on phase constants for, 2100
- in magnetic-dielectric medium, resonance in, 2464
- mode conversion at junction with copper pipe, 3932
- theory and application of, 703
- irregular, critical cross-sections in, 699
- irregularities in, reflection and scattering from, 1766
- isolators, ferrite, design for magnetron, 11
- field-displacement, analysis for, 2839
- resonance-type, high-power, L-band, 3563
- for 70 kMc/s, 1439
- junctions, hybrid, 3560
- matrix representation of, 2139
- stepped, frequency compensation technique, 1077
- transformation of admittance using variable reactance and phase shifter, 2111
- loaded, with attenuating foil, 1772
- evaluation of equivalent-circuit parameters by field measurement, 340
- for low-temperature cryostats, 1767
- manufacture of components for, electroforming process for, 1436
- frozen-mercury process for, 3553
- techniques for, 700
- for mm waves, 2463
- mode transducer, centre-excited, 2831
- obstacles in, anisotropic, theory of, 706
- phase-shifter, ferrite-type, 'serrodyne' modulator for frequency translation, 3942
- for 200-800 Mc/s, 3941
- phenomenological theory for, 2837
- 90° wide-band, 2114
- 'plasma cable', with brass outer conductor and external magnetic field, 2104
- polarization measurements at 4 kMc/s, equipment for, 3564
- propagation in, theory for discontinuous periodic structures applied to, 2103
- propagation at sub-mm  $\lambda$  in, analysis of, 13
- pulse waveform distortion due to dispersion in, 1071
- reflectometer for, rotating-loop, 2117
- ring circuits, nonreciprocal, resonance properties of, 2462
- scattering in, characteristic functions of wave equation for, 2696
- serrated, 1074
- slotted, surface-wave launching efficiency of, 2110
- step discontinuities in, 14
- strip and parallel-plate types, characteristics and manufacture of, 2108
- strip-type, characteristic-impedance calculation, 3555
- with coaxial feed, properties of, 2828
- directional couplers, 3556
- ferrite-filled, propagation in, 2109
- high-Q triplate-type, impedance and phase velocity of, 701
- optimum dimensions for, 1072
- as wide-band balun, 3931
- surface-type, dielectric, excitation of, 3558
- dielectric-cylinder, excitation of transverse magnetic wave, 1438
- dielectric-rod, launching efficiency of wires and slots for, 2830
- with gyrotropic medium, analysis of, 1076
- propagation along ferrite-coated plane conductor with constant external magnetic field, 1435
- reactance calculation for, 3557
- switches, Faraday-rotation, for TH system, 2835
- fast, for 70 kMc/s, 2834
- high-power duplexer, 2833
- switches and branching networks, comparison of different types, 1080
- tapered, reflections in, 1768
- terminations, with film-type resistors, 1082
- trough-type, cut-off wavelength of, 3554
- periodic structures in, 3934
- wave equation for, asymptotic integration of, 2461
- Wavemeters, (See also Frequency, meters)
- absorption-type, 1-100-Mc/s, using transistors, 1979
- microwave, cavity-type, cylindrical, 3066
- Waves, (See also Diffraction; Sound; Ultrasonics)
- growing, kinematics of, 1849
- space-charge and e.m., growth in moving ion streams, 3267, 4030
- Wire, U.S. specifications and codes for, 3046

# ERRATA

## IN ABSTRACTS AND REFERENCES 1959

Abstract No.	
515	Change U.D.C. number to 537.311.33 : 535.215
1052	For 'F. A. Vaniar' read 'F. A. Veniar'
1529	In line 5, for 'auroral' read 'annual'
1824	In line 7, for 'frequency band' read 'energy band'
1958	For 'J. F. Ditton, Jr' read 'J. F. Dillon, Jr'
1986	Change U.D.C. number to 621.384.8 : 537.54
2113	In line 4, for 'three-part' read 'three-port'
2159	In line 7, for 'joints' read 'points'
2278	In title, for 'Electric' read 'Elastic'
2408	In line 7, for '805-line' read '625-line'
2669	For 'S. Asanabo' read 'S. Asanabe'
2720	Change U.D.C. number to 621.384.8 : 537.54
2831	In title, for 'TE <sub>10</sub> -TE <sub>01</sub> ' read 'TE <sub>10</sub> -TE <sub>01</sub> '
2857	In title, for 'm <sup>1</sup> /N' read 'N <sup>1</sup> /m'
2958	In line 4, for 'change-exchange' read 'charge-exchange'
3030	In line 5, for 'function' read 'junction'
3136	In line 5, for '3136' read '3138'
3171	For 'W. R. Aitken' read 'W. R. Aiken'
3256	Change U.D.C. number to 538.566 : 535.42
3350	Change U.D.C. number to 537.311.3 : 539.23
3836	For 'J. L. Veshaghe' read 'J. L. Verhaeghe'

## IN PAPERS ABSTRACTED

The practice of allocating individual abstract numbers to corrections has been largely discontinued; a list of published corrections noted during 1959 is given below. The journal in which the correction appeared was in each case the same as that in which the original paper was published.

