F. P. Hedrick

TELE-TECH &

ELECTRONIC INDUSTRIES

Life Testing of Selenium Rectifiers

Care and Feeding of Image Orthicons

Measuring Capacitor Temperature Coefficients

Transistorized Portables in Review

Bistable Ferromagnetic Elements

10th Annual NARTB Convention

April • 1956
A Chilton Publication

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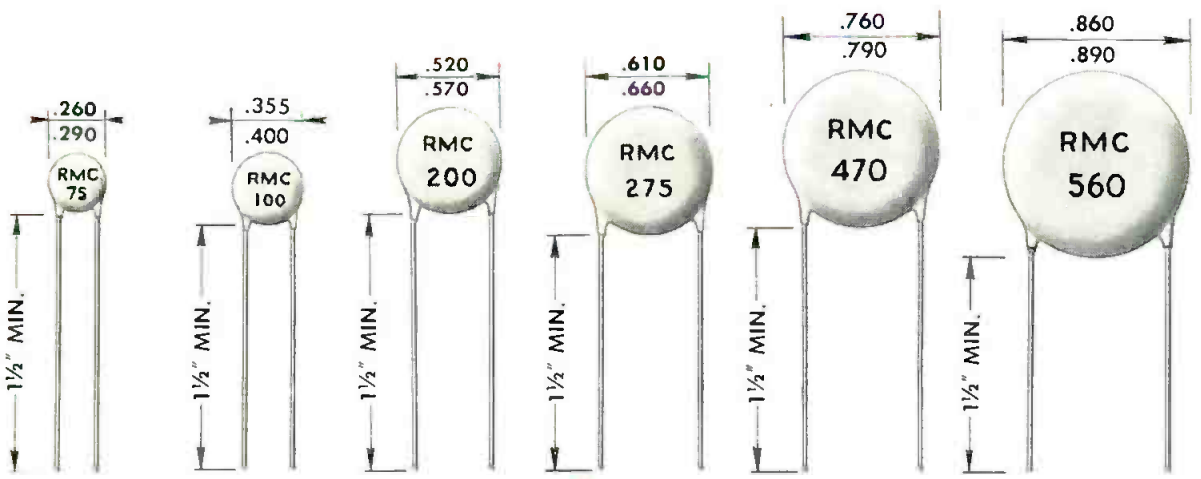
The Complete Line of TC Capacitors

RMC DISCAPS



TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	1- 3 MMF	4- 9 MMF	10- 20 MMF	—	—	—
NPO	2- 13	14- 29	30- 69	70- 85 MMF	86-115 MMF	116-150 MMF
N- 33	2- 13	14- 29	30- 56	57- 62	63-100	101-150
N- 75	2- 14	15- 27	28- 56	57- 68	69-110	111-150
N- 150	2- 15	16- 30	31- 68	69- 75	76-140	141-150
N- 220	3- 15	16- 30	31- 75	76- 90	91-130	131-190
N- 330	3- 15	16- 30	31- 75	76-100	101-150	151-190
N- 470	3- 20	21- 40	41- 80	81-120	121-200	201-240
N- 750	5- 29	30- 68	69-150	151-180	181-300	301-350
N-1500	15- 50	51-120	121-200	201-250	251-330	331-560
N-2200	47- 75	76-150	151-200	201-275	276-470	471-560

Temperature coefficients up to N-5200 available on special order.

SPECIFICATIONS

POWER FACTOR: Over 10 MMF less thon .1% at 1 megacycle. Under 10 MMF less thon .2% at 1 megacycle.

WORKING VOLTAGE: 1000 V.D.C.

TEST VOLTAGE (FLASH): 1750 V.D.C.

CODING: Copacity, tolerance and TC stamped on disc.

INSULATION: Durez phenolic-vacuum waxed.

INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms.

AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms.

LEADS: No. 22 tinned copper (.026 dia.).

TOLERANCES: ±5% ±10% ±20%

These capacitors conform to the RTMA specificotion for Class 1 ceramic condensers.

The capacity of these condensers will not change under voltage.

Type C DISCAPS are available in a wide range of capacities and temperature coefficients and the millions used over the years prove them to be the ideal replacement for tubular ceramic and mica capacitors.

Their smaller size, greater stability, and greater mechanical strength are features that leading manufacturers of electrical and electronic products have found advantageous. Rated at 1000 working volts, Type C DISCAPS cost no more than ordinary 600 volt capacitors.

If your applications involve printed circuits, Type C DISCAPS are available with plug in leads.

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

TELE-TECH &
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APRIL, 1956

MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

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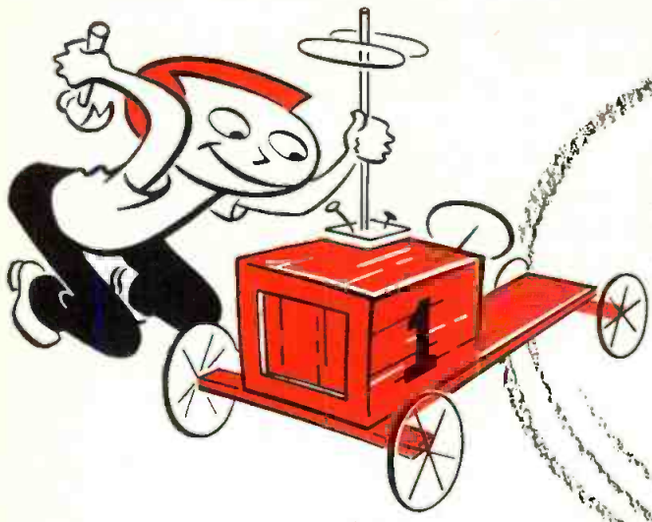
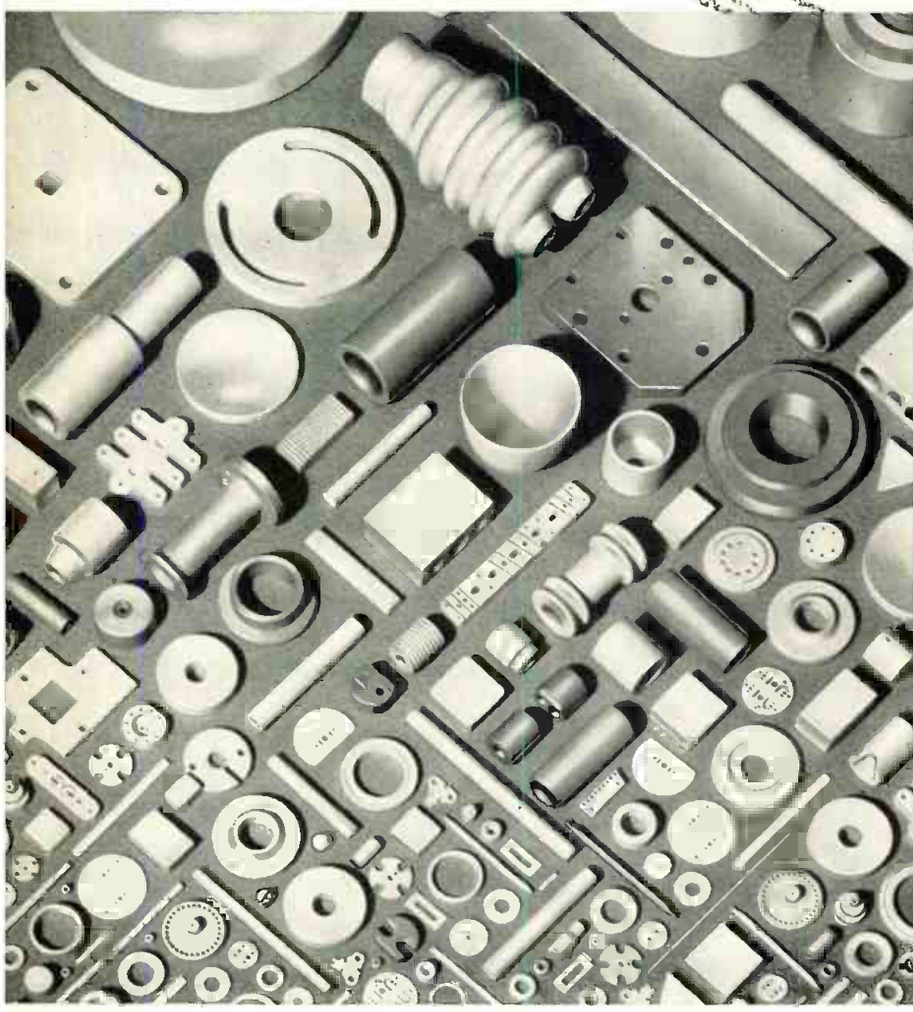


Improve your product with ALSIMAG® ALUMINA CERAMICS



STRENGTH. High compressive, flexural and tensile strengths.

STABILITY. Successfully withstand radiation bombardments and elevated temperatures without producing contaminants.

HARDNESS. Extremely hard, 9 on Mohs' scale. Resist wear and abrasion of most known materials.

UNIFORMITY. Manufactured under the most rigid standards of Quality Control. Shipped within your tolerance spread.

RUGGEDNESS. Resist mechanical shock, vibration and high ambient or operating temperatures.

CHEMICAL INERTNESS. Will not rust, corrode or deteriorate with time.

PRECISION TOLERANCES. Can be fabricated to extremely close tolerances on dimensions. Parts as thin as .009" are practical in production quantities.

SURFACE FINISHES. Surfaces may be ground or polished to 10 micro-inches RMS or better.

HEAT SHOCK RESISTANCE. Not affected by elevated temperatures. Withstand repeated hot-cold shock.

THERMAL CONDUCTIVITY. Dissipate heat by rapid thermal conduction.

SUPERIOR ELECTRICAL CHARACTERISTICS. Markedly superior electrical characteristics even at extremely high frequencies and elevated temperatures.

THE ANSWER TO YOUR PRODUCTION PROBLEMS MAY BE ALSIMAG ALUMINA CERAMICS! Why not investigate? Send us a blueprint or sketch along with details of your operating procedure, for complete details. Special Alumina Bulletin on Request.

PLANTWIDE VACATION
First two Weeks of July

55TH YEAR OF CERAMIC LEADERSHIP

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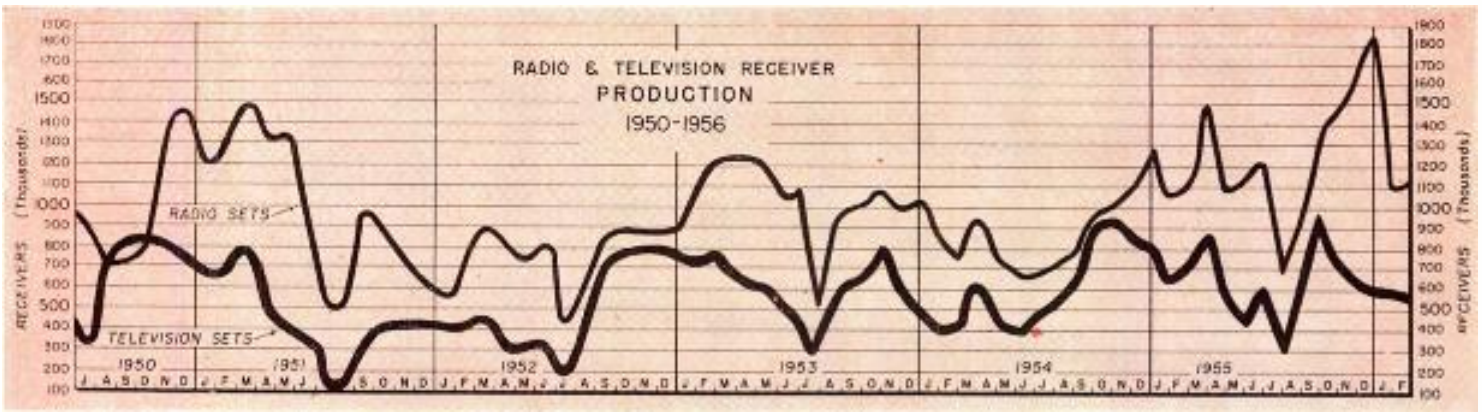
TOTALS



Employment

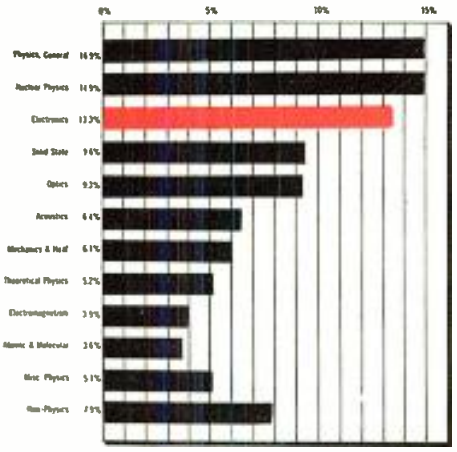
Statistics at right were taken from "Trends in the Employment of College and University Graduates in Business and Industry—1956," the results of a survey of 168 well-known business and industrial concerns, undertaken by Northwestern University, Evanston, Ill.

Average Starting Salaries for College Men

Field	Number Companies Reporting	$300 or less	$301 to $325	$326 to $350	$351 to $375	$376 to $400	$401 to $425	$426 and over	Average Starting Salary 1956	1955
Engineering	106	0	3	3	13	53	28	6	$394	$371
Accounting	87	5	10	27	28	12	5	0	$352	$339
Sales	80	6	12	22	16	19	4	1	$358	$339
Gen. Bus. Trainees	80	8	13	26	20	11	2	0	$348	$337
Other Fields	31	1	3	5	7	11	2	2	$374	$362
Average Starting Salary All Fields									$366	$349

Occupational Specialties of Physicists

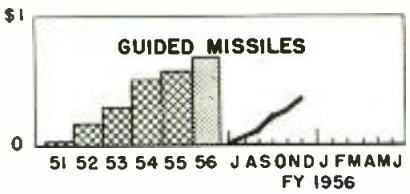
From the article, "American Physicists in the Current Quarter Century," by Marsh White, in the Jan. 1956 issue of "Physics Today."

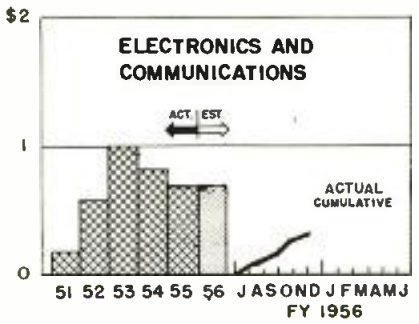


Bottom of Range and Top of Range in Starting Salaries

Field	No. Companies Reporting	Average Bottom of Range	Average Top of Range	Average Spread
Engineering	101	$378	$423	$45
Accounting	84	$338	$383	$45
Sales	74	$341	$376	$35
Gen. Bus. Trainees	80	$331	$370	$39

Dept. of Defense Expenditures. Major production and procurement (billions of dollars). From the Dept. of Defense, Monthly Report on Status of Funds by Budget Category, 30 Nov. 1955.





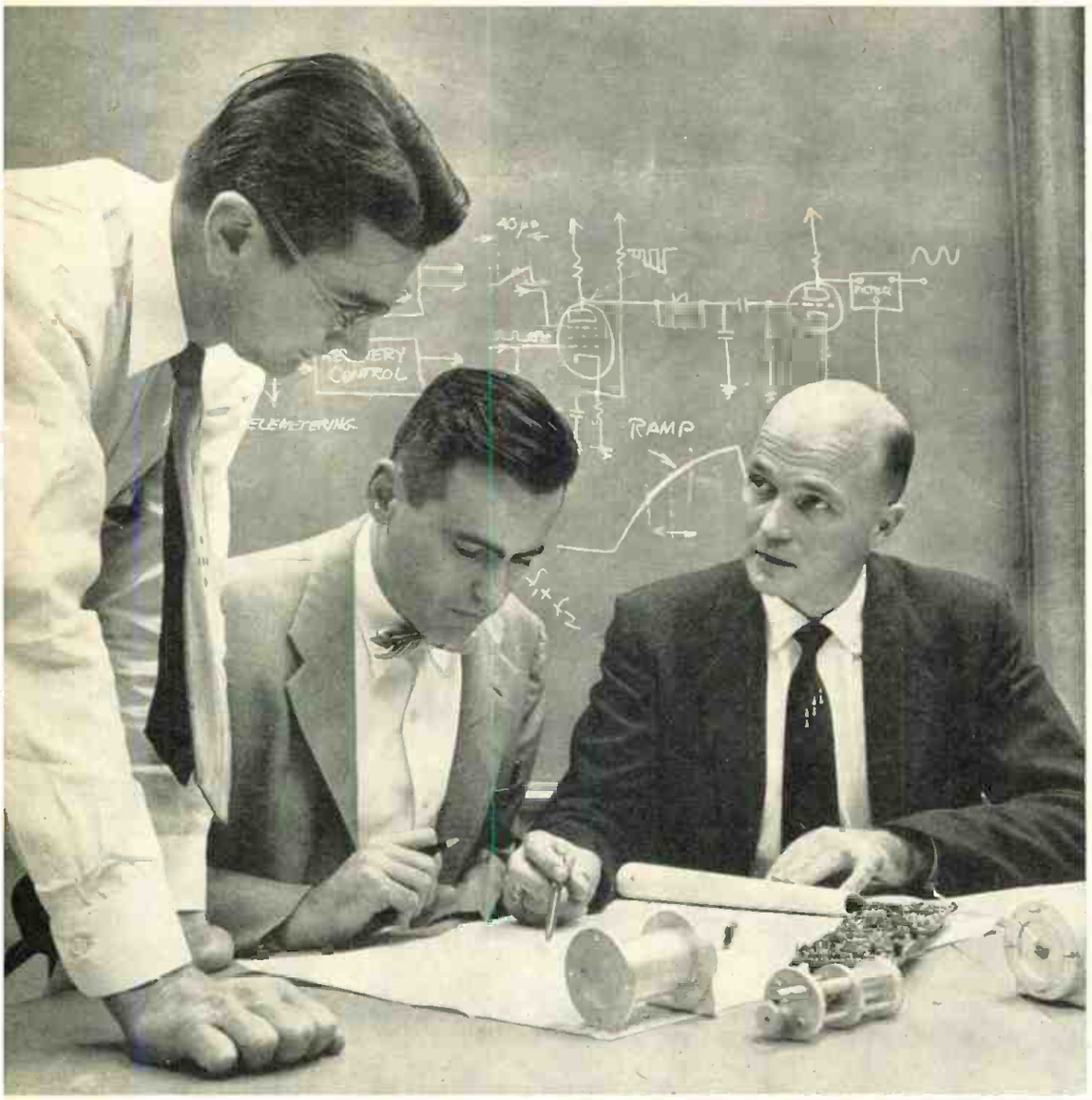
GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in Feb. 1956.

Accelerometers	287,980	Gyro Compass Systems	101,179	Radio Interference Measuring Sets	201,375
Actuators	188,172	Gyros, Rate	118,080	Radio Sets	127,765
Amplifiers	701,916	Handsets	33,010	Receivers, Radio	590,720
Antenna Systems	12,399,069	Headsets	113,710	Receiver-Transmitters	1,401,778
Batteries	811,042	Indicators	420,773	Recorders	123,853
Cable	1,308,059	Intercom Systems	47,629	Relays	244,780
Capacitors	75,000	Kits, Avionic Modifications	6,817,032	Resistors	131,920
Communication Equipment	29,249	Klystrons	5,647,950	Strobotachometers	53,219
Connectors	90,796	Loudspeakers	86,855	Switches	84,825
Controls	25,844	Magnetic Tape	90,432	Synchros	87,500
Data Reproducers	154,000	Microphones	93,150	TACAN Facilities	32,017
Direction Finders	238,640	Motor-Generators	448,524	Telemetering Ground Stations	106,517
Drives, Tuning	146,000	Motors	65,167	Test Sets	703,209
Filters, Bandpass	34,183	Navigation Systems	1,974,099	Transformers	29,675
Fire Control Systems	10,000,000	Oscilloscopes	108,783	Transmitters	3,227,813
Frequency Meters	147,657	Plotters, Digital	25,419	Tubes, Electron	4,339,517
Generators	1,135,773	Power Supplies	138,063	Waveguides	32,938
Generators, Signal	1,120,801	Radar Sets	1,091,737		

SCIENCE AND ENGINEERING

AT LOCKHEED MISSILE SYSTEMS DIVISION



Charles W. Goedecke, Electronic Design Group Engineer, Emerson M. Hoyt, Electronic Research Specialist, and George L. Larse, head of Electronic Systems Development in the Flight Test Electronics Department, discuss important aspects of new electronic command decoding devices for missile guidance systems.

MISSILE ELECTRONICS

DATA TRANSMISSION LINKS SYSTEMS AND COMPONENTS

The advancement of missile systems technology can be measured to a great extent by increasing demands imposed on the ability of electronic systems and components engineers.

Electronic problems encountered in hypersonic flight, particularly at high ambient temperatures, require creative efforts and coordination of a high order from engineers in fields of radar, guidance, telemetry and instrumentation.

New developments at Lockheed Missile Systems Division offer a wide variety of assignments in the following fields:

Command guidance involving the development and application of radio frequency components, video amplifiers, pulse circuitry, decoding and control devices.

Automatic data processing equipment involving analog-to-digital conversion circuitry; electronic and magnetic storage components; pulse and timing circuitry of all types.

Data transmission and telemetry involving development and application of antennas, transducers, FM oscillators, VHF transmitters and receivers.

Those possessing keen interest in both systems and component development are invited to write.

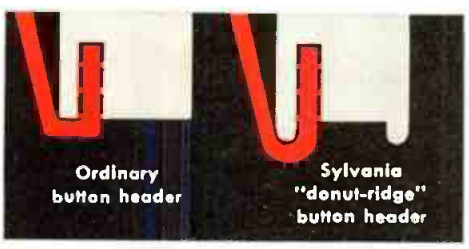
Lockheed **MISSILE SYSTEMS DIVISION** *research and engineering staff*

LOCKHEED AIRCRAFT CORPORATION VAN NUYS · CALIFORNIA

"donut-ridge"

Button Header

—builds in extra reliability and versatility



Here's a simple reliability test you can make yourself to demonstrate important advantages of Sylvania's "donut-ridge" button header. When you bend the tube leads as shown, ordinary headers will flake, chip, or crack: but leads bend cleanly around the "donut-ridge" header in Sylvania "Gold-Brand" subminiatures.

THE "DONUT-RIDGE" is an original Sylvania refinement in button header design: you'll find it on all Sylvania T-3 premium subminiature tubes. By preventing sharp angle bends in the leads the "donut-ridge" eliminates header cracking and chipping —leads can be clipped short for tight component spacing.

These reliability "extras" are added to the basic advantages of button header design. Greater protection against mechanical shock and vibration; wider lead spacing to retard electrolysis for more stable operation at high temperatures; heavier leads and less lead fatigue; more rigid seating in socket applications; these are just a few of the benefits the button header has over pressed stem construction.

And only the button header accommodates eight external leads which make possible the twin triode with separate cathode connections. Pioneered by Sylvania, the twin triode broadens subminiature application and provides greater versatility in subminiature circuit design.

Standardize your reliable equipment designs with Sylvania "Gold-Brand" subminiatures. There's a "donut-ridge" button header type to meet all your subminiature needs and Sylvania offers you the most complete line. 39 types are detailed in the "Sylvania Gold-Brand Subminiatures" brochure. Write for it. Address department D40P.

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Chart shows how this month's circulation of 27,000 is concentrated among top-level engineers in the principal buying power groups of the electronic industries

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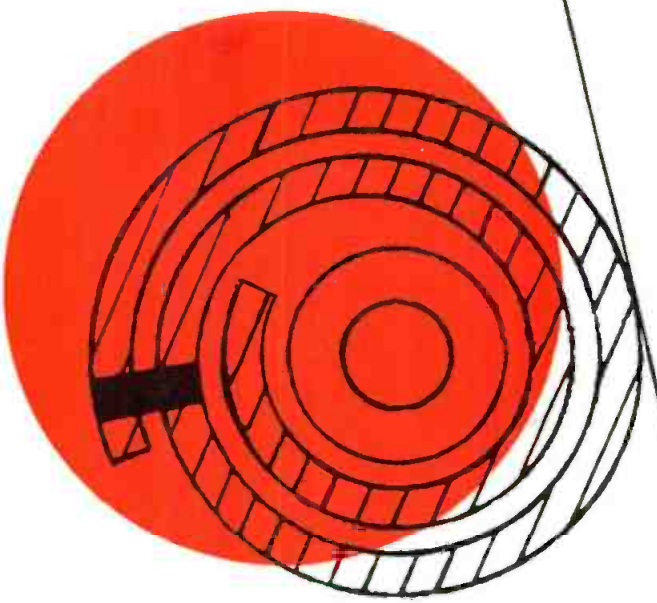
THE ELECTRONIC INDUSTRIES DIRECTORY

Published annually as an integral section of the June issue



Burroughs BIMAG *tape wound* **Magnetic Cores**

set new standards for uniformity!

- **Burroughs is experienced** in both the manufacture and application of cores.
- **Burroughs has specialized** on a specific range of core materials, sizes, and performance characteristics.
- **Burroughs has developed** improved core manufacturing and testing techniques.

Available in quantity or in sample lots. For information write to Dept. M.

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ELECTRONIC INSTRUMENTS DIVISION
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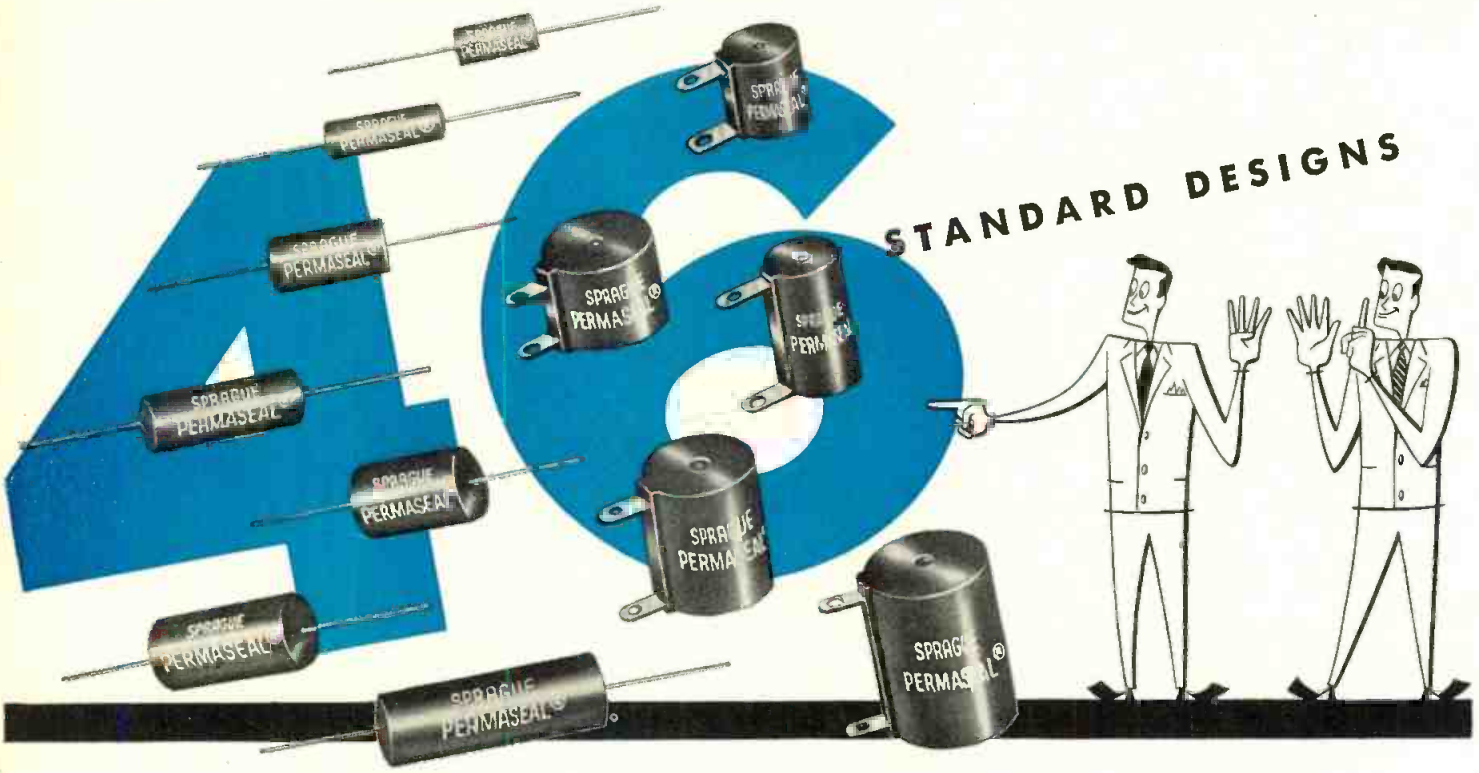
A COMPLETE LINE OF DEPENDABLE ENCAPSULATED RESISTORS



PERMASEAL®

PRECISION WIREWOUND RESISTORS FOR 85C AND 125C AMBIENTS

For applications requiring accurate resistance values at 85C and 125C operating temperatures—in units of truly small physical size—select the precise resistor you want from one of the 46 standard Permaseal designs in tab or axial lead styles.

Winding forms, resistance wire and embedding material are matched and integrated, resulting in long term stability at rated wattage over the operating temperature range. The embedding material is a special plastic that extends protection well beyond the severe humidity resistance specifications of MIL-R-93A and Proposed MIL-R-9444 (USAF).

These high-accuracy units are available in close resistance tolerances down to ± 0.1%. They are carefully and properly aged by a special Sprague process so that they maintain their accuracy within the limits set by the most stringent military specifications.

SPRAGUE

FOR COMPLETE DATA WRITE FOR COPY OF SPRAGUE ENGINEERING BULLETIN NO. 122A

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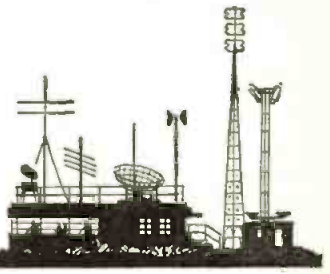
As We Go To Press...



Broadcasters Hail Colo. Court Decision

The action of the Colorado Supreme Court last month in amending existing laws to permit radio and TV coverage of courtroom proceedings was hailed by NARTB pres., Harold E. Fellows, as a "historic landmark in broadcasters' efforts to achieve equal access in covering public proceedings."

The decision upset Canon 35 of the American Bar Assn., which held that radio and TV broadcasting per se detracts from the dignity and decorum of court proceedings. Six days of testimony were heard, and a trial "TV coverage" was held to determine to what extent broadcasting interfered with the proceedings. The exceptionally favorable opinion of the presiding judge was a large factor in the decision.

With this break in what had been solid opposition to the intrusion of broadcasters into courtroom proceedings, broadcasters see hope of other states following suit, leading to a new, enlarged field of radio-TV reporting.

Longest Chain Radar Tracks Guided Missiles

Missiles fired at the Air Force's Florida Guided Missile Range are being tracked by the world's largest chain radar system, a string of 21 units installed on the eight islands scattered along the 1800-mi. route.

The radar system is a safety measure to prevent damage resulting from uncontrolled missiles. When the radar indicates that the missile is not following its course, or that it is behaving erratically, the safety officer at the launching site pushes a control which explodes the missile.

Designed and built by Reeves Instrument Corp., subsidiary of Dynamics Corp. of America, at a cost of $10,000,000, the system is reportedly the first chain radar capable of long-range continuous and uninterrupted tracking. Bearing information flashed back to the launching site near Coco Beach, Fla. is reportedly accurate to within 0.02°.

CRYSTAL GROWING

Physicist in Delco Radio Div.'s Semiconductor Lab is shown studying the growth of a large germanium crystal. In 5 hrs. the crystal will be 11 in. long, 1½ in. thick, and worth $3,000

European Computer Center

Europe's first large-scale general purpose computing center will be established in Frankfurt/Main, Germany late this year by the Remington Rand International Div. of Sperry Rand Corp. The same service will be offered to European customers as is presently available at the Univac Computing Centers in L.A. and N.Y.C.

"Heat Camera" Seen Aid To Electronic Reliability

A unique heat camera demonstrated last month by Baird Assoc. of Cambridge, Mass. may prove a great boon to electronic reliability. Called the "Evaporograph," the device provides a color picture in which the various hues indicate different degrees of heat.

As applied to electronic equipment, the device could, for instance, give an immediate indication of the heat at the cathode of an electron tube, or when focused on an electronic chassis, could show the points of maximum heat dissipation.

Principle of operation is in the fact that objects give off infrared radiation in proportion to their heat. The object to be analyzed is focused through a lens system on an oil film. The oil evaporates away from point to point at rates varying with the amount of radiation received at each point. Seen in reflected light, these differences in oil film thickness appear as different colors, like oil films on water.

MORE NEWS on page 10

NEW MILITARY FIELD TV

Shown in action is the new 55-lb. remote telecasting unit developed for the Army by Signal Corps Engineering Labs. Completely self-contained, the unit will transmit up to ½ mi. Power is supplied by rechargeable 5-cell silver zinc batteries. Camera weighs 8 lbs., and includes 4 lenses, including wide angle and telephoto. Soldier at left is providing audio report over handie-talkie phone.

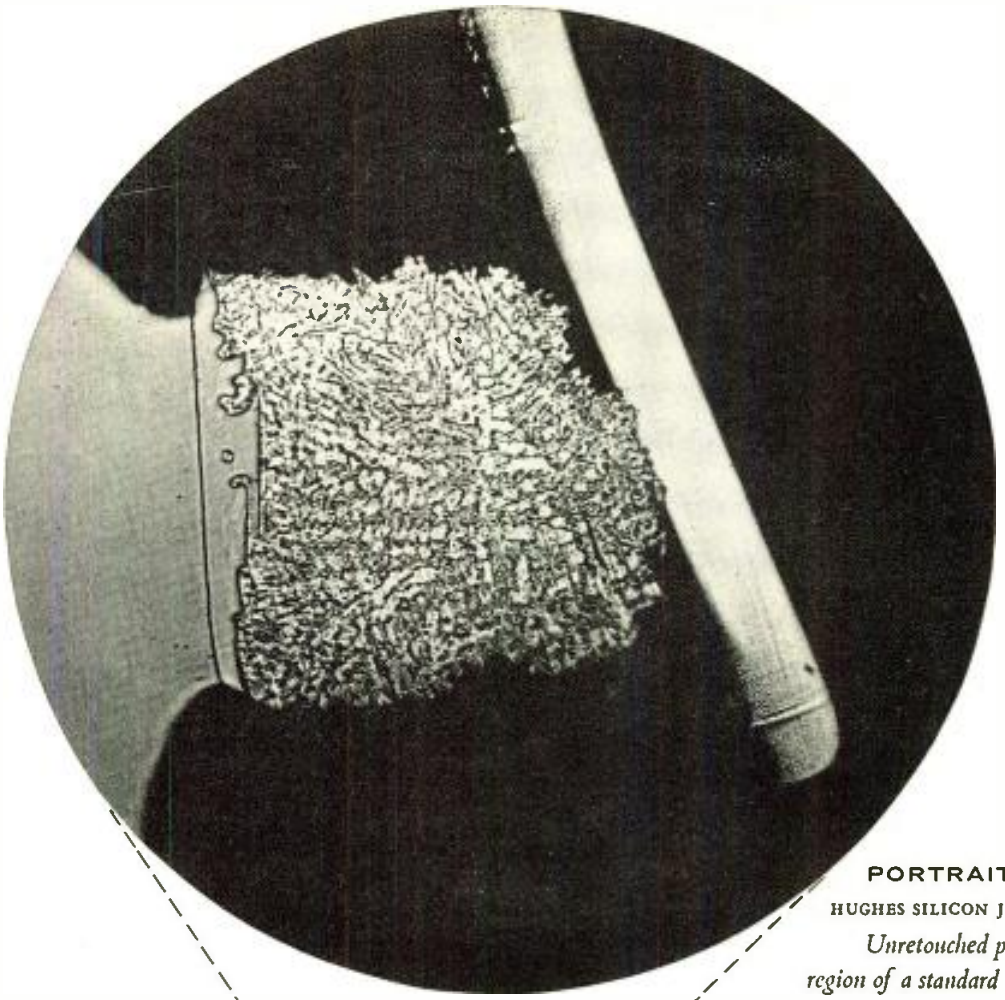
43 Million TV Sets Shipped In Decade

Over 43 million television sets have been shipped to dealers during the years 1946 through 1955, according to cumulative figures compiled by RETMA.

The following table shows the set shipments by states for the ten-year period.

State	*Total*
Alabama	491,112
Arizona	162,939
Arkansas	263,744
California	3,751,730
Colorado	285,780
Connecticut	741,694
Delaware	126,270
District of Columbia	415,633
Florida	811,860
Georgia	725,159
Idaho	103,156
Illinois	2,903,079
Indiana	1,231,889
Iowa	677,992
Kansas	406,098
Kentucky	550,994
Louisiana	544,931
Maine	227,943
Maryland	733,480
Massachusetts	1,657,906
Michigan	1,993,345
Minnesota	701,332
Mississippi	217,669
Missouri	1,115,971
Montana	62,753
Nebraska	346,967
Nevada	30,280
New Hampshire	148,548
New Jersey	1,895,545
New Mexico	91,234
New York	5,432,487
North Carolina	749,069
North Dakota	85,969
Ohio	2,988,373
Oklahoma	518,303
Oregon	307,674
Pennsylvania	3,596,248
Rhode Island	266,323
South Carolina	324,288
South Dakota	80,028
Tennessee	611,834
Texas	1,766,884
Utah	185,206
Vermont	75,692
Virginia	694,830
Washington	617,574
West Virginia	380,700
Wisconsin	892,509
Wyoming	22,997
U. S. TOTAL	43,014,021
Alaska	12,986
Hawaii	72,789
GRAND TOTAL	43,099,796

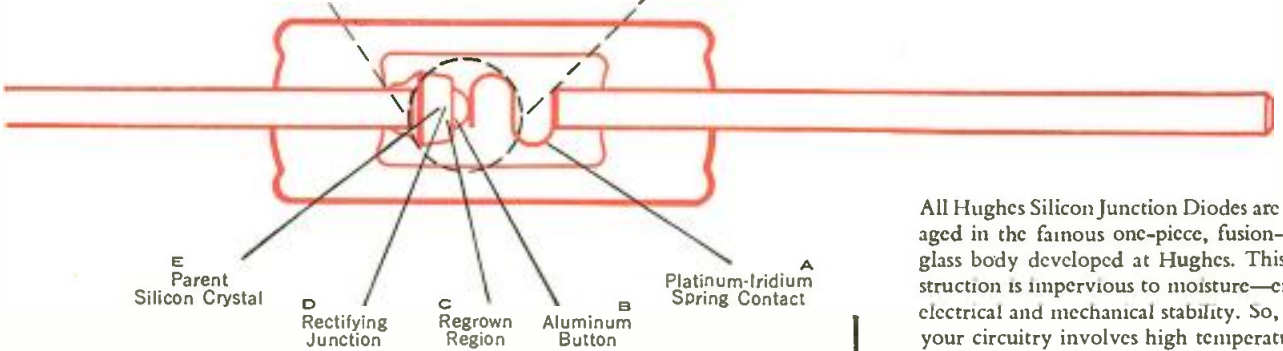
MORE NEWS on page 14



PORTRAIT OF RELIABILITY

HUGHES SILICON JUNCTION DIODES

Unretouched photomicrograph of the junction region of a standard Hughes Silicon Junction Diode.



RELIABILITY YOU CAN SEE

In this cross section (made from a standard, non-selected production specimen), renowned Hughes quality is clearly visible. (A) The platinum-iridium whisker makes firm, positive contact with the aluminum button. (D) The rectifying junction is clean, sharp, and straight. (E) The parent silicon crystal is free from strain-induced cracks, fissures or blemishes around the junction. Such meticulous workmanship gives microscopic evidence that, in semiconductors, HUGHES QUALITY *means* HIGHEST QUALITY.

**Characteristics rated at 25° C and at 150° C. Ambient operating range, —80° C to +200° C.*

Actual size

***Dimensions, diode glass body: 0.265-inch by 0.105-inch, maximum.*

All Hughes Silicon Junction Diodes are packaged in the famous one-piece, fusion-sealed glass body developed at Hughes. This construction is impervious to moisture—ensures electrical and mechanical stability. So, when your circuitry involves high temperature or high back resistance requirements, be sure to specify *Hughes* Silicon Junction Diodes. Available now, at lower prices, in nine different standard and several special types. And, as always, they are First Of All . . . For RELIABILITY!

FEATURES:

*High Temperature Operation**
Extremely High Back Resistance
Very Sharp Back Voltage Breakdown
Excellent Forward Conductance
*Subminiature Size***
Exceptionally Stable Characteristics

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A DIVISION OF THE HUGHES AIRCRAFT COMPANY

an Ampex accountant can keep your happy too!

it can cost less per hour than any other recorder you can buy

A few cents per hour is all it costs in the long run . . . because year after year an Ampex continues to perform within original specifications (18,000 known hours of service in one actual instance). Inevitably it requires fewer adjustments and parts replacements than machines of lesser quality. And because an Ampex is the recorder that everyone wants, it maintains the highest percentage of its original value. For lasting economy, buy the best — buy Ampex.

For further information, write Dept. U-2290

SIGNATURE OF PERFECTION IN SOUND

AMPEX CORPORATION

934 Charter Street, Redwood City, California

CAN AmpliFILM DO THIS?

Many times we have been asked if Ampli-Film Dielectric can be *curved*. We had anticipated applications in which Ampli-Film would be made in shapes other than flat . . .

Yes, AmpliFILM can be formed in unusual shapes

The size and shape of some electronic gear require that components be manufactured in unusual shapes. Dielectrics must, in turn, be formed to fit. Ampli-Film meets the requirement. The curved Capitron® Wafer Capacitor pictured is an example. A truly remarkable versatility in a dielectric.

AmpliFILM ***the all-purpose dielectric,*** is insoluble, incompressible and inert . . . undergoes no distortion from heat or pressure . . . can be bonded by adhesives . . . is free from pinholes and flaws . . . is easy to handle and fabricate.

AIRCRAFT-MARINE PRODUCTS, INC.

Chemicals and Dielectrics Division • 155 Park Street, Elizabethtown, Pa.

A-MP of Canada, Ltd., Toronto, Canada • Aircraft-Marine Products (G.B.) Ltd., London, England
A-MP—Holland N.V., 's-Hertogenbosch, Holland • Societe A-MP de France, Courbevoie, Seine, France

As We Go To Press . . . (Continued)

New lightweight, "personal" TV receiver

New CRT, Semiconductors Key To Compact TV Design

A new short-neck 8½-in. picture tube, and a liberal use of double purpose tubes and semiconductors are the significant design features in the light-weight portable TV receiver introduced to the market last month by RCA Victor.

The new 8DP4, designed especially for this application, has a 90° deflection angle, and electrostatic focusing, and is 10¾ in. long. The short length permits overall dimensions of the receiver of 12⅞ x 9¼ x 10¼ in.

The new chassis contains 10 tubes plus the kinescope, 4 crystals, 1 tube rectifier and a double selenium rectifier. Seven of the 10 tubes are double purpose tubes.

A V-type disappearing rod antenna is built in as part of the metal cabinet, and provision is also made for an external antenna. Total weight of the receiver is 22 lbs. without the stand. Price is $125.

Shockley Semiconductor Lab. Set Up At Beckmann

A new laboratory, headed by Dr. William Shockley and bearing his name, has been established at Stanford, Calif. by Beckman Instruments Inc. to develop and produce transistors and other semiconductor devices.

Dr. Shockley left his position as Director of Transistor Physics at Bell Labs to assume leadership of this new laboratory.

Nucleus of the new research team at the lab. consists of four prominent scientists, G. Smoot Horsley, formerly of Motorola and Bell Labs; Leo B. Valdes, formerly with Pacidific Semiconductors Inc.; Wm. W. Happ, formerly of Raytheon; and R. V. Jones, until recently at the Univ. of California.

Closed-Circuit TV System Installed in Idaho Schools

The nation's first demonstration of a completely "televised" public school system, held in Pocatello, Idaho last month, saw Gov. Robert E. Smylie of Idaho conduct a class in political science at Idaho State College which was witnessed simultaneously over TV by youngsters in 11 different elementary schools.

In addition to being connected to the district schools the college is also connected directly into Pocatello's community antenna system so that educational programs can be brought directly into the homes.

The network was financed jointly by Jerrold Electronics Corp. and Bannock Cable TV Inc. of Pocatello.

Multiplex Microwave Electric Utility Link

Multiplexing equipment for what will be the longest private commercial microwave communication system in Canada will be supplied by Stromberg-Carlson, division of General Dynamics Corp.

The communication system is being built for the Quebec Hydro Electric Commission by the RCA Victor Co. of Montreal. The multiplexing equipment is being purchased through Hackbusch Electronics Ltd. of Toronto.

Multiplexing equipment gets final touches

When completed, the system will extend more than 400 mi., from the Commission's headquarters in Montreal to its two huge new power developments on the Bersimis River, near the Gulf of St. Lawrence. It will provide more than 30 circuits for voice communication, teletype, telemetering and load frequency control, providing centralized control over nearly 2 million horsepower.

Fountain-Pen Dosimeter Developed For Military

A rugged gamma radiation detector, of fountain-pen size, has been developed by Bendix Aviation Corp. for the army and civil defense. Tests recently completed by the Signal Corps Engineering Labs indicate that it is the best personal dosimeter so far developed for field use.

Soldier takes a quick reading of amount of gamma rays he absorbed from radioactive source

Known technically as the Radiacmeter IM-93, the dosimeter will record radiation up to 600 roentgens. It can be stored indefinitely without deterioration, and after an original charge can be used for years with infrequent recharge.

Estimated cost of the unit, in quantity production, is less than $10.

Oscilloscope-Type Auto Engine Analyzer

The electronic industries have come to the aid of the automobile mechanic with an oscilloscope-type automobile engine analyzer, a product of the Allen B. DuMont Laboratories, Inc.

Simultaneous patterns of the behavior of each cylinder in an operating engine may be viewed on the 5 in. crt, heart of the analyzer. The unit weighs less than 60 lbs. and is approx. the size of a suitcase.

Each line of information starts at the instant the points open for firing. The traces, one below the other in firing order, begin with the number one cylinder, and from 4 to 18 cylinders can be accommodated.

Nearly all ignition troubles including fouled, misfiring, open or shorted sparkplugs; defective coils, condensers, wiring and switches; and worn distributor cam and shaft bearing can be detected by the instrument.

MORE NEWS on page 16

RELIABILITY

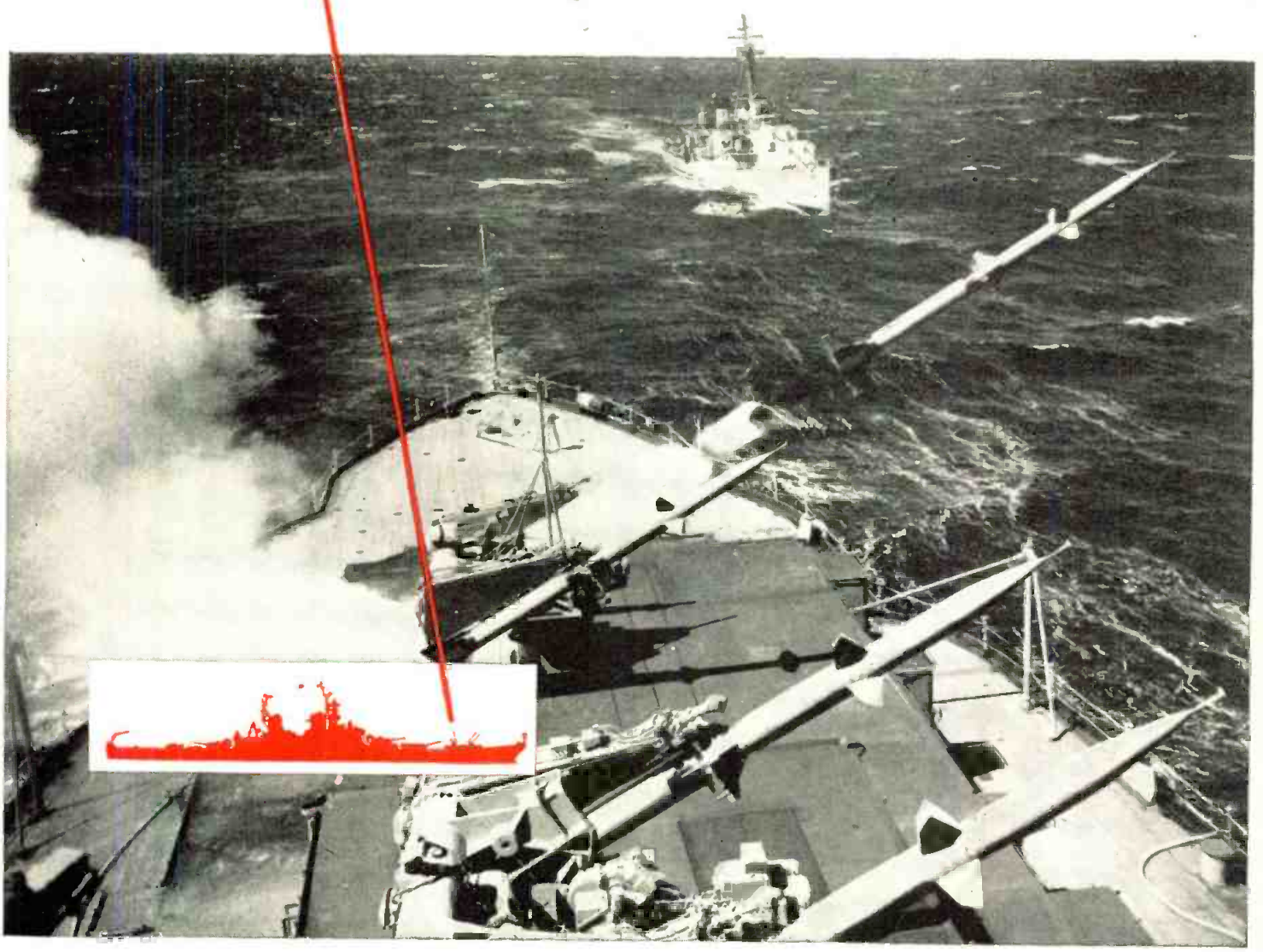
Dependable performance is a quarter-century tradition at Motorola—the world's largest exclusive manufacturer of electronic equipment. Under subcontract to Convair, Motorola *engineered for reliability*, and is now producing the guidance equipment for the Navy's new all-weather anti-aircraft missile, the "Terrier".

Positions open to qualified Engineers and Physicists

MOTOROLA

COMMUNICATIONS & ELECTRONICS DIVISION
National Defense Department

2710 N. CLYBOURN AVE. • CHICAGO, ILL. • Laboratories: Phoenix, Arizona and Riverside, California



As We Go To Press (Cont.)

New RETMA Standards List of Crystal Diodes

The Engineering Dept. of RETMA has announced 7 new recommended standards.

"The Summary of Registered Crystal Diodes" was prepared from registered specifications supplied to JETEC. Copies are available at $1 each.

ET-108-A—Tube Type Designations (Principally for Industrial Applications), 25¢. (Supersedes ET-108 dated June 1947.)

ET-115—Designation System for Solid-State Devices, 25¢.

REC-135-B—Type Designations for Receiver Type Tube Sockets, 80¢. (Supersedes REC-135-A dated August 1952.)

REC-113-D—Vibrators for Auto Radio, 90¢. (Supersedes REC-113-C dated Sept. 1954.)

TR-141—Microwave Relay Systems for Communications, $1.30.

TR-142—Microwave Housing Facilities, 40¢.

GEN-101-A—Color Coding for Numerical Values, 50¢. (Supersedes GEN-101 dated July 1948.)

MARINE RADARS

Assembly line at Bendix-Pacific looks like this as they swing into production on 57 new Bendix MR-3 Marine Radars ordered by U. S. Coast Guard for the service's patrol and rescue vessels

Printed Wiring Glossary

RETMA Engineering Committee 40C, in line with its assignment to formulate standards for printed wiring, has compiled a glossary of terms and definitions covering printed wiring and the printing processes. Copies are available from RETMA Engineering Dept., 11 W. 42nd St., N.Y. 36, N.Y.

MORE NEWS on page 22

P. R. MALLORY & CO. Inc.
MALLORY

At temperatures from —55° to +200° C, Mallory XT Tantalum Capacitors maintain stable capacity, series resistance and impedance . . . and provide long life.

Mallory Tantalum Capacitors

lead in long, stable life at extreme temperatures

New Mounting Designed for heavy shock and vibration

Mallory XT tantalum capacitors are now available in a design which will withstand severe shock and vibration. A flatted neck with ½-20 threads fits through a keyed slot in the chassis . . . is held in place by a lock washer and hex nut. Assembly takes only seconds . . . requires no strap or other hardware. This design is supplied in a variety of ratings, with cases up to 2¼" in height. Write for information.

WHEN YOU design for extreme temperatures . . . in military electronic equipment, miniaturized apparatus and the like . . . be sure to choose capacitors that you *know* will meet severe conditions.

Specify Mallory XT tantalum capacitors . . . proved by test and field usage to give consistently long, stable service across an extremely wide temperature range. Pioneered by Mallory, these units embody design and production techniques developed during twelve years of research and manufacturing in the high temperature capacitor field.

Standard XT's cover the range from —55° C to +175° C. When specified, they can be supplied rated for continuous operation at 200° C. A complete selection of capacitance and voltage values is available.

Representative performance data, based on sampling tests representing hundreds of thousands of capacitors, is now available on Mallory tantalum capacitors. To see for yourself the specifications which these units can be relied upon to meet, write today for our latest Technical Bulletin.

Expect more . . . get more from

Serving Industry with These Products:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceromics • Welding Materials

Parts distributors in all major cities stock Mallory standard components for your convenience.

P. R. MALLORY & CO. Inc.
MALLORY
P. R. MALLORY & CO., Inc., INDIANAPOLIS 6, INDIANA

About a Sawtooth, Clamping and your Efficiency...

Let's look at it this way—What features should an instrument incorporate to make your job easier, help prevent costly mistakes? Take the case of the new PRD Klystron Power Supply. Should we incorporate a sawtooth rather than a sine wave modulation? It's easier to put in a sine wave. However, a sawtooth has the definite advantage of eliminating phasing and blanking problems when the frequency response of a transmission device is to be studied. So, in goes the sawtooth. It's easy enough to get hold of some sine wave modulation which can be applied through the external modulation input.

As for preventing mistakes—consider switching from cw to square wave modulation. Suppose you forget to readjust the reflector voltage . . . Sure, you'll catch the mistake later, but time is lost. The new PRD Klystron Power Supply has an electronic clamping circuit which locks the top of the square wave to the previously chosen reflector voltage. No readjustments to think about, no mistakes.

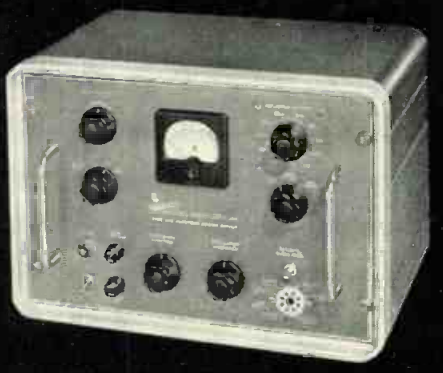
Want to modulate with pulses—use the external input. The rise time degradation of your pulses will be less than .1 microsecond!

Another point, good regulation! Here's an example: a ±10% line change or *any* load change will cause a reflector voltage change of only ±0.1%.

Compare . . . chances are that you'll send in your order for the PRD Type 809, too.

The New PRD

KLYSTRON POWER SUPPLY



HERE'S WHAT THE TYPE 809 CAN DO FOR YOU—

- Powers most low and medium voltage klystrons—up to 600 V. beam supply
- Has electronic readjustment of reflector voltage when changing from cw to square wave modulation—no errors due to forgetfulness
- Has square wave, sawtooth and provision for external modulation for pulses
- Affords exceptional stability and regulation at modest cost
- Price $350.00 F.O.B. New York

(Available from stock. Call or write for new Bulletin.)

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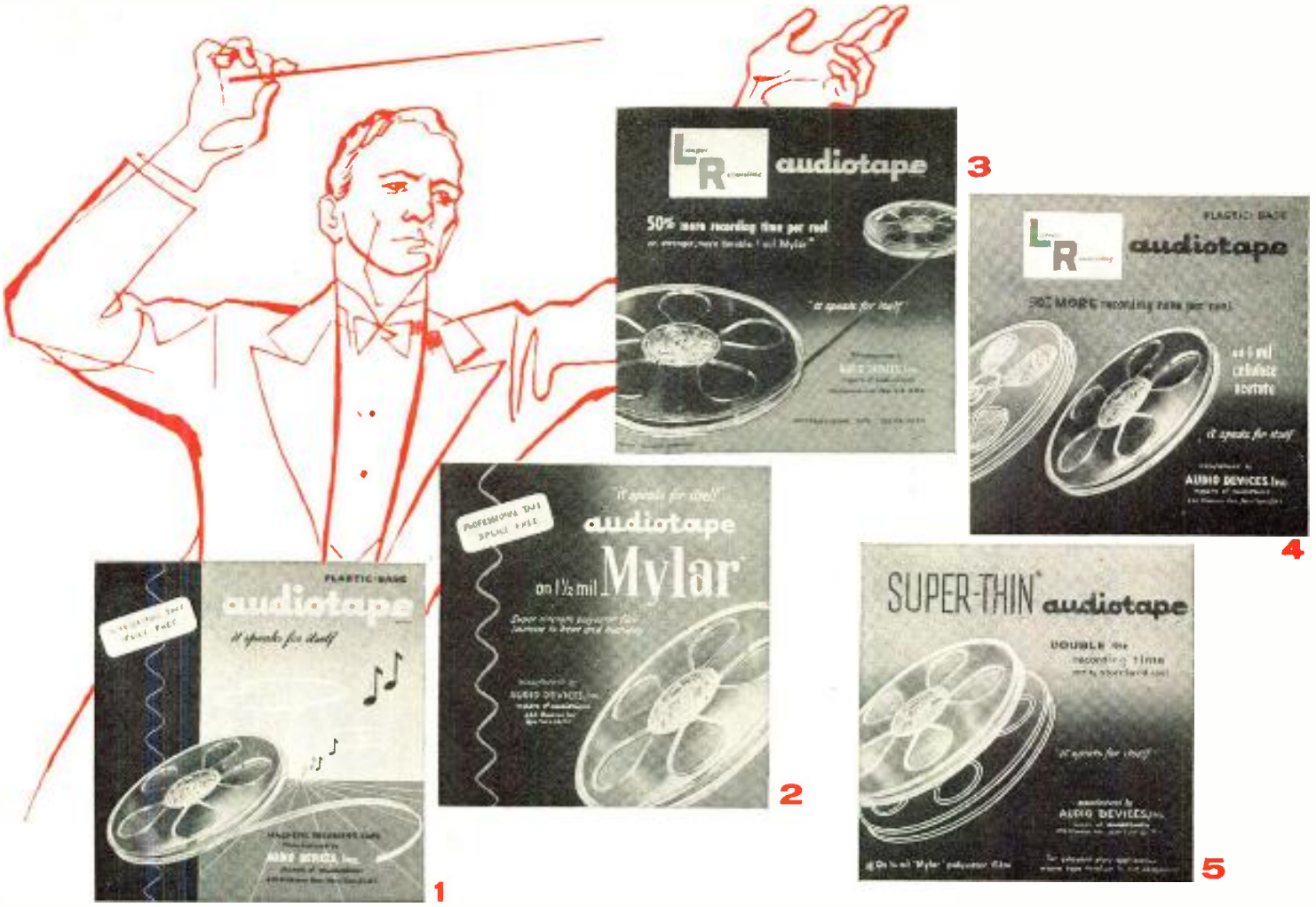

NOW... a truly professional quality audiotape

for EVERY sound recording need and EVERY recording budget!

PLASTIC-BASE AUDIOTAPE, on 1½-mil cellulose acetate, meets the most exacting requirements of the professional, educational and home recordist to excellent advantage, providing unsurpassed recording quality at minimum cost. This is the *standard* Audiotape, which has already been sold in billions of feet. Series 51, in the *red and black box.*

AUDIOTAPE ON 1½-MIL MYLAR* is a premium-quality tape that provides the utmost in mechanical strength and immunity to extremes of temperature and humidity. Assures freedom from breaking or stretching under stresses of super-fast rewind, instant stops and starts or poorly adjusted clutches. Will not dry out or embrittle with age, even under unfavorable storage conditions. Series 71, in the *green box.*

* Du Pont Trade Mark for polyester film

TYPE LR AUDIOTAPE on 1-mil "Mylar" gives you *50% more* recording and playback time — eliminates reel changes and permits uninterrupted recording of program material that exceeds conventional reel capacity by up to 50%. The 1-mil "Mylar" base is actually stronger at high humidity than the standard 1½-mil plastic base, assuring long tape life even under unfavorable conditions of use or storage. Series 61, in the *black and red box.*

PLASTIC-BASE LR AUDIOTAPE provides 50% more recording and playback time per reel, on a low-cost 1-mil cellulose acetate base. Hence it affords maximum economy for extended-play applications where high mechanical strength is not required. Series 41, in the *blue box.*

SUPER-THIN AUDIOTAPE on ½-mil "Mylar" gives you twice as much recording time per reel as standard plastic base tape. 1200 ft on a 5" reel, 2400 ft on a 7" reel. Suitable for extended play applications where tape tension is not excessive. Series 31, in the *yellow box.*

★ ★ ★

These five types of Audiotape differ only in base material, tape thickness and footage per reel. Whatever type best meets your particular requirements, you can be *sure* that there's no finer recording tape made anywhere, at any price. That's because there's only *one* Audiotape quality — the very finest that can be produced. Its fidelity of reproduction and consistent, uniform quality have made it the first choice of critical professional recordists the world over. Now amateur and home recordists can get this same professional-quality Audiotape at *no extra cost.* There's no need to go elsewhere or accept substitutes. You can meet *all* your requirements with genuine Audiotape. For the complete story on all 5 types, ask your Dealer for a copy of the new, 5-color Audiotape Bulletin No. 250. Or write to Audio Devices, Inc., Dept. T.

AUDIO DEVICES, Inc.

444 MADISON AVE., NEW YORK 22, N. Y.

IN HOLLYWOOD: 1006 N. Fairfax Ave. • IN CHICAGO: 6571 N. Olmsted Ave.

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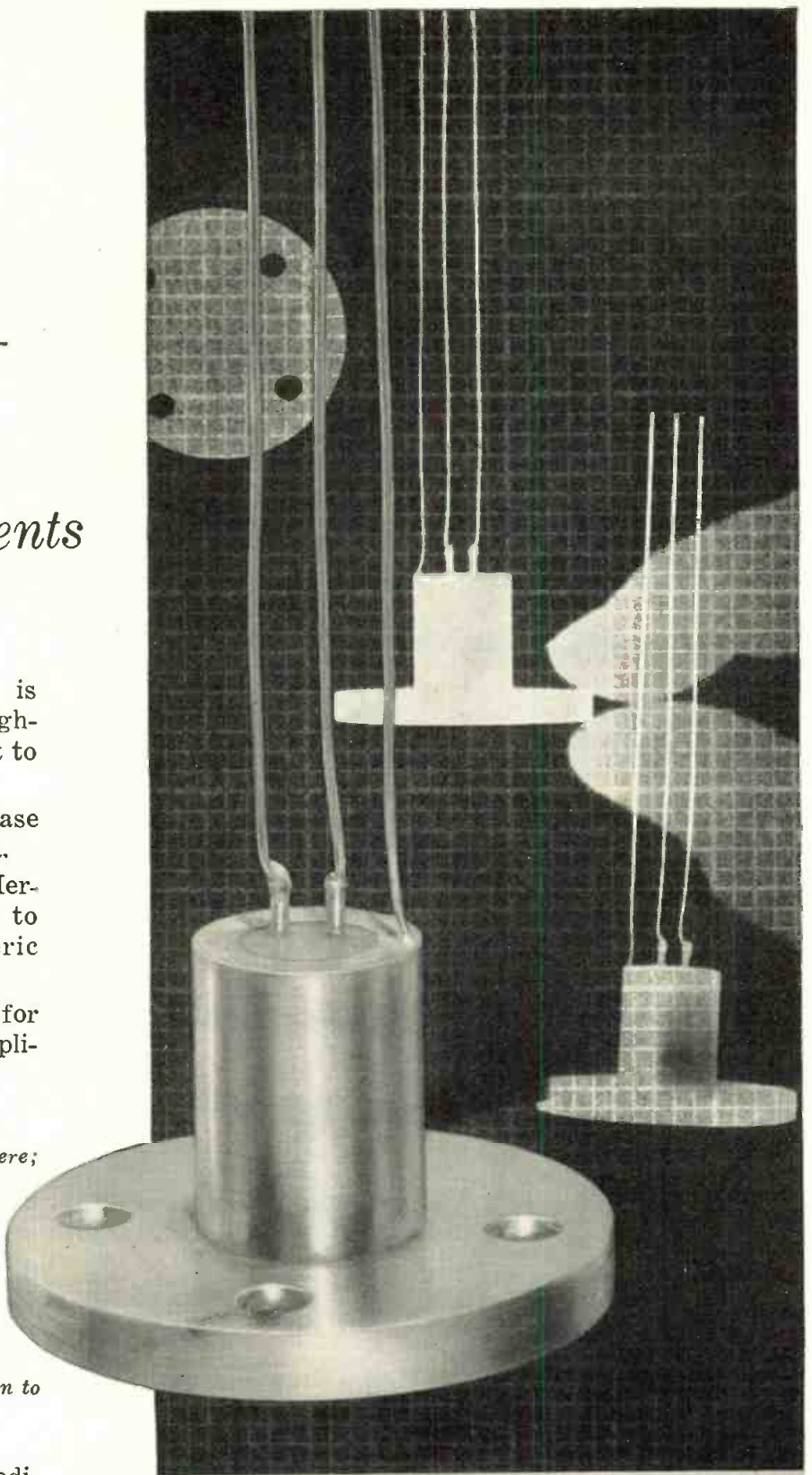
WESTINGHOUSE
2-AMP GERMANIUM
POWER TRANSISTORS

High Current Gain— Maintained at Large Collector Currents



New Westinghouse XD-5081 transistor is characterized by high current gain throughout its operating range. Distortion is cut to a minimum.

THERMAL DISSIPATION. Large copper base provides an ample heat dissipating area.

LONG LIFE — RELIABLE OPERATION. Hermetically sealed in glass and metal to exclude moisture, prevent atmospheric contamination.

TYPICAL APPLICATION. Ideally suited for audio output stages and switching applications.

Performance data on the XD-5081:

Large signal current gain . . . 70 at Ic = 1 ampere; 55 at Ic = 2 amperes

Large signal frequency cutoff (common emitter) . . . > 10 kc

Maximum voltage (Vce) . . . 35 volts

Maximum current (Ic) . . . 2 amperes

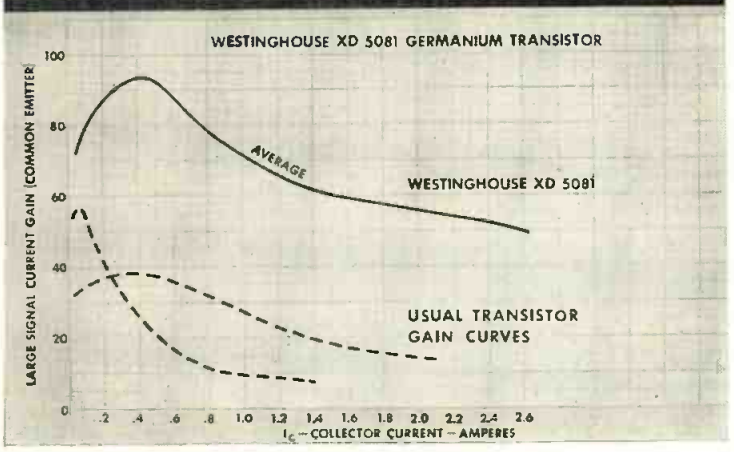
Saturation characteristic (Vce) . . . < 1 volt at Ic = 1 ampere

Thermal drop . . . 3.5°C per watt from junction to case

Maximum junction temperature . . . 100°C

Sample quantities are available immediately. Contact your nearest Westinghouse district sales office or write, Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

J-09002



YOU CAN BE SURE...IF IT'S

Westinghouse

All in One Package!

Millivoltmeter
Micro-microammeter
Mega-megohmmeter

Ranges, Full Scale
Voltage: 30 mv to 10 volts
Current: 1 ma to 3 x 10^{-13} amp
Resistance: 300 kΩ to 10^{13} ohms

Type 1230-A Amplifier and Electrometer as shown, $440.
Type 1230-AE Amplifier and Electrometer in Esterline Angus Cabinet, $502.

The G-R Type 1230-A D-C Amplifier and Electrometer represents a new and important contribution to the field of electrical-measuring equipment.

A *low-cost* instrument of high performance for the measurement of extremely small d-c voltages, currents and charges has not been hitherto available. As if not enough, this device is also a completely self-contained megohmmeter with provision for measuring higher resistances than possible with many instruments specializing in this measurement. Output jacks, at the rear, permit use as a sensitive d-c amplifier to drive 1-ma or 5-ma recording equipment such as the Esterline Angus Recorders.

Superior performance is obtained through a carefully thought-out design. An electrometer tube is used in the first of three direct-coupled stages to keep grid current effects truly negligible. The stringent stability requirements necessary for an instrument such as this are met through use of excellent supply regulation, insulation of the highest quality, shock mounting, wire-wound resistors at all critical locations, and aging of both tubes and components . . . in short, through adherence to the high standards of engineering and manufacture which have come to be expected of the General Radio Company.

The Type 1230-A Amplifier and Electrometer has many applications in industrial-process control and in physical and chemical research, in addition to its obvious uses in the electronics laboratory. The instrument may be used: to operate from strain gauges; to indicate or record time-current curves of capacitors under charge or discharge; to record life tests on vacuum tubes and other components; to measure semi-conductor resistance, piezo-electric potentials, electrostatic fields, ph indications, contact potentials, grid currents in tubes, and insulation resistance of motors, generators and appliances; and, in general, to measure any physical or chemical reaction where a d-c voltage or current proportional to the change is available.

This instrument is a truly versatile device . . . one we're proud to present, and one every laboratory will want to own.

Six Voltage Ranges: ±30 mv, 100 mv, 300 mv, 1v, 3v, and 10v d-c, full scale — accuracy, 2% of full scale on all five higher ranges, 4% of full scale on lowest 30-mv range.

Twenty Current Ranges: from ±1 ma to ±3 x 10^{-13} amp d-c, full scale — accuracy, 3% of full scale from ±1 ma to ±3 x 10^{-9} amp and 10% to ±3 x 10^{-13} amp.

Sixteen Resistance Ranges: direct reading 300 kΩ to 10 MMΩ, full scale; 5 x 10^{14}Ω at smallest meter division — accuracy, 3% from 3 x 10^{5}Ω to 10^{10}Ω and 8% to 10^{13}Ω — with external 300v batteries in place of the internal 9v source, resistance range can be extended to read 6 x 10^{15}Ω at smallest meter division.

Since resistance is easily measured with different voltages applied to the unit under test, voltage coefficients are readily obtained.

Internal Resistance Standards: 10^{4} and 10^{5} ohm steps accurate to 0.25%; 10^{6}, 10^{7} and 10^{8} ohms accurate to 1%; 10^{9}, 10^{10}, 10^{11} ohms accurate to 5% and have been treated to prevent adverse humidity effects. 0 and ∞ steps also available.

Switch provided for checking higher resistance standards in terms of more precise 10^{4} and 10^{5} ohm wire-wound units (makes possible working back to high basic accuracy over the complete range).

High Input Resistance: determined by setting of resistance standards switch; 10^{14} ohms at "open" position; input insulation is entirely teflon and siliconized glass, insuring reliable operation under high humidity conditions.

Drift: less than 2 mv per hour after initial warm up.

Temperature, Humidity, Line-Voltage Effects: all negligible.

Output: panel meter indicates voltage, current and resistance; output jack provided for connecting recorder having resistance up to 1500Ω.

Guard Terminals: three terminals in addition to input and output provide versatility in ground and guard connections.

Input Switch Disconnects Unknown: without upsetting unknown or electrometer input circuit.

Power Supply: 105-125v (210-250v), 50-60 cycles.

Useful Accessories:
Esterline Angus 5-ma or 1-ma Graphic Recorder.

G-R Type 1230-P_1 Component Shield at $40 provides a fully shielded chamber for measurement of very high resistance components.

WE SELL DIRECT
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WAVE ANALYZERS
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As We Go To Press (cont.)

Color TV Industry Host To European Study Group

The start of a five-month study of the world's color TV systems, which will ultimately determine the system adopted for all Europe began last month at the United Nations Bldg. in N.Y. as the American color TV industry played host to almost 100 radio-TV engineers from 21 European countries, including Poland and Czechoslovakia.

The meetings were held under the aegis of the International Radio Consultative Committee (CCIR) of the International Telecommunications Union, a U.N. specialized agency. Hosts for the affair were the NTSC, under the chairmanship of Dr. W. R. G. Baker, and the U.S. State Dept.

At the opening meeting on March 5, top American color TV engineers described to the visiting group the steps in the achievement of the present U.S. color TV standards. Particular emphasis was laid on the need for compatibility, which has guided American developments.

Following the meeting, the group witnessed numerous demonstrations of color TV. Sets shown were Admiral, Capehart, DuMont, Emerson, and Magnavox, using the shadow-mask tube, a Philco using the "apple" tube, a G.E. with post-acceleration tube, and a Hazeltine projection type color receiver. R.C.A. was not participating; they held separate meetings with the CCIR group later.

At the conclusion of this American tour, the group proceeds to England, France and the Netherlands, where they will witness further demonstrations of color television. The final color standards will be drafted at the CCIR meeting in August, in Warsaw, where it will be decided whether Europe's color system is to be compatible with present monochrome standards, or whether color is to be incompatible, and operated in the UHF bands.

Dr. Balth. van der Pol, CCIR director, to emphasize the importance of this study, pointed out that "forward-scatter" techniques are opening up "new possibilities of connecting different continents by radio-television links."

Transistor Tax Relief

RETMA has filed two letters with the Forand Subcommittee, House Ways and Means Committee, asking for consideration of rate reduction on black and white and color TV sets and other industry products, and also opposing extension of the tax to transistors.

The Forand Subcommittee has voted tax relief for a number of industries and the RETMA letter on rate reduction sought to capitalize on these rate reduction activities and obtain similar consideration for the radio and TV industry.

The letter pointed out that in 1954 Congress voted a 50% reduction in the manufacturers' excise tax on practically all home products but left unchanged the rate applicable to radios, TV sets and phonographs. The result is that these items pay 60% of the excise tax on durable home products although they represent only 44% of the sales of such products, RETMA stated.

New Gadget Knocks Out Co-Channel Interference

An imaginative ex-ham may have the answer to the co-channel interference problem that plagues so many fringe TV areas.

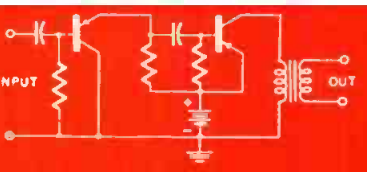
S. D. Wooten, of Memphis, filed a patent last month on his new "Co-Phaser" device which cancels out the unwanted signal by mixing it with a 180°-reversed version of itself.

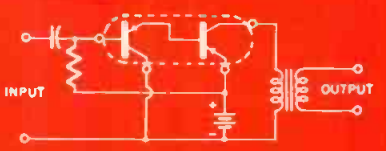
The device is remarkably simple. A secondary antenna is mounted below the main receiving antenna and 180° out of phase. The interfering signal is usually from a direction 180° removed from the station desired. The signal from the secondary antenna and the main antenna are fed into the "Co-Phaser" and the amplitude of the signal from the secondary antenna is adjusted so that it cancels out the interfering signal.

"CAT'S EYE"

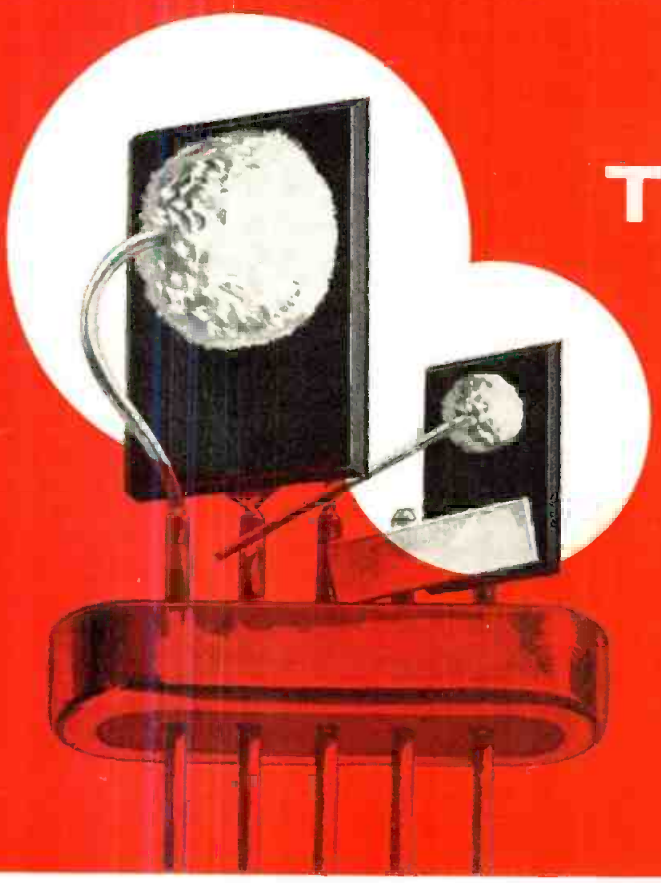
Pilots will see in the dark with daylight clarity with this new tube developed by the AF and Westinghouse. The tube is approx. 1,000 times more sensitive than the standard TV camera.

MORE NEWS on page 25

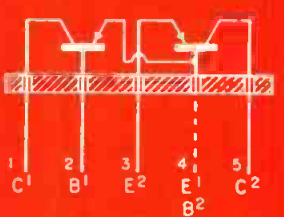




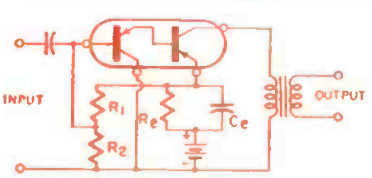
NOW from MARVELCO laboratories . . .



TANDEM TRANSISTORS!



The outstanding development in the field of semi-conductor devices



Housed in a single case, two dc-coupled transistors now open an entirely new field for the mighty midgets of electronics as oscillators, multivibrators, flip-flops, switching devices, etc.!

A common-collector transistor stage acts as the input device of a second transistor to serve as a useful type of dc matching transformer. No extra power supply is required since the first transistor represents the base leak for its successor.

Now available in limited quantities for laboratories and research.

For complete details on the MT-1 Tandem Transistor write or wire:

MARVELCO *Electronics Division*
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VENTY YEARS . . .

MINIATURIZED TRANSFORMER COMPONENTS FROM STOCK

Items below and 650 others in our catalog A.

HERMETIC SUB-MINIATURE AUDIO UNITS

These are the smallest hermetic audios made.

Dimensions . . . 1/2 x 11/16 x 29/32 . . . Weight.8 oz.

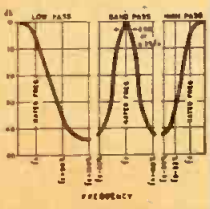
TYPICAL ITEMS

Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri MA	Response ±2 db (Cyc.)	Max. level dbm
H-30	Input to grid	TF1A10YY	50*	62,500	0	150-10,000	+13
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF1A13YY	10,000*	200	3	300-10,000	+13
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+ 6
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor Interstage	TF1A15YY	25,000	1,000	.5	300-10,000	+10

an be used with higher source impedances, with corresponding reduction in frequency range and current

COMPACT HERMETIC AUDIO FILTERS

UTC standardized filters are for low pass, high pass, and band pass application in both interstage and line impedance designs. Thirty four stock values, others to order. Case 1-3/16 x 1-11/16 x 1-5/8 — 2-1/2 high . . . Weight 6-9 oz.

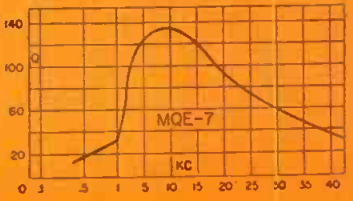


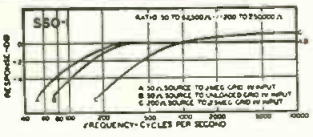
HERMETIC MINIATURE HI-Q TOROIDS

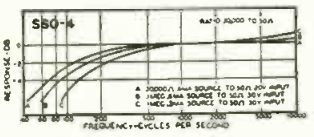
MQE units provide high Q, excellent stability and minimum hum pickup in a case only. 1/2 x 1-1/16 x 17/32 . . . weight 1.5 oz.