Abstract No.	
3235 of 1955	Jan. 1959, Vol. 14, No. 1, pp. 115-116
1405 of 1957	July 1957, Vol. AP-5, No. 3, p. 313
2959 of 1957	Dec. 1958, Vol. 5, No. 6, pp. 510-513
84 of 1958	Jan. 1959, Vol. 6, No. 1, p. 80
295 of 1958	Sept. 1959, Vol. 36, No. 9, p. 352
971 of 1958	Sept. 1958, Vol. 29, No. 9, p. 1383
1228 of 1958	Dec. 1959, Vol. 47, No. 12, p. 2105
1858 of 1958	April 1958, Vol. 3, No. 30, p. 312
1892 of 1958	April 1958, Vol. 3, No. 30, p. 312
3028 of 1958	Sept. 1958, Vol. 29, No. 9, p. 1383
3271 of 1958	Dec. 1959, Vol. 47, No. 12, p. 2084
3472 of 1958	Dec. 1958, Vol. 18, No. 12, p. 714
3544 of 1958	15th Dec. 1958, Vol. 112, No. 6, p. 2139
3890 of 1958	15th Sept. 1959, Vol. 115, No. 6, p. 1778
3902 of 1958	15th March 1959, Vol. 113, No. 6, p. 1697
3962 of 1958	Dec. 1958, Vol. 46, No. 12, p. 1913
173 of 1959	15th March 1959, Vol. 113, No. 6, p. 1696
239 of 1959	July 1957, Vol. AP-5, No. 3, p. 313

337 of 1959	Dec. 1957, Vol. CP-4, No. 4, pp. 135-137
379 of 1959	Feb. 1959, Vol. 4, No. 37, p. 220
385 of 1959	May 1959, Vol. 4, No. 39, p. 272
501 of 1959	1st June 1959, Vol. 73, No. 474, p. 976
635 of 1959	Oct. 1958, Vol. 17, No. 10, p. 117
745 of 1959	Feb. 1959, Vol. 4, No. 37, p. 220
855 of 1959	March 1959, Vol. 36, No. 3, p. 95
890 of 1959	March 1959, Vol. 9, Nos. 3/4, p. 340
1233 of 1959	15th June 1959, Vol. 114, No. 6, p. 1652
1368 of 1959	Sept. 1959, Vol. 47, No. 9, pp. 1653-1654
1372 of 1959	June 1958, Vol. 2, No. 3, p. 144
1493 of 1959	Dec. 1958, Vol. 17, No. 12, p. 38
1498 of 1959	Feb. 1959, Vol. 4, No. 37, p. 220
1559 of 1959	April 1959, Vol. 47, No. 4, p. 567
1615 of 1959	1st Sept. 1959, Vol. 3, No. 5, p. 244
1693 of 1959	Feb. 1959, Vol. 4, No. 37, p. 220
1795 of 1959	May 1959, Vol. 65, No. 5, p. 232
1952 of 1959	1st June 1959, Vol. 73, No. 474, p. 976
2024 of 1959	Oct. 1958, Vol. 2, No. 5, p. 252
2202 of 1959	15th June 1959, Vol. 114, No. 6, p. 1652
2408 of 1959	Aug. 1959, Vol. 36, No. 8, p. 314
2410 of 1959	July 1959, Vol. 47, No. 7, p. 1252
2503 of 1959	July 1959, Vol. 31, No. 377, p. 427
2750 of 1959	Aug. 1959, Vol. 47, No. 8, p. 1324
2841 of 1959	Jan. 1959, Vol. AP-7, No. 1, p. 104
3076 of 1959	Jan. 1959, Vol. 16, No. 1, p. 58
3077 of 1959	Jan. 1959, Vol. 16, No. 1, p. 58
3078 of 1959	April 1959, Vol. 14, No. 4, p. 547
3081 of 1959	Dec. 1958, Vol. 10, No. 12, p. 576
3419 of 1959	Oct. 1958, Vol. 2, No. 5, p. 252
3588 of 1959	Nov. 1959, Vol. 47, No. 11, p. 1840
3965 of 1959	July 1959, Vol. AP-7, No. 3, p. 251

# LIST OF JOURNALS

A selection of the journals which are regularly scanned is given below, together with the addresses of their publishers or editorial offices and the abbreviations of their titles as used in 'Abstracts and References'. Applications for copies of any journal should be made to the addresses given. Enquiries concerning Russian journals may be made to D.S.I.R. Lending Library Unit, 20 Chester Terrace, London, N.W.1. The full title of each journal is given in bold type and is followed by the address, the abbreviated title being shown within brackets. In a few cases the nature of a journal is indicated, where neither the title nor the address shows it clearly.