TYPICAL ITEMS

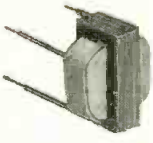
e No.	Inductance		DC Max.
E-1	7	mhy.	135
E-3	20	mhy.	80
E-5	50	mhy.	50
E-7	100	mhy.	35
E-10	.4	hy.	17
E-12	.9	hy.	12
E-15	2.8	hy.	7.2







SUB-SUBOUNCER AUDIO UNITS



UTC Subouncer and sub-subouncer units provide exceptional efficiency and frequency range in miniatur size. Constructional details assure maximum relia bility. SSO units are 7/16 x 3/4 x 43/64 . . . Weigh 1/50 lb.

Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	370
SSO-2	Interstage /3:1	+ 4 V.U.	10,000	0-.25	90,000	750	325
*SSO-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	3
SSO-4	Output	+20 V.U.	30,000	1.0	50	2875	4.
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.						
SSO-6	Output	+20 V.U.	100,000	.5	60	4700	3.
*SSO-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	12

* Impedance ratio is fixed, 1250:1 for SSO-1,1:50 for SSO-3. Any impedance between the values shown may be employed.

OUNCER (WIDE RANGE) AUDIO UNITS

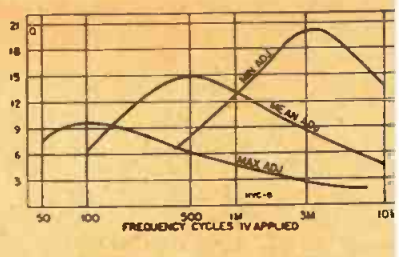
Standard for the industry for 15 yrs., these units provide 30-20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

TYPICAL ITEMS

ype o.	Application	Pri. Imp	Sec. Imp
-1	Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
-4	Single plate to 1 grid	15,000	60,000
-7	Single plate to 2 grids, D.C. in Pri.	15,000	95,000
-9	Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600
-12	Mixing and matching	50, 200/250	50, 200/250, 500/600
-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C., 6000 ohms		

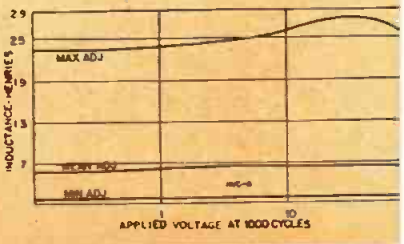
HERMETIC VARIABLE INDUCTORS

These inductors provide high Q from 50 - 10,000 cycles with exceptional stability. Wide inductance range (10 - 1) in an extremely compact case 25/32 x 1-1/8 x 1-3/16 . . . Weight 2 oz.



TYPICAL ITEMS

TYPE No.	Min. Hys.	Mean Hys.	Max. Hys.	DC Ma
HVC-1	.002	.006	.02	100
HVC-3	.011	.040	.11	40
HVC-5	.07	.25	.7	20
HVC-6	.2	.6	2	15
HVC-10	7.0	25	70	3.5
HVC-12	50	150	500	1.5



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CABLES: "ARLAB"

As We Go To Press . . . (Continued)

GYRO CHECK-OUT

Sensitive gyroscopes, heart of new supersonic pilot for jet planes developed by Minneapolis-Honeywell, are put through "wobble test." Drift rate recorded must be less than .35° per minute.

New TV Microwave Gear For National Convention

The first TV microwave relay equipment available for commercial operation in the 12-13 KMC band has been purchased by Western Electric for use during the 1956 Republican National Convention in August.

Ten complete systems, purchased for the Pacific Tel. and Tel. Co. from Raytheon Mfg. Co., will feed televised convention activities from points in and around San Francisco to convention HQ at the Cow Palace.

RCA To Announce New Test Equipment Line

A new line of precision test equipment for industrial and laboratory applications will be unveiled this month by RCA. The announcement will mark the company's full-scale entry into the specialized test equipment field.

The instruments, 13 in all, will feature a high order of accuracy, and a number of the models reportedly feature characteristics unique in the test equipment field.

The line will include: 4 signal generators, 1 pulse generator, 2 impedance bridges, 2 r-f power meters, 2 null-reading dc voltmeters, a VTVM and a multimeter.

Improved Accuracy At WWV

Improvements in technical radio broadcast services provided by its radio stations WWV, Wash, D.C., and WWVH, Hawaii have been announced by NBS.

The broadcasts have been increased in accuracy from a part in 50 million to a part in 100 million; also the broadcast frequencies at WWV are now normally held within plus or minus one part in a billion of the NBS primary standard of frequency. This is done, if necessary, by making daily adjustments at 1900 UT.

NEW PRODUCTION METHOD

"Ferris wheel" arrangement of parts bins which move up or down by flip of a switch is used to speed assembly of military units at G-E's plant in Utica, N. Y. System was developed for specific needs of job-lot military electronics assembly work. "Ferris wheel," with 3,000 bins, occupies 150 sq. ft. of floor space

Portable Microwave Relay Station for the Air Force

The development of a portable microwave relay station, including a 100-ft. magnesium tower, that can be transported to a site by helicopter, and put into operation within 2 hours, has been announced by the Air Research and Development Command.

The station fills an Air Force requirement for portable equipment having a large microwave data handling capacity. It is also adaptable to remote radar set control and use in GCA systems. Voice communications can also be transmitted.

Army helicopter lifts microwave station

All, the equipment, including a shelter, radio equipment and antenna mast, with adjustable reflector, weighs a total of 1100 lbs. The tower telescopes into a 12-ft. package.

The equipment was developed by Motorola Inc. in conjunction with ARDC's Rome Air Development Center, Rome, N. Y.

Translator-Cable Link For Community TV

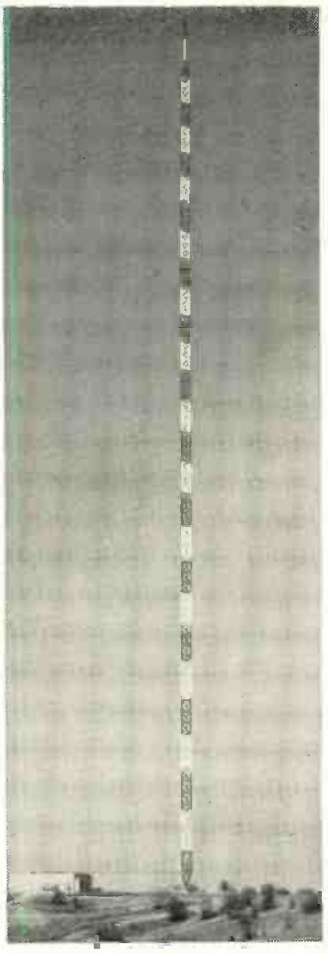
The Senate Interstate and Foreign Commerce Committee heard a proposal last month from Milton J. Shapp, pres. of Jerrold Electronics, to provide TV in remote communities through a combined VHF-UHF translator and coaxial cable system.

The system described would pick up the TV signals from network TV stations on large tower-mounted antennas some distance from the community. The signals would then be amplified and converted to the unused frequencies in the top 14 UHF bands, and beamed to receiving horn antennas in the center of town. There the signals would be reconverted to VHF frequencies and distributed through town over a coaxial cable system.

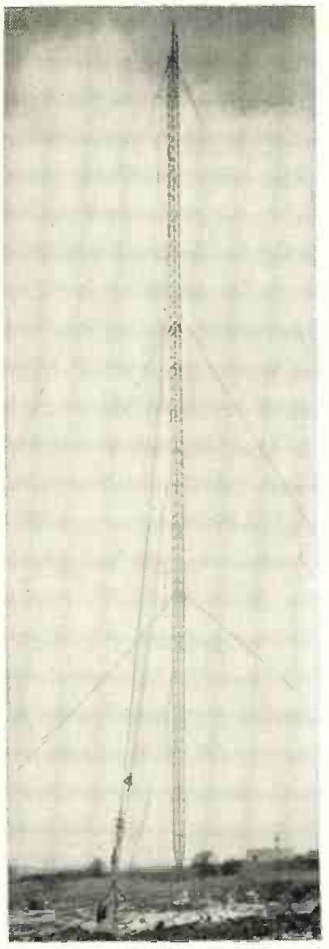
The FCC has already proposed that relatively low-power (10 watt) translators be used to rebroadcast programs in 14 UHF channels.

MORE NEWS on page 28

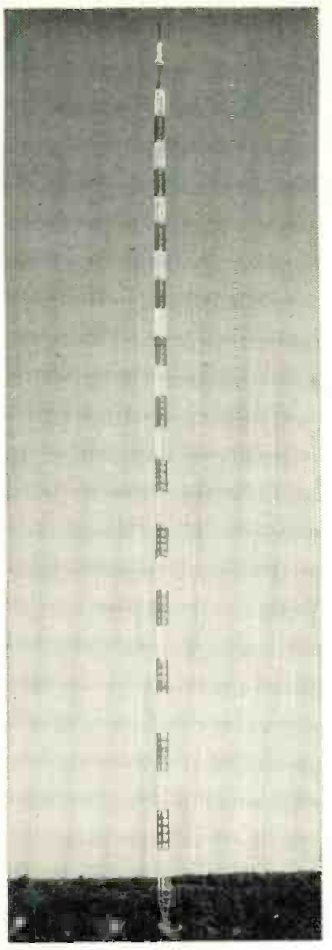
for peak performance ... in all weather



KTBS-TV, Shreveport, La.
1153 feet tall



WFMJ-TV, Youngstown, Ohio
1015 feet tall



WBAP-TV, Fort Worth, Texas
1113 feet tall

TRUST TRUSCON'S TALL TOWERS

Construction close-up on new 1282-foot Truscon Triangular Guyed Tower for WWTV in Cadillac, Mich.

"Neither snow nor rain nor heat nor gloom of night..."

This part of the inscription on New York's main post office might have been written about Truscon® Towers. And we might add, "nor wind ..."

It's a fact, when you specify Truscon you get more than a tower of steel. You get dependability—peak performance *proved* under all weather conditions. You can trust Truscon's tall towers. They go up to stay.

Whatever your tower requirements—any height—guyed or self supporting—tapered or uniform—for AM, FM, TV or Microwave—Truscon has the experience, skill and facilities to design and build the tower you need, *right,* from the ground up.

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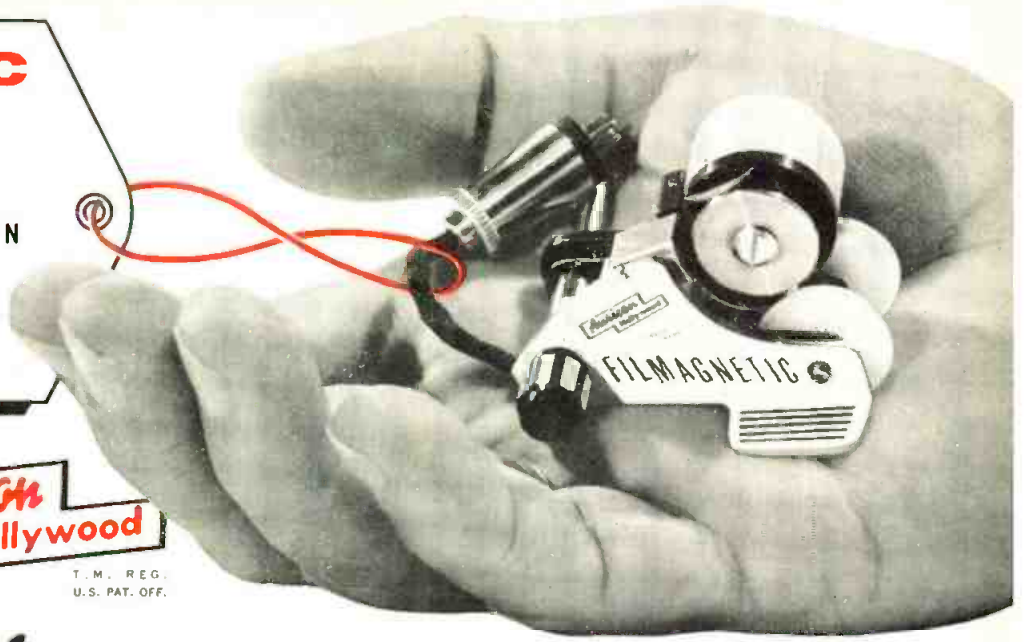
AVAILABLE FOR FACTORY INSTALLATION

ON ALL NEW OR EXISTING AURICON

OPTICAL SOUND-ON-FILM CAMERAS



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Presenting

AURICON FILMAGNETIC

TRADE MARK

Auricon proudly presents "Filmagnetic" High-Fidelity sound-on-film Recording, for lip-synchronized Talking Pictures and Music of Quality, on 16 mm black and white or color film pre-striped for magnetic sound before it is exposed to light. "Filmagnetic" sound and optical picture are recorded Single-System on the same film at the same time! The "Filmagnetic" Unit, installed at the Factory in any Auricon Camera, can be temporarily removed without the use of tools, thus providing a choice of High-Fidelity Optical or Magnetic sound-tracks. Your pre-striped film with magnetic sound lip-synchronized to your picture, passes through the normal picture-development and is played back on any 16 mm Magnetic Sound Projector, including the Ampro, B&H, RCA, and others.

"Filmagnetic" Outfit complete . . . $870.00

PLEASE MAIL COUPON BELOW FOR FREE INFORMATION . . .

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"Filmagnetic" 3 Input Amplifier, Model MA-10, with High-Fidelity Microphone, complete Cables and Batteries, in a Cowhide-Leather Carrying Case. Super-portable, weighs only 7 pounds, carries easily with shoulder-strap during operation!

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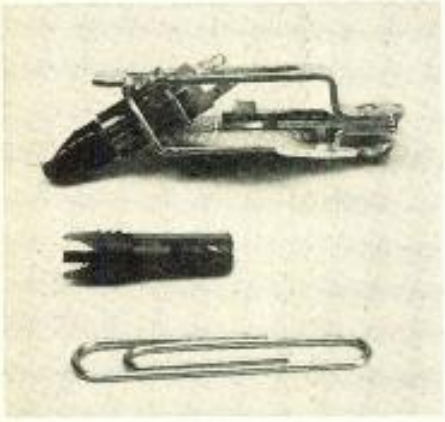
As We Go To Press (Cont.)

New E-V Cartridge Of Lightweight Plastic

Electro-Voice Inc. will soon announce a new miniaturized ceramic phone cartridge which could start a new trend in cartridge design. The unit, which is encased in a lightweight plastic cylinder, can reportedly be manufactured at much less cost than conventional units.

The cartridge, exceptionally light



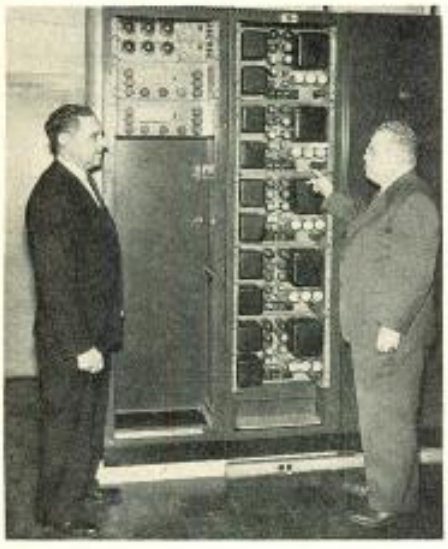
Miniaturized ceramic phono cartridge

in weight, has been especially tailored for the replacement market and comes in four basic cartridges and three adapter types which reportedly replace 75% of all cartridges.

The cartridge is a flip-over type and has 1- and 3-mil non-replaceable sapphire stylii; diamond stylii are also available. The output is 1 v.

Electro-Voice's vice-pres. in charge of sales, Larry LeKashman, disclaimed hi-fidelity performance for the cartridge but said that its response characteristic is comparable to any other ceramic cartridge on the market.

BROADCAST EQUIPMENT



A. R. Hopkins, Manager, and V. E. Trouant, Chief Engineer, of RCA's Bcst. and TV Equip. Dept. discuss new RCA WP-15 Power Supply (left) which replaces five of the earlier models (right).

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period March through October, 1956 that are of special interest to electronic engineers

April 2-4: Symposium on Microwave Properties and Applications of Ferrites, sponsored by Harvard Univ., AF Cambridge Research Center, and the IRE Prof. Gp. on Microwave Theory and Techniques, at Harvard University, Cambridge, Mass. Advance registration by mail is required.

April 5-6: Special Technical Conference on Magnetic Amplifiers, co-sponsored by: AIEE Committee on Magnetic Amplifiers, IRE PRO. Group on Industrial Electronics, ISA Central N.Y. Sec. Hotel Syracuse, Syracuse, N.Y.

April 10-12: Twelfth Annual Meeting and 1956 Metal Powder Show of the MPA, at the Hotel Cleveland, Cleveland, Ohio.

April 11-12: IRE 7th Region Technical Conference, Salt Lake City, Utah.

April 13-14: Tenth Annual Spring Television Conference, sponsored by Cincinnati Sec., IRE, 1349 E. McMillan St., Cincinnati, Ohio.

April 15-19; 34th annual convention of NARTB, Conrad Hilton Hotel, Chicago, Ill.

April 17-19: Fourth National Conference on Electromagnetic Relays, Oklahoma Inst. of Tech. Stillwater, Okla.

April 19-20: Spring Assembly Meeting of the Radio Technical Commission for Marine Services, at the Sheraton Hotel, St. Louis, Mo.

May 10-12: Fourth JETEC General Conference, at the Hotel Traymore, Atlantic City, N. J.

May 14-16: 8th Annual National Conference on Aeronautical Electronics, co-sponsored by the Dayton Chapter of the IRE, and the Prof. Gp. on Aeronautical and Navigational Electronics (IRE), at the Biltmore Hotel, Dayton, Ohio.

May 21-22: RETMA Symposium on Reliable Applications of Electron Tubes, at Irvine Auditorium, University of Pennsylvania, Philadelphia, Pa.

May 29-June 2: International Congress on Microwave Tubes, at the Conservatoire National des Arts et Metiers, Paris, France.

Aug. 15-17. The National Telemetering Conference, sponsored jointly by the IRE, the AIEE, the IAS, and the ISA, in Los Angeles, Calif.

Aug. 21-24: WESCON Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 22-Sept. 1: 23rd Annual (British) National Radio Show, sponsored by the Radio and Electronic Component Manufacturers Federation, at Earls Court, London, England.

Sept. 11-12: Second RETMA Conference on Reliable Electrical Connections, at Irvine Auditorium, University of Penn., Philadelphia, Pa.

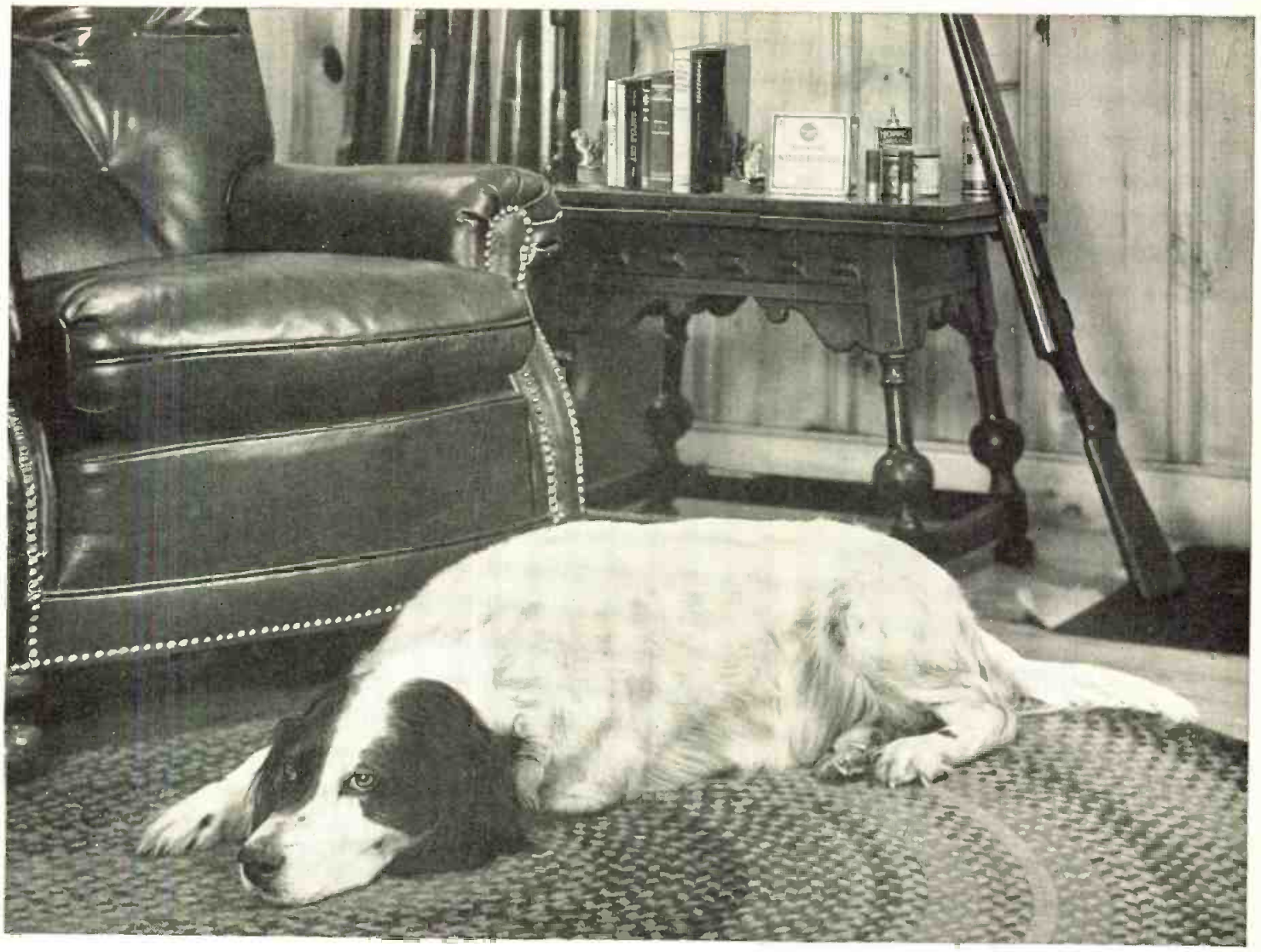
Sept. 17-21: 11th Annual Instrument-Automation Conference and Exhibit, sponsored by the ISA, at the New York Coliseum, New York, N.Y.

Oct. 1-3: Canadian IRE Convention and Exposition, in the Automotive Bldg., Canadian National Exhibition Pk., Toronto, Canada.

Oct. 9-10: Conference on Computer Applications, sponsored by Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Abbreviations:

ASTE: American Society of Tool Engineers
AIEE: American Institute of Electrical Engineers
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
JETEC: Joint Electron Tube Engineering Council
MPA: Metal Powder Association
NARTB: Nat'l. Assoc. of Radio and TV Broadcasters
NACE: National Assoc. Corrosion Engineers
RETMA: Radio-Electronics-TV Manufacturers Assoc.



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laminated plastics . . . a combination of properties for trouble-shy designers

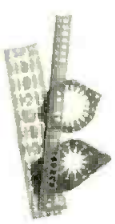
When a man goes a-hunting for a material for a specific application, he wants one that satisfies his own combination of property requirements . . . *and is easy to machine.* Synthane laminated plastic is just the material—*plenty* of good mechanical, electrical, electronic and chemical properties . . . combined with excellent machining and fabricating characteristics.

DIELECTRIC STRENGTH

MOISTURE RESISTANCE

EASILY MACHINED

DIMENSIONAL STABILITY



Electronic components made of Synthane laminated plastic combine high dielectric strength with excellent mechanical and machining properties. Synthane is strong, light in weight and possesses unusual dimensional stability over a wide range of operating temperatures. It can be easily punched, machined and otherwise fabricated to close tolerances. Synthane also has good resistance to heat, moisture, oils and corrosive solutions of many types.

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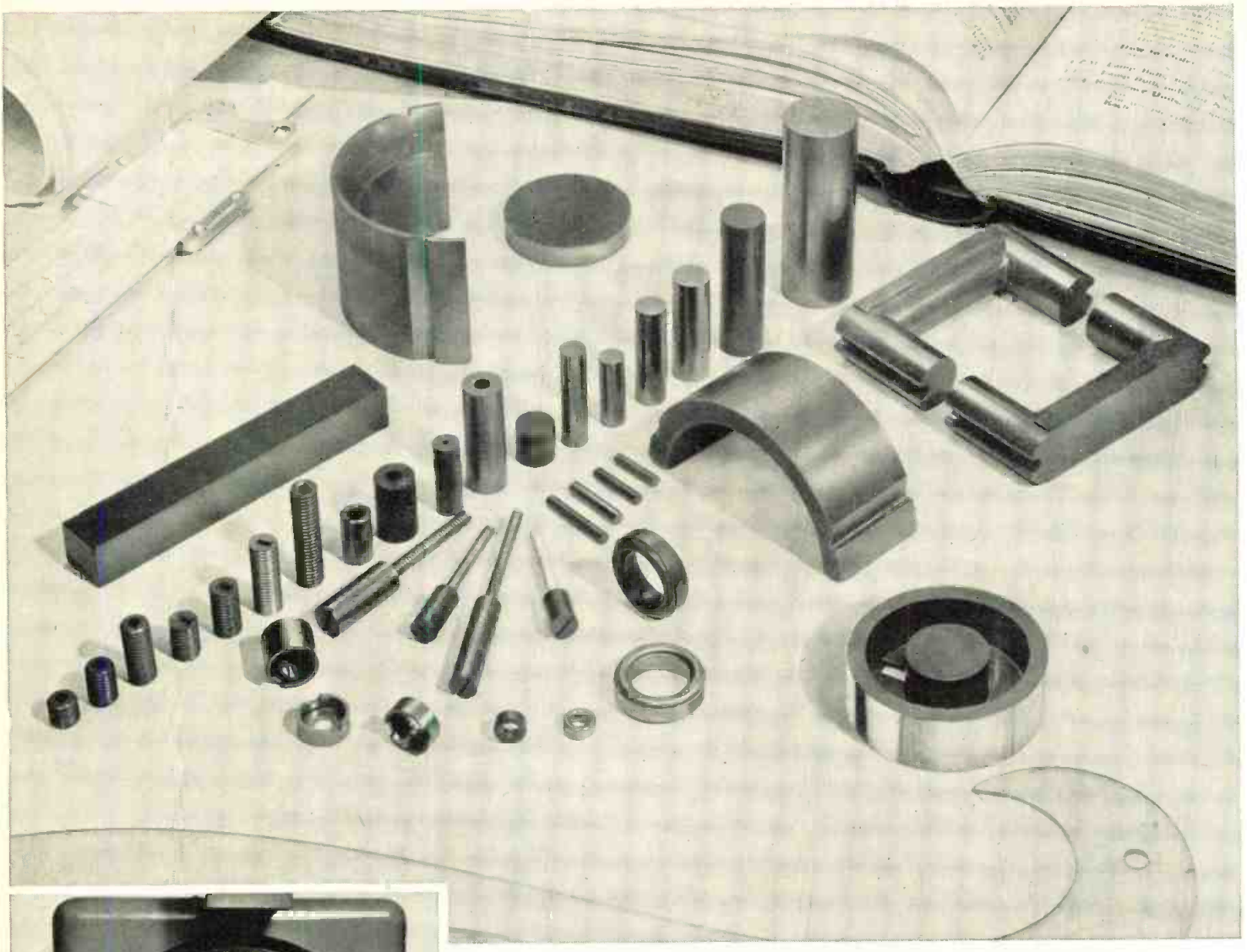

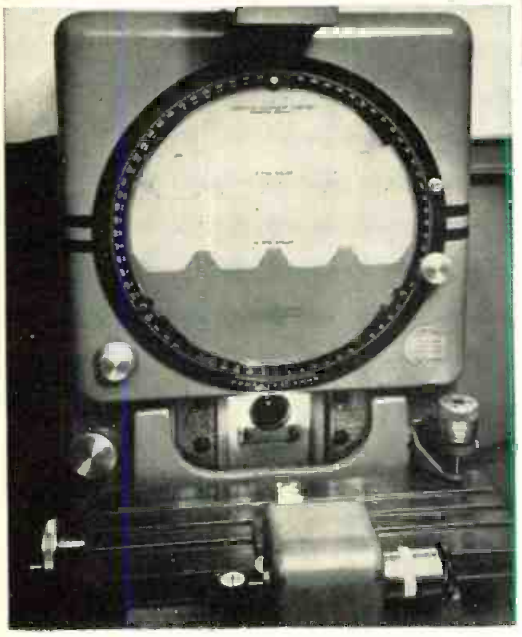

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Contains essential data on processing, control methods, applications, types, sizes, suggested use frequencies, etc. of Arnold iron powder cores.

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Here are the essential facts to keep in mind about iron powder cores—and Arnold. As illustrated above, we make a wide selection of cores, from simple cylinders to special cores of complicated design. That includes all standard types and sizes of threaded cores, cup, sleeve, slug and cylindrical insert cores you may require: for use in antenna and RF coils, oscillator coils, IF coils, perm tuning, FM coils, television RF coils, noise filter coils, induction heating and bombarder coils, and other low frequency applications. Also, a standard series of iron powder toroids is being engineered at this time, which will conform to the standard sizes proposed by the Metal Powder Association. • We'll appreciate the opportunity to supply your needs . . . *let us quote on your requirements.*

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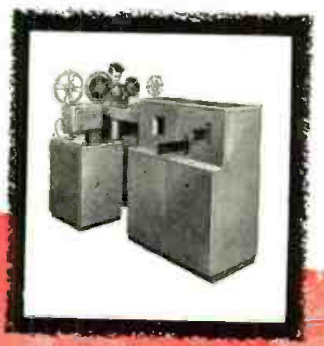
Speaking of chain reactions...



1 Excellent monochrome slides, opaques, and 16 mm film.

2 Superior color slides, opaques and 16 mm film, as well as monochrome.

3 Limited live color in addition to slides, opaques, and 16 mm film. Unlimited Live Color.

Here's one you can control!

the vitascan

4 UNLIMITED LIVE COLOR

And now, the biggest news of all... the Vitascan camera, a portable light source for live color TV broadcasting. The light source is a simple, portable camera assembly that provides unlimited live programming at a cost far below other color systems. Again, Du Mont shows the way for simple, practical television broadcasting.

Start your scanner operations at any point you need! If you need a source for only monochrome film, opaques, and slides choose the Monochrome Multi-Scanner. If you plan color for later on, you can always convert at minimum expense. At any time, you can add live color with either the fixed or portable light sources. Here is television broadcasting equipment tailored to your exact needs!

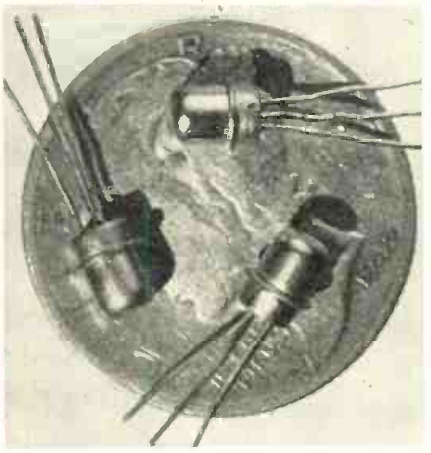
DU MONT®

Television Transmitter Department
Allen B. Du Mont Laboratories, Inc.
Clifton, New Jersey

As We Go To Press (Cont.)

Sub-Miniature Transistor Announced By Philco

A miniaturized PNP audio-frequency transistor, so small that the amplifier designed around it can be no larger than an ordinary pencil eraser, is now in production at Philco Corp., Phila.



20 of the transistors fit on a dime

Engineers at Philco's Govt. and Industrial Div. actually assembled the amplifier for demonstration purposes. It has a 70 db gain, or power gain of 10,000,000, and utilizes a new direct-coupled circuitry developed by Philco for computers.

The transistor, an alloy-junction type, and labeled M-1, is capable of withstanding 20,000 "G's" without change in characteristics. Case is hermetically sealed metal can.

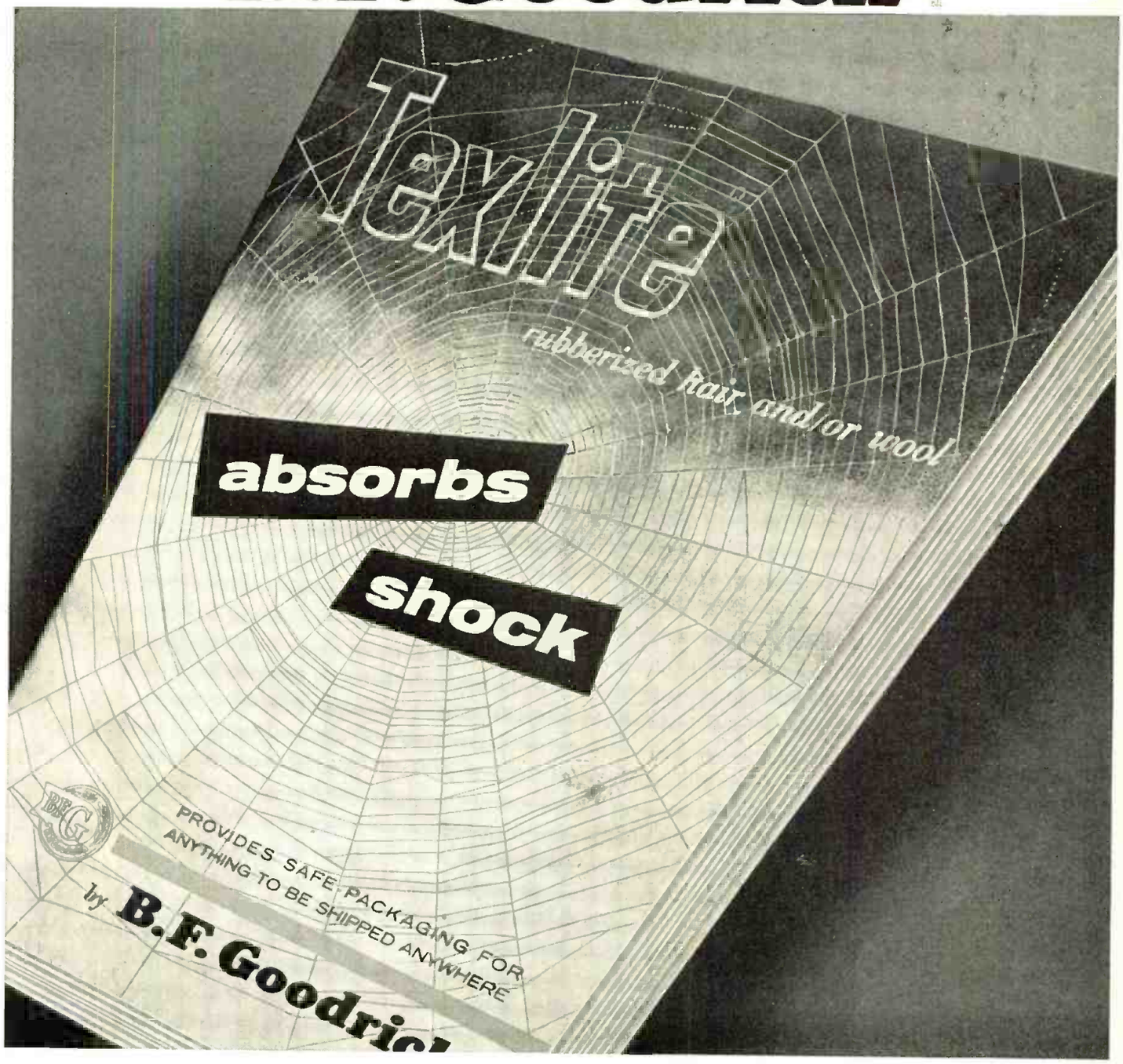
Push 110° Picture Tube

The U.S. TV industry took a step toward achieving standardization on a much-discussed, but still developmental shallow TV picture tube when a committee of the RETMA decided to omit from future consideration a projected 120-degree deflection tube. Instead, it was decided to concentrate on a proposed 110-degree deflection tube with a small tube neck.

LOW-POWER TV

KHAD-TV, Laredo, Tex., has gone on the air as one of the first low-power stations. Here's a view of the Kay Lab-equipped installation

RESEARCH KEEPS **B.F. Goodrich** FIRST IN RUBBER



New basic fact book for Packaging Engineers

Not just another propaganda piece but the basic data on cause and prevention of shipping damage plus characteristics of cushioning materials such as compression resistance, efficiency, cushion factor, drift, set, corrosion, etc.

Naturally, the specifications, properties and advantages of Texlite are also included.

But seeing is believing, so fill in the coupon for your personal copy.

B. F. Goodrich Sponge Products Division
279 Derby Place, Shelton, Connecticut

Please send free Texlite packaging booklet to:

Name_____

Company_____

Address_____

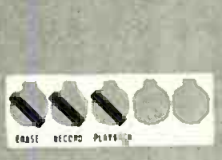
_____

For product information, use inquiry card on last page.

NEW BERLANT DELUXE series 30 TAPE RECORDER

Now an improved model of the famous Berlant Broadcast Recorder that was designed to meet every requirement of the recording studio, radio station and industrial user.

all these professional features



3 HEADS—for instantaneous monitoring from the tape while recording. Space for 2 extra heads allows modifications to sound on sound, stereo recording, echo effects and delayed broadcast playback while simultaneously recording new signal.

3 MOTORS—direct drive, no belts, pulleys, clutches or gears to wear out and cause flutter and wow. Fastest forward and reverse speed for almost instantaneous location of desired spot on tape . . . 2500 feet in less than one minute. HYSTERESIS SYNCHRONOUS MOTOR WITH DIRECT DRIVE AND 99.8% TIMING ACCURACY.

A-B TEST FADER—compare original sound with recorded sound while making recording. Set record level separately from playback level using 2 different control knobs. Permits accurate comparison.

CUEING AND EDITING—simplest, fastest, most accurate means of locating tape at exact desired spot, splicing in desired sections, cutting out undesirable sound.

4½ SIGNAL LEVEL METER—eliminates guesswork in recording by accurately measuring input signal and output signal. Reduces distortion due to over-modulation. Measures bias level to insure proper operation.

Berlant Concertone

Audio Division of American Electronics, Inc.
655 West Washington Blvd., Los Angeles 15, Calif.
For industrial requirements consult Recordata Division

plus these new features

Complete restyling of all models accentuating functional beauty • New speed change switch • New tape damper assembly with guides • New tape guide bracket • Tape transport pre-drilled for stereo and sync pulse adaptations.

The new Berlant Deluxe Series 30 is now available for rack mounting or in newly styled carrying cases. See your Berlant distributor for an actual demonstration of this outstanding recorder. Also available as a complete tape recording and reproducing sound system.

Electronic Industries News Briefs

Capsule summaries of important happenings in affairs of equipment and component manufacturers

EAST

AEROVOX CORP. has expanded its program toward the development of full-scale automatic production of the "Project Tinkertoy" module. A development program has been maintained at its Arlington, Va., facility. Further development, detail design, and construction of production equipment has started at the Olean, N.Y., and New Bedford, Mass. plants.

ASTRON CORPORATION, East Newark, N.J., has purchased all of the outstanding stock of Skottie Electronic Corp., Inc., of Peckville, Pa. Purchase includes the plant buildings and production facilities.

BENDIX AVIATION CORPORATION announces, from Teterboro, N.J., that American Airlines' new fleet of Lockheed-Electra 400-mile-an-hour airliners will be equipped with a completely transistorized automatic flight system developed by Bendix.

CLAREMONT TUBE CORPORATION, manufacturers of TV picture tubes, has established a new warehouse in Silver Spring, Md., at 8933 Brookville Rd.

GENERAL PRECISION LABORATORY, INC., Pleasantville, N.Y., has been awarded a contract to equip three multi-engine planes with the latest electronic meteorological instruments and navigation gear for the U.S. Weather Bureau, Dept. of Commerce.

B. F. GOODRICH SPONGE PRODUCTS, Shelton, Conn., has announced price reductions averaging 10% to be applied against "Spongex" microwave absorbents.

INTERNATIONAL RECTIFIER CORPORATION, El Segundo, Calif., has established a branch office at: 132 E. 70th St., New York 21, N.Y. Arno Nash, district manager, is in charge.

JERROLD ELECTRONICS CORP., Philadelphia, Pa., has established a new research laboratory in Huntingdon Valley, Pa., 20 miles north of the company's plant and office building.

LINEAR EQUIPMENT LABORATORIES INC., Copiague, N.Y., has changed its name to LEL Inc. At present, LEL Inc. is concentrating on the manufacture of IF strips for industry and transistorized products.

DONALD P. MOSSMAN, INC., Brewster, N.Y., manufacturers of multiple circuit lever and push button switches, has recently established a new Electronics Division which will handle assembly of various electronic equipments to individual customer requirements.

THE NEW LONDON INSTRUMENT CO., New London, Conn., has announced a change in ownership, with H. Dowd, R. L. Barrows and R. Coshnear, of Boston, assuming control. Samuel Gubin, one of the three founders of the company, is new General Manager.

OLYMPIC RADIO & TELEVISION INC. has purchased all of the outstanding stock of David Bogen Co., Inc., 29 Ninth Ave., New York, N.Y.

SCHWARZKOPF DEVELOPMENT CORP., 320 Yonkers Ave., Yonkers, N.Y., succeeds the American Electro Metal Corp. of Maryland, and its activities will cover all fields of powder metallurgy.

ROGER WHITE ELECTRON DEVICES, INC., Ramsey, N.J., manufacturers of microwave equipment, has acquired a new plant in Haskell, N.J.

S. O. & C. COMPANY, Ansonia, Conn., eyelet manufacturing branch of the United Shoe Machinery Corp., has selected a tract of land in Shelton, Conn., for the purpose of building a new manufacturing plant.

SPRAGUE ELECTRIC COMPANY, North Adams, Mass., announces that construction will begin shortly at Concord, N.H., on a new plant to manufacture surface-barrier transistors.

STROMBERG-CARLSON, Rochester, N.Y., division of General Dynamics Corp., has received a $1.5 million contract from the U.S. Signal Corps for communications equipment for South Korea.

TRACERLAB INC., Boston, Mass., announces that maintenance and service on Tracerlab Instruments is now handled directly from the New York City office at 660 First Ave.

MID-WEST

ATOMIC INDUSTRIAL FORUM announces that the second annual Trade Fair of the Atomic Industry will be held at the Navy Pier, Chicago, Ill., during the period Sept. 24-28, 1956.

CENTRAL TRANSFORMER CO., 910 W. Jackson Blvd., Chicago, Ill., has leased an additional floor at the same location. This move doubles the manufacturing space of the company.

EDUCATIONAL TELEVISION AND RADIO CENTER, 1610 Washtenaw Ave., Ann Arbor, Mich., is carrying on the promotional activities of the National Citizens Committee for Educational TV which is no longer functioning.

HALLICRAFTERS CO., Chicago, Ill., stockholders have approved the sale of their corporation's assets to the Penn-Texas Corp., New York City. Terms of the sale call for the issuance by Penn-Texas of 332,600 shares of its common stock on an exchange basis.

MOTOROLA COMMUNICATIONS & ELECTRONICS, INC., Chicago, Ill., has received a contract from the U.S. Air Force amounting to more than $1.9 million for military microwave relay equipment.

THE NAZ-DAR COMPANY, 461 N. Milwaukee Ave., Chicago, Ill., announce the availability of their screen dept. for preparation of silk screens for printed circuits on a national basis.

SANGAMO ELECTRIC CO., Marion, Ill., has instituted a high reliability capacitor processing and inspection program designed to provide capacitors fully insured against latent defects.

TEXAS INSTRUMENTS INC., Dallas, Tex., has announced an agreement to purchase the business and assets of the Burlington Instrument Co. of Burlington, Iowa.

WEST

AMPEX CORPORATION, Redwood City, Calif., has constructed a laboratory version of what is believed to be a practical system for the recording and reproduction of TV pictures on magnetic tape. However, it is expected that considerable time and effort will be required to convert this laboratory prototype into a commercially acceptable unit.

BYRON JACKSON DIVISION, BORG-WARNER CORP., has approved architectural plans and construction has commenced on the company's new 65,000 sq. ft. electronics plant at Santa Ana, Calif.

GENERAL ELECTRIC COMPANY has announced plans to establish headquarters in San Jose, Calif., for its Atomic Power Equipment Dept.

G. M. GIANNINI & CO., INC., has added The Controls Division, 969 N. La Brea Ave., Hollywood, Calif., to the company's present activities. The facility was acquired from Brinkman Manufacturing Co., Inc.

MERIT COIL & TRANSFORMER CORP., Chicago, Ill., has opened a new warehouse at 312 Seventh St., San Francisco, Calif.

THE ORBITRAN COMPANY, P.O. Box 635, Lakeside, Calif., has recently entered the field of electronic instruments and component parts manufacturing.

RCA has transferred to its office at 11819 Olympic Blvd., Los Angeles, Calif., all sales activities for its line of custom aviation equipment for commercial and private aircraft.

THE RAMO-WOOLDRIDGE CORP., Los Angeles, Calif., is planning the erection of a major electronics manufacturing plant in the Denver, Colo.. area. Ground will be broken in May or June on the first structure, a 172,000 sq. ft. factory for the production of electronic systems for military customers.

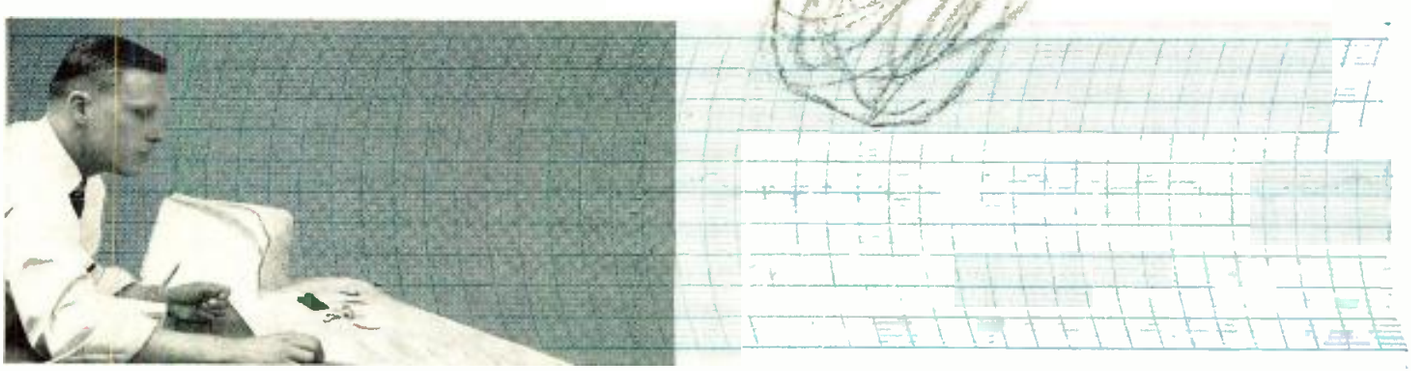
FOREIGN

KAY LAB, San Diego, Calif., reports sale of equipment for a low-power TV station in Venezuela. The deal was closed by Luis Iliceto, owner of Tesa Electronics in Caracas.

RAYTHEON MANUFACTURING COMPANY, Waltham, Mass., has announced the sale of two one-watt microwave links to the Melbourne (Australia) Herald-Sun TV Station, in preparation for the advent of TV broadcasting in that country early this fall.

TRUMBULL COMPONENTS DEPT. OF G-E has formed a subsidiary corporation. Caribe General Electric Inc., to operate a plant in Palmer, Puerto Rico, for the manufacture of low voltage electrical distribution protective and disconnect devices.

Look mom...no hands!



Mom died a thousand deaths when Junior free-wheeled his two-wheeler down Deadman's Hill... no hands, yet!

Despite dire predictions, Junior grew up... but he didn't change a bit.

True, he's outgrown his bike... more complex machines are his meat today. He's designing industrial indicators, recorders and computers... automatic machine tools... six-figure process controllers. Tomorrow, his dream of automation will come true in the completely automatic factory.

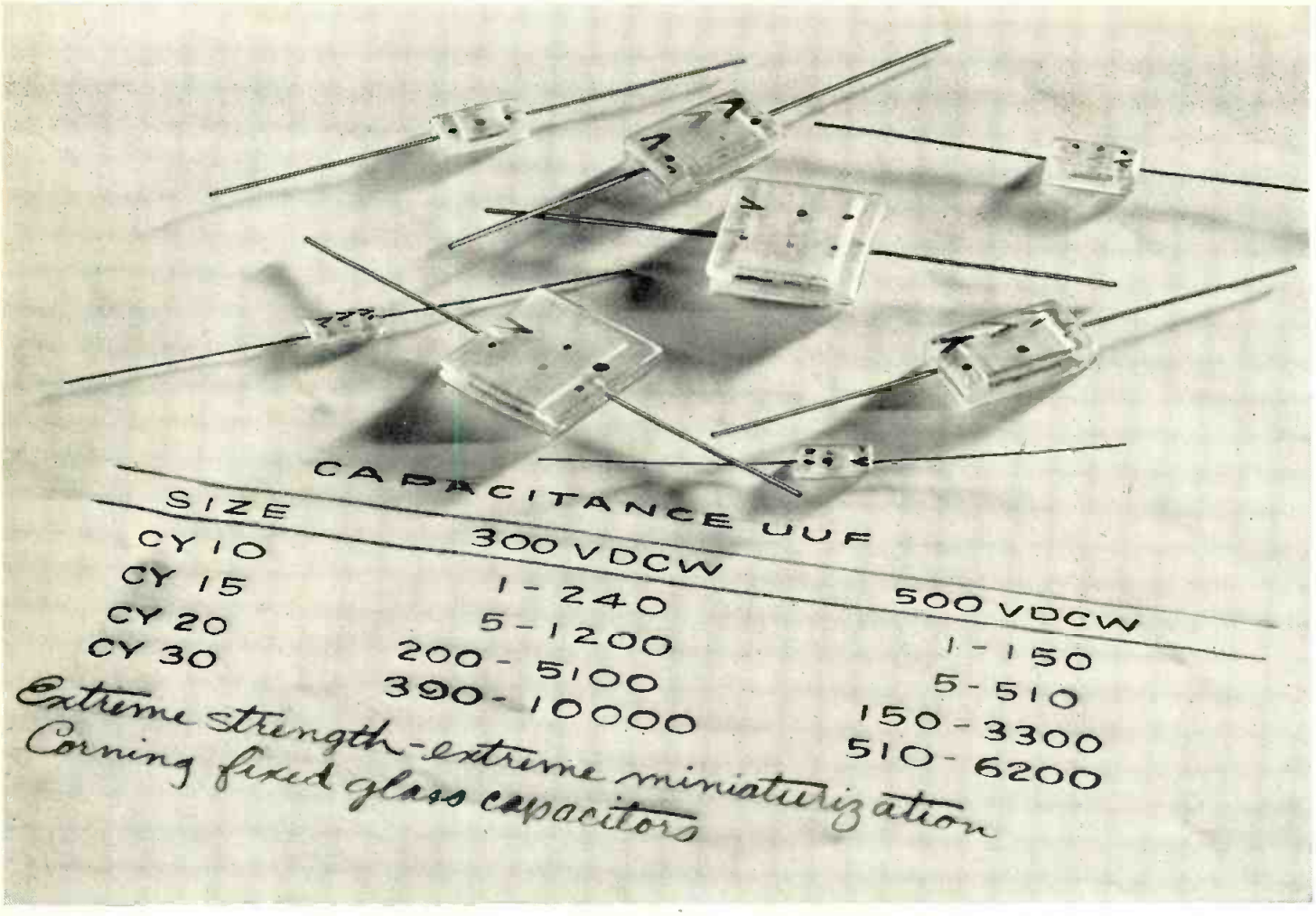
Yes, Junior's grown up, but his war-cry is the same..."look mom, no hands!"

Junior outgrew his bike when he discovered HELIPOT* *precision potentiometers. If you're still riding in circles, join Junior! You'll find that Helipot makes the most complete line... linear and non-linear... in the widest choice of sizes, mounting styles and resistances ...that our engineers will gladly adapt standard models to your requirements... even design entirely new ones for you. For information and specifications... write for data file 404.*

Helipot®

first in precision potentiometers
Helipot Corporation/South Pasadena, California
Engineering representatives in principal cities
a division of Beckman Instruments, Inc.

BECKMAN



You'd have to smash a Corning Capacitor before you could alter its values by mechanical shock

That's how rugged these miniature fixed glass capacitors are. ("Miniature" means about one-third smaller than other kinds of equal capacitance.)

Their strength comes from the way we make them. Layers of conductor and dielectric are sealed together under heat and pressure into a monolithic structure. No mechanical shock short of shattering the seal alters the value. Speaking of values, the table illustrated above shows them.

Because everything is sealed in the same material as the dielectric, nothing outside can get inside.

You can use these capacitors to temperatures of 125° C. and higher with proper voltage derating. Even after repeated temperature cycling, the TC remains the same. And TC stays within close limits over a wide temperature range, varies little between capacitors. Capacitance drift is so close to zero that it's generally less than the error of measurement.

We can make capacitors to your electrical and physical specifications over an unusually varied range. Single, self-supported units can be designed for high voltages or high capacitances. Series parallel combinations still further extend the range.

Circle the reader service of this publication, or write direct for more information about Corning Fixed Glass Capacitors, prices and samples.

Ask for information on these other Corning Capacitors:

Medium Power Transmitting—CY-60 and CY70. Ideal for mobile RF transmitters.

Canned High Capacitance—provide the advantages of rugged glass design to your specifications.

Subminiature Tab-Lead—up to 90% less volume compared to pigtail types. To your specifications.

Special Combinations—the performance and benefits of glass in infinite shapes, sizes and leads. To custom order.

Other electronic products by Corning Components Department:

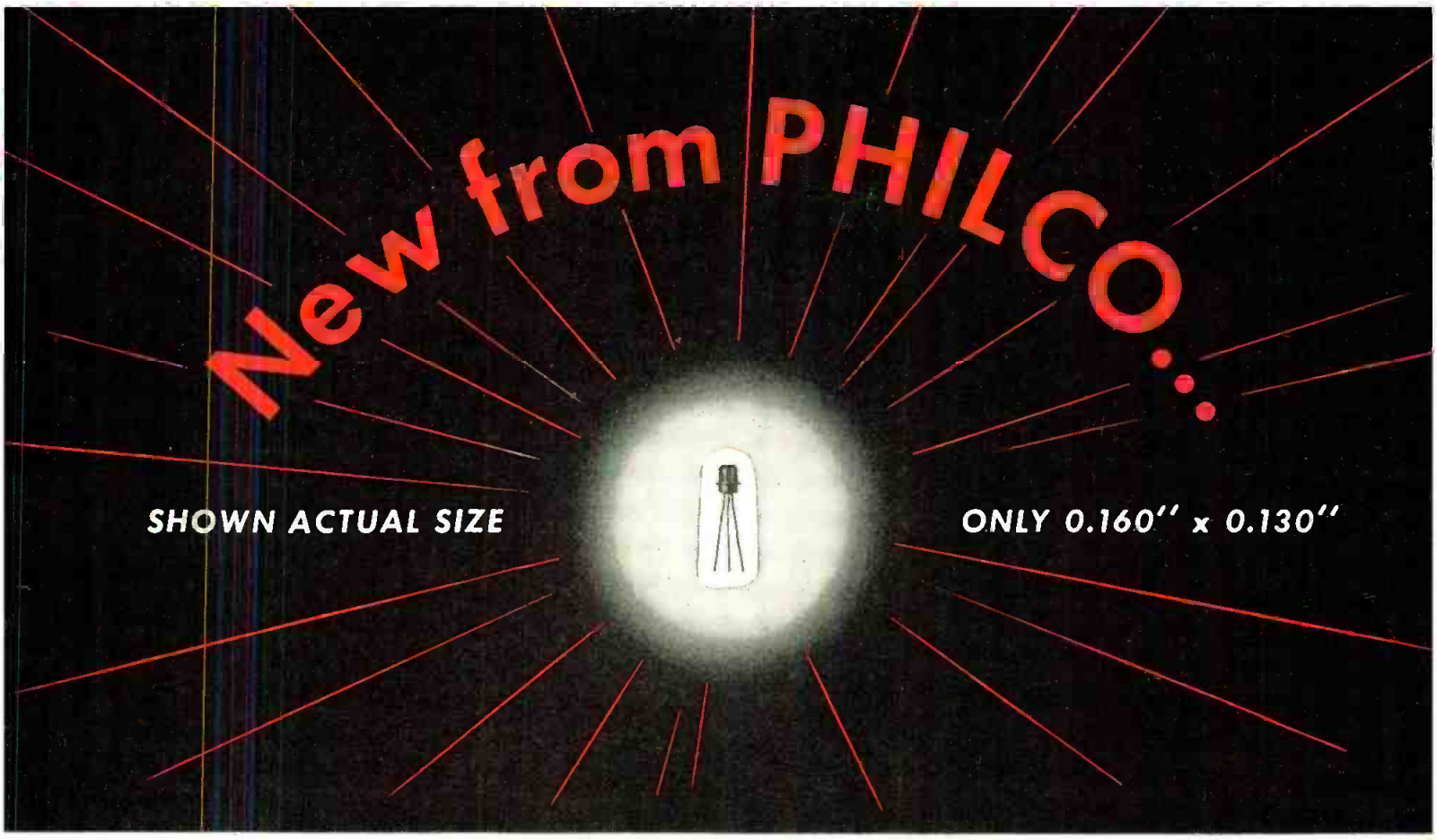
Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*, Metallized Glass Inductances, Resistors.

Distributed by Erie Resistor Corporation

CORNING GLASS WORKS, 95-4 Crystal Street **CORNING, N. Y.**

Components Department, Electrical Products Division

Corning means research in Glass



World's Smallest Transistor

- Hermetically sealed, resistance-welded metal case . . . leads sealed in glass.
- Exceedingly low noise.
- Uniformity of electrical characteristics.
- Maximum reliability and long life.
- Impervious to moisture and humidity.

Opens the way to new advances in space-saving audio design

A new achievement from Philco laboratories, the M-1 "Audio Mite" Transistor is smaller than any transistor now in production! It retains all the desirable electrical characteristics, all the mechanical features, all the performance of the Philco 2N47 . . . the transistor proved in the field to be without equal in hearing aid applications. The "Audio Mite" is hermetically sealed in metal the unique Philco way . . . the design that has earned a reputation as the most reliable hermetic seal in the industry. A wide new field in low level audio applications is opened to design engineers by this tiny PNP alloy junction transistor.

For complete technical information write to Dept. TT-2

LANSDALE TUBE COMPANY
A DIVISION OF PHILCO CORPORATION
Lansdale, Penna.

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

EIMAC Klystrons bring new power to another frequency range...

Eimac X563E, 5900-6400mc, and amplifier circuit assembly.

TYPICAL OPERATING CONDITIONS PER TUBE X563 KLYSTRONS

D-C Beam Voltage . .	2750v	Power Output	60w
D-C Beam Current . .	110ma	Efficiency	20%
D-C Focusing Voltage . .	—50v	Driving Power	5mW

Eimac X563 amplifier klystrons make 50 watt CW power output commercially available at 5400-7400mc. A bonus feature of the X563 is its adaptability to present C-Band systems. Existing milliwatt equipment is sufficient to drive a conservatively rated X563 to power gains of 10,000 times and efficiencies of 20-25%.

Single adjustment tuning knobs make each of the X563's four integral cavities as easy to tune as a standard AM broadcast receiver.

The Eimac X563 is also available with magnetic circuit components, output waveguide fitting and collector and cathode sockets comprising a suitcase-size amplifier assembly weighing only 20 pounds.

● *Eimac offers the most extensive selection of high power amplifier klystrons for pulse, CW and AM applications. For information and a copy of "Klystrons Facts #3" contact our Technical Services Dept.*

Eimac

EITEL-McCULLOUGH, INC.

SAN BRUNO • CALIFORNIA

The World's Largest Manufacturer of Transmitting Tubes

Consult CHATHAM for all four

including tubes, aircraft conversion equipment, selenium rectifiers and radar components. Illustrated bulletins sent on request.

1 *HIGH PERFORMANCE*

HYDROGEN THYRATRONS

Years of experience in the design and production of these special types have resulted in tubes that offer superior service in the generation of pulse voltages in the order of microseconds.

CHATHAM TYPE 5949/1907

Hydrogen filled, zero bias thyratron with hydrogen reservoir for generation of peak pulse power up to 6.25 megawatts.

CHATHAM TYPE VC-1258

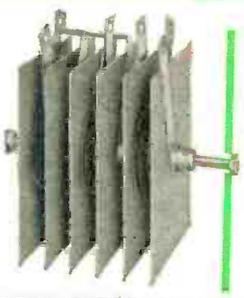
Zero bias miniature thyratron for generation of peak pulse power to 10 KW. Available with 28 volt heater, ruggedized for extreme vibration.

CHATHAM TYPE 5948/1754

Hydrogen filled, zero bias thyratron with hydrogen reservoir for generation of peak pulse power up to 12.5 megawatts.

CHATHAM TYPE VC-1257

Hydrogen filled, zero bias thyratron with hydrogen reservoir for generation of pulse power up to 33 megawatts.



2 *LIGHTWEIGHT CHATHAM "kotron"*

SELENIUM RECTIFIERS

Both electrically and mechanically, Chatham kotron Selenium Rectifiers offer important design advantages. Combining lighter weight with smallest efficient size, kotrons are built rugged to last longer. Improved design assures longer short circuit loads, twice the voltage surge of ordinary rectifiers.

3 *ADVANCE DESIGNED*

AIRBORNE CONVERSION EQUIPMENT

Input – 195 to 210 volts, 3 phase, 400 cycles
Output – 28 v. DC, 100 amps.
Regulation – 25 to 31 volts
Weight – under 17 lbs.

Type 28V100 Power Supply illustrated provides substantial weight savings, reduced size, greater reliability and improved electrical characteristics. Ruggedized throughout. Type 28V-100 exceeds MIL-P-7212 requirements.

4 **CUSTOM-DESIGNED EQUIPMENT**

CHATHAM specializes in the development, design and production of equipment built to customers' needs. Our engineers will supply estimates on receipt of your drawings and specifications.

High power Radar modulators built to government specifications.

IF YOU HAVE A PROBLEM — Chatham facilities are available for the solution of problems involving tubes and special equipment for industrial and military applications. Your inquiry will receive prompt attention.

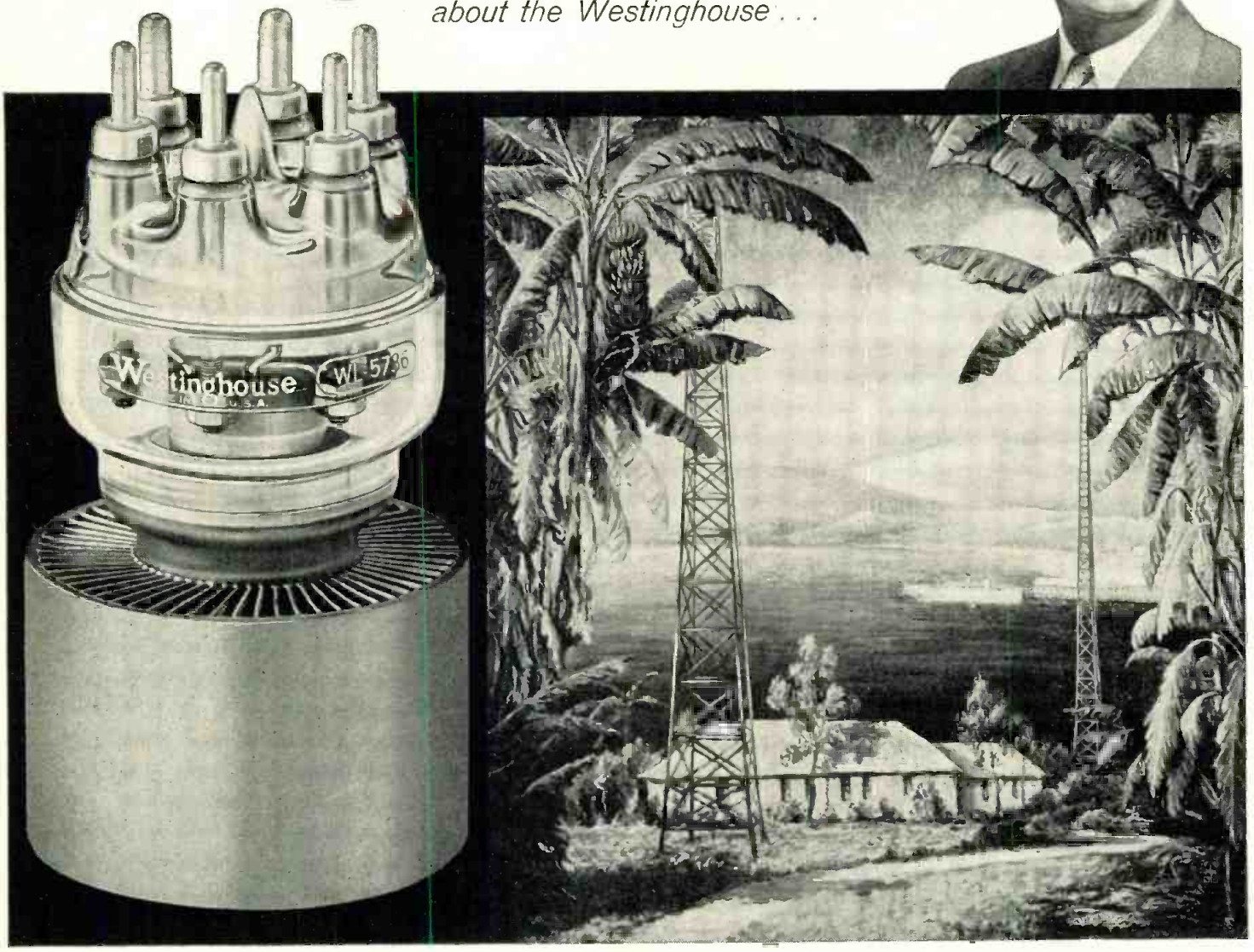
CHATHAM ELECTRONICS

LIVINGSTON, NEW JERSEY

Division of Gera Corporation

"Reliability where it counts,"

says C. C. Harris,
Vice President and Chief Engineer,
Tropical Radio Telegraph Company,
about the Westinghouse . . .



WL-5736 POWER TUBE

"We have been using the WL-5736 for seven years," says Mr. Harris. "We have found it to be highly reliable and to give long life. Tropical Radio Telegraph Company requirements are strenuous, especially in hot, humid, tropical climates. Our radio network is vital to Middle-American tele-communications service, and the WL-5736 has given us reliability where it counts."

Reports from dozens of other users echo the experience of Tropical Radio Telegraph. For the WL-5736 has long set the standard of excellence in communications and RF heating equipment of all types.

Wherever you need 2.5 kilowatts RF in a small, dependable package, you too will find its performance unbeatable.* Write today for full design data. Commercial Engineering Dept., Westinghouse Electric Corporation, Elmira, N. Y. **ENGINEERS!** For challenge, security, growth potential, investigate career opportunities now being offered by Westinghouse Electronic Tube Division. Write Technical Placement Director today.

6ET-4106

**Where cooling by low-pressure blower is desirable, specify the new WL-6623 with extra-large radiator and "flying leads."*

YOU CAN BE SURE...IF IT'S Westinghouse

RELIATRON® TUBES

WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y.

going...

going...

gone!

KESTER "44" RESIN, PLASTIC ROSIN AND "RESIN-FIVE" FLUX-CORE SOLDERS owe their production line popularity to the simple fact that they provide the exactly right solder for every soldering application. It's not difficult to realize why Kester is consumed so rapidly . . . because of its great adaptability to so many different soldering operations.

SEND TODAY *for Kester's new 78-page informative textbook "SOLDER . . . Its Fundamentals and Usage."*

KESTER SOLDER

4210 Wrightwood Avenue, Chicago 39, Illinois; Newark 5, N. J.; Brantford, Canada

TELE-TIPS

THE ENGINEERING SHORTAGE has its comical side, too. Story is told of one prominent company, particularly desperate for engineers, that resolved to do a real bang-up recruiting job at a recent show. They took nine of their top engineers out of the lab, briefed them on recruiting and sales techniques, gave them a big rah-rah pep talk, and hustled them off to the show. The only trouble—some other firms were doing an even better selling job. Only two of the nine came back.

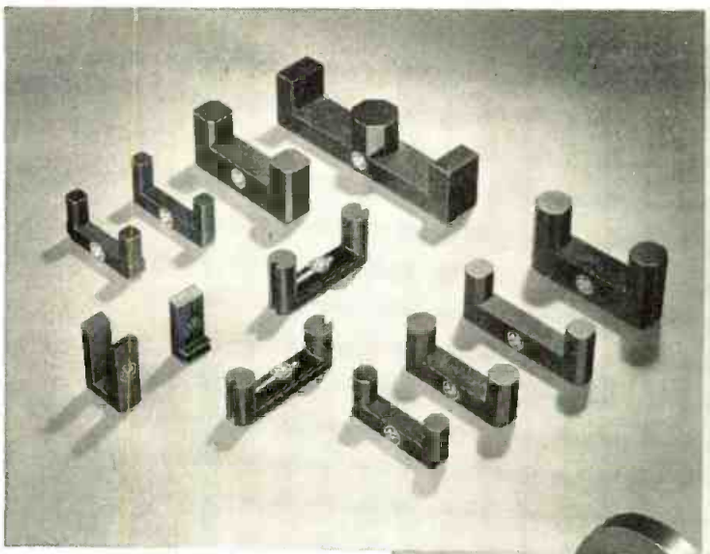
"COMPUTER-IZED" VERSION of the revised Holy Bible has been compiled by Remington-Rand's Univac. The work, a complete concordance, lists more than 350,000 words, with the contexts in which they were used, the order of appearance in the Bible, and a complete description of the location. Original concordance, published in 1894, took 30 yrs. to compile. Application of the Univac cut the time to 9 months.

THIS "ELECTRONIC BRAIN" THING is being carried too far. One publicity writer got carried away last month, and referred to a poorly-functioning computer as "intoxicated."

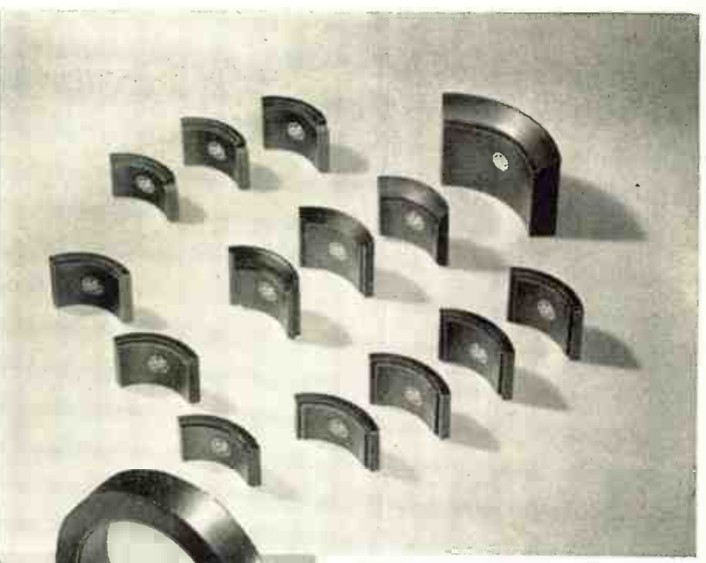
NEW TECHNICAL TYPEWRITER available from Remington-Rand will be of interest to engineers. The machine has removable and interchangeable symbols, and all the characters can be changed in a matter of minutes. Remington-Rand is also making available a full line of mathematical and engineering symbols to fit the machines. Owners of older models can have the new type keys installed in their present machines to take advantage of the new interchangeable type.

SEVERE MAGNETIC STORMS which tied up communications last month were due to a tremendous explosion on the face of the sun. Scientists described the blast as equivalent to 1,000,000 hydrogen bombs, and at its height the earth was receiving more than twice its normal cosmic ray radiation. The disturbance made trans-Atlantic phone calls almost impossible.

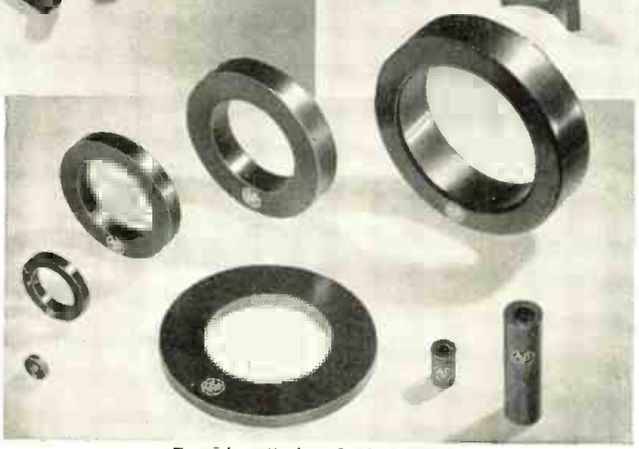
(*Continued on page 48*)



E-cores, L-cores & U-cores



Deflection yoke cores—¼ section



Toroid, cylinder, & ring cores

HIGH EFFICIENCY FERRITE COMPONENTS

For TV and Electronic Circuits

Three performance standards—WO-1, WO-2, and WO-3—have been established for the performance characteristics of Allen-Bradley ferrite parts:—

WO-1 and WO-3 are somewhat more efficient but are interchangeable with other makes of ferrite components.

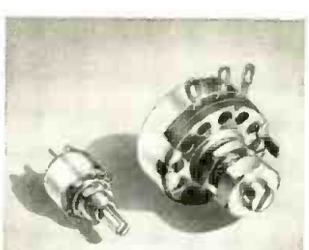
Allen-Bradley WO-2 ferrite parts have much lower losses and higher permeability with greater flux density at maximum operating temperature. Their higher magnetic efficiency permits reduction in size of the ferrite parts and the use of less copper. Lower over-all cost is often the result.

In some color TV circuits, Allen-Bradley WO-2 ferrites have eliminated two tubes and related parts. It will pay you to investigate the use of Allen-Bradley ferrites in your electronic circuits.

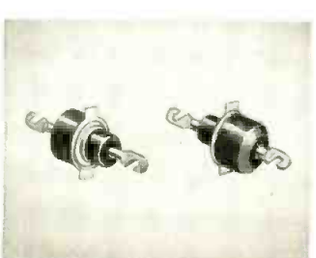
Allen-Bradley Co., 1342 S. Second St., Milwaukee 4, Wis. In Canada—Allen-Bradley Canada Limited, Galt, Ont.

OTHER QUALITY COMPONENTS FOR RADIO, TV & ELECTRONIC APPLICATIONS

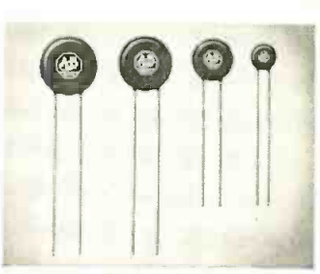
Fixed Molded Resistors
1/10, 1/2, 1 & 2 watt



Variable Molded Resistors
1/2 & 2 watt



Ferri-Cap Feed-thru Filters
with ferrite material



Ceramic Dielectric Capacitors
for by-pass and filtering

ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

THE LATEST NEWS IN PRINTED CIRCUITS

New HP Series Copper Clad Laminates Give Double Bond Strength—Assure Perfect Circuits In Less Dip Solder Time

Bond strength—12 to 15 pounds! Dip solder temperature resistance—30 seconds at 500°F.! These unique features of National's new HP Series of copper clad laminates may well revolutionize printed circuits.

Base of these laminates is National's Phenolite laminated plastic—most widely used material for printed circuits. To this we apply a new surface conditioning process and a super-strong bonding adhesive. Result; faster processing and fewer rejects—better printed circuits than any made by other methods.

In production, HP Series laminates speed dip soldering and provide cleaner joints. In service, they minimize bridging in the printed circuit. The high heat resistant bonding adhesive also assures unusual retention of bond strength—even after repeated heating and cooling, which occurs in electronic circuits when current is turned on and off.

Manufacturers using automatic assembly machinery will find HP series clad laminates especially useful. The new process uniformly conditions the bonding surface of both electrolytic and rolled copper foil. And the speed-up in soldering, *without* sacrificing perfect connections, permits production line assembly of printed circuits—particularly when cold punching grades of Phenolite are used.

WRITE FOR NEW HP SERIES EDITION—PRINTED CIRCUIT CATALOG. Etchers and users of printed circuits will find the key to better production, reduced costs and improved products in our new HP Series manual "Mechanize Your Wiring." Write for free copy to Dept. F-4.

NATIONAL
VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE

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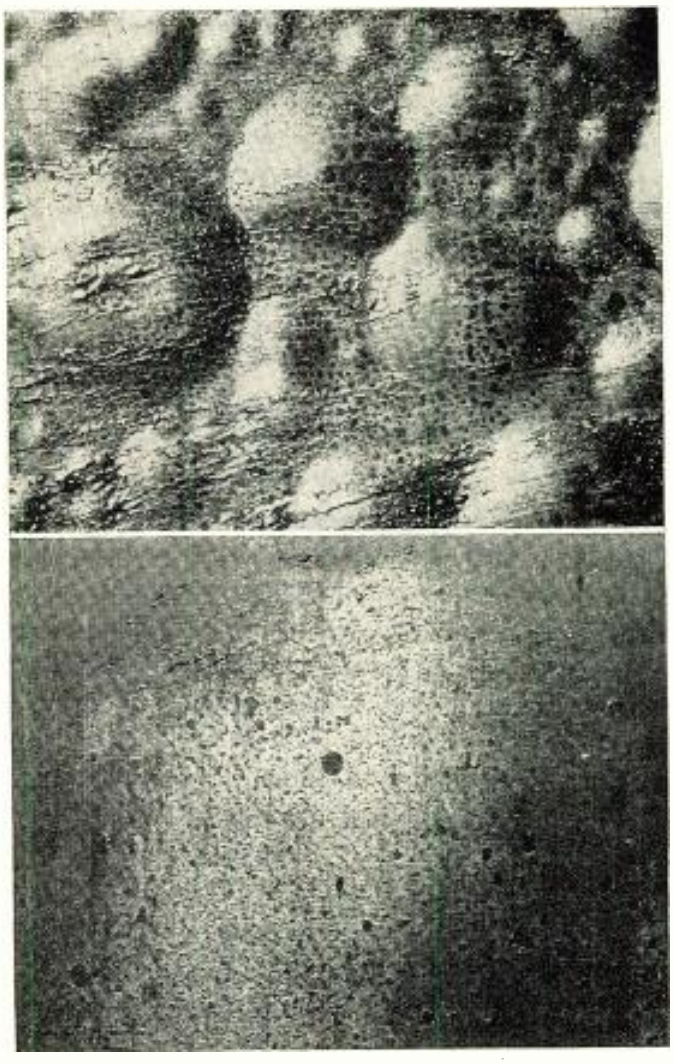
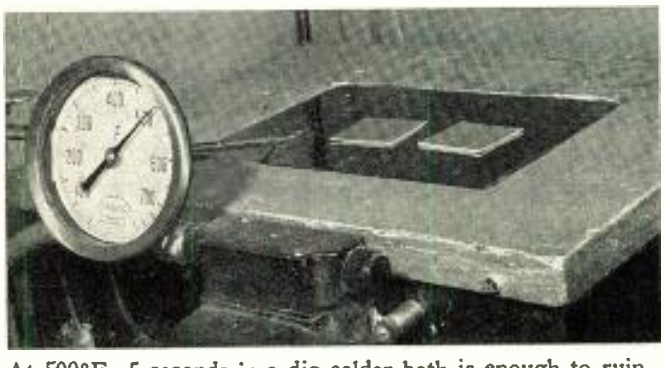
VULCANIZED FIBRE • PHENOLITE LAMINATED PLASTIC • PEERLESS INSULATION
KENNETT MATERIALS HANDLING RECEPTACLES • VUL-COT WASTEBASKETS
LESTERSHIRE TEXTILE BOBBINS • VULCOT PRODUCTS FOR THE HOME



Unretouched photographs show effect of 5 seconds dip soldering at 500°F. on conventional copper clad laminate and 30 seconds at 500°F. on new HP Series laminates made by National Vulcanized Fibre. Note severe blistering of conventional laminate (top) and the virtually unmarred surface of National's HP Copper Clad (bottom).



At 500°F., 5 seconds in a dip solder bath is enough to ruin ordinary printed circuit laminates. Bonds lose their strength. Cladding develops blisters. Production becomes impossible. But *not* with new National HP Series Copper Clads. These take the punishing temperature for up to 30 seconds—without damage.

TELE-TIPS

(*Continued from page 44*)

UNKINDEST CUT—Sikorsky Aircraft Corp. requested a $3,000,000 reduction in the $10,000,000 assessment on their plant in Stratford, Conn. The Town Board of Tax Review dutifully took the matter under consideration and recommended a reduction—$345 for a barn demolished last year.