**Acta Polytechnica Scandinavica**, Publishing Office, Box 5073, Stockholm 5, Sweden. (*Acta polyt. scand.*)

**Acustica**, S. Hirzel Verlag, Stuttgart-N, Germany. (*Acustica*)

**Advances in Physics**, Taylor & Francis Ltd, Red Lion Court, Fleet Street, London, E.C.4, England. (*Advances Phys.*)

**Akusticheskii Zhurnal**, Moskva, B-64, Podsovenskii per., 21, U.S.S.R. (*Akust. Zh.*)

**Akustische Beihefte**, as for Acustica. (*Akust. Beihefte*)

**Alta Frequenza**, Associazione Elettrotecnica Italiana, Milano (202), Via S. Paolo 10, Italy. (*Alta Frequenza*)

**Annalen der Physik**, J. A. Barth, Leipzig C1, Salomonstrasse 18B, East Germany. (*Ann. Phys., Lpz.*)

**Annales de Géophysique**, Service des Publications du C.N.R.S., 13 Quai Anatole France, Paris 7<sup>e</sup>, France. (*Ann. Géophys.*)

**Annales de Physique**, Masson & Cie, 120 Boulevard Saint-Germain, Paris 6<sup>e</sup>, France. (*Ann. Phys., Paris*)

**Annales de Radioélectricité**, 10 rue Carducci, Paris 19<sup>e</sup>, France. (*Ann. Radioélect.*)

**Annales des Télécommunications**, 3 & 5 Boulevard Pasteur, Paris 15<sup>e</sup>, France. (*Ann. Télécommun.*)

**Applied Scientific Research**, Martinus Nijhoff, The Hague, Netherlands. (*Appl. sci. Res.*)

**Archiv der elektrischen Übertragung**, S. Hirzel Verlag, Stuttgart, Germany. (*Arch. elekt. Übertragung*)

**Archiv für Elektrotechnik**, Springer Verlag, Berlin-Wilmersdorf, Heidelberger Platz 3, Germany. (*Arch. Elektrotech.*)

**Archiv für technisches Messen**, R. Oldenbourg KG, München 8, Rosenheimer Str. 145, Germany. (*Arch. tech. Messen*)

**Arkiv för Fysik**, published for Royal Swedish Academy of Sciences by Almqvist & Wiksell, Stockholm, Sweden. (*Ark. Fys.*)

**A.T.E. Journal**, Automatic Telephone & Electric Co. Ltd, Strowger Works, Liverpool 7, England. (*A.T.E. J.*)

**Audio**, Radio Magazines, Inc., P.O. Box 629, Mineola, N.Y., U.S.A. (*Audio*)

**Australian Journal of Physics**, Commonwealth Scientific and Industrial Research Organization, 314 Albert Street, East Melbourne C.2, Victoria, Australia. (*Aust. J. Phys.*)

**Avtomatika i Telemekhanika**, Moskva, I-53, Kalanchevskaya ul., 15a, U.S.S.R. (*Avtomatika i Telemekhanika*)

**A.W.A. Technical Review**, Amalgamated Wireless (Australasia) Ltd, Sydney, Australia. (*A.W.A. tech. Rev.*)

**B.B.C. Engineering Division Monographs**, British Broadcasting Corporation, 35 Marylebone High Street, London, W.1, England. (*B.B.C. Engng Div. Monographs*)

**Beama Journal**, British Electrical and Allied Manufacturers' Association, 36 Kingsway, London, W.C.2, England. (*Beama J.*)

**Bell Laboratories Record**, 463 West Street, New York 14, N.Y., U.S.A. (*Bell Lab. Rec.*)

**Bell System Technical Journal**, American Telephone and Telegraph Company, 195 Broadway, New York 7, N.Y., U.S.A. (*Bell Syst. tech. J.*)

**British Communications & Electronics**, Heywood & Co. Ltd, Drury House, Russell Street, Drury Lane, London, W.C.2, England. (*Brit. Commun. Electronics*)

**British Journal of Applied Physics**, 47 Belgrave Square, London, S.W.1, England. (*Brit. J. appl. Phys.*)

**Erown Boveri Review**, Baden, Switzerland. (*Brown Boveri Rev.*)

**Bulletin de l'Association Suisse des Electriciens**, Seefeldstrasse 301, Zürich 8, Switzerland. (*Bull. suisse. elektrotech. Ver.*)

**Bulletin of the Technical University Istanbul**, Istanbul Teknik Üniversitesi, Gümüssuyu, Istanbul, Turkey. (*Bull. tech. Univ. Istanbul*)

**Cables & Transmission**, Sotelec, 16 rue de la Baume, Paris 8<sup>e</sup>, France. (*Cables & Transm.*)

**Cahiers de Physique**, 165 rue de Sèvres, Paris 15<sup>e</sup>, France. (*Cah. Phys.*)

**Canadian Electronics Engineering**, Maclean-Hunter Publishing Co. Ltd, P.O. Box 100, Toronto, Canada. (*Canad. Electronics Engng*)

**Canadian Journal of Physics**, National Research Council, Ottawa 2, Ont., Canada. (*Canad. J. Phys.*)

**Chalmers tekniska Högskolas Handlingar**, Gumperts Förlag, Göteborg, Sweden. (*Chalmers. tek. Högsk. Handl.*)

**Communication and Electronics**, American Institute of Electrical Engineers, 20th and Northampton Streets, Easton, Pa, U.S.A. (*Commun. & Electronics*)

**Communications on Pure and Applied Mathematics**, Interscience Publishers Inc., 250 Fifth Avenue, New York 1, N.Y., U.S.A. (*Commun. pure appl. Math.*)

**Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences**, Gauthier-Villars, 55 Quai des Grands-Augustins, Paris 6<sup>e</sup>, France. (*C. R. Acad. Sci., Paris*)

**Doklady Akademii Nauk S.S.S.R.**, Moskva, B-64, Podsovenskii per., 21, U.S.S.R. (*Dokl. Ak. Nauk S.S.S.R.*)

**E.B.U. Review**, 32 Avenue Albert Lancaster, Bruxelles 18, Belgium. (*E.B.U. Rev.*)

**Electrical Communication**, International Telephone and Telegraph Corporation, 67 Broad Street, New York 4, N.Y., U.S.A. (*Elect. Commun.*)

**Electrical Engineering**, American Institute of Electrical Engineers, 33 West 39th Street, New York 18, N.Y., U.S.A. (*Elect. Engng, N.Y.*)

**Electrical Journal**, Bouvier House, 154 Fleet Street, London, E.C.4, England. (*Elect. J.*)

**Electrical Manufacturing**, 205 East 42nd Street, New York 17, N.Y., U.S.A. (*Elect. Mfg.*)

**Electrical Review**, Dorset House, Stamford Street, London, S.E.1, England. (*Elect. Rev., Lond.*)

**Electronic Applications**, N. V. Philips' Gloeilampenfabrieken, Technical and Scientific Literature Department, Eindhoven, Netherlands. (*Electronic Applic.*)