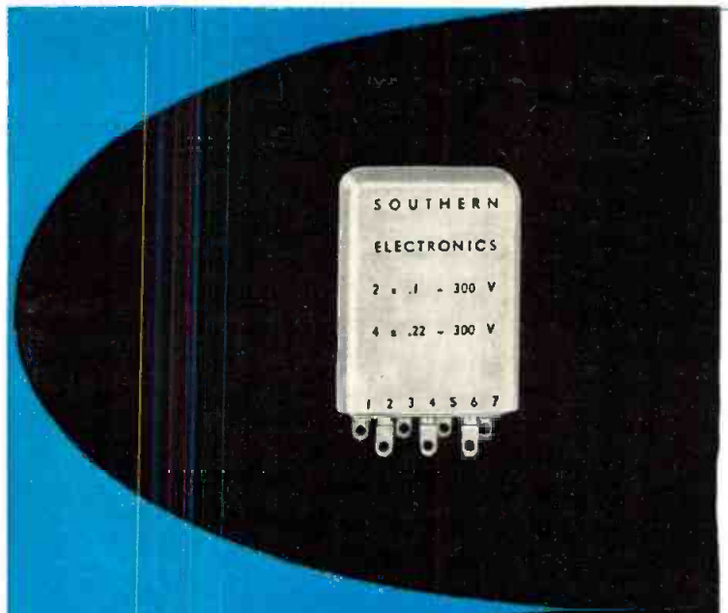
"ELECTRONIC NOSE," developed at Purdue Univ. to measure air contamination, grew out of discovery that odorous materials absorb into test surfaces in sufficient amounts to change the contact potential difference by several millivolts

SMALL COMPANIES are the backbone of our economy. Of the country's four million businesses, 95% are small, and they amount for one-third of the national output.

AUDIO MYSTERY. Why, in this age of "tape" fever, are the sales of blank discs increasing steadily. Presto officials put the question to various hi-fi salons and came up with as many different answers. Most probable: music fans use the record as insurance against loss or erasure of the tape as well as for cutting copies to sell.

TRANSISTOR PORTABLE RADIOS are finding some strange uses. Raytheon reports that one Midwest power company is employing a tiny transistor portable to track down electrical troubles. The unit's high sensitivity coupled with the directivity of the antenna makes it a particularly efficient detector of the hum which results from malfunctioning receptacles, fluorescent and incandescent bulbs and fixtures.

INDUSTRIAL TV made such a big hit with one New York banking firm that they are planning to increase the service to other branches. Link presently in operation ties branch in to central accounting room so that tellers at the branch can quickly check on customer's accounts. Experiments are planned with microwave transmission that may lead to setting up the bank's own TV network.



CONDENSE AND SAVE!

Plastic condenser block capacitors save you space, labor, money!

Multiple capacitors in one block! Now you can install one capacitor case and use 125% less space than before — at a saving in labor costs of up to 300%.

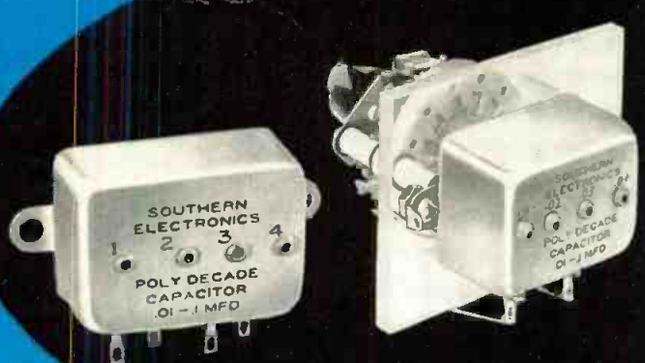
Let us solve your condenser block problems. Send us your requirements. Many case sizes and configurations are available with polystyrene or MYLAR* dielectric to tolerances as close as 1%.

now after years of intense research and development of military requirements offers you **RC NETWORKS**

PITCH FILTERS
INTEGRATOR NETWORKS

RC NETWORK as low as ½% capacitors and ½% resistors for reliable RC value of 1%.

- Hermetically sealed and potted
- Meets exacting military specifications
- SAVES SPACE & LABOR



PRECISION DECADE CAPACITORS with attached rotary switch or completely boxed!

Now on special order! Decade capacitors with higher voltage ratings, closer tolerances and capacitance from .001 to 10 M.F.D. with polystyrene or MYLAR* dielectric to tolerances as low as 1%.

CHECK THESE OUTSTANDING FEATURES:

- Standard voltage rating . . . 200 V.D.C.
- Very high insulation resistance
- Low dissipation factor
- Low dielectric absorption
- Small sizes

*DuPont T.M.

SOUTHERN ELECTRONICS *Corporation*

POLYCON S·E·C MYCON

For your most exacting requirements—

always specify S.E.C.

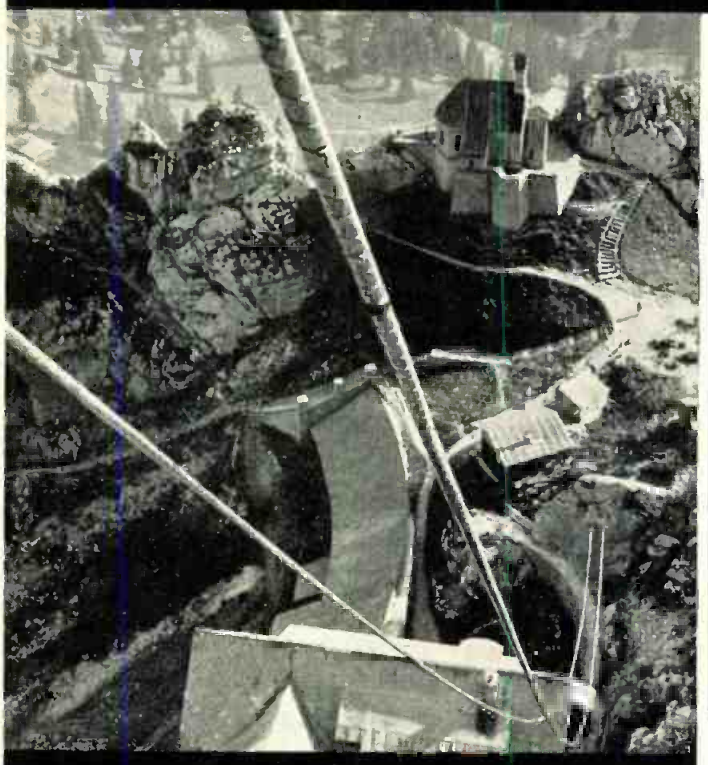
Wire, write or phone for a complete catalog today!

239 West Orange Grove Ave., Burbank, California

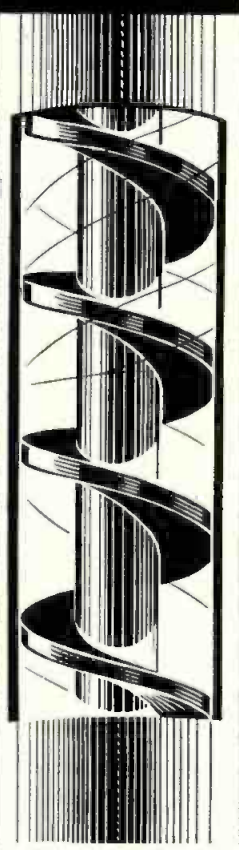
Styroflex Coaxial Cable

IS GOING PLACES—DOING THINGS in the Broadcast Field!

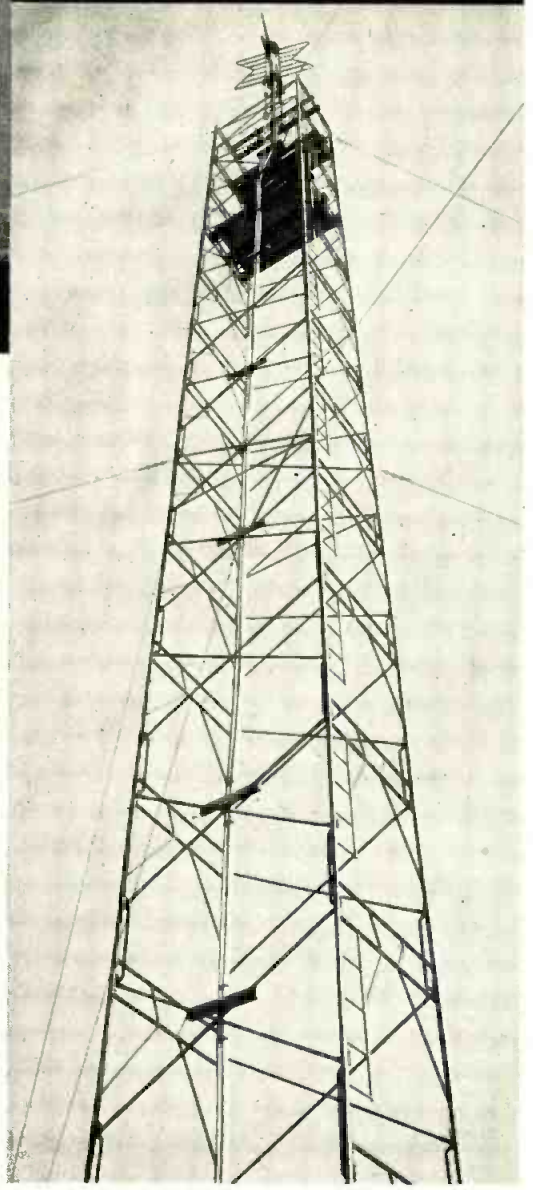
NORTH CAROLINA



SWISS ALPS



MINNESOTA



Perhaps Styroflex can answer your particular problem.
Inquiries welcomed by our engineering staff.

PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

El-Menco Capacitors

If it depends on El-Menco Dur-Mica capacitors, it can run from 12 to 15 years with average use! Not 1,000—but 6,000 or more hours of accelerated testing!

In rigid life tests in which the applied voltage was 1½ times rated voltage and the ambient temperature was 125° centigrade, El-Menco DM-15, DM-20 and DM-30 capacitors out-distanced all normal ratings with each lasting over *6,000 hours* at 125° centigrade. Because of the acceleration of these tests the life of these capacitors may be equivalent to 12 to 15 years or more under normal operating conditions.

For television, guided missiles, hearing aids, computors, miniaturized printed circuitry, electronic brains, and other civilian or military applications . . . test the life-long potentialities of long-life El-Menco capacitors.

El-Menco Dur-Mica DM-15, DM-20 and DM-30 Dipped Mica Capacitors offer:

1. LONGER LIFE
2. EXCELLENT STABILITY—SILVERED MICA
3. POTENT POWER
4. SMALLER SIZE
5. PEAK PERFORMANCE

Made To Meet Government and Civilian Requirements

For your special requirements — we are pleased to offer information and assistance. Write for free samples and catalog on your firm's letterhead.

El-Menco Capacitors

THE ELECTRO-MOTIVE MFG. CO., INC.
WILLIMANTIC, CONNECTICUT

• molded mica • mica trimmer
• tubular paper • ceramic

Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.
Exclusive Supplier To Jobbers and Dealers in the U.S. and Canada

PERSONAL

Dr. Thomas T. Goldsmith, Jr., who has headed the Research Div. at Allen B. Du Mont Laboratories, Inc., Clinton, N. J., since 1936 has been named vice-president and general manager of the Government and Research Divisions of that company.

Norman S. Kornetz has been appointed Manager of Engineering, Television-Radio Div., Westinghouse Electric Corp., Metuchen, N. J.

Norman S. Kornetz

John L. Dalke

John L. Dalke has been appointed chief of the high frequency impedance section of the Radio Standards div. of the Boulder Laboratories of the National Bureau of Standards, Boulder, Colo.

Walter S. Smith has joined the Electronics Dept. of United States Testing Co., Inc., Hoboken, N. J., as Senior Engineer.

Thomas M. Butler has been appointed to the new post of director of engineering for the Burroughs Corporation, Detroit, Mich.

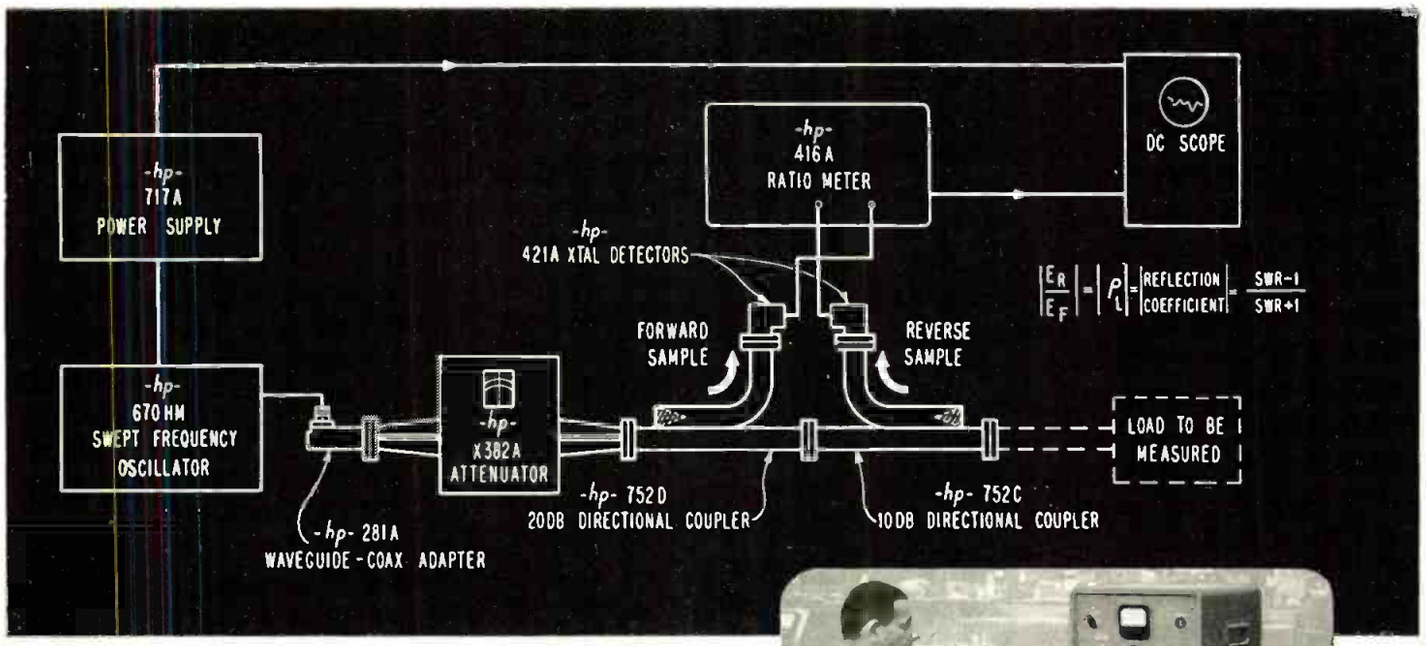
The appointment of **Fred Gluck** as Director of Engineering has been announced by the Astatic Corp. of Conneaut, Ohio.

Robert R. Mawson has been appointed project chief for special electronic pressure-sensing equipment at the Transducer Div., Consolidated Electrodynamic Corp., Pasadena, Calif.

T. E. Roberts, Jr., has been named technical director at the Raleigh Engineering Laboratories, Raleigh, N. C., of the American Machine & Foundry Co.

Wind Turbine Co., West Chester, Pa., has appointed **Edward H. Shively** Assistant Chief Engineer to concentrate on communications antenna development.

Dr. Eugene B. Johnston has been appointed Project Engineer in charge of research and development of instruments and equipment for medical research and treatment at WacLine, Inc., Dayton, Ohio.



Reflectometer system. Swept rf power is provided by Oscillator. Directional Couplers sample forward and reverse power. Waveguide Detector Mounts terminating both Couplers demodulate power and present a 1,000 cps signal to Ratio Meter. Oscilloscope presents continuous visual study of reflection coefficient over the swept frequency range.

New!

REFLECTOMETER SYSTEM

for fast, accurate, wide range microwave impedance measurements

- **Instantly measures SWR or reflection coefficient**
- **Continuous swept frequency oscilloscope presentation**
- **Ends tedious checking; unaffected by amplitude variation**
- **Systems for frequencies 2.6 to 10 KMC**

This fast, accurate, practical new reflectometer system eliminates hours of tedious engineering in microwave impedance measurements. It gives direct, instantaneous reflection coefficient or SWR readings, ends need for separate forward and reverse power measurements and does away with corrections for amplitude variation. It provides for continuous oscilloscope or recorder presentation and is easily operated by non-technical personnel. The system includes several new *-hp-* instruments:

***-hp-* 416A Ratio Meter,** automatically combining forward and reverse signals and displaying ratio directly; or provides output for oscilloscope or recorder. Unaffected by amplitude variation. $450.00.

***-hp-* 670 Swept Frequency Oscillators,** three models, covering frequencies 2.6 to 10 KMC. Manually tuned or motor driven to sweep any band at velocity insuring good oscilloscope trace. $1,000.00.

***-hp-* 717A Klystron Power Supply,** specially designed to power *-hp-* 670 Swept Frequency Oscillator. *-hp-* 717A, $375.00.

***-hp-* 752 Directional Couplers,** multi-hole couplers having directivity better than 40 db and very accurate coupling factor. Sampled signals are detected with *-hp-* 421A Crystal Detectors and *-hp-* 485 series Detector Mounts. *-hp-* 752 Couplers, $100.00 to $260.00.

For details see your -hp- representative or write direct

HEWLETT-PACKARD COMPANY

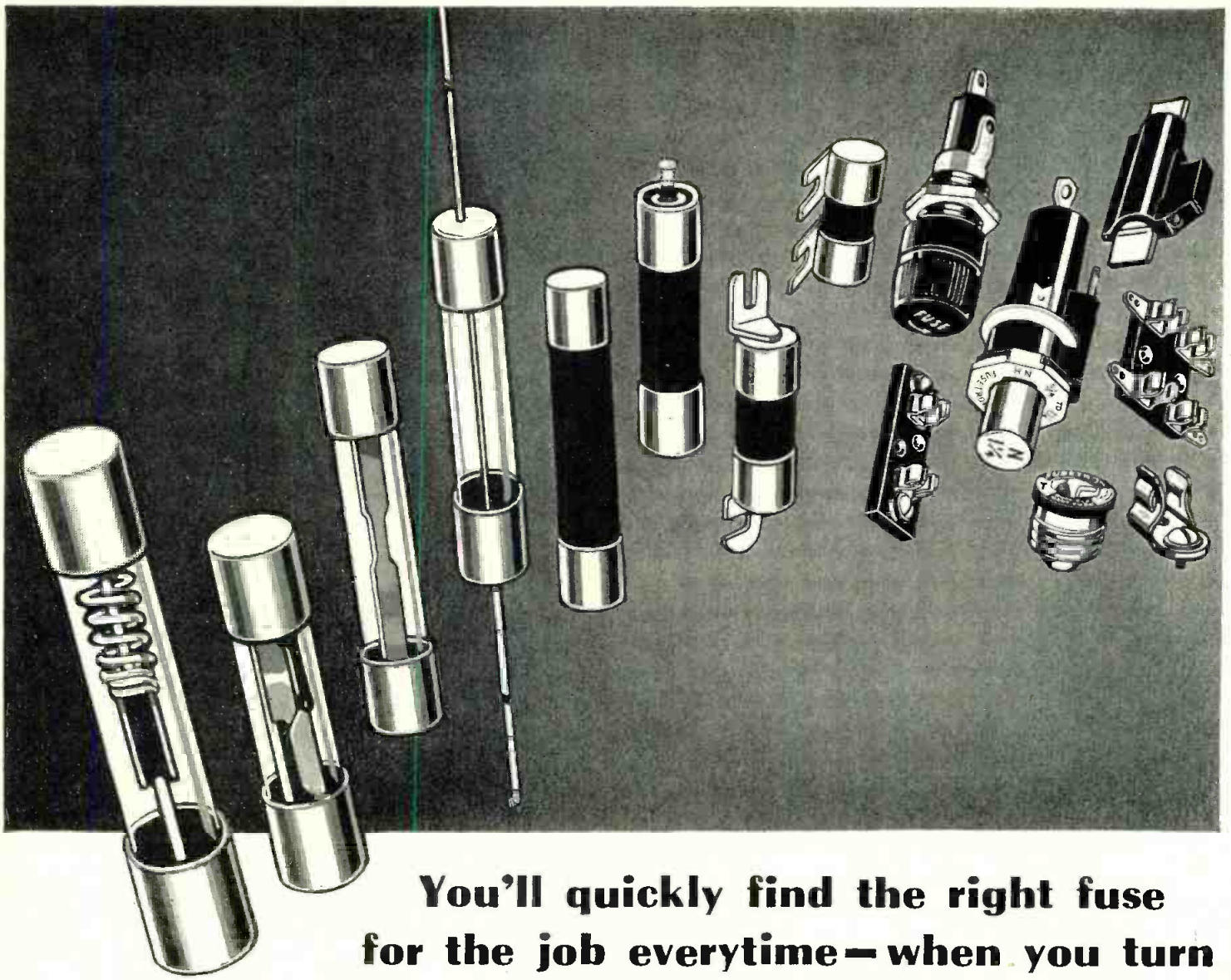
3337T PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.

Cable "HEWPACK"

Sales representatives in all principal areas

Prices f.o.b. factory. Data subject to change without notice.

hp ELECTRONIC MEASURING INSTRUMENTS



You'll quickly find the right fuse for the job everytime—when you turn to BUSS Fuses

The complete BUSS fuse line includes: standard types, dual-element (slow blowing), renewable and one-time types — available in all standard sizes, and many special sizes and designs. Plus a companion line of fuse clips, blocks and holders.

Simplify your purchasing, stock handling and records — by standardizing on this one, reliable source for fuses.

BUSS Trademark is your assurance of "trouble-free" protection

BUSS fuses are electronically tested to make sure they will operate as intended under all service conditions. A sensitive device automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

Save engineering time on electrical protection problems. The BUSS fuse engineers are at your service to help you determine the fuse or fuse mounting best suited to your needs. If possible, they will suggest a fuse or fuse mounting already available in local wholesalers' stocks, so that your device can be easily serviced.

For more information on BUSS and FUSETRON small dimension fuses and fuseholders, write for bulletin SFB.

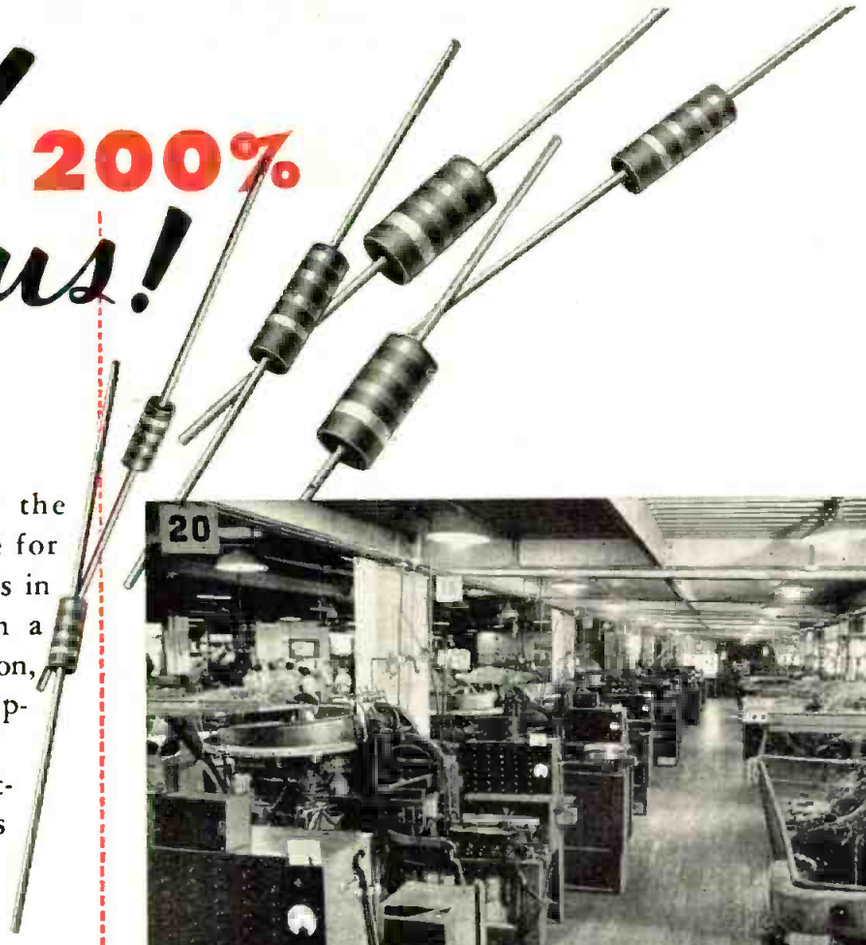
456

MAKERS OF A COMPLETE LINE OF FUSES FOR HOME, FARM, COMMERCIAL, ELECTRONIC, AUTOMOTIVE AND INDUSTRIAL USE.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN MFG. CO.
(Div. of McGraw Electric Co.)
UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.

TESTED 200% *plus!*



YOU'VE probably noticed the steadily growing preference for Stackpole fixed composition resistors in critical military uses as well as in a high percentage of today's television, radio and industrial electronic equipment.

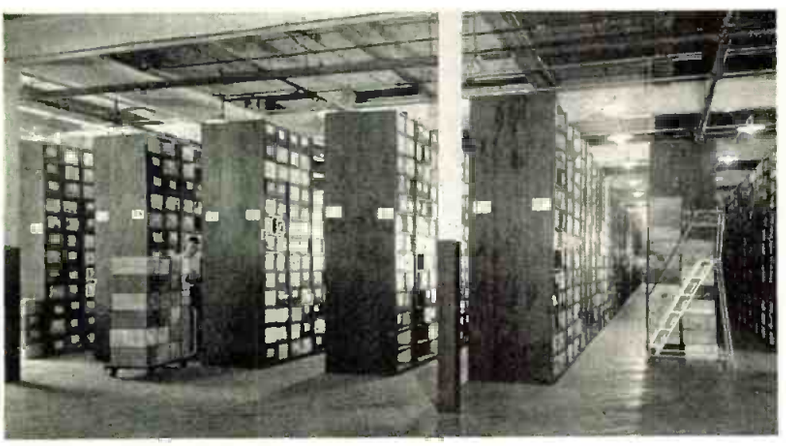
There are two main reasons: Outstandingly dependable products backed by equally dependable, personalized service.

Dependability is assured by the most modern manufacturing techniques *plus* constant testing. From preliminary sorting tests to the final 100% test and numerous quality control tests extending from raw materials through production, it is conservative to say that Stackpole resistors are tested well over 200%.

As for service in meeting resistor requirements accurately and when promised—this is a Stackpole factor that is just as carefully controlled and tested as the manufacturing processes themselves.

And it is our sincere aim to keep it that way.

ELECTRICAL TESTING— Each Stackpole fixed composition resistor gets a final test on automatic machines like these. Other tests before and during production bring the total test percentage to well over 200%.



SERVICE IN THE MAKING— A portion of the huge fixed composition resistor stock Stackpole strives to maintain to assure prompt deliveries.

Electronic Components Division
STACKPOLE CARBON COMPANY
St. Marys, Pa.

Canada: Canadian Stackpole Ltd.,
550 Evans Ave., Etobicoke, Toronto 14, Ont.

THIS IS OUR 50th Year
STACKPOLE
FOUNDED 1906

Sold by leading parts distributors in quantities up to 1,000 of a value

STACKPOLE RESISTORS

FIXED COMPOSITION

INDUSTRY NEWS

Samuel J. Childs has been appointed vice-president and general manager of Weston Electrical Instrument Corp., Newark, N. J. The company has also announced the appointment of **John D. MacNamara** as field sales manager.

Dr. Wallace C. Caldwell has been appointed to head a new department for expanded research into, and production of, transistors, at the Red Bank (N.J.) division of Bendix Aviation Corp.

Two West Coast executive appointments have been announced by the Robertshaw-Fulton Controls Co. **Wilbur Jackson**, a vice-president of the company, has been named general manager of the Grayson Controls Div., Long Beach, Calif. **Robert L. Wehrli** has been appointed general manager of the Aeronautical Div., Anheim, Calif.

The election of **Walter W. Slocum** as vice-president in charge of operations of Daystrom, Inc., Elizabeth, N. J., has been announced. **George J. Parker** has been appointed vice-president in charge of Daystrom's Washington office.

Lt. Col. John J. Slattery has been named Assistant to the Vice-President and General Manager of the Government and Industrial Div. of The Magnavox Co., Fort Wayne, Ind.

The appointment of **J. J. Jensen** to the post of general manager of Nebraska Electronics Manufacturing Co., Ogallala, Neb., has been announced.

Howard R. "Pat" Patterson has joined Varian Associates, Palo Alto, Calif., as manager of the Production Engineering Dept.

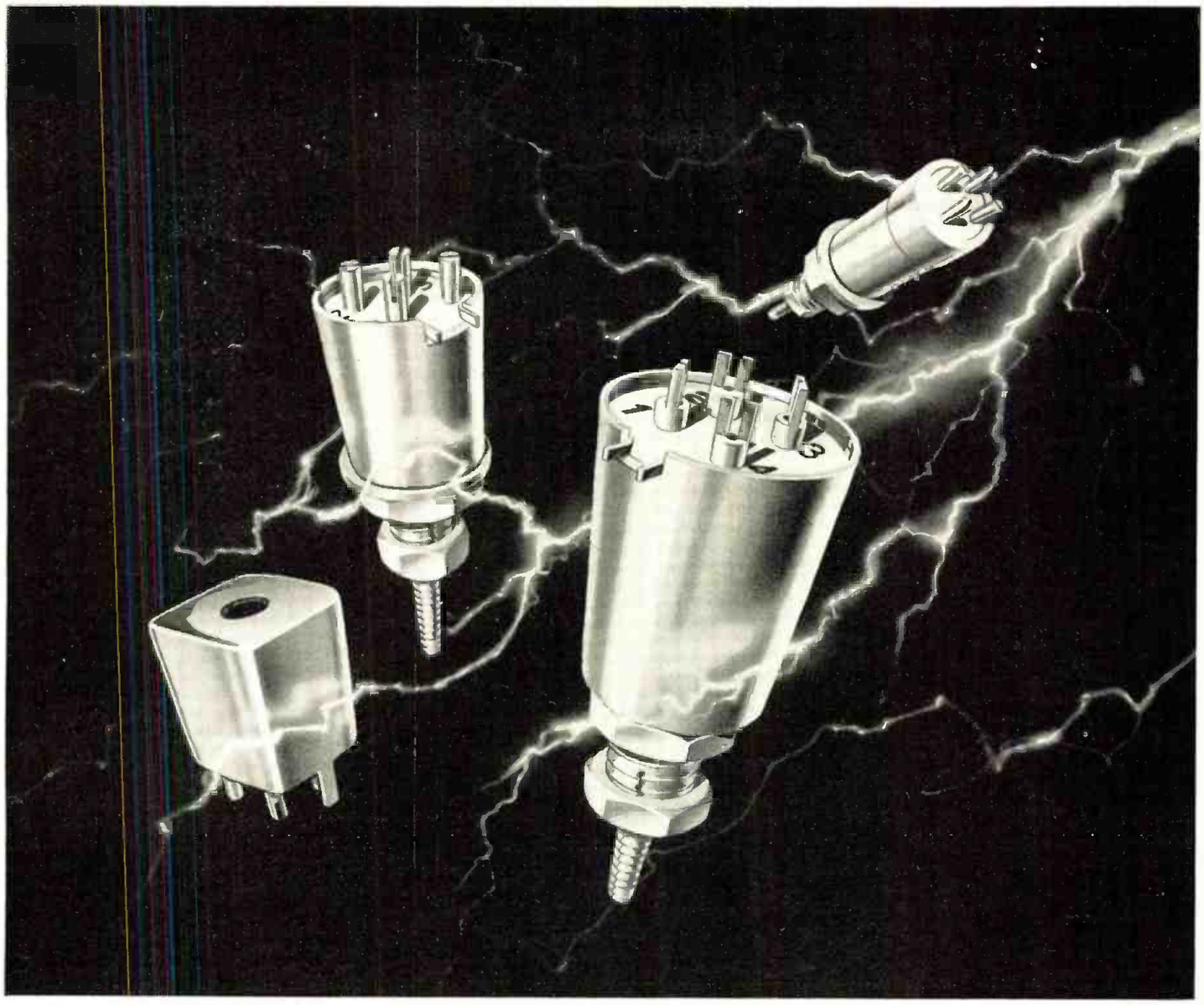
Honorary memberships in the Audio Engineering Society have been awarded to **Peter L. Jensen**, chairman of the board of Jensen Industries, Forest Park, Ill., and **Edwin S. Pridham**, who retired in 1954 as vice-president of The Magnavox Co.

John M. Palmer has been appointed manager of the new Spring City, Pa., plant of the Lansdale Tube Co., div. of Philco Corp.

Appointment of **Thomas B. Horton** as Assistant to the Deputy Director of the Burroughs Corp. Research Activity, Paoli, Pa., has been announced.

As another step in the expansion program of Tung-Sol Electric Inc., Newark, N. J., **Harold F. Cook** has been appointed to the newly-created post of director of advertising and market research.

(*Continued on page 58*)



Four sizes of shielded coil forms cover a wide range of design requirements. Dimensions when mounted, including terminals, are: LS-12 (square type for printed circuits), ½" x ½" x ½"; LS-9, 7/16" diameter x ½" high; LS-10, 5/8" x 15/16"; LS-11, 15/16" x 17/32". Each form mounts by a single stud. Windings may be universal or wound to your specifications.

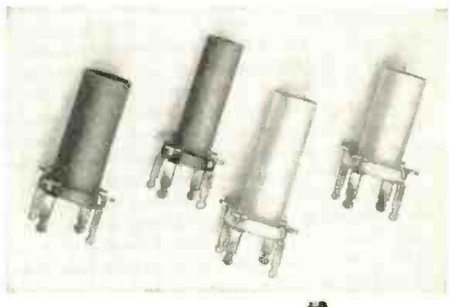
Where shock treatment doesn't work

CTC miniaturized shielded coil forms are highly shock resistant. With mechanically enclosed, completely shielded coil windings, they bring all the ruggedness and dependable performance you require for your "tight spot" applications — IF strips, RF coils, oscillator coils, etc.

CTC combines *quality control* with *quantity production* to supply exactly the components you need, in any amount. CTC *quality control* includes material certification, checking each step of production, and each finished product. And CTC *quantity production* means CTC can fill your orders for any volume, from smallest to largest.

For samples, specifications and prices, write to Sales Engineering Dept., Cambridge Thermionic Corporation, 436 Concord Ave., Cambridge 38, Mass. On the West Coast contact E. V. Roberts and Associates, Inc., 5068 West Washington Blvd., Los Angeles 16, and 61 Renato Court, Redwood City, Cal.

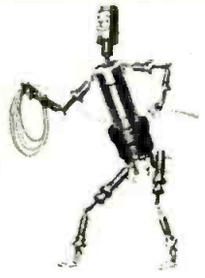
TYPE SPC phenolic and ceramic printed circuit coil forms can be soldered after mounting. Phenolic forms: ¾" high when mounted, in diameters of .219" and .285". Ceramic forms: ¼" diameter, in mounted heights of 5/8" and 13/16", with 19/32" powdered iron core, and collars of silicone fibreglas. Forms come with threaded slug and terminal collar. Units mount through two to four holes, as required. Available as forms alone or wound as specified.



CTC

CAMBRIDGE THERMIONIC CORPORATION

makers of guaranteed electronic components
custom or standard



INDUSTRY NEWS

(*Continued from page 56*)

Frank J. Skwarek has been elected a vice-president of the Polarad Electronics Corp., Long Island City, N.Y.

Herbert L. Reichert has been named Midwest Regional Manager, CBS-Hytron Sales Corp., Danvers, Mass. His headquarters will be located at 4935 W. Fullerton Ave., Chicago, Ill. CBS-Hytron has also announced the appointment of **Jon B. Jolly** as Sales Manager, Semiconductors.

Dr. J. Nelson Grace, nuclear reactor control specialist at the Westinghouse Bettis plant (Pittsburgh, Pa.), has received an honorable mention citation as Outstanding Young Electrical Engineer for 1955, from Eta Kappa Nu, the scholastic honorary fraternity for electrical engineers.

The promotion of **Allen B. Du Mont, Jr.**, to the position of assistant to the manager of the Television Receiver Div. at Allen B. Du Mont Laboratories, Inc., Clifton, N.J., has been announced.

Harold A. DeMooy has been appointed mgr. of Manufacturing for the RCA receiving tube activities at Harrison and Woodbridge, N.J., Indianapolis, Ind., and Cincinnati, Ohio.

National Aircraft Corp. has announced the appointment of **James W. Browder** as technical advisor to the vice-president, Marvelco Electronics Div., Burbank, Calif.

B. F. Steiger has been named vice-president, Chatham Electronics, Livingston, N.J.

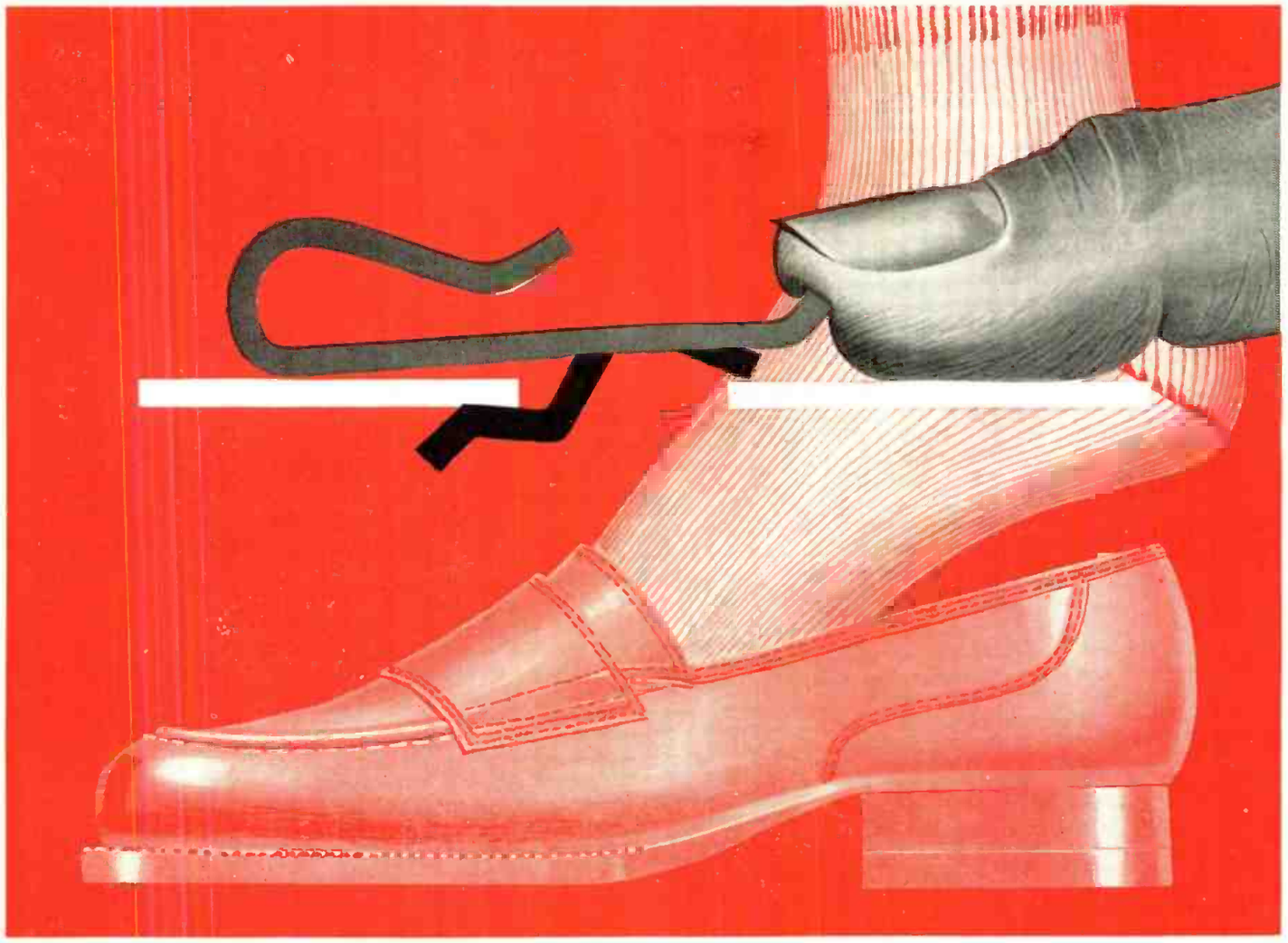
Election of sales manager, **Daniel Dewey, Jr.**, as vice-president of the Eaton Electronics Corp., Moodus, Conn., has been announced.

Larry King has been appointed to the staff of the Newark, N.J., sales engineering office of Transitron Electronic Corp., Melrose, Mass.