**Electronic Engineering**, 28 Essex Street, London, W.C.2, England. (*Electronic Engng*)

- Electronic Equipment Engineering**, Sutton Publishing Company Inc., 172 South Broadway, White Plains, N.Y., U.S.A. (*Electronic Equipm. Engrng*)
- Electronic Industries**, Chestnut and 56th Sts, Philadelphia 39, Pa, U.S.A. (*Electronic Ind.*)
- Electronic & Radio Engineer**, Iliffe & Sons Ltd, Dorset House, Stamford Street, London, S.E.1, England. (*Electronic Radio Engr*)
- Electronics**, 330 West 42nd Street, New York 36, N.Y., U.S.A. (*Electronics*)
- Elektronische Rundschau**, Verlag für Radio-Foto-Kinotechnik G.m.b.H., Berlin-Borsigwalde, Eichborndamm 141-167, Germany. (*Elektronische Rundschau*)
- Elektrosvyaz'**, Moskva, K-9, ul. Gor'kogo, 7, 8-1 pod'ezd, 3-1 etazh, U.S.S.R. (*Elektrosvyaz'*)
- Elektrotechnik und Maschinbau**, Journal of the Elektrotechnischer Verein Österreichs, Springer Verlag, Wien 1, Mollkerbastei 5, Austria. (*Elektrotech. u. Maschinbau*)
- Elektronische Zeitschrift**, Edition A & B, VDE-Verlag G.m.b.H., Berlin-Charlottenburg 2, Bismarckstrasse 33, Germany. (*Elektronisch. Z.*)
- Endeavour**, Imperial Chemical Industries Ltd, North Block, Thames House, Millbank, London, S.W.1, England. (*Endeavour*)
- Engineer**, 28 Essex Street, London, W.C.2, England. (*Engineer, Lond.*)
- Engineering**, 36 Bedford Street, London, W.C.2, England. (*Engineering, Lond.*)
- Ericsson Review**, Telefonaktiebolaget L. M. Ericsson, Stockholm 32, Sweden. (*Ericsson Rev.*)
- Ericsson Technics**, as for Ericsson Review. (*Ericsson Tech.*)
- Fizika Tverdogo Tela**, Leningrad, V-164, Mendeleevskaya lin., 1, U.S.S.R. (*Fiz. Tverdogo Tela*)
- Frequenz**, Fachverlag Schiele & Schön G.m.b.H., Berlin S.W.61, Markgrafenstrasse 11, Germany. (*Frequenz*)
- Funk-Technik**, Verlag für Radio-Foto-Kinotechnik G.m.b.H., Berlin-Borsigwalde, Eichborndamm 141-167, Germany. (*Funk-Technik, Berlin*)
- G.E.C. Journal**, General Electric Company Ltd, Magnet House, Kingsway, London, W.C.2, England. (*G.E.C. J.*)
- G.E.C. Telecommunications**, General Electric Company Ltd, Coventry, England. (*G.E.C. Telecommun.*)
- Geofisica Pura e Applicata**, Istituto Geofisico Italiano, Milano, Piazza Leonardo da Vinci 12, Italy. (*Geofis. pura appl.*)
- Geophysical Journal of the Royal Astronomical Society**, Burlington House, London, W.1, England. (*Geophys. J. R. astr. Soc.*)
- Helvetica Physica Acta**, Journal of the Schweizerische Physikalische Gesellschaft, Birkhäuser Verlag, Basel, Switzerland. (*Helv. phys. Acta*)
- Hochfrequenztechnik und Elektroakustik**, Akademische Verlagsgesellschaft Geest & Portig K.-G., Leipzig C1, Sternwartenstr. 8, East Germany. (*Hochfrequenztech. u. Elektroakust.*)
- IBM Journal of Research and Development**, International Business Machines Corporation, 590 Madison Avenue, New York 22, N.Y., U.S.A. (*IBM J. Res. Developm.*)
- Indian Journal of Physics** (and Proceedings of the Indian Association for the Cultivation of Science), Jadavpur, Calcutta 32, India. (*Indian J. Phys.*)
- Izvestiya Akademii Nauk S.S.S.R.** (a) seriya fizicheskaya, Moskva, B-64, Podosenskii per., 21, U.S.S.R., (b) seriya geofizicheskaya, Moskva, B. Gruzinskaya, 10, U.S.S.R., (c) otdelenie tekhnicheskikh nauk, Moskva, M. Khariton'evskii per., 4, U.S.S.R. (*Izv. Ak. Nauk S.S.S.R., (a) ser. fiz., (b) ser. geofiz., (c) otd. tekhn. nauk*)
- Journal of the Acoustical Society of America**, American Institute of Physics, 335 East 45th Street, New York 17, N.Y., U.S.A. (*J. acoust. Soc. Amer.*)
- Journal of the American Ceramic Society**, 20th and Northampton Streets, Easton, Pa, U.S.A. (*J. Amer. ceram. Soc.*)
- Journal of Applied Physics**, American Institute of Physics, 335 East 45th Street, New York 17, N.Y., U.S.A. (*J. appl. Phys.*)
- Journal of Atmospheric and Terrestrial Physics**, Pergamon Press Ltd, 4 & 5 Fitzroy Square, London, W.1, England. (*J. atmos. terr. Phys.*)
- Journal of the Audio Engineering Society**, P.O. Box 12, Old Chelsea Station, New York 11, N.Y., U.S.A. (*J. audio Engrng Soc.*)
- Journal of the British Institution of Radio Engineers**, 9 Bedford Square, London, W.C.1, England. (*J. Brit. Instn Radio Engrs*)
- Journal of the British Interplanetary Society**, 12 Bessborough Gardens, London, S.W.1, England. (*J. Brit. interplan. Soc.*)
- Journal of the Electrochemical Society**, 1860 Broadway, New York 23, N.Y., U.S.A. (*J. electrochem. Soc.*)
- Journal of Electronics and Control**, Taylor & Francis Ltd, Red Lion Court, Fleet Street, London, E.C.4, England. (*J. Electronics Control*)
- Journal of the Franklin Institute**, Benjamin Franklin Parkway at Twentieth Street, Philadelphia 3, Pa, U.S.A. (*J. Franklin Inst.*)
- Journal of Geomagnetism and Geoelectricity**, Society of Terrestrial Magnetism and Electricity of Japan, Geophysical Institute, Kyoto University, Kyoto, Japan. (*J. Geomag. Geoelect.*)