Promotion of **Paul C. Ketchersid** to the position of Personnel Manager has been announced by the Capehart-Farnsworth Co., Fort Wayne, Ind.

Dr. James J. Brophy has been promoted to assistant manager of the physics research dept. at Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Russell W. Johnson, formerly assistant advertising manager, has been appointed advertising and sales promotion manager of the television-radio div. of Westinghouse Electric Corp., Metuchen, N.J.



MONEY-SAVING MAGIC IN THIS "HEEL AND TOE"

This Tinnerman fastener is modeled after your foot . . . there's a heel and toe . . . it slides easily into the holes punched in the metal, fiber, or plastic, even as your foot slides into a shoe. But it is much easier to put on than to take off!

The primary function of this SPEED NUT fastening principle is to provide a fast, easy-to-apply, low-cost, self-retaining fastener. Its snap-on attachment feature requires little skill and no welding or staking. Yet it assures positive retention for center panel or blind locations.

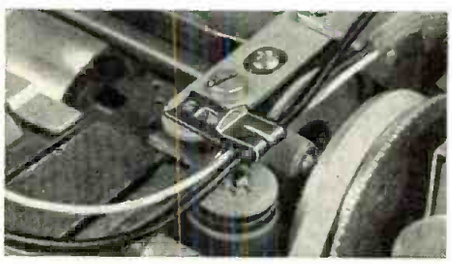
Tinnerman "heel-and-toe" fasteners can also have a wide variety of fastening features. The self-retaining heel-and-toe can be combined with the famous Tinnerman SPEED NUT impression. Or with a speedy cable clip . . . or a spring catch . . . a molding clip . . . a wire retainer . . . almost any fastening idea you require.

Tinnerman sales engineers are ready to make a SPEED NUT Analysis of your fastening requirements. Or you can write to us for details and engineering data. *Tinnerman Products, Inc., Box 6688, Dept. 12, Cleveland 1, Ohio.*

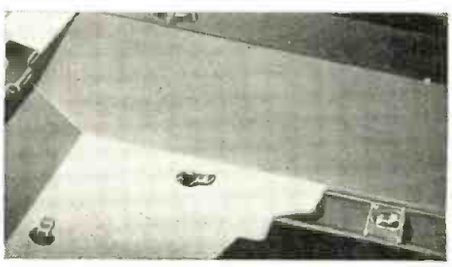
TINNERMAN

Speed Nuts

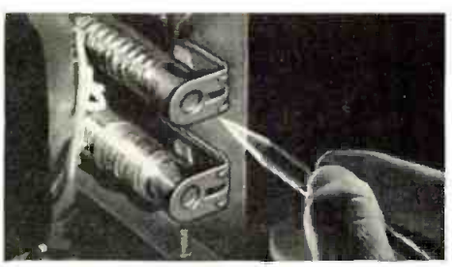
FASTEST THING IN FASTENINGS®



On dictating equipment, this SPEED CLIP® holds wires safely away from moving parts.



SPEED CLIPS secure molding on plastic sign, help manufacturer gain 48% assembly saving.



Assembly of TV tuning coil to chassis and servicing simplified with special SPEED CLIP.

BOOKS

Synchros, Self-Synchronous Devices and Electrical Servo-Mechanisms

By Leonard R. Crow. Second edition, published 1955 by The Scientific Book Publishing Co., 530 S. 4th St., Vincennes, Ind. 222 pages, price $4.20.

The purpose of this book is to contribute a broad understanding of the fundamental principles underlying the functional operating theory, as well as the effective use and application, of synchros and allied self-synchronous electrical mechanisms.

Beginning with general information pertaining to the construction and operation of synchro devices, the subjects covered include synchro control transformers, differential synchros, position indicators, power synchros, and magnesyns and other saturable-core electrical servos. Many special synchros and devices that have evolved from the fundamental form are considered.

The great scientific and engineering interest that exists today in the use of self-synchronous devices and their principles as applied to electrical servomechanisms and closed-loop controls should make this book a valuable one to the practicing engineer.

Worldwide Radio Noise Levels Expected in the Frequency Band 10 KC to 100 MC

By W. Crichlow, D. Smith, R. Morton, and W. Corliss. NBS circular 557, published 1955 by Government Printing Office, Washington 25, D. C. 36 pages, paper bound. Price 30¢.

External radio noise in the frequency range covered by this circular is of 3 types: atmospheric, which is generated principally by thunder storms; galactic, which originates in the galaxy, principally from the direction of the constellation Sagittarius; and man made, which arises from such sources as industrial machinery, power lines, and ignition systems. Each type is discussed separately.

Using noise grade charts of the world and related families of curves, expected radio noise levels are given during 4 hour time blocks for each season, as a function of frequency.

Results of measurements in Colorado, Virginia, and England are compared with expected levels.

Proceeding of the RETMA Symposium on Automation

Published by Engineering Publishers, GPO Box 1151, New York 1, N. Y. 114 pages, paper bound. Price $5.00.

This book is a permanent record of the papers given at the Symposium on Automation sponsored by the Engineering Dept. of RETMA. It's contents, following the program of the Symposium, are grouped under the head-

(*Continued on page 62*)

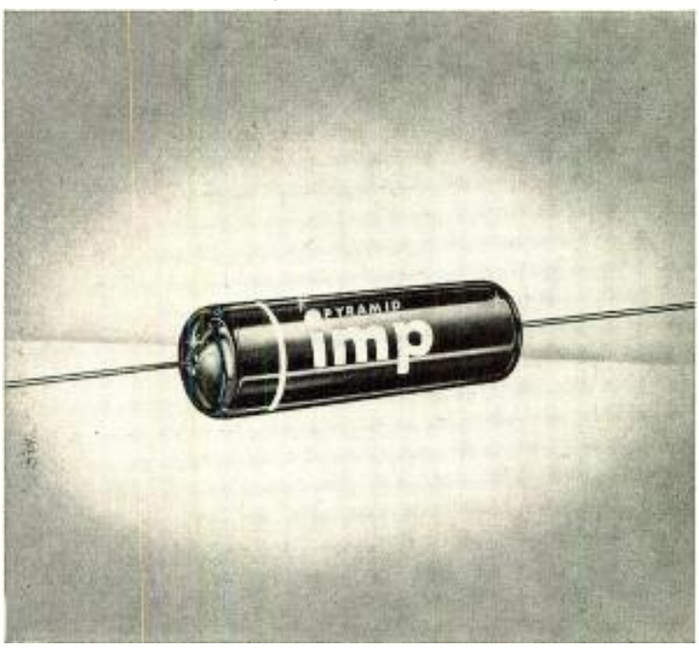
PYRAMID technical bulletin

NO. 57

THERE IS MORE TO A CAPACITOR THAN ITS DESIGN FORMULA:

$$C = \frac{K\,D}{A}$$

Pyramid's production and life tests of their capacitors are among the most stringent in the industry. Production test for voltage breakdown, capacitance, power factor, insulation resistance and seal are performed on 100% basis. In consisting of life, temperature and immersion cycling, vibration, and corrosion where applicable. These serve to guarantee that the capacitors you purchase are consistently as represented to be.



Pyramid capacitors also owe their exceptional performances to the type of materials used in their manufacture and the production methods which Pyramid engineers have devised. For example, in the new Pyramid IMP capacitor, a new, exclusive plastic molding technique was developed which bonds casing, impregnated element, and tinned copperweld leads into one compact assembly capable of withstanding severe physical abuse. In addition, this unit is heat and moisture resistant withstanding the RETMA humidity-resistance test to a remarkable degree. In another capacitor, type MT metallized paper units, vacuum impregnation is employed and the ends of the capacitor are sealed with plastic. Then, as a final step, the entire unit is completely coated with a highly moisture resistant wax. It is production techniques such as these which, in conjunction with high quality papers, impregnants (such as Halowax, Mineral Oil, or Silicone Base Synthetic Oil), and metals, that account for the excellent stability and long life that Pyramid capacitors exhibit.

Pyramid capacitors, particularly electrolytic capacitors, are specifically designed for long shelf life. To achieve this goal requires that the various materials and chemicals used in the manufacture of these units possess a high quality and long term stability. Another contributing factor to long shelf life is the care which is taken to provide maximum protection against the corrosive effects of chemicals in the atmosphere. This necessitates a container which is well insulated against the intrusion of moisture, i.e., one which is air tight and hermetically sealed.

* * * *

The number of different types of capacitors that Pyramid manufactures is extensive. Included in this line are the following:

1. Electrolytic capacitors, type TD, with each unit sealed in a metal tubular case. Available in single sections, dual sections, and triple sections.
2. Electrolytic capacitors in screw base metal containers, type MC. Available in single and dual sections.
3. Twist-Mount electrolytic capacitors, type TM. Available in single, dual, and triple sections. Different sections may have different working voltages.
4. HI-TEMP Twist-Mount Electrolytic capacitors, type TWH. Designed for 100°C operation.
5. Dry Electrolytic capacitors in wax-filled, impregnated cardboard tubes, type CDB. Available in single, dual, and triple sections. Sections may possess individual leads or share a common negative terminal.
6. Plug-in Electrolytic capacitors, type DO, provided with 4 pins on standard octal base.
7. High-capacitance, low voltage electrolytic capacitors, type PFB.
8. Molded tubular paper capacitors, type IMP.
9. Miniature tubular paper capacitors. Type 85LPT.
10. Ceramic-cased tubular paper capacitors, type CT.
11. Bathtub-Type Oil-Paper Capacitors, types PDM, PDMT, PDMB.
12. Metal-tubular Oil-Paper capacitors, types PTIM, PTDMV, 4PTIM, 4PTIMV, 7PTIM.
13. Small-base oil-paper capacitors, types PKM, PKMF, PKMS, PKMT, and PKMB.
14. High-voltage oil-paper capacitors, types PLM, PLMF, PLMS, PLMU, PLMR.
15. Kraft-tube metallized paper capacitors, type MT.
16. Metal-can metallized paper capacitors, types MPGK, MPGM.
17. Metal-tube metallized paper capacitors, types MPTIK, MPTIM.
18. "Glasseal" subminiature paper tubular capacitors, and many others.

Pyramid capacitors are competitive in price because of the modern production methods that are empolyed throughout every phase of capacitor production. Whenever possible, automation techniques are being applied so that more uniform high quality may be achieved. Much of Pyramid's success is due also to the aggressiveness of Pyramid engineers in pioneering new products.

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PYRAMID IS THE BIG NAME IN CAPACITORS AND SELENIUM RECTIFIERS TODAY!

BOOKS

(Continued from page 60)

ings: Mechanization for High Volume Assembly; Data Sensing, Processing and Utilization; The Future of Automation; Automation for Low Volume Production; and Redesign for Automation of Components and Products.

Practical and theoretical considerations of techniques and systems are treated and economic problems discussed. Design principles and application details are also presented.

Specific items covered range from such subjects as automatic production of components and electronic assemblies to automatic warehousing and automatic ticket reservation systems.

Included are questions and answers from the informal discussions following the presentation of each paper at the Symposium.

Vacuum Valves in Pulse Technique

By P. A. Neeteson. Published 1955 by Philips Technical Library, Eindhoven, Holland, 178 pages, price $4.50.

It is the aim of this book to study circuits in which electron tubes are used as switches with a view towards more efficient use and new applications. After introductory chapters on basic switching circuits and some operational calculus principles, there follows a thorough study of vacuum tubes as switches. This is subdivided into a treatment of the grid and anode circuits of both triodes and pentodes.

The last chapters and greater part of the book cover bistable, monostable, and astable multivibrators.

While this book deals with vacuum tubes only, it will be helpful in supplying designers of transistor switching circuits with the basic method of analysis of switching circuit action.

Books Received

TV Field Service Manual, Vol. 5

By Harold Alsberg. Published 1955 by John F. Rider Publisher, Inc., 480 Canal St., N.Y., N.Y. Paper bound, 137 pages, price $2.40.

Covers TV servicing in the home, using test patterns. Tube lists and layouts of over one thousand 1949 to 1955 TV receivers are given.

Salt & Water, Power & People

Published by the Hooker Electrochemical Co., Niagara Falls, N.Y. 109 pages. The story of the Hooker Electrochemical Co., presently celebrating its 50th anniversary.

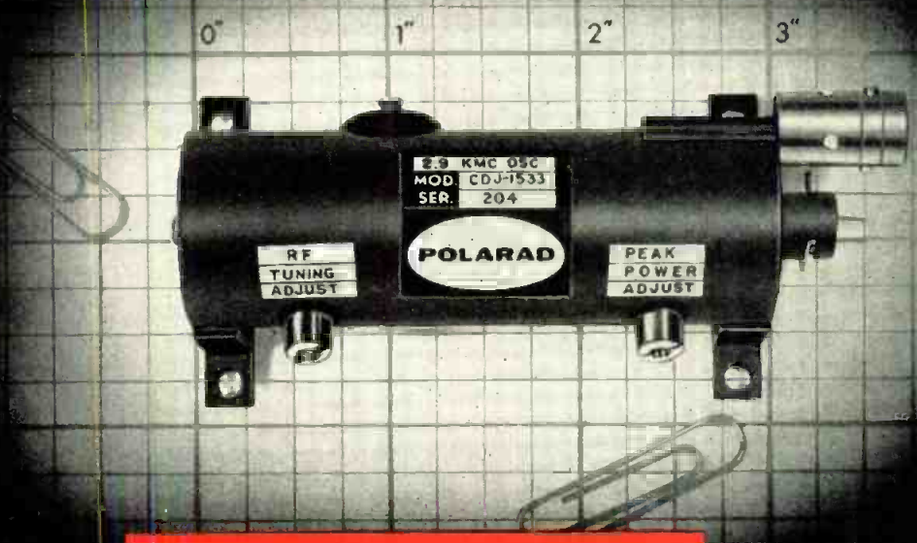
Introduction to TV-Servicing

By H. L. Swaluw and J. van der Woerd. Published 1955 by Philips' Technical Library, Eindhoven, Holland. 264 pages; price $5.50.

Although this book deals only with faults found in receivers using the 625 line system, the principles presented are applicable to the 525 line system.

SUB-MINIATURE S-BAND CAVITIES

2750-3000 mc



Sub-miniature is the word. The new Polarad S-Band cavities are only 3" long and 1" in diameter, yet outperform many larger cavities. They are particularly suited for beacon transmitters, missiles, radar, etc., where miniaturization is a key factor in the choice of components. These cavities withstand vibration, 500 g shock test, 100 g longitudinal acceleration, and are temperature compensated over the range of 0°C to 70°C. They are available for grid-pulsed, plate-pulsed, or CW operation. They may be code modulated by conventional drive circuits using hard tube or gaseous tube types.

All S-Band cavities are factory tuned to the desired frequencies, and can be varied by means of a simple special tool which permits simultaneous frequency and locking adjustment.

FEATURES:

- Extremely small size, 1" x 3"
- Ruggedized pencil triode
- 300 V DC supply is required for grid pulsing
- Temperature compensated
- Meets all MIL specifications
- Fixed low impedance output coupling into 50 OHM BNC connector

SPECIFICATIONS:

MODEL	Modulation	Power Output	PRF
CGP-1	Grid Pulsed	2 watts peak	0-4,000 PPS
CPP-1	Plate Pulsed	100 watts peak	0-1500 PPS
CCW-1	CW	50 MW	— —

Tuning Range..... 2750 — 3000 mc
Pulse Width..... 0.75 + 0.1 μSec.
Rise Time..... 0.1 μSec.
Frequency Stability..... 0.02 mc/°C.

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metallized paper capacitors

Operate at temperatures to 125°C without voltage derating

Withstand dielectric test of twice rated voltage

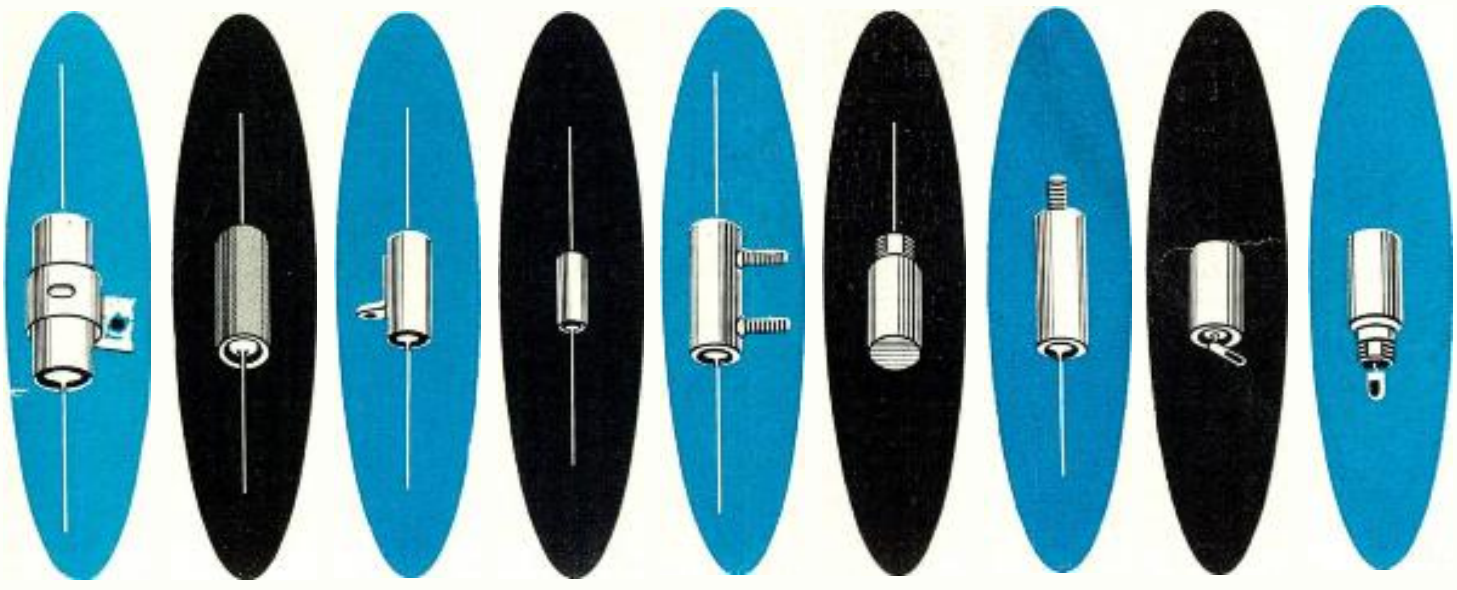
Insulation resistance higher than any other *metallized paper capacitor*

Self healing dielectric

Here are the finest capacitors which the present state of the art can produce.

In the application of stringent quality controls, Sprague has gone so far as to metallize its own paper . . . the only commercial manufacturer to do this. Thus Sprague is the only capacitor manufacturer with *complete* control over the end product. And in no other type of capacitor does quality in manufacture play so important a part in performance.

SPRAGUE®



A complete range of ratings and sizes, hermetically sealed with glass-to-metal solder-seals in corrosion-resistant cases, is available in numerous mounting and terminal styles. Write for Engineering Bulletin 224 on your letterhead.

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TELE-TECH &
ELECTRONIC INDUSTRIES

M. CLEMENTS, Publisher ★ O. H. CALDWELL, Editorial Consultant ★ B. F. OSBAHR, Editor

The Changing Times

With this issue the editorial staff of Tele-Tech & ELECTRONIC INDUSTRIES embarks on a new and vastly broader editorial program than ever before. This April issue marks our first issue as a new publication of the Chilton Company, Inc., Philadelphia, Pa. The Chilton Company has long been known as a leading publisher of technical and trade periodicals. With the purchase of Tele-Tech & ELECTRONICS INDUSTRIES, Chilton's management signified their recognition of the growing role that the electronic industries will take in the industrial world of tomorrow and their determination to remain abreast of the changing times. Here is a list of Chilton publications now serving American industry:

Automotive Industries
The engineering, production and management of cars, trucks, buses, aircraft; farm and road machinery

Boot & Shoe Recorder
National voice of the boot and shoe trade

Butane-Propane News
Headquarters for LP gas information since 1931

Commercial Car Journal
The magazine for truck and bus fleet operators

Department Store Economist
The magazine of Dept. store merchandising and management

Distribution Age
Materials handling, transportation, warehousing

Gas
Management, engineering and utilization of pipelines

Hardware Age
The hardware dealer's magazine

Hardware World
In the West for the West

The Iron Age
The national metalworking weekly

The Jeweler's Circular Keystone
Authority and leader of the jewelry industry since 1869

Motor Age
For the automotive service industry

The Optical Journal and Review of Optometry

The Spectator
Insurance authority since 1868

Tele-Tech & ELECTRONIC INDUSTRIES
For the electronic research, design, development and operational engineers

All of us are aware of the constantly expanding horizons due to new application of electronic techniques. The Institute of Radio Engineers for example, reports that there have been 24 professional groups formed over the past 8 years and yet each of these groups is only concerned with one broad avenue of electronics engineering. In turn, each of these avenues may serve many industries. Almost daily we read reports of how electronic equipment has been employed in some new phase of control, computing, communication, instrumentation etc. Typical of these topics are:

Recorded signals on magnetic tapes used to control the operations of all types of machine tools.

Closed circuit TV, in color or in black and white, finding enormous applications . . . for remote process control in heavy industry; for vehicular and aircraft traffic control; for industrial plant security as a silent watchman; as a merchandising aid in department stores; for signature verification in banks; etc.

Transistors and the electronic guided missile requirements have fostered tremendous advances in miniaturization. Today such equipment is assembled with the precision tools of the jeweler and the watchmaker. Interestingly, every large American watchmaker of yesteryear has a very active electronic division today.

A former shoe machinery producer has now turned to the manufacture of electronic production equipment.

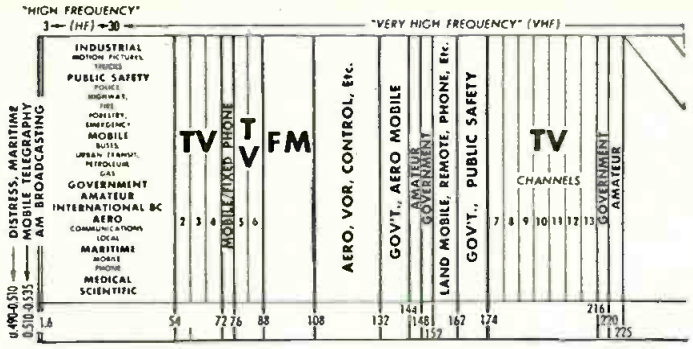
There is a constant procession of new computers to solve complex equations and counting problems in internal combustion engines; statistical forecasts for life insurance tables, voting, etc.; inventory control for the distribution of merchandise and materiel in commercial and military establishments etc.

Thus we see that the electronic industries today are constantly expanding and becoming an increasingly important element in all other types of American industry. We see too the tremendous editorial possibilities that accrue by being affiliated with a publishing concern serving as many industries as the Chilton Co.

Our front cover this month reflects the ELECTRONIC INDUSTRIES emphasis that we shall have in future editorials. Caldwell-Clements has been engaged by the Chilton Co. to continue the publication of Tele-Tech & ELECTRONIC INDUSTRIES. Our editorial and business address therefore still remains at 480 Lexington Ave., New York 17, N.Y. We hope that you will contact us here and let us know of any way in which we can be of greater service to you.

RADARSCOPE

Revealing important developments and trends throughout the spectrum for radio, TV and electronic research, manufacturing and operation

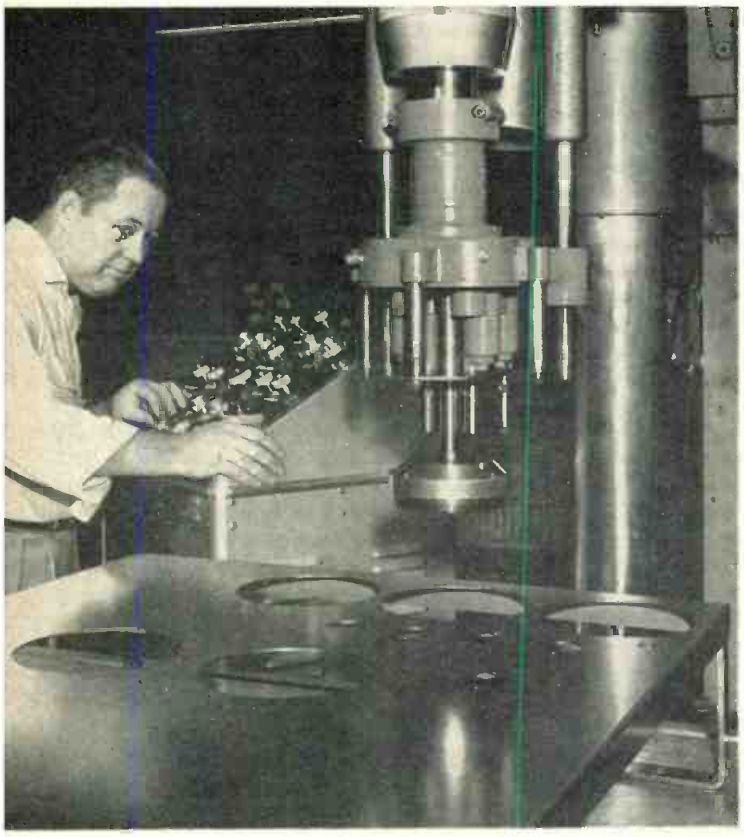


HOW TO "FIND" ENGINEERS. One large electronics firm has come up with a workable—if expensive—solution to the engineering shortage. Having exhausted the normal recruiting methods they are looking, now, to acquire further engineering help through the outright purchase of smaller well-staffed firms.

TOUGHER PRINTED CIRCUITS are in sight through a new bonding process developed by National Vulcanized Fibre Co. The new copper clads possess double bond strength (12 to 15 lb.) and much higher dip solder resistance (30 secs. at 500°F).

THE FCC has announced new rules for the permissible radiation from radio and TV receivers. All commercial radios and TV receivers manufactured after May 1, 1956, operating in the band 30-890 MC, must be certified as complying with the Commission's new regulations, and a seal must be atttached to that effect.

"AUTOMATED" DRILLING MACHINE



Electronic control system at rear permits operator of this drilling system to dial the "X" and "Y" coordinates of the hole that he wants drilled. Minneapolis-Honeywell designed the system to handle special custom drilling jobs difficult to handle by normal production methods

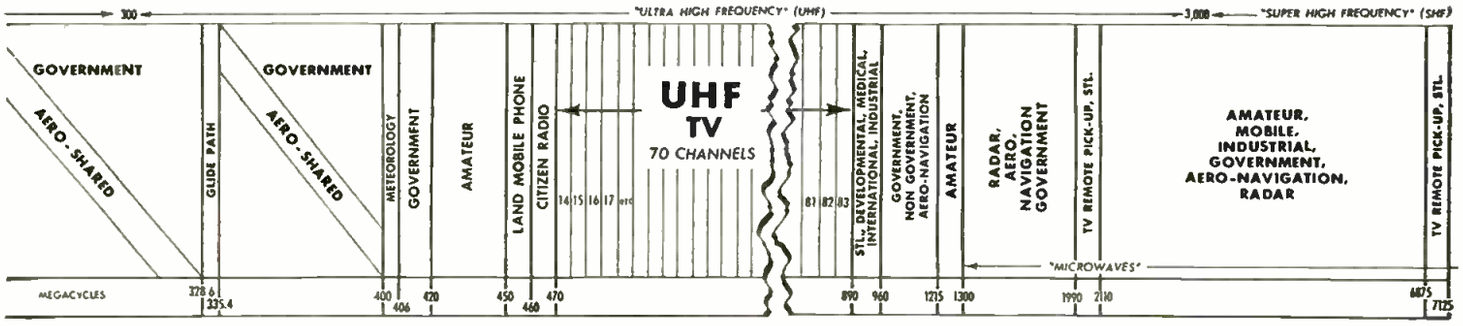
THE NARTB has petitioned the FCC to institute a rule making proceeding looking to authorize the remote control of standard and FM broadcast transmitters operating with directional antenna systems or power in excess of 10 kw.

MOBILE RADIO is being used increasingly by highway departments to coordinate the flow of materials with paving operations. An added feature, they find, is that now one engineer can cover two or more projects for he can be contacted immediately when needed.

ONE RESULT OF AUTOMATION will be the adjustment of marketing and sales to a constant flow of goods and services instead of today's practice of adjusting production to sales, points out RCA's Dr. E. W. Engstrom. Since there will be a great increase in the capital investment per worker, the capital investment, and the people who man the facility, must be kept steadily at work if appropriate returns are to result.

THREE-YEAR FCC PROGRAM. Because the use of radio as an industrial tool has become such an established and essential part of the Nation's economy FCC Chairman George C. McConnaughey recently informed Congress that the Commission is commencing a 3-year program of studying basic engineering and economic data to produce material on which to base revisions of the FCC's safety and special radio services rules. The Commission Chairman stressed to the House Appropriations Committee that this move was mandatory to keep the government from becoming "a stumbling block in this field." He cited the fact that the tremendous expansion in the industrial usage of radio frequencies requires a drastic revision of present allocations and rules.

THE IMPORTANCE OF INVESTMENT CAPITAL is the subject of a sharp dispute between the National Assoc. of Manufacturers and labor union quarters. Root of the dispute is recent statistics which show that the amount of capital employed to produce each unit of output has been getting smaller over the past 35 years; hence the "productivity of capital" has been rising. Labor circles interpret this as showing that investment capital is becoming less important to economic growth, and that tax policies should give little attention to the need for capital. Spokesmen for the NAM insist, however, that instead of being evidence of a declining need for capital, the statistics are "evidence of a growing scarcity of capital—in relation to the opportunities for using it productively."



NEW "SOLID STATE" BATTERY will extend the applications of battery-powered equipment. Developed by P. R. Mallory & Co., the new battery generates voltage by the differential in contact potential between two conductors in contact with a solid electrolyte. No water solution is used. Result of this "water-less" construction is stable output voltage over a temperature range from —65° to 165°F. Shelf life is reportedly 10 yrs., or more.

"DECCA" AIR NAVIGATION SYSTEM, the official air navigation and air traffic control system in the United Kingdom, is being tested here by the Signal Corps. The system employs low-frequency radio signals to provide continuous an all-weather, flight-position picture for aircraft. Bendix Aviation Corp., American licensees for the system, are supplying technical assistance in the tests which are being conducted in southeastern Arizona.

RENEWED INTEREST IN UHF-TV may result from an appeal made before the Senate Interstate and Foreign Commerce Committee last month by the General Electric Co. Company spokesman, Paul L. Chamberlain, asked that the FCC make "a thorough, objective inquiry into possibilities of the more effective use of UHF-TV" before the UHF channels are lost "either by intent or by default." The UHF service problem, he said, has never been the subject of an intensive inquiry by the Commission. "Thus, it may well be that no one is today properly qualified to state whether UHF can, or cannot give an adequate TV service." He added that the UHF transmitting and receiving equipments available today are definitely capable of furnishing adequate service, and that G-E has developed a tiny, "radically different tube" for the front end of the UHF receiver which has the effect of quadrupling the effective radiated power of the transmitter.

MANPOWER

ENGINEER'S GRIEVANCES were summed up at the Midwinter Personnel Conference of the American Management Assoc. by John E. Gagnon, Director of Personnel, Olin Mathieson Chemical Corp. He stated that "Engineers have become more vulnerable to unionization in recent years. Their grievances include professional status, more time off for professional meetings, leaves to take additional courses; but here, too, money is a very important element. Starting salaries this year for engineers with bachelor's degrees are reasonably high. The trouble, however, develops later on. They don't progress fast enough to keep ahead of new recruits in succeeding years. As a result, turnover increases, which is more expensive than paying higher salaries."

AVIONICS

NEW 'INTEGRATED FLIGHT INSTRUMENT SYSTEM' announced last month by Kollsman Instrument Corp. is a significant step toward providing airline pilots with more precise and interrelated flight data. Of particular importance, the system features greatly increased altimeter accuracy to provide precision in altitude separation. The complete system consists of three pressure instruments—a sensitive altimeter, a standard indicated airspeed instrument and a Machmeter. The system also includes an angle of attack sensor, an outside air temperature probe, and a computer. By means of servo components the instruments are interconnected to each other and to the computer. Information signaled from one instrument is used to correct the data of the other instruments. The important advantage of the system is that it depends on conventional pressure instruments which are connected electrically to each other and to a computer but which can function independantly in case of an electrical interruption.

ELECTRONIC FILING CABINET

Single 2,700-ft. spool of magnetic tape shown being threaded into one of the 100 file units in the new "Datamatic 1000" computer by engineer Bob Wilkins, can store as much data on its 31 channels as can be found on a half-million punched cards.

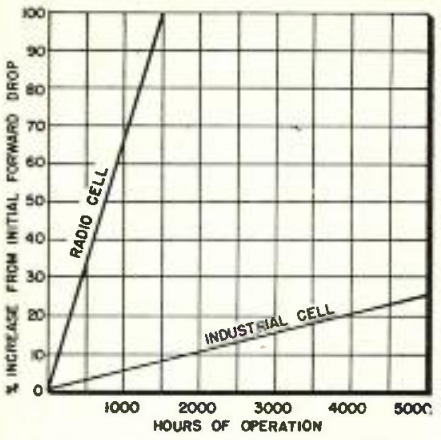


Fig. 1: Radio-type cell ages very quickly

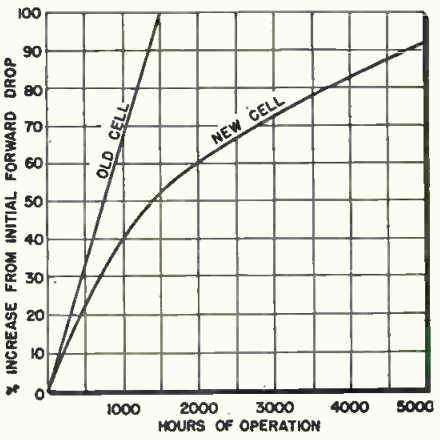


Fig. 2: New barrier layer decreases aging

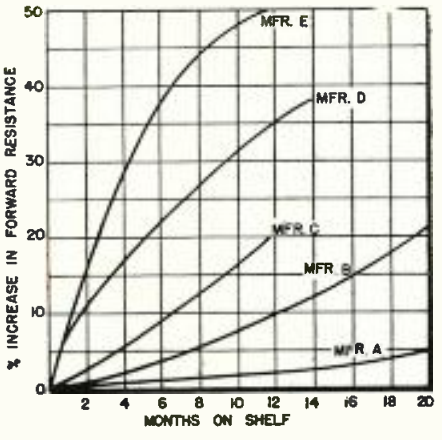


Fig. 3: Units of Mfr A have greatest shelf life

Life-Test Results On Selenium Rectifiers

By G. C. CHERNISH

THE life-testing of selenium rectifiers manufactured for radio-TV applications underscores two very important facts. (1) It is impossible to predict, with any degree of accuracy, the inherent behavior of a given unit during service. (2) Quality variations between even the five leading brands are often phenomenal.

Although curves on the life-testing of industrial cells have been published from time to time, there exists in the literature very little data on the performance of the higher voltage, radio-type stack. Attempts have been made to devise a reliable form of accelerated life test; but, as in the case of industrial cells, no accepted correlation has resulted.

Unlike the industrial stack, whose operating characteristics are relatively stable, the radio-type rectifier exhibits with time a behavior distinctly its own. Continual operation at full rating becomes, in many cases, a sheer gamble. From the standpoint of useful life, derating probably no other single component accomplishes so much.

Aging

Consider, first of all, the problem of aging. Fig. 1 plots an industrial cell versus a radio-type cell, both of the same manufacture. Both were operated at 100% of rating—voltage, current and temperature. Twenty samples of each were selected at random from various production lots, their respective curves representing average performance.

Observe now how output from the radio-type cell falls off sharply, almost at once. The industrial plate, on the other hand, ages only gradually, by comparison. Although only one manufacturer is represented in this particular test, the results hold for just about any make tried, with one notable exception.

Barrier Layer

The last few years have witnessed welcome advances in the art of selenium-rectifier manufacturing. A process known as vacuum metalizing has been developed whereby the so-called "barrier layer," which does the rectifying, is more effectively formed. Since this layer is only microns thick, crystallization of the selenium had long been a very touchy process. It is felt that the new technology affords much closer control over crystal nucleation, thereby resulting in a higher yield of good, workable cells.

Fig. 2 depicts the strides made recently with the new barrier layer. The two samples are radio-TV rectifiers made by the same firm. Again, each curve represents an average of several samples. While forward resistance of the older cell still rises in linear fashion after only 1500 hrs. of operation, that of the new cell begins to level off at this point.

In considering the radio-type selenium rectifier as manufactured today, the broad differences in performance between leading brands may be high-lighted even from the standpoint of shelf life. This is not to claim that the cell is a perishable commodity, although one or two of the lesser-known makes might almost be termed just that. In general, rectifiers of current manufacture bear up relatively well while in stock.

Fig. 3 plots shelf aging versus time for the five leading brands. With only a 5% increase in forward resistance after twenty months in stock, manufacturer "A" is obviously in a class by himself. In sharp contrast, manufacturer "E" has a cell whose forward resistance is still climbing after increasing by 50% within a year.

It is readily apparent that, despite recent advances in rectifier technology, no two firms are alike, quality-wise. The outstanding criterion is of course forward aging, with its consequent detriment to output voltage.

Forward Resistance

Since selenium has a negative coefficient of resistance in the forward direction, voltage output will increase with rising temperature. However, it can be shown that we

G. C. CHERNISH, P.E., Senior Liaison Engineer, TV Design, Sylvania Electric Products Inc., Radio and TV Div., 254 Rano St., Buffalo, N. Y.

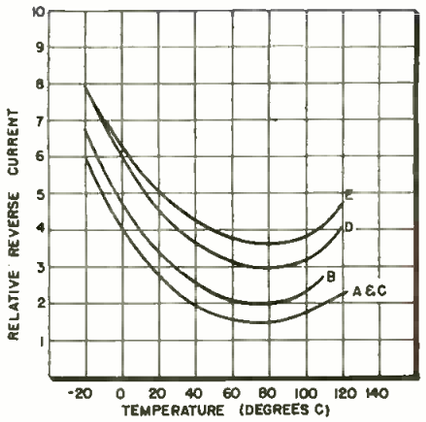


Fig. 4: Reverse current increases at low temps.

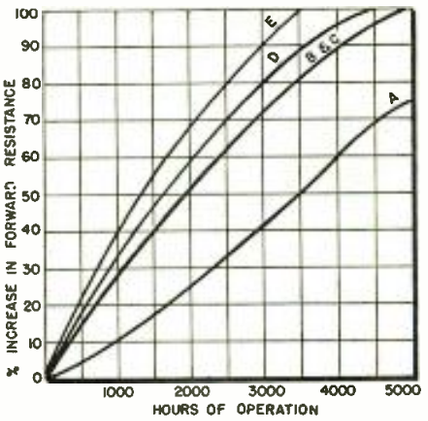


Fig. 5: Tests at full ratings at 25°C.

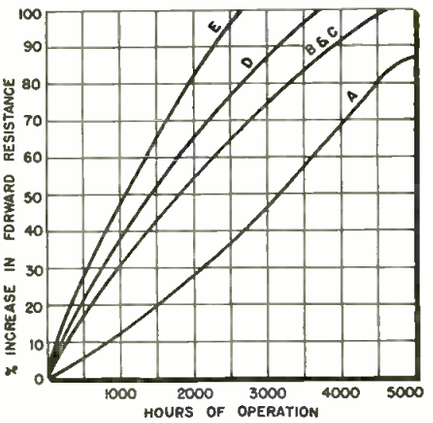


Fig. 6: E literally fell apart at 85°C.

Tests of radio-TV type stacks manufactured by five different firms disclose phenomenal variations in shelf life, forward resistance change with temperature and useful life. Discussion points up the difficulty in predicting individual rectifier performance and the need for derating.

soon reach the stage of diminishing returns. Again, to a marked degree. this depends on the make of rectifier, manufacturer A once more outstripping his competitors.

If the forward resistance remains relatively high even after warm-up, as in the case of cells made by some lesser-known manufacturers, serious overheating may result when rated load is drawn from the stack. For, in the final analysis, the greatest single enemy of selenium is heat, whether generated within the cell itself, or externally. If excessive, the barrier layer may rupture, and fail at rectification.

Thermal losses due to forward resistance normally account for 70% of the total heat generated in the cells. The remaining 30% may be charged to losses resulting from current which flows in the reverse direction, as plotted in Fig. 4. Here also, temperature plays a vital role. At the lower thermal levels, reverse current becomes relatively high.

As a rule, this increase in reverse current at low temperature will not impair too seriously the operation of a selenium rectifier in radio-TV applications. Unless the unit goes into special equipment (magnetic amplifiers, for instance), there would be little detriment, providing reverse current does not exceed the levels shown in Fig. 4.