- Journal of Geophysical Research**, 1515 Massachusetts Avenue, N.W., Washington 5, D.C., U.S.A. (*J. geophys. Res.*)
- Journal of the Indian Institute of Science**, Indian Institute of Science, Bangalore 12, India. (*J. Indian Inst. Sci.*)
- Journal of the Institute of Navigation**, John Murray Ltd, 50 Abchurch Lane, London, W.1, England. (*J. Inst. Nav.*)
- Journal of the Institution of Telecommunication Engineers**, Post Box 481, New Delhi, India. (*J. Instn Telecommun. Engrs, India*)
- Journal of Mathematics and Physics**, Massachusetts Institute of Technology, Cambridge 39, Mass., U.S.A. (*J. Math. Phys.*)
- Journal of Meteorology**, Prince and Lemon Streets, Lancaster, Pennsylvania, U.S.A. (*J. Met.*)
- Journal of the Optical Society of America**, American Institute of Physics, 335 East 45th Street, New York 17, N.Y., U.S.A. (*J. opt. Soc. Amer.*)
- Journal of the Physical Society of Japan**, Maruzen Publishing Co., P.O. Box 605 Central, Tokyo, Japan. (*J. phys. Soc. Japan*)
- The Journal of the Physics and Chemistry of Solids**, Pergamon Press Ltd, 4 & 5 Fitzroy Square, London, W.1, England. (*J. Phys. Chem. Solids*)
- Journal de Physique et le Radium**, 12 place Henri-Bergson, Paris 8<sup>e</sup>, France. (*J. Phys. Radium*)
- Journal of the Radio Research Laboratories**, Ministry of Posts and Telecommunications, Koganei-shi, Tokyo, Japan. (*J. Radio Res. Labs, Japan*)
- Journal of Research of the National Bureau of Standards**, U.S. Government Printing Office, Washington 25, D.C., U.S.A. (*J. Res. nat. Bur. Stand.*)
- Journal of Scientific Instruments**, 47 Belgrave Square, London, S.W.1, England. (*J. sci. Instrum.*)
- Journal of the Society of Motion Picture and Television Engineers**, 55 West 42nd Street, New York 36, N.Y., U.S.A. (*J. Soc. Mct. Pict. Telev. Engrs*)
- Journal of the Television Society**, 166 Shaftesbury Avenue, London, W.C.2, England. (*J. Telev. Soc.*)
- Marconi Review**, Marconi House, Chelmsford, England. (*Marconi Rev.*)
- Metal Industry**, Iliffe & Sons Ltd, Dorset House, Stamford Street, London, S.E.1, England. (*Metal Ind., Lond.*)
- Metallurgia**, 31 King Street West, Manchester 3, England. (*Metallurgia, Manchr*)
- Meteorological Magazine**, Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2, England. (*Met. Mag., Lond.*)
- Microtechnic**, 23 Avenue de la Gare, Lausanne, Switzerland. (*Microtechnic*)
- Modern Plastics**, 575 Madison Avenue, New York 22, N.Y., U.S.A. (*Mod. Plast.*)
- Monthly Notices of the Royal Astronomical Society**, Burlington House, London, W.1, England. (*Mon. Not. R. astr. Soc.*)
- Mullard Technical Communications**, Mullard House, Torrington Place, London, W.C.1, England. (*Mullard tech. Commun.*)
- Nachrichtentechnik**, V.E.B. Verlag Technik, Berlin C2, Oranienburger Str. 13/14, East Germany. (*NachrTech.*)
- Nachrichtentechnische Zeitschrift**, F. Vieweg & Sohn, (20b) Braunschweig, Burgplatz 1, Germany. (*Nachrichtentech. Z.*)
- Nature**, Macmillan & Co. Ltd, St. Martin's Street, London, W.C.2, England. (*Nature, Lond.*)
- Naturwissenschaften**, Springer Verlag, Berlin-Wilrersdorf, Heidelberger Platz 3, Germany. (*Naturwissenschaften*)
- Note Recensioni e Notizie**, Istituto Superiore delle Poste e delle Telecomunicazioni, Viale Trastevere 189, Roma, Italy. (*Note Recensioni Notiz.*)
- Nucleonics**, 330 West 42nd Street, New York 36, N.Y., U.S.A. (*Nucleonics*)
- Nuovo Cimento**, Editore Nicola Zanichelli, Bologna, Via Irnerio 34, Italy. (*Nuovo Cim.*)
- Observatory**, Royal Greenwich Observatory, Herstmonceux Castle, Hailsham, Sussex, England. (*Observatory*)
- L'Onde Électrique**, Éditions Chiron, 40, rue de Seine, Paris 6<sup>e</sup>, France. (*Onde elect.*)
- Optik**, Wissenschaftliche Verlagsgesellschaft m.b.H., Stuttgart 1, Postfach 40, Germany. (*Optik, Stuttgart*)
- Philips Research Reports**, N.V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands. (*Philips Res. Rep.*)
- Philips Technical Review**, as for Philips Research Reports. (*Philips tech. Rev.*)
- Philips Telecommunication Review**, Philips Telecommunication Division, P.O. Box 32, Hilversum, Netherlands. (*Philips Telecommun. Rev.*)
- Philosophical Magazine**, Taylor & Francis Ltd, Red Lion Court, Fleet Street, London, E.C.4, England. (*Phil. Mag.*)
- Philosophical Transactions of the Royal Society**, Burlington House, Piccadilly, London, W.1, England. (*Phil. Trans.*)
- Physica**, Physica Foundation, Lucas Bolwerk 4, Utrecht, Netherlands. (*Physica*)
- Physical Review**, American Institute of Physics, 335 East 45th Street, New York 17, N.Y., U.S.A. (*Phys. Rev.*)
- Physical Review Letters**, American Institute of Physics, 335 East 45th Street, New York 17, N.Y., U.S.A. (*Phys. Rev. Lett.*)
- Physics and Chemistry of Solids**. See Journal of the Physics and Chemistry of Solids.
- Point to Point Telecommunications**, Communications Division, Marconi's Wireless Telegraph Co. Ltd, Chelmsford, England. (*Point to Point Telecommun.*)
- Post Office Electrical Engineers' Journal**, Engineer-in-Chief's Office, Alder House, Aldersgate Street, London, E.C.1, England. (*P.O. elect. Engrs' J.*)
- Poste e Telecomunicazioni**, Roma, Via della Vite 107, Italy. (*Poste e Telecomunicazioni*)
- Priroda**, Moskva, Tsentr, Malyi Khariton'evskii per., 4, U.S.S.R. (*Priroda, Moskv.*)
- Proceedings of the Cambridge Philosophical Society (Mathematical and Physical Sciences)**, Cambridge University Press, Bentley House, 200 Euston Road, London, N.W.1, England. (*Proc. Camb. phil. Soc.*)
- Proceedings of the Institute of Radio Engineers**, 1 East 79th Street, New York 21, N.Y., U.S.A. (*Proc. Inst. Radio Engrs*)
- Proceedings of the Institution of Electrical Engineers**, Parts A, B and C, Savoy Place, London, W.C.2, England. (*Proc. Instn elect. Engrs*)
- Proceedings of the Institution of Radio Engineers, Australia**, Science House, 157 Gloucester Street, Sydney, N.S.W., Australia. (*Proc. Instn Radio Engrs Aust.*)
- Proceedings of the Physical Society**, 1 Lowther Gardens, Prince Consort Road, London, S.W.7, England. (*Proc. phys. Soc.*)
- Proceedings of the Royal Society**, Burlington House, Piccadilly, London, W.1, England. (*Proc. roy. Soc.*)
- Progress of Theoretical Physics**, The Publication Office, Yukawa Hall, Kyoto University, Kyoto, Japan. (*Progr. theor. Phys.*)
- QST**, American Radio Relay League Inc., 38 La Salle Road, West Hartford 7, Conn., U.S.A. (*QST*)
- Quarterly of Applied Mathematics**, Brown University, Providence 12, R.I., U.S.A. (*Quart. appl. Math.*)
- Quarterly Journal of Mathematics**, Oxford University Press, Aiken House, London, E.C.4, England. (*Quart. J. Math.*)
- Quarterly Journal of Mechanics and Applied Mathematics**, Oxford University Press, Aiken House, London, E.C.4, England. (*Quart. J. Mech. appl. Math.*)
- Quarterly Journal of the Royal Meteorological Society**, 49 Cromwell Road, London, S.W.7, England. (*Quart. J. R. met. Soc.*)
- Radio**, Moskva, B-66, Novo-Ryazanskaya ul., 26, U.S.S.R. (*Radio, Moskv.*)
- Radio & TV News**, Ziff-Davis Publishing Company, 434 South Wabash Avenue, Chicago 5, Ill., U.S.A. (*Radio TV News*)
- Radio-Electronics**, 154 West 14th St., New York 11, N.Y., U.S.A. (*Radio-Electronics*)
- Radioschau**, Technischer Verlag Erb, Wien VI, Mariahilferstrasse 71, Austria. (*Radioschau*)
- Radiotekhnika**, Moskva, K-9, ul. Gor'kogo, 7, 3-1 pod'ezd, U.S.S.R. (*Radiotekhnika, Moskv.*)
- Radiotekhnika i Elektronika**, Moskva, K-9, Mokhovaya, 11, U.S.S.R. (*Radiotekhnika i Elektronika*)
- RCA Review**, RCA Laboratories, Princeton, N.J., U.S.A. (*RCA Rev.*)
- Referativnyi Zhurnal, Fizika**, Moskva, D-129, Baltiiskaya ul., 14, U.S.S.R. (*Referativnyi Zh. Fiz.*)
- Report of Ionosphere Research in Japan**, Ionosphere Research Committee, Science Council of Japan, Ueno Park, Tokyo, Japan. (*Rep. Ionosphere Res. Japan*)
- Reports of the Electrical Communication Laboratory**, Nippon Telegraph and Telephone Public Corporation, 1551 Kichijoji, Musashino-shi, Tokyo, Japan. (*Rep. elect. Commun. Lab., Japan*)
- Research**, Butterworth's Scientific Publications Ltd, 88 Kingsway, London, W.C.2, England. (*Research, Lond.*)
- Review of Scientific Instruments**, American Institute of Physics, 335 East 45th Street, New York 17, N.Y., U.S.A. (*Rev. sci. Instrum.*)
- Reviews of Modern Physics**, American Institute of Physics, 335 East 45th Street, New York 17, N.Y., U.S.A. (*Rev. mod. Phys.*)
- Revista Española de Electrónica**, Apartado 5252, Barcelona, Spain. (*Rev. española Electrónica*)
- Revista de Telecomunicación**, Palacio de Comunicaciones, Madrid, Spain. (*Rev. Telecomunicación, Madrid*)
- Revista Telefónica Electrónica**, Arbó Editores, Buenos Aires, Argentina. (*Res. telegr. Electrónica, Buenos Aires*)
- Revue générale de l'Électricité**, 12 place Henri-Bergson, Paris 8<sup>e</sup>, France. (*Rev. gén. Elect.*)
- Revue HF**, 55 rue Defacqz, Bruxelles, Belgium. (*Rev. HF, Brussels*)
- Revue d'Optique**, 3 & 5 Boulevard Pasteur, Paris 15<sup>e</sup>, France. (*Rev. d'Optique*)
- Ricerca scientifica**, Consiglio Nazionale delle Ricerche, Piazzale delle Scienze, 7, Roma, Italy. (*Ricerca sci.*)
- R.S.G.B. Bulletin**, New Ruskin House, Little Russell Street, London, W.C.1, England. (*R.S.G.B. Bull.*)
- Rundfunktechnische Mitteilungen**, H. H. Nölke G.m.b.H., Hamburg 20, Hegestrass 40, Germany. (*Rundfunktech. Mitt.*)
- Science**, 1515 Massachusetts Avenue, N.W., Washington 5, D.C., U.S.A. (*Science*)
- Science Reports of the Research Institutes Tohoku University**, Series A and B, Tohoku University, Sendai, Japan. (*Sci. Rep. Res. Inst. Tohoku Univ.*)
- Short Wave Magazine**, 55 Victoria Street, London, S.W.1, England. (*Short Wave Mag.*)
- Sylvania Technologist**, Sylvania Electric Products Inc., Bayside, N.Y., U.S.A. (*Sylvania Technologist*)