These levels may also be exceeded by the application of sustained overvoltage. From the standpoint of potential gradient, the barrier layer as formed by some manufacturers will survive fairly rough surges. But the instantaneous rise in reverse current could puncture the layer and lead to complete breakdown of the cell. Consequently, selenium-rectifier manufacturers will allow no latitude whatever on overvoltage.

Life Test

Fig. 5 depicts the results of a 5000-hour life test on selenium rectifiers manufactured for the radio-TV industry. Of the five different brands represented, all were operated in a normal ambient of 25° C. at 100% rated dc load and input voltage. Since the standard 130 v. unit is designed for a peak inverse potential of 380 v., the full-wave doubler circuit was selected, so that ability of the cells to withstand rated back emf could be put to the test. This same circuit, incidentally, was employed throughout these various life tests.

As can be seen in Fig. 5, the familiar pattern of quality variance between brands repeats itself here. Again in a class by himself, manufacturer A has a product whose forward resistance increases by only 75% after 5000 hrs. Moreover, the aging characteristic shows signs of levelling off at this point. On the other hand, manufacturer E produces

(*Continued on page* 166)

Fig. 7: 10% overload increases aging rapidly

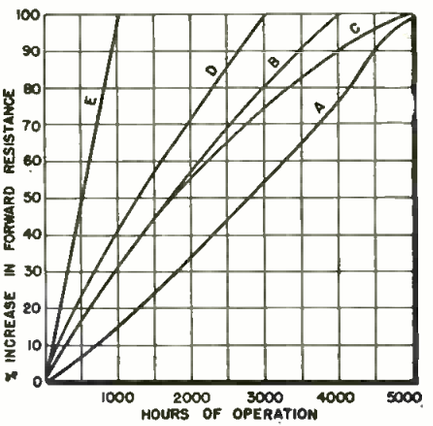


Fig. 8: Humidity test is most rugged of all

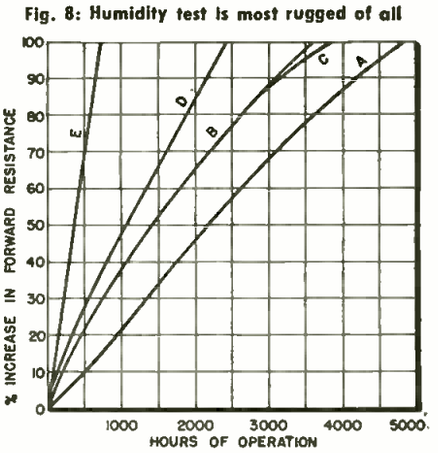
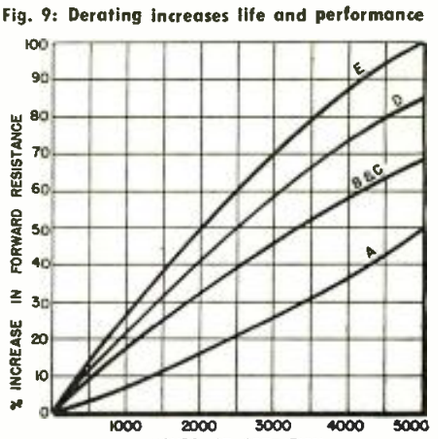


Fig. 9: Derating increases life and performance



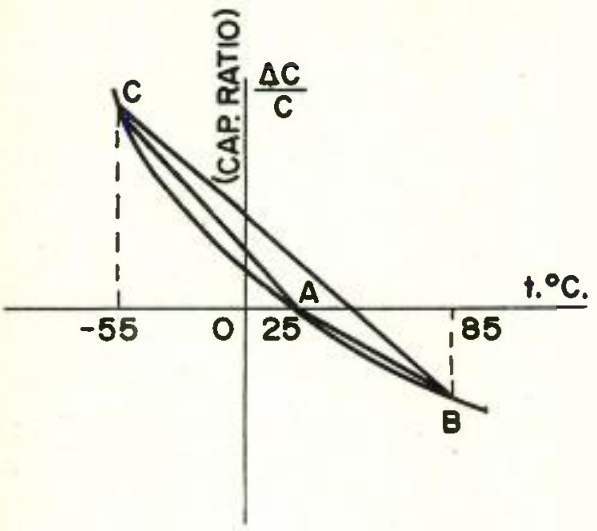


Fig. 1: Capacity variation with temperature

Automatic production machine for measuring the TC of precision ceramic dielectric capacitors features an operating speed of one measurement every 40 secs. Coefficient accuracy is 2 parts/million and direct capacity measurement exact within 0.0038 μμf. Machine utilizes analog computer in bridge circuit to provide direct readings.

By J. PEYSSOU and J. LADEFROUX

Measuring Capacitor Temperature Coefficients

CERAMIC dielectric capacitors occupy a special position among circuit components. While it is almost impossible to manufacture resistors and inductors with thermal drifts of precisely given sign and magnitude, it is a normal operation to make ceramic dielectrics with positive or negative temperature coefficients, and, in the negative range which is more commonly used, to give this coefficient a predetermined value over a wide range.

Circuit stability is an essential element in electronic devices, such as computers, instruments, and communications equipment which must function over a wide range of temperatures. Since the selection of components whose characteristics are independent of temperature is usually not possible, components are generally chosen with equal and opposite thermal drift to achieve stability. Consequently, negative coefficient ceramic dielectrics are most frequently employed, particularly in oscillating circuits where the inductances to be balanced have positive temperature coefficients. Where negative coefficient carbon resistors are used, positive ceramics are selected.

Temperature Coefficient

Consider a capacitor of value C at 25°C. For a temperature change $\Delta t°$, the capacity C changes by ΔC. The temperature coefficient (TC) is:

$$TC = (\Delta C/C)\,(1/\Delta t).$$

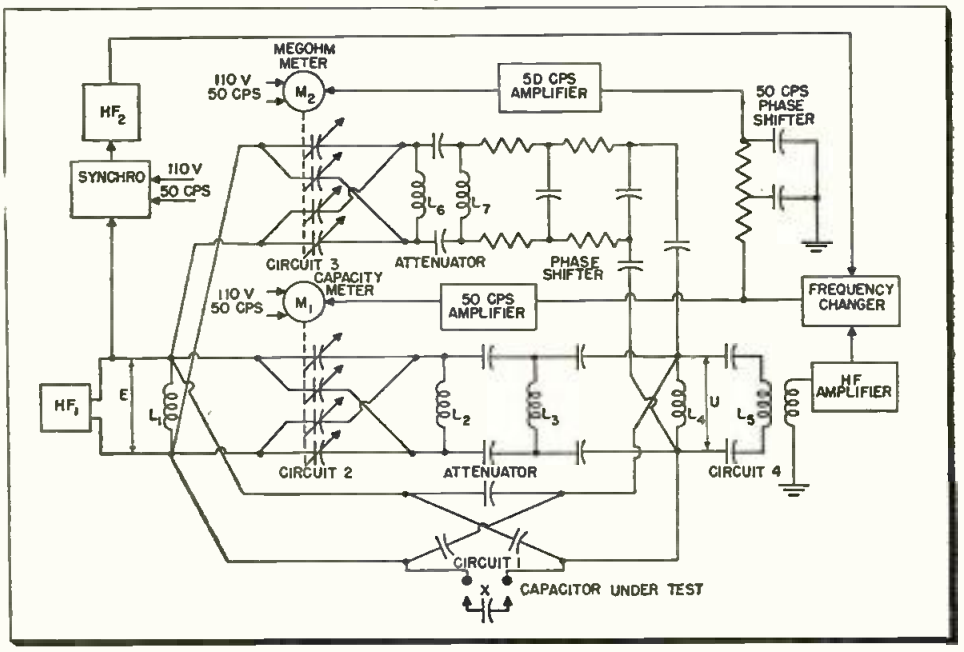
In general, the curve of $\Delta C/C = f(t)$ is more or less concave between −55°C and +85°C. See Fig. 1. Depending on the choice of the limits of the temperature interval t, it is possible to speak of true TC at 25°C (slope of the tangent to the curve at 25°C), of average TC between 25°C and 85°C (slope of the chord AB), of average TC between −55°C and +25°C (slope of the chord AC), and of average TC between −55°C and +85°C (slope of the chord BC).

The definition of TC has been the subject of much discussion in committees dealing with the standardization of component tests. In the case of ceramic capacitors, it may be shown that measurement between 25°C and 85°C is sufficient for evaluating behavior between −55°C and 85°C.

Roughly speaking, capacitor ceramics may be divided into two groups:

(A). Ceramics with TC near zero or slightly negative. The dielectric constant varies from 15 to 35. To a certain extent, the TC appears to be a substantially linear function of the

Fig. 2: Analog computer ckt used as a capacity meter and megohm meter in measuring machine



J. PEYSSOU and J. LADEFROUX, Compagnie Generale de Telegraphie Sans Fil, Paris, France.

dielectric constant. These two parameters are essentially dependent on the material's composition. In this class, TC is practically constant from −55°C to +85°C, and measurements made down to 25°C are adequate, any slight difference introduced being within measurement error of 2×10^{-6}.

(B). Ceramics with dielectric constants between 60 and 100, usually based on titanium dioxide, have a more negative TC, and may vary from -470×10^{-6} to -1200×10^{-6}. The concavity of the curve in Fig. 1 increases with dielectric constant. For ceramic with TC of -750×10^{-6} at 25°C, as is often employed in this range, the TC of a batch manufactured without special precautions will give a value of -900×10^{-6} from −55°C to 25°C, and -650×10^{-6} from 25°C to 85°C. Under these conditions, the choice of measurement temperatures is essential. However, this temperature characteristic is well known, and the curvature is roughly identical for almost all ceramics in this class. Consequently, it is sufficient to know the general shape of these curves by experience to obtain an adequate evaluation of measurements limited to the 25°-85°C range.

Taking into account the general requirements and ceramic properties of components produced throughout the world, the International Electrotechnical Committee presented, in Sept. 1954, a series of standardized coefficients and tolerances for temperature compensation capacitors. These are divided into two types: 1A for narrow tolerance, and 1B for medium tolerance. See Table I.

TC Measurement

Capacities used to compensate for the TC of oscillating circuits generally range from a few μμf to about 400 μμf. In order to learn the capacitor's TC, 3 functions must be measured: capacity at about 25°C, capacity variation, and temperature change.

At 1 MC, bridges and Q-meters can measure capacity with an accuracy of the order of 1/1000 on the average, taking into account calibration inaccuracies. However, accuracy may drop to 5/1000 for capacities around 20 μμf. Increasing measuring sensitivity would be to no avail as long as the variable capacitor calibration inaccuracies remained.

To measure capacity change conventionally, the capacitor is inserted in an oscillating circuit, and the resulting change in frequency is compensated by adjusting a calibrated variable capacitor to return the oscillation to its original frequency. In general, a ΔC sensitivity of 0.005 μμf is sufficient. Measurement difficulties are due to the very small value of ΔC, and the great stability demanded of the electronic equipment to detect frequency change.

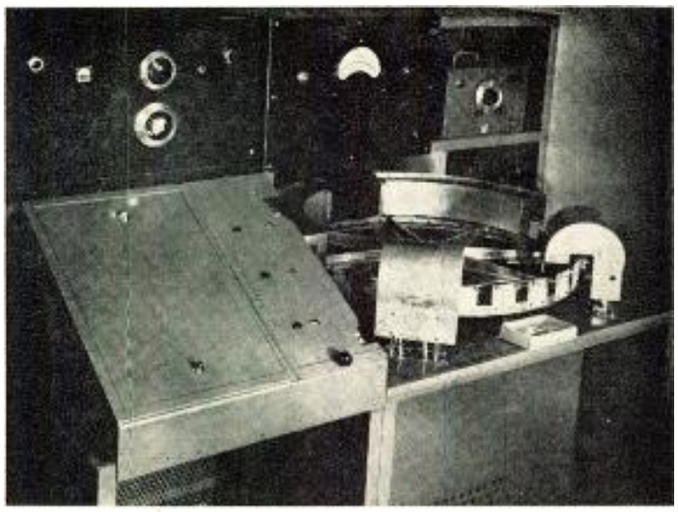


Fig 4: Complete temperature coefficient measuring machine

Various types of conventional apparatus provide, more or less satisfactorily, these simultaneous qualities of sensitivity and stability.

Direct measurement of capacitor temperature is not readily possible. However, by exercising well established precautions regarding warm-up time, heat circulation, etc., measurement of the surrounding air will give an accurate indication. In general, a temperature indetermination of 0.5°C is permissible.

The abandonment of quartz crystals in some portable transmitters, plus the requirements of certain military devices, have created a demand for temperature coefficient tolerances closer than 30 ppm; 15 ppm has not been uncommon. It became apparent that an accurate production testing machine would be needed.

Machine Design

The machine's range is up to 400 μμf, with a TC measurement accuracy of better than ±2 ppm for a 300 μμf unit when the coefficient is between 20 positive and 20 negative. For TC more positive or negative, the error is increased by 4 to 5% of the TC value.

Less than one sec. after the capacitor is connected to the instrument, the capacity is automatically indicated on two dials with an accuracy of ±0.0038 μμf. One fine dial division corresponds to 0.0075 μμf, and stability is better than one-half division. Capacity meter drift is limited to 0.03 μμf per 24 hrs., which is negligible during the complete 20 min. measurement cycle from 25°C to 90°C and back to 25°C. Maximum capacity change during test is 10 μμf.

During operation, one measurement is accomplished every 40 sec., permitting 500 to 600 measurements daily with 2 unskilled operators.

(*Continued on page* 163)

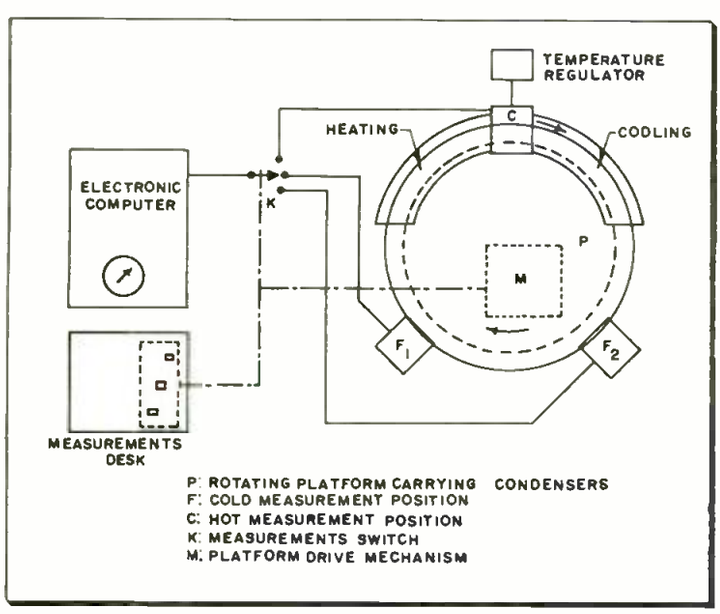


Fig. 3: Rotating platform carries condensers to be measured through hot and cold cycles

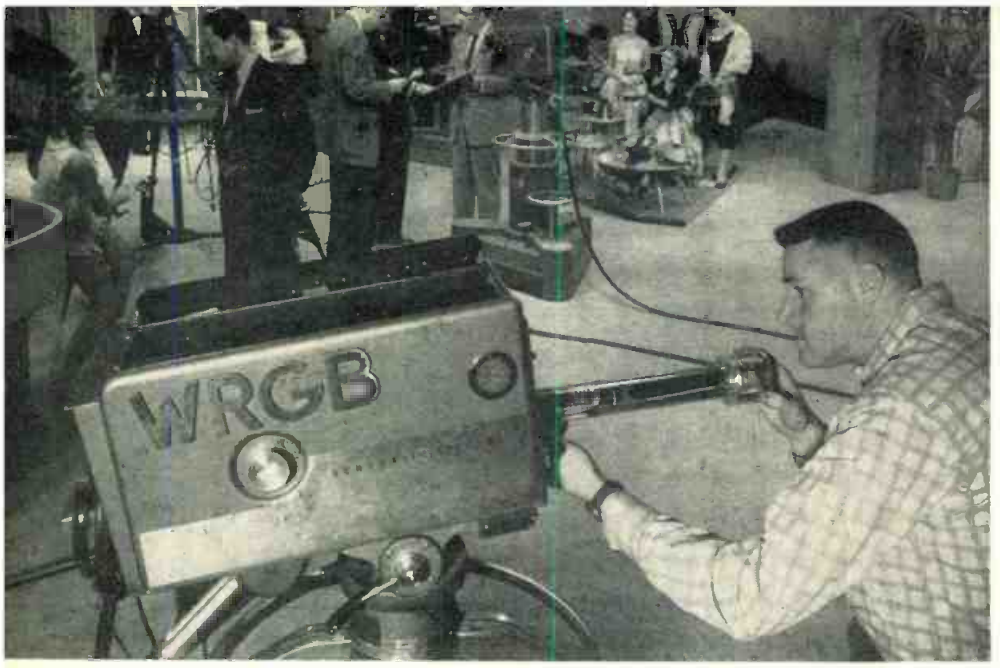


Fig. 1: Careful handling pays dividends in long life

Fig. 2: Never carry tube face down

Care and Feeding of The Image Orthicon

THE precision assembly of the many delicate parts of an image orthicon—and the high cost of air time—make it imperative the tube be accorded the best care possible. Care in handling, stocking and operation should begin the moment a tube is received and continue through and beyond the end of its life.

When a shipment arrives, the tubes should be unpacked and examined, and a tube record card made out for each tube. This card, (Fig. 3) should incorporate spaces for maintaining a complete record of the tube's history, starting with date of receipt, date tested, results of tests, location of tube, dates in and out of cameras, and tube hours of use. Any movement of this tube in and out of stock or in and out of cameras, must be faithfully noted on the card so that a complete case history is always available. Such information is necessary for validating the guarantee in the event of short life for any reason, and it can possibly pay dividends by indicating means of increasing tube life.

Handling and Storage

It is important that proper methods of physically handling these tubes be instilled into every member of the staff. The rules for handling are simple and easily observed:

1. Except when a tube is in a camera *always* keep it in the plastic packing case in which it is shipped. This case will protect the tube against damage by physical shock. Carry with both hands.

2. Never store or carry tubes with the large (target) end down. (Fig. 2) Minute particles of material fall rapidly in a vacuum and can pit and badly damage the photocathode surface. In fact, a target-end-down shipment can result in pitting the photocathode to such an extent that the tube is a total loss. Tubes may be stored on their side to prevent tipping or falling.

3. Use lens tissue for cleaning the face of the photocathode. (Fig. 4) Never wipe face with sleeve, nor blow on the face. Small scratches become very objectionable when magnified to normal picture size.

Removal and Insertion

1. Remove the lens turret. (Fig. 7) This is a good time to inspect and clean lens surfaces, and to check turret mechanical fit.

2. Remove camera tube mask plate. In some cameras it is necessary that the view finder first be removed.

3. Remove the base socket.

4. With one hand held over the camera front tube opening, smoothly

R. L. SMITH, engineer, TV station WRGB, General Electric Co., Schenectady, N.Y.

Fig. 3: Tube record card should be made out as soon as image orthicon is received

TUBE LIFE RECORD

TYPE GL-5820 SERIAL # 71259 LOCATION CAMERA #1 HEAD #2

DATE RECEIVED & TESTED 10/13/55 BRAND G.E. REPLACED BY SERIAL # 52463

DATE IN	TUBE HR. METER	DATE OUT	TUBE HR. METER	SERVICE HOURS	DATE IN	TUBE HR. METER	DATE OUT	TUBE HR. METER	SERVICE HOURS
10/13/55	22973	10/26/55	23175	202					
11/30/55	23614	12/21/55	23925	311					
1/18/56	24721	1/31/56	24857	136					

Fig. 4: Use lens tissue to clean tube face

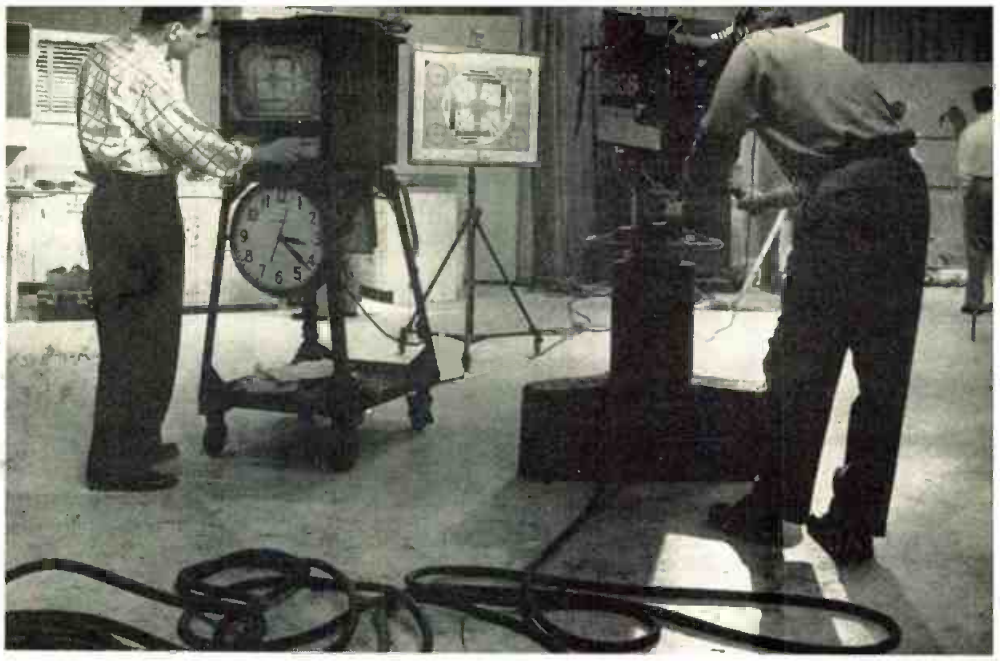


Fig. 5: Checking the gray scale with standard RETMA chart and normal lighting

By R. L. SMITH

The usable life of a tube can be substantially increased by careful handling and systematic record keeping, and operating the tube over the most favorable portion of its curve. Here are simple rules that should be followed by all personnel dealing with these camera tubes

eject the camera tube from the annular socket with a steady pressure on the base end and carefully withdraw from the camera and place in an empty carton.

5. Remove the new tube from its carton and clean the tube face, using a soft brush first to remove coarse materials. Noting the position of key pin hole in the annular socket, carefully insert tube with firm pressure until seated. Now thoroughly clean the tube face with lens tissue.

6. Replace the mask plate and, if necessary, adjust this plate mounting so that the plate exerts pressure on the tube face to hold the tube in the socket.

7. Replace the tube base socket, lens turret and view finder.

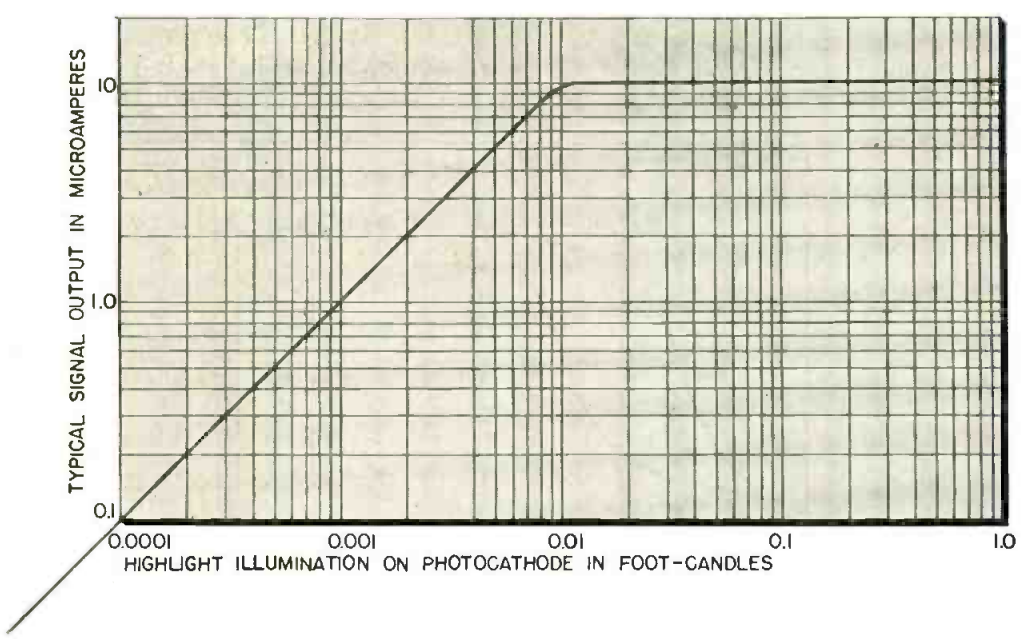
8. Turn on the channel for warm up. While this warming up is in process, return the old tube to stock and make all entries on the record cards of both the tube coming out and the one going in.

Record Keeping

Each camera channel should be equipped with a tube hour meter which will show filament hours on the tubes in service. WRGB channels have an additional meter activated by a switch on the target control which records the amount of time that the target is "up." Although this second meter has no bearing on the guaranteed hours, it is recommended because it may uncover wasteful practices and result in a higher percentage of actual to filament life. These target hour figures are also carried in the records.

At regular intervals the data from the individual tube cards is transferred to a tabulation sheet so that an analysis of tube life can be made by individual cameras, operating studios, length of camera operating day, or other criteria. Studies of this type may reveal operating habits which are wasteful of tube life, and indicate means by which closer control of life may be attained.

Fig. 6: Output is linear function of light input up to a certain point



Tube Life Vs. Camera Adjustment

A skillful cameraman is an important key in the success of a live program. There are means of adjusting an I.O. tube camera in such a manner that brightness level changes in excess of 4/1 can be easily accommodated with little or no changes in camera output. A brief reference to the I.O. output charac-

(*Continued on page* 172)

Bistable ferromagnetic elements offer the advantages of reliability, small size, ruggedness and low power consumption. This article reviews basic concepts of these elements and indicates telemetering and navigational uses as applied to airborne navigational systems.

Fig. 1: Bistable ferromagnetic elements exist in 2 basic forms—microthin metallic tape and molded ferrites

By I. L. AUERBACH

Applications of Bistable

I. L. Auerbach

THE bistable ferromagnetic element we will describe is relatively new in the electronic field. It vies for prominence with the transistor in control systems where reliability, small size, ruggedness, and low power consumption are the critical features. This article (1) presents a few fundamental concepts about these elements so that a better appreciation of its capabilities can be gained, (2) reviews a few typical circuits in which they have been used, and (3) indicates several applications of this new component as applied to airborne control systems.

The bistable ferromagnetic element is not completely new. It is in fact extremely old; it is really a tiny lodestone. Its magnetic properties have been developed over recent years to maximize specific characteristics of particular value in electronic engineering. The Germans during the beginning of World War II, while working in the field of magnetic amplifiers, developed a 47 per cent nickel-iron alloy with a rectangular hysteresis loop. The unique properties of this alloy are its high retentivity relative to the maximum magnetization, and its very low coercive force. These properties are the major differences between the rectangular-hysteresis-loop materials for these elements and the S-shaped hysteresis-loop materials common to most magnetic laminations for transformers and motors. Prof. Howard Aiken of the Harvard Computation Lab. introduced this new metal into the U.S. about 6 years ago. He also suggested the first circuit use in the form of a magnetic register for storing and shifting discrete data. Discrete information was introduced in the register and successively stepped along, passing the information from core to core when an electrical signal excited the cores. When no signal was applied to the register, the information or data was held statically, with no power required within the tiny magnets or within the circuits.

This initial development led to widespread investigations in many laboratories throughout the country. The material and circuit applications of these elements have been advanced considerably since the early work in 1949.

Application

Bistable ferromagnetic elements, due to their natural "memory" ability, have been applied extensively to large memory arrays in computers. Jay W. Forrester of the Digital Computer Lab., MIT, first proposed their use in a coincident-current memory system for large-scale computer applications. At Burroughs, the writer and his associates developed the corediode memory system for higher speed computer use. These techniques have been thoroughly developed during the past few years, and these memories are now commonplace in many military and commercial computers.

In addition to the early memory work, considerable effort has been expended in the application of bistable ferromagnetic elements to the arithmetic, control and input-output problems of computers or

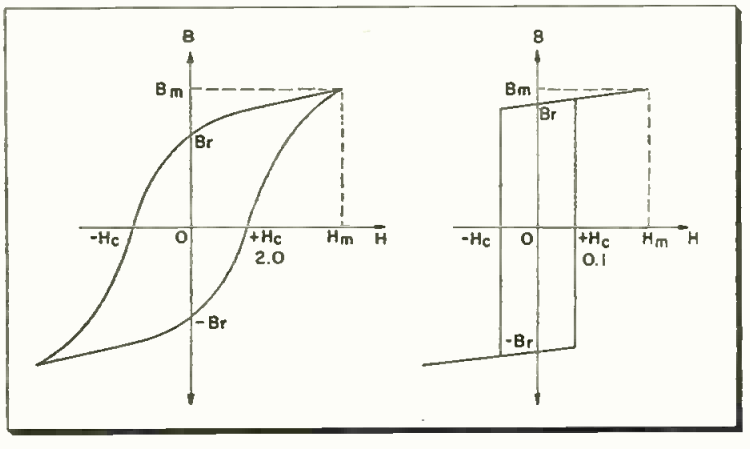


Fig. 2: Most magnetic materials have S-shaped hysteresis loops. Bistable ferromagnetic loops are rectangular with low coercive force

I. L. AUERBACH, Manager, Special Products Div., Burroughs Corp. Research Center, Paoli, Pa.

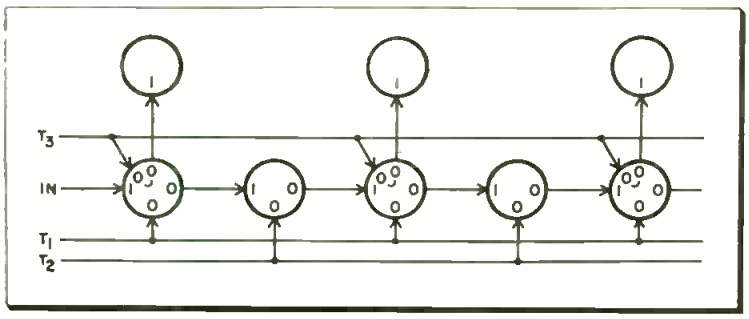


Fig. 3 (above): Magnetic shift register. Bistable ferromagnetic elements are coupled together by single diode transfer loops

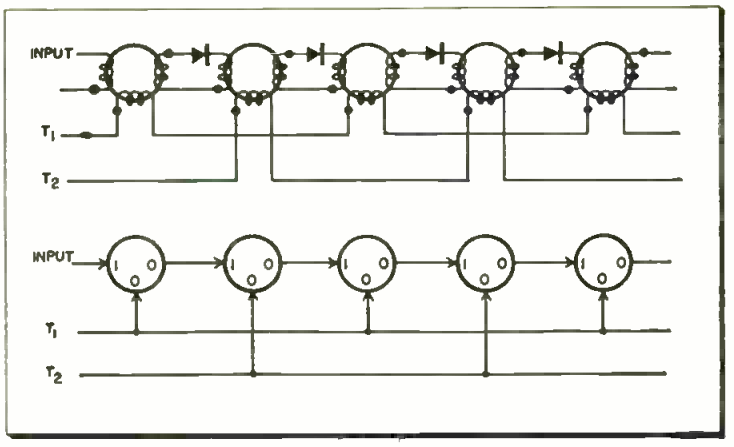


Fig. 4 (r.): Conditional transfer loop, provides parallel read-out and storage to shift register

Ferromagnetic Elements

data processing systems. An electronic data processing system that utilizes 800 magnetic cores and 48 vacuum tubes and performs all of the arithmetic and control operations normally required of a digital computer has been recently completed. This system replaced a 530-vacuum tube electronic version and resulted in a power saving of 5 to 1 and a volume reduction of greater than 6 to 1. Our current technology has indicated ways of reducing the remaining 48 vacuum tubes to a mere handful.

The bistable ferromagnetic element exists in two basic forms—microthin metallic tape and molded ferrites. (See Fig. 1.) The tape form usually consists of a number of wraps of very thin metal tape wound on a ceramic bobbin, the tape being spot-welded and the assembly heat-treated in a dry hydrogen atmosphere.

The ferrite form, on the other hand, is fabricated very much like ceramics. After the base material has been ball-milled into a fine powder, it is pressed into small toroidal shapes, a binder is added, and the unit is fired in a reducing atmosphere.

Characteristics

The most common method of describing the characteristics of magnetic materials is the B-H, or hysteresis, loop. (See Fig. 2.) As stated above, the vast majority of magnetic materials used by industry have an S-shaped hysteresis loop. The magnetic materials used in these new elements however have a rectangular hysteresis loop. The coercive force (H_c) is a small fraction of that required by transformer type magnetic materials. The rectangularity, the low coercive force, and the consequent high speed of switching are the characteristics of these magnetic materials that have made this new element so successful in electronic information processing systems. Another important characteristic is that the residual magnetization (B_r) is very nearly that of the maximum magnetization (B_m). This enables the magnetic core to store information very efficiently. The ratio of B_r/B_m, or the squareness ratio, for generally available cores ranges between 0.85 and 0.95, depending on the core material.

In brief, then, the usefulness of the magnetic core results from the fact that once the material is magnetized in the positive sense, it will remain so until it is magnetized in the opposite sense. The reapplication of magnetization in the same direction causes very little flux change and hence very little voltage in the windings around the core. It is thus possible to distinguish between the two states of magnetization by interrogating the core and inspecting the flux change.

Another way of viewing this new element is as a bistable impedance. An interrogation of the element in the same sense to which it had already been switched will find a low impedance on the order of a few hundred ohms. An interrogation in in the sense opposite to which it had already been switched, however, will find a high impedance of several thousand ohms during the switching time, and finally a low impedance after the element has been completely switched. This large change in impedance on the application of the interrogation or sensing signal, which is a result of its previous history, is a particularly valuable property and is the basis for numerous circuits.

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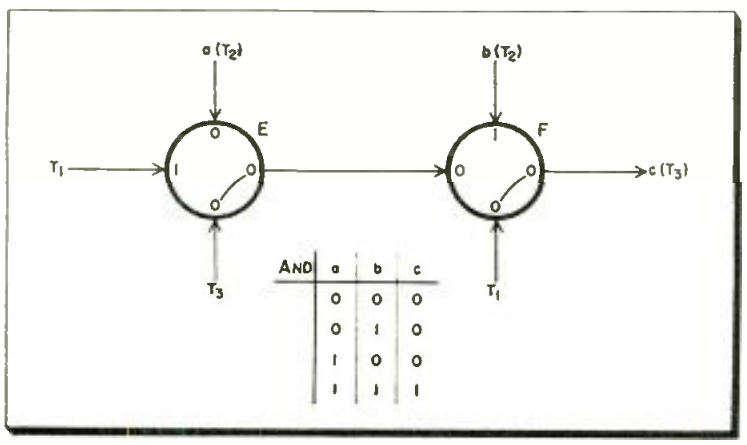


Fig. 5: Logical AND circuit. Truth table shows gate produces output only with a AND b inputs

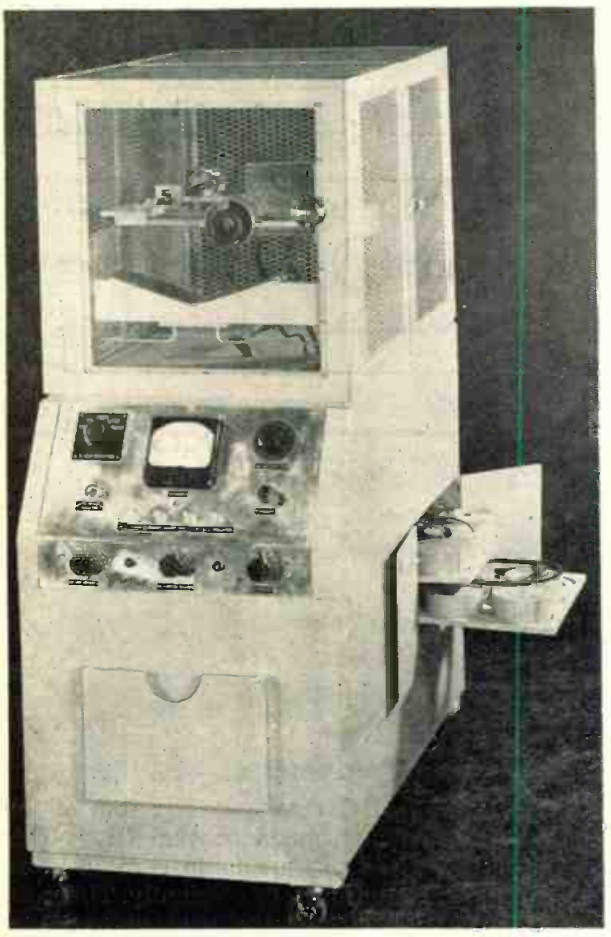


Fig. 1: Production line CRT tester

Developed by the military, this unique CRT tester completely checks a tube in 50 secs., including high impedance shorts, gas, focus, cut-off and emission. Handles all types, and can be operated by unskilled personnel.

By W. S. TREITEL and S. NOZICK

Production Line

RAPID production testing of cathode ray tubes is facilitated by a new, low-cost piece of equipment developed by the U.S. Naval Material Lab. for use by the Armed Forces. The tester is faster, cheaper, and simpler than the quality control

W. S. Treitel

S. Nozick

equipment used by industry. With minor modifications, one major TV mfr. is using the equipment in its television tube quality control. A single unskilled stock clerk can be taught to use the equipment in a half hour, and after practice can test a tube completely in 50 secs.; much faster than present production testing by several trained operators. Change-over time of tube types is extremely short, 1½ minutes for an unskilled person. This permits the rapid testing of mixed batches of tube types, which was impractical previously. This is accomplished by eliminating meter interpretation; only neon lamps and a good-bad indicator are used.

The equipment, Fig. 1, consists of a universal tube holder, the test circuits and the housing. The tube mount and circuitry were designed for simplicity of operation and a minimum of maintenance. The unit tests any cathode ray tube in use by the Armed Forces today, including all electrostatic and electromagnetic types. The tests include high impedance shorts, gas, screen condition. focus, cut-off and emission under JAN conditions. No voltage settings need be made for any tube type.

Table Mount

The universal mount, Fig. 2, is capable of supporting all electrostatic and electromagnetic tubes with the screens near the transparent front window. A movable master socket at the rear of the mount provides all tube base voltages. In operation, the master adapter socket is positioned according to a scale and clamped in place. (Fig. 3.) The deflection yoke and focus coils are on arms and can roll along the two longitudinal rods, which permit them to automatically position flush against the tube shoulder as the tube is inserted. The deflection yoke is coated with a tough, resilient plastic to protect the windings from being damaged by the base pins during insertion and withdrawal of the tubes to be tested.

The front V tube support height is set according to the scale to accommodate different diameter tubes, as shown in Fig. 4.

When electrostatic tubes are tested, the deflection yoke and focus coil arms fold down as shown in Fig. 5.

Anode connections are made to virtually every anode button type, using a specially designed ground clip.

Test Circuits

The test circuitry was designed for simplicity and ruggedness. Only seven tubes plus an electronic eye are needed to test for shorts, gas, screen, focus, cut-off, emission and to adjust line voltage variations. The unit tests tubes under JAN high voltage conditions with full safety to the unskilled operator. Therefore all access doors to the test cage and chassis are interlocked to interrupt the high voltage and deflection circuits. Due to the unskilled operators

WERNER S. TREITEL, U. S. Naval Material Lab., N. Y. Naval Shipyard, Brooklyn 1, N. Y. and SEYMOUR NOZICK, Combat Development Dept., Army Electronic Proving Ground, Ft. Huachuca, Ariz. The work described in this article was undertaken while Mr. Nozick was employed at the Naval Material Lab.