**Technical News Bulletin of the National Bureau of Standards**, U.S. Government Printing Office, Washington 25, D.C., U.S.A. (*Tech. News Bull. nat. Bur. Stand.*)

**Technische Mitteilungen aus dem Betriebslaboratorium für Rundfunk und Fernsehen**, Agastrasse, Berlin-Adlershof, East Germany. (*Tech. Mitt. BRF, Berlin*)

**Technische Mitteilungen PTT**, Journal of the Swiss Post Office, Bern, Speichergasse 6, Switzerland. (*Tech. Mitt. PTT*)

**Telefunken Zeitung**, Telefunken G.m.b.H., Berlin-Charlottenburg 1, Ernst-Reuter-Platz, Haus der Elektrizität, Germany. (*Telefunken Zig*)

**Télévision**, 42 rue Jacob, Paris 6<sup>e</sup>, France. (*Télévision*)

**Tellus**, Lindhagensgatan 124, Stockholm, Sweden. (*Tellus*)

**Tijdschrift van het Nederlands Radiogenootschap**, Jagtlustlaan 9, Santpoort-Zuid, Netherlands. (*Tijdschr. ned. Radiogenoot.*)

**Toute la Radio**, 9 rue Jacob, Paris 6<sup>e</sup>, France. (*Toute la Radio*)

**Transactions of the Institute of Radio Engineers**, 1 East 79th Street, New York 21, N.Y., U.S.A. (*Trans. Inst. Radio Engrs*)

**Transactions of the South African Institute of Electrical Engineers**, The Associated Scientific and Technical Societies of South Africa, P.O. Box 5907, Johannesburg, South Africa. (*Trans. S. Afr. Inst. elect. Engrs*)

**TSF et TV**, Éditions Chiron, 40 rue de Seine, Paris 6<sup>e</sup>, France. (*TSF et TV*)

**Uspekhi Fizicheskikh Nauk**, Moskva, V-71, Leninskii Prospekt, 15, U.S.S.R. (*Usp. fiz. Nauk*)

**Le Vide**, Journal of the Société française des Ingénieurs et Techniciens du Vide, 44 rue de Rennes, Paris 6<sup>e</sup>, France. (*Le Vide*)

**Weather**, 49 Cromwell Road, London, S.W.7, England. (*Weather*)

**Wireless World**, Iliffe & Sons Ltd, Dorset House, Stamford Street, London, S.E.1, England. (*Wireless World*)

**Zeitschrift für angewandte Mathematik und Physik**, Birkhäuser-Verlag, Basel, Switzerland. (*Z. angew. Math. Phys.*)

**Zeitschrift für angewandte Physik**, Springer-Verlag, Berlin-Wilmersdorf, Heidelberger Platz 3, Germany. (*Z. angew. Phys.*)

**Zeitschrift für Metallkunde**, Dr. Riederer-Verlag G.m.b.H., Stuttgart, Marienstrasse 52, Germany. (*Z. Metallkde*)

**Zeitschrift für Meteorologie**, Akademie-Verlag G.m.b.H., Berlin W.1, Leipziger Strasse 3-4, East Germany. (*Z. Met.*)

**Zeitschrift für Naturforschung**, (14b) Tübingen, Postfach 61, Germany. (*Z. Naturf.*)

**Zeitschrift für Physik**, Springer-Verlag, Berlin, Wilmersdorf, Heidelberger Platz 3, Germany. (*Z. Phys.*)

**Zhurnal eksperimental'noi i teoreticheskoi Fiziki**, Moskva, V-133, Vorob'evskoe shosse, 2, U.S.S.R. (*Zh. eksp. teor. Fiz.*)

**Zhurnal tekhnicheskoi Fiziki**, Leningrad V-164, Mendeleevskaya lin., 1, U.S.S.R. (*Zh. tekh. Fiz.*)