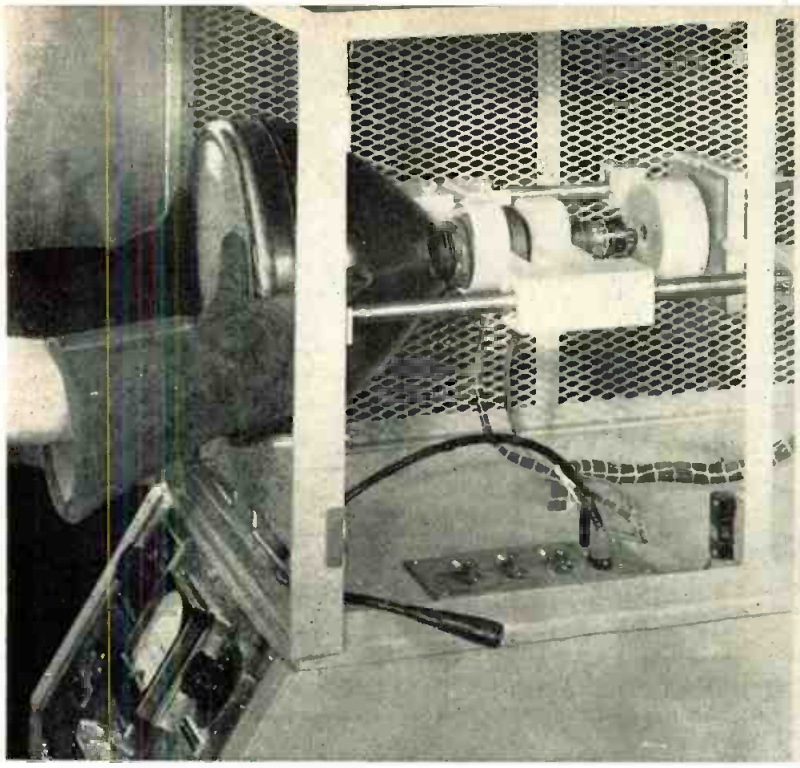


Fig. 2: Inserting tube. Universal mount handles all types

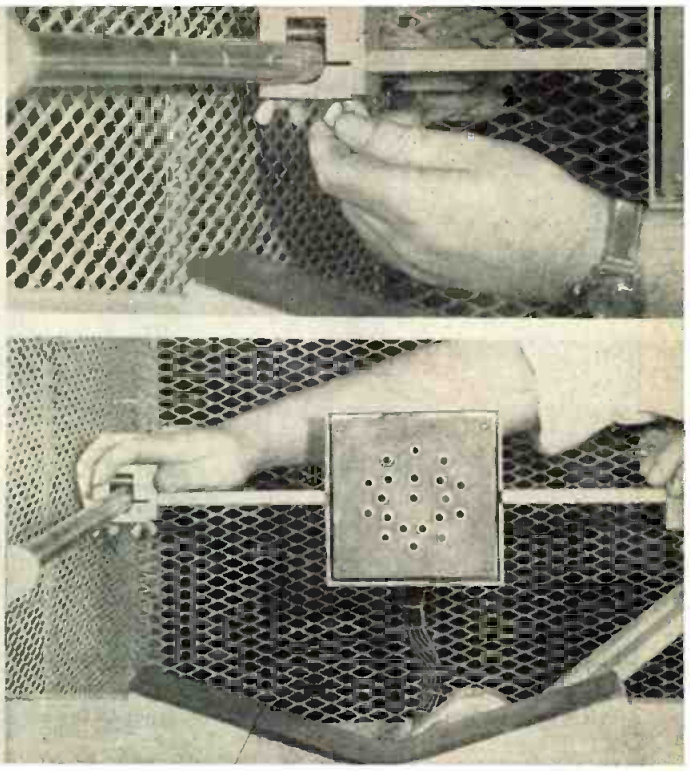


Fig. 3: Socket slides along arms at side

Cathode-Ray Tube Tester

anticipated, automatic limits on the controls were incorporated to prevent damaging the tube under test.

As shown in the block diagram, Fig. 6, the tester circuitry is contained on two chassis, one for the high voltage power supply and its associated components and the other for all test and indicating circuitry.

The high voltage power supply consists of a half wave rectifier and a tapped bleeder resistance to supply all the voltages required. The bleeder is made up of wire wound resistors, as carbon resistors were found to drift excessively. Line voltage indication and adjustment is provided by a 6E5 "eye" tube to standardize the measurements. A sample voltage from the high voltage power supply is compared with a reference potential obtained from a VR tube in the low voltage power supply by means of a tuning indicator tube. To compensate for line voltage variations, the operator adjusts the high voltage power supply to just close the eye.

The control chassis contains the test selecting system, the short test circuitry, the gas test circuit and its calibrator, the line adjust indicator and associated components, the deflection generators, and the low voltage power supply, including a VR tube for the stabilized reference voltage required.

In operation, the tube under test is scanned by means of two sinusoids, yielding a free-running Lissajou pattern. The raster size is adjustable by means of a single control. Standard commercial parts are used throughout. Horizontal deflection is obtained from a push-pull Colpitts oscillator, which utilizes the horizontal windings of the deflection yoke in its tank circuit. The circulating current in the yoke windings is sufficient to deflect all present tubes. The voltage across the windings can deflect a 12 in. electrostatic tube, the largest in military use. A variable power supply drives the oscillator, thus affording deflection amplitude control.

Vertical deflection is obtained from the power line. Standard power transformers supply sufficient voltage for vertical electrostatic deflection and adequate current for the vertical windings of the deflection yoke. The variable transformer, which adjusts the horizontal oscillator supply voltage, also controls the vertical deflection transformers, thus providing simple, one-knob control for both vertical and horizontal deflection in electrostatic and magnetic tubes.

Short and leakage testing is accomplished by connecting neon indicators and suitable voltages, ob-

Fig. 4: Front support adjusts to tube size

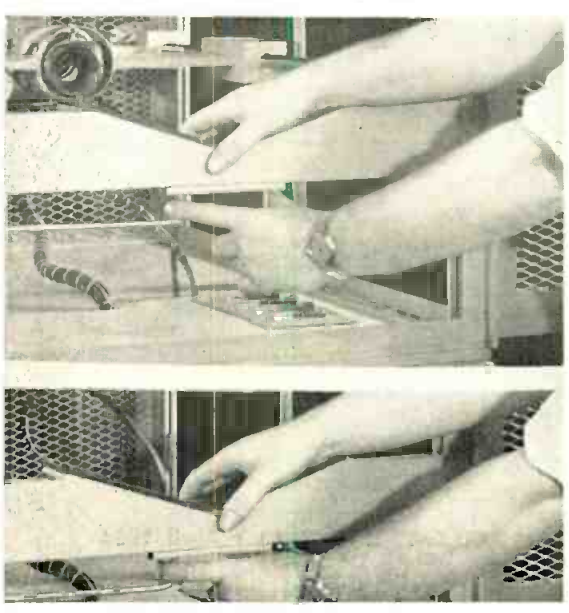
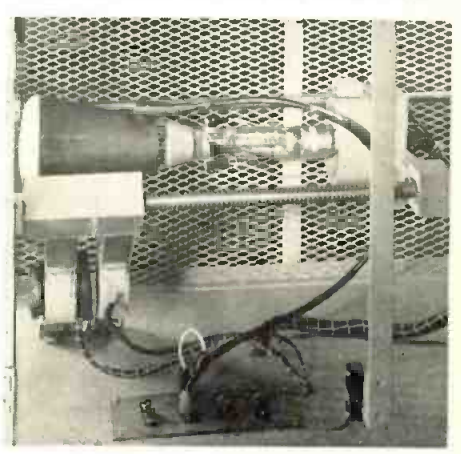
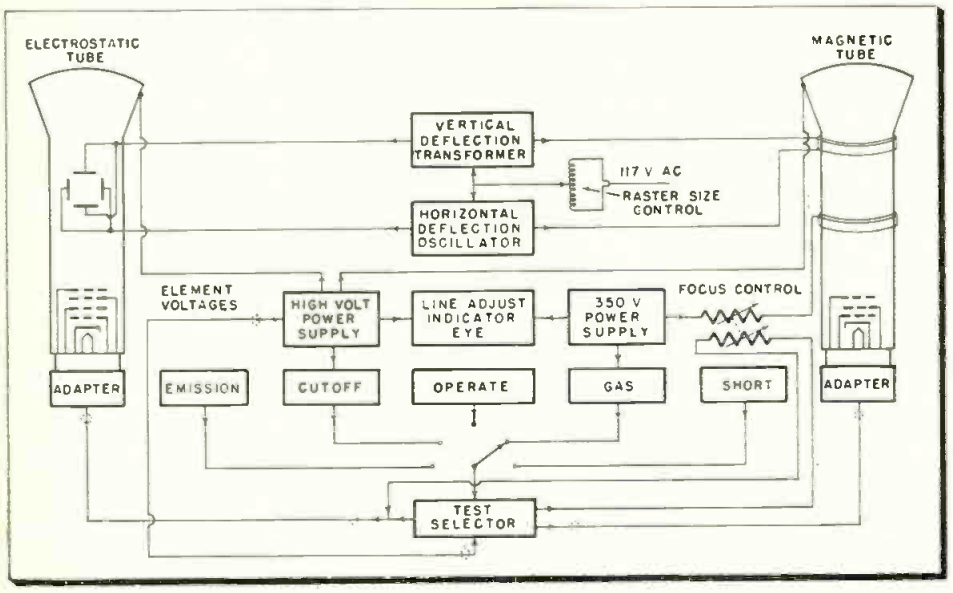
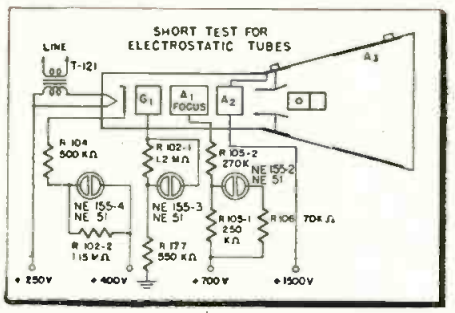


Fig. 5: For electrostatic tubes the deflection yoke and focus coil arms are folded down







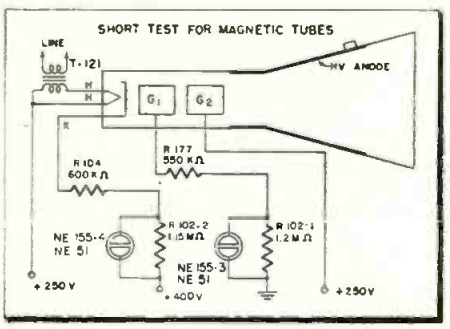


Fig. 6: (above) Block diagram of cathode-ray tube tester. Fig. 7: (top right) In short test, suitable voltages are applied to tube elements. Fig. 8: (r) Leakages on the order of 1 megohm will light indicators

tained from the high voltage power supply divider, to alternate tube elements. Figs. 7 and 8. Conducting paths between adjacent tube elements of the order of 1 megohm will light the neon indicators.

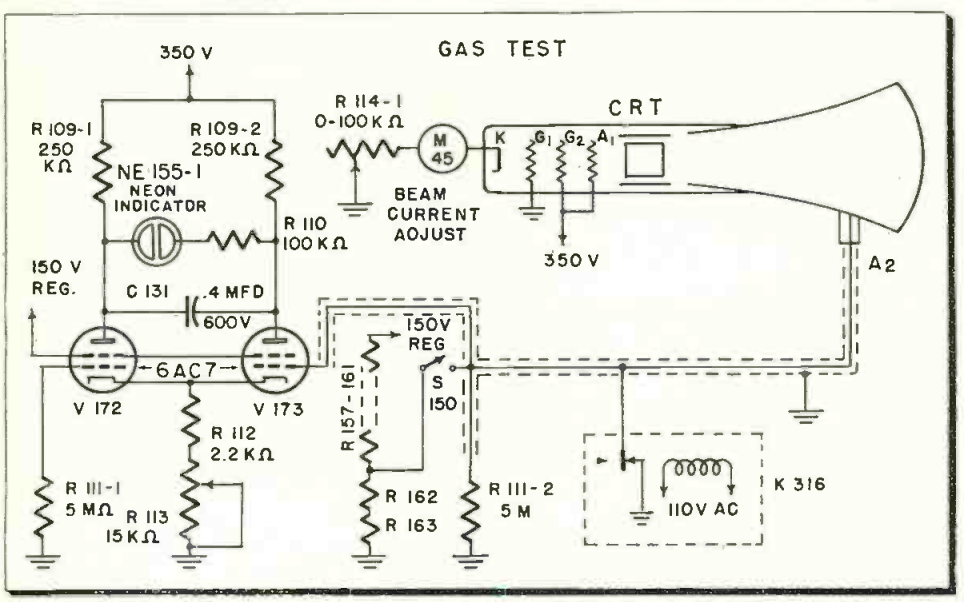
Theory of operation of the gas test, Fig. 9, is as follows: When the electron beam leaves the cathode, it collides with gas molecules, forming ions. The positive ions thus formed are attracted to the aquadag coating, which is made negative with respect to the cathode. Electrons flow through a load resistor to the aquadag coating to neutralize these ions. This electron flow constitutes a current which produces a signal voltage across the load resistor. This signal is amplified by a direct coupled, high gain amplifier, which lights a neon indicator when the gas current is excessive. The MIL-E-1B specifications define gas ratio as the gas current in μamps divided by a cathode current of 0.5 ma. If this quotient exceeds 0.25, the tube is rejected as being gassy. The tester was designed to reject tubes displaying a gas ratio greater than 0.25. The MIL-E-1B specifications call for this gas ratio test on magnetic cathode ray tubes only and the gas cross- test for electrostatic tubes. This tester applies a modified gas ratio test to electrostatic as well as magnetic tubes, where feasible. The authors are of the opinion that a more stringent gas test for electrostatic tubes is needed rather than the antiquated gas cross test.

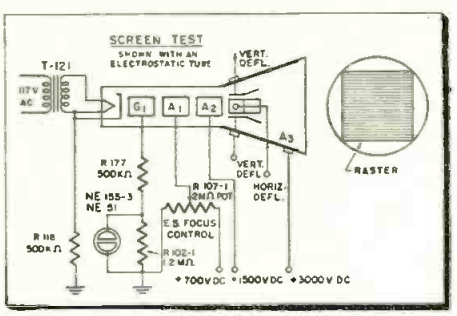
In the screen condition test, Fig. 10, MIL-E-1B specification voltages are applied to the tube under test in almost all cases and scanning means are provided to light up the entire screen. The operator then tests for satisfactory focusing and examines the phosphor for blemishes and flaked off areas.

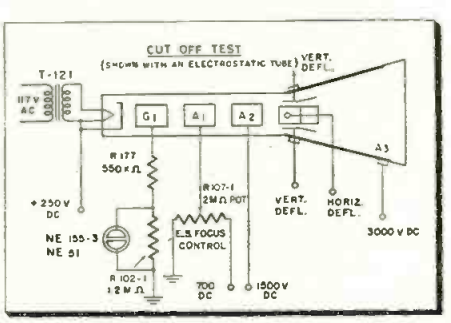
The cut-off test connections, Fig. 11, are the same as for the screen condition test, with the exception that a high positive cathode bias is applied to the tube. This indicates proper gun structure alignment and satisfactory grid control characteristics. The MIL-E-1B specifications call for a standard condition under which a certain limited range of bias is supposed to cut off the tube under test. Such a measurement entails

(*Continued on page* 160)

Fig. 9: (below) Gas content is determined by ratio of gas current to a cathode current of 0.5 ma. Fig. 10: (right) Checking focus and phosphor condition. Fig. 11: (below right) Testing grid control characteristics







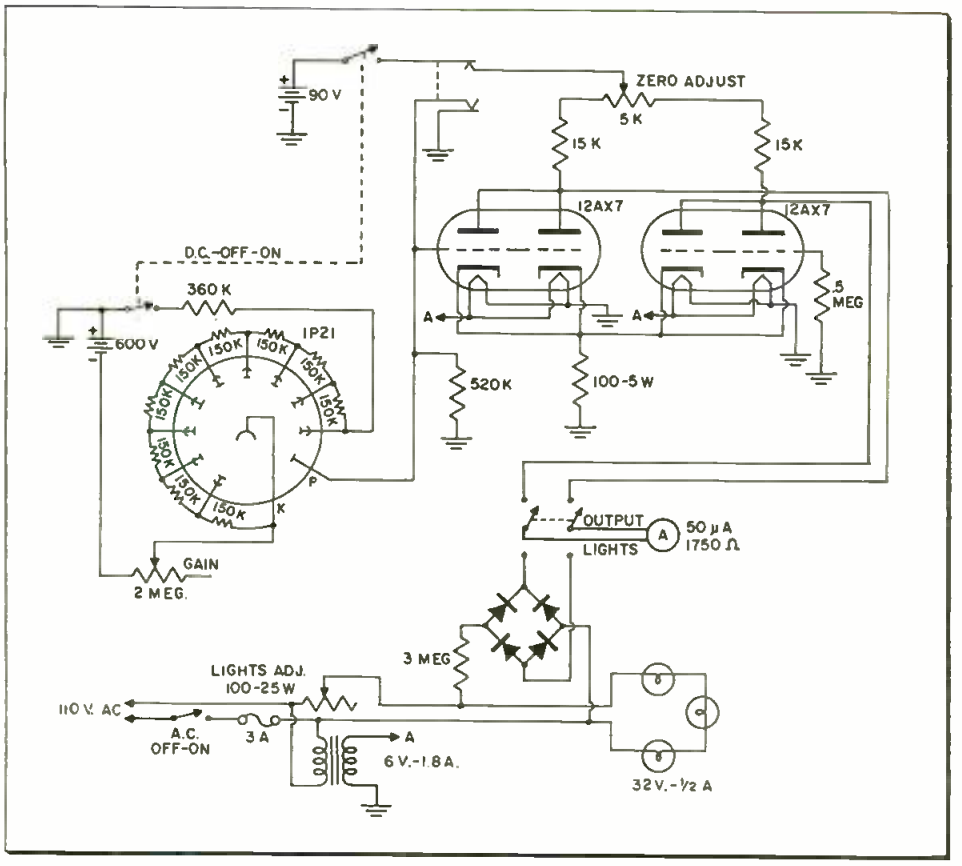


Fig. 1: Schematic diagram of photomultiplier and differential amplifier

By S. NEWMAN

Diffuse Reflectivity Meter

Compact, portable device which detects and measures small variations in illumination is particularly useful in checking dark trace PPI CRT's

DIFFUSE reflectivity is the ratio of the amount of light diffusely scattered from a surface to the amount of light scattered from a perfectly white surface. The measurement of the contrast of signals on the screen of a dark trace cathode ray tube is essentially a measurement of the percent change in diffuse reflectivity of the screen material caused by the incident electron beam as compared to the blank screen. To measure contrast, therefore, one measures the reflectivity of the screen before and after the display of a signal.

A dark trace tube[1] is a cathode ray tube with a light absorbing screen rather than a light emitting screen as in conventional tubes. Its principal application to date is a display tube for PPI radar. The screen material is potassium chloride, an alkali halide. When electrons hit the screen at an energy on the order of 10 kv., color centers or F-centers are formed in the crystalline potassium chloride. These are light absorbing centers with absorption occurring in the yellow-green region of the spectrum. The formation of F-centers causes a magenta coloration in the screen and therefore changes the diffuse reflectivity.

A compact, portable device for laboratory and field use for contrast measurements in the evaluation of dark trace tube operation has been designed and constructed at the Material Laboratory. Transmittances may also be measured with this instrument. It has a wide range of sensitivities so that it may be used at various light levels and its operation is simple, trouble free, and stable.

As shown in Fig. 1, the detector is a 1P21 photomultiplier with a Photovolt photopic filter which corrects the spectral response to simulate the

(*Continued on page* 146)

SAM NEWMAN, Material Laboratory, N. Y. Naval Shipyard, Brooklyn 1, N. Y.

Figs. 2 & 3: Rear and front views of instrument. Contrast is read in percent change of indication

Fig. 1: Transistorized, printed circuit summing amplifier

By R. C. WEYRICK

Transistorized Computer Amplifiers

Summing amplifier, and power amplifier, designed for a 400 CPS analog computing system in flight simulators, and utilizing printed-circuit construction, are compared for performance and physical characteristics with interchangeable vacuum-tube units.

A WIDELY used flight simulation method for flight trainers is the use of an analog computing system employing a modulated 400 CPS carrier. A recent article[1] described four basic computing components that have been developed for use in computing systems of this type. Two of these components are vacuum-tube amplifiers; one, a summing amplifier of the voltage feedback type having a 1% accuracy of summation and the other, a power amplifier for servo motor operation.

This article describes the design and characteristics of two transistor amplifiers that are directly interchangeable with these vacuum-tube amplifiers.

Summing Amplifier

To provide for interchangeability and direct comparison the performance requirements of the transistor summing amplifier are the same as those previously established for its vacuum-tube equivalent. These requirements are:

1. The amplifier should produce a balanced output of 25 v. RMS across a load consisting of four 20,000 ohm potentiometers (two on each output), or a tuned resolver. This condition requires a power output of 125 milliwatts.

2. With the feedback resistor and each input resistor having a value of 500,000 ohms, the amplifier should sum a maximum of four inputs without introducing an error of more than 1%. This condition requires a minimum effective gain of 40 db where effective gain is defined as the open-loop gain from one input to the output, and with the feedback resistor and the other three input resistors grounded through low impedance sources.

3. The amplifier should remain stable when the shunt capacity of the resistive load is 0.001 μf. or less for each potentiometer.

Circuit Design

The schematic diagram of the transistor summing amplifier is shown in Fig. 2. Seven junction transistors are used.

In the design of the output stage, the desire for low power consumption and high efficiency led to the choice of class B push-pull operation. The availability of both NPN and PNP transistors made possible the use of complementary symmetry.[2] Basically, such an arrangement utilizes transistor characteristics whereby the input signal polarity which increases conduction in a PNP transistor is opposite to the polarity which increases conduction in an NPN transistor. The use of such a circuit eliminates the need for two inputs having opposite phase.

A grounded-base connection is used for the output transistors V1405 and V1407 because it exhibits better linearity and dc stability than a grounded-emitter connection. A split-primary output transformer T1401 is required since the supply voltages for NPN and PNP transistors are of opposite polarity.

The input resistance of a grounded-base stage is low—generally less than 100 ohms. Because of this low resistance the output stages are driven by directly coupled, grounded-collector transistors to provide a relatively high input resistance and low output resistance.

With the output transistors operating Class B, some distortion is present in the output wave form because of increased emitter resistance at low values of emitter current. This distortion is removed by biasing the output transistors so that their operation is slightly Class AB. These bias resistors are R1417 and

Table 1: Physical Comparison Of Transistor and Tube Amplifiers

	Summing amplifiers (Two units each)		Servo amplifier	
	Transistor	Vacuum-tube	Transistor	Vacuum-tube
Weight (oz)	13	53	51	103
Volume (cu. in.)	61	208	98	216

R. C. WEYRICK, Goodyear Aircraft Corp., Akron 15, Ohio.

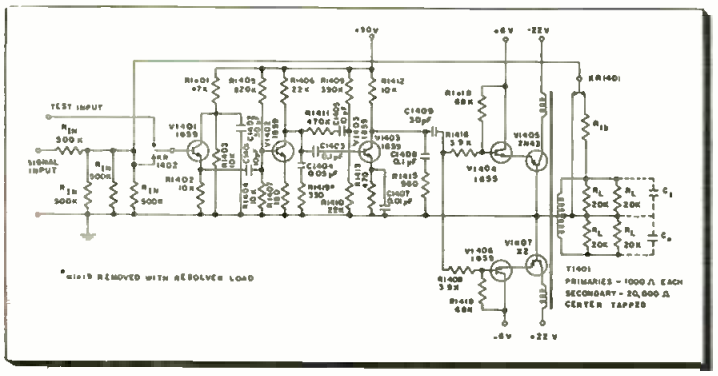


Fig. 2: Schematic of the transistor summing amplifier

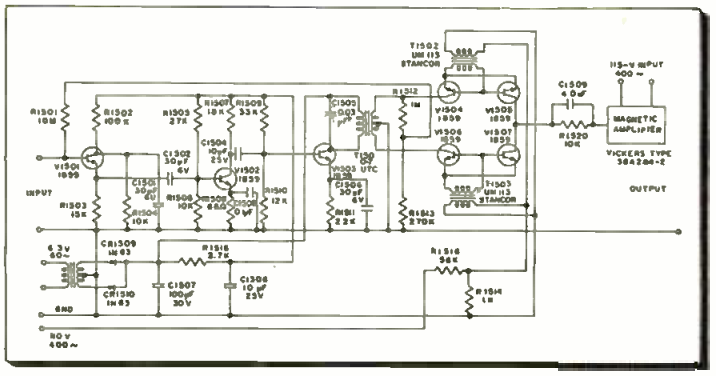


Fig. 5: Schematic diagram of servo amplifier

R1418. Such operation results in a maximum collector dissipation of approximately 75 milliwatts. The two types of output transistors used in this stage are Texas Instruments type X-2 (NPN) having a maximum dissipation of 100 milliwatts at 50°C, and Transitron type 2N43 (PNP) having a maximum dissipation of 90 milliwatts at 55°C.

The input transistor V1401 is also wired as a grounded-collector stage to obtain a high value of input resistance at the summing point. This

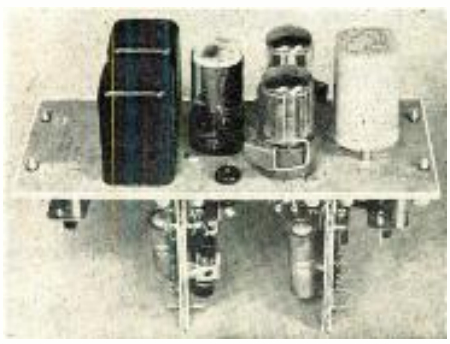


Fig. 3: Equivalent VT unit is 3½ times bulkier and 4 times heavier than transistor model

input resistance is approximately 200,000 ohms at 400 cps. Because of the low signal level at this stage it was considered desirable to reduce the noise level. Since transistor noise increases with collector voltage[3] the collector voltage of the input transistor was reduced to approximately 3 v. by a divider composed of R1401 and R1403. The voltage gain of this input stage is very near unity. Transistors V1402 and V1403 are grounded-emitter stages and provide voltage gains of 17 and 4.5 respectively. The emitter resistors R1407 and R1413 provide a measure of gain stabilization.

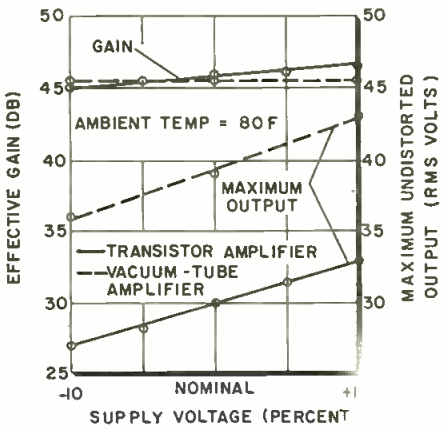
Because of the large amount of negative feedback around the amplifier, stabilizing networks were necessary to prevent oscillation from excessive phase shifts at high and low frequencies. The high-frequency response of junction transistors is, in general, dependent on both collector capacity and alpha cut-off frequency. Grown-junction NPN transistors usually have both a lower collector capacity and a higher alpha cut-off frequency than alloy-type PNP transistors. More adequate high-frequency stabilization is therefore obtained from the NPN units.

Two phase-lag networks (R1419, C1404) and (R1415, C1408) are included for high-frequency stabilization with a resistive load. The phase margin at high frequencies was further extended by bypassing the emitter resistor R1413 with an 0.01 μf. capacitor C1407. When the amplifier is used with the tuned resolver load, the network consisting of R1419 and C1404 is removed. Low-frequency stabilization is provided by a phase-lead network R1411 and C1403 connected between V1402 and V1403.

Relays K1401 and K1402 are provided for test purposes. In the operating position, the input signal is connected to the amplifier. In the testing position a known 400 cps test voltage from the trainer is applied to the amplifier, and the feedback resistor is disconnected. This arrangement permits a measurement of the open-loop gain at 400 cps.

The dc power requirements of the summing amplifier for an output of 125 milliwatts are ±22 v. at 9 ma.

Fig. 4: Effect of varying dc supply voltage



each, ±6 v. at 9 ma. each, and +30 v. at 3 ma., or a total power requirement of approximately 0.6 watt. By comparison, the power required for the equivalent vacuum-tube summing amplifier is 8.4 watts.

View of the transistor summing amplifier is shown in Fig. 1. Printed circuitry and miniature components are employed throughout. Fig. 3 shows a unit containing two equivalent vacuum-tube summing amplifiers. Table 1 provides a physical comparison of these units.

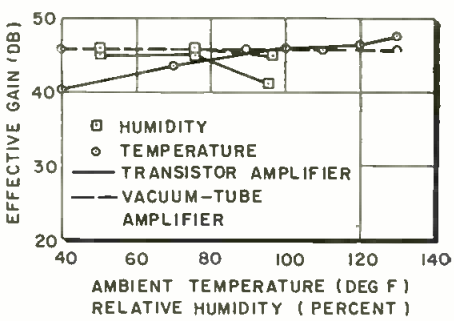


Fig. 6: Effective gain as function of ambient temperature and relative humidity at 90°F.

Performance

The performance of the transistorized summing amplifier was evaluated by comparing its characteristics with those of its vacuum-tube equivalent.

Table 2 summarizes the significant points of the amplifier frequency response under various load conditions. At 400 cps the effective gain and the phase shift at a closed loop gain of one are comparable in all uses. The phase and gain margins of the transistor amplifier are, in some cases, less than those of the vacuum-tube amplifier; however, they provide adequate stability against high frequency oscillation.

Fig. 4 shows the effect of a ±10% variation of dc supply voltage. The maximum undistorted output was determined under closed loop conditions and at a voltage gain of one.

Fig. 6 shows the effect of ambient-

Table 2
Frequency Response Data For Summing Amplifiers

	Transistor Amplifier	Vacuum-tube Amplifier
Condition 1: Balanced resistive load of four 20 K potentiometers. C_s (shunt capacity across load) as indicated		
Effective gain at 400 CPS (db)	44.4	45.3
Closed loop phase shift at 400 CPS (deg)	0.4	0.6
Phase margin, $C_s = 0.0$ μf (deg)	45	51
Gain margin, $C_s = 0.0$ μf (db)	7.4	15
Phase margin, $C_s = 0.002$ μf (deg)	30	38
Gain margin, $C_s = 0.002$ μf (db)	9.5	18
Condition 2: Resolver load tuned with 0.27 μf capacitor		
Effective gain at 400 CPS (db)	47.6	46.1
Closed loop phase shift at 400 CPS (deg)	0.0	0.0
Phase margin (deg)	41	41
Gain margin (db)	12	17

Note: Gain and phase margins are those at high frequency end.

Table 3: Effects Of Transistor Replacement On Summing Amplifier Gain

Current gain α/(1—α)	Effective gain (db) V1401	V1402	V1403	V1404	V1407
30	41.1	42.8	41.9	42.1	
25	43.8	41.8	41.7	41.7	
38	40.1	42.7	42.8	42.3	
40	44.1	43.0	42.8	42.3	
33	43.8	42.7	42.2	42.2	
46	41.1	42.9	43.0	42.8	
48	42.8	43.2	43.0	43.2	
52	44.8	43.4	43.3	43.3	
56	45.2	42.7	43.1	43.1	
61	44.0	44.0	43.8	43.9	
28					43.5
20					43.4
27					43.7

Computer Amplifiers (continued)

temperature and humidity variations. The effective gain is shown as a function of (1) ambient temperature and (2) relative humidity at an ambient temperature of 90°F. The gain of the transistor amplifier increases with increasing temperature. This gain change develops in the grounded collector stages of V1404 and V1406 and is caused by the operating point changing with temperature. This drift also affects the maximum undistorted output of the amplifier at temperatures above 120°F. At 130°F the maximum output drops from 29v. RMS to 23v. RMS. By comparison, the effects of temperature and humidity over these ranges on the vacuum-tube amplifier are slight.

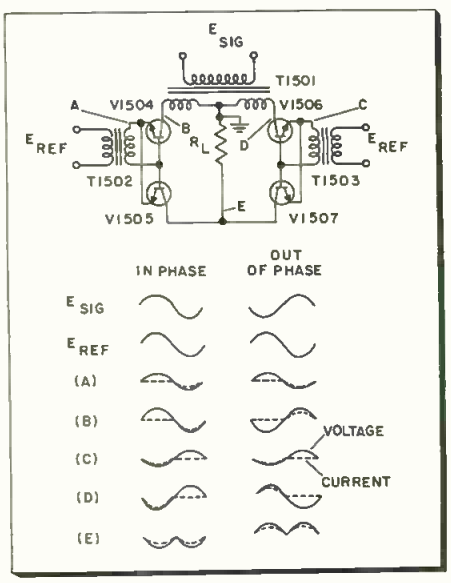
A number of transistors were substituted in the different amplifier stages to determine what effect transistor replacement would have on performance. The gain of the various stages (with the exception of the grounded base output stages) was found to vary somewhat with the current gain α (1 — α) of the transistor. The other transistor parameters-emitter resistance, base resistance, and collector resistance, had little effect on gain. Table 3 shows the effective amplifier gain at 400 CPS when transistors having various current gains were substituted in the different stages, and when all voltage amplifier stages except the stage receiving the substitution retained original transistors having approximate current gains of 50 each.

The performance requirements of the servo amplifier are the same as for its vacuum-tube equivalent and are as follows:

1. The amplifier should be designed to operate a 5 watt servomotor.
2. The amplifier should sum a maximum of four inputs and produce a shaft rotation proportional to within ±1.0° of the sum of the inputs.
3. The frequency response of the output shaft should extend to 10 CPS.

The transistor servo amplifier consists of a three-stage voltage amplifier, a phase detector using four transistors, and a magnetic amplifier output stage. A full-wave rectifier and filter are added to the amplifier circuit to provide dc voltage supply. The over-all schematic diagram of this amplifier is shown in Fig. 5.

Fig. 7: Transistor phase detector operation



The function of the amplifier section is to amplify the resultant voltage of the various signal inputs to a level suitable for the magnetic amplifier input. The input stage is similar to that of the summing amplifier. Transistor V1501 is connected as a grounded-collector stage to obtain a high input resistance, and the collector voltage is reduced to five by a divider composed of R1502 and R1504. Transistor V1502 is emitter-grounded, and resistance-capacitance coupled to the input stage. The voltage gain of this stage is approximately seven.

Transistor V1503 is also a grounded-emitter stage, and its output is transformer-coupled to the phase detector. The maximum undistorted output is 11 v. RMS. To maintain this value, the dc operating point is stabilized by the addition of R1511 in the emitter circuit.[4] This resistance is bypassed for 400 CPS by C1506.

Negative feedback is added around the transistor amplifier through resistors R1512, R1513, and R1501. Primary purpose of this feedback is to lower the effective output impedance of the amplifier from about 16,000 to 2,500 ohms. This lower value of output impedance increases the effectiveness of the lead network R1520 and C1509 in the magnetic amplifier control-winding. This negative feedback also stabilizes the amplifier gain when transistors

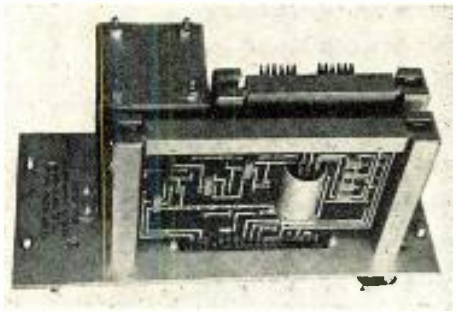


Fig. 8: Assembled transistor servo amplifier

the amplifier gain when transistors are replaced by units having slightly different characteristics.

The function of the phase detector is to convert the ac output of the transistor amplifier to a polarity-reversing dc input for the magnetic amplifier. This phase detector employs transistors V1504, V1505, V1506, and V1507. The use of transistors for this detector provides two advantages over a diode-bridge type detector. Since there is no large circulating current through the transistors no offset or unbalance can develop, and the amount of reference power required is appreciably less.

The operation of the transistor phase detector is shown by the wave forms in Fig. 7. The 400 cps reference voltage is supplied to the emitters through step-down transformers T1502 and T1503. These transformers are phased so that forward emitter current flows in V1504 and V1505 during one-half cycle and in V1506 and V1507 during the other half cycle (waveforms A and C). The collectors of each pair of transistors are connected in series. During a half cycle of forward emitter current the two paired transistors present a low-resistance path from the secondary winding of T1501 to the output, and current will flow as shown by waveforms B and D. During a nonconducting half cycle, these transistors present a high-impedance path. The resulting output current (waveform E) is full-wave rectified dc and reverses polarity as the signal changes phase with respect to the reference voltage.

Fig. 8 is a photograph of the transistor servo amplifier along with the adaptor plate used for substituting the amplifier in the computing system. The transistor amplifier and phase detector are on the printed circuit board in the foreground. The magnetic amplifier and its rectifiers are in the rear. Table 1 physically compares this transistorized unit with its vacuum-tube equivalent. The power required by this transistorized servo amplifier is 0.3 watt as compared to 6.0 watts for its vacuum-tube equivalent.

The performance of the transistor servo amplifier was evaluated while operating in a positional servo system composed of amplifier, servo motor, feedback potentiometer, and summing resistors. A positional servo of this type is used in the computing system to perform multiplication.

The frequency response of this system is shown in Fig. 9 and is seen to be comparable to that obtained with a vacuum-tube amplifier. Both amplifiers showed a static accuracy of approximately ±0.5°.

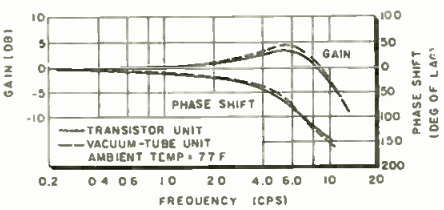
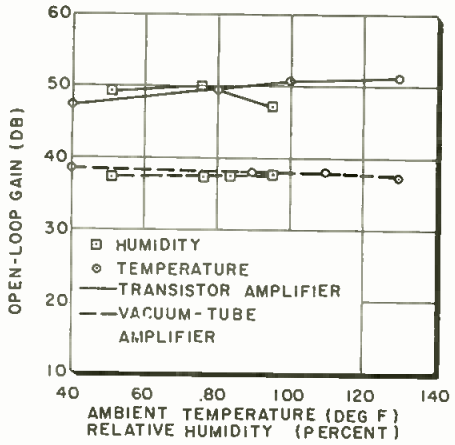


Fig. 9: Freq. response of positional servo

Fig. 10 shows the effect of ambient temperature and humidity on amplifier gain. The gain of the transistor unit is seen to increase with ambient temperature. This change, however, occurs in the magnetic amplifier, and the gain of the transistor amplifier and phase detector are essentially constant.

The substitution of transistors having current gains in the range of 30 to 60 had only a slight effect on amplifier gain. The substitution of transistors in the phase detector had no effect on its operation.

Fig. 10: Temperature and humidity effects



Presented at the 1955 National Electronics Conference.

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"Field Emitter" Electron Source

A unique method of electron emission which utilizes a high electric field, rather than heat, to liberate the electrons has been developed at Linfield College, McMinnville, Ore. Linfield scientists, under the direction of Dr. W. P. Dyke, have successfully operated a 1-megawatt tube using "field emission," the new method of obtaining electrons.

Electrons are usually supplied by heating a metal filament in a vacuum tube. Heat sources, however, are cumbersome and expensive, and the electron supply obtained in this manner is slow and inefficient. In field emission the application of a high voltage releases a flood of electrons from the metal with no heat required.

A field emitter is a tiny tungsten needle so small (less 0.0001 in. diameter) that it cannot clearly be seen in an ordinary microscope, but requires the use of the modern electron microscope to reveal details of its outline. In spite of this small size, the electron supply within the needle is so sensitive to the applied voltage that currents of several amperes have been drawn from one needle. When several emitters are mounted in a comb-like array and operated in parallel, currents up to 20 a. at a peak power of more than a megawatt have been obtained. The Linfield scientists believe that considerably higher powers are within reach in the near future.

Keys to the successful harnessing of the electron source in useful form have been the use of an intermediate temperature to maintain a smooth, clean metal surface, and limiting the emission to short bursts, say a millionth of a second, such as are used in radar, TV, etc. Thus, in its present state of development, the electron source is useful in pulsed electronic devices; however, work is in progress on a similar, but cold, cathode for use in steady state emission.

Radar Instructor Exams

The U. S. Civil Service Comm. has announced a new examination for filling Radar Instructor and Radar Instructor (Trainee) positions at the Keesler Air Force Base in Biloxi, Miss. The entrance salaries are $3,670 and $4,525 a year.

To qualify, applicants must have had appropriate education or experience. Full information and application forms, may be obtained at post offices throughout the country, and from U. S. Civil Service Commission, Washington 25, D. C.

Fig. 1: Top view showing chassis layout

Design and construction details of a unity gain dc amplifier of high input impedance and an output impedance of less than one ohm. The amplifier acts as a coupling unit between the high impedance source and the low impedance load. A 0-1 voltmeter, connected across the output, functions as a VTVM, with ranges of 1 to 1,000 volts

Unity Gain Voltmeter

THE common bridge type dc VTVM, while a very useful instrument, has some inherent disadvantages. The accuracy can be no better than that of the included meter movement, and frequent calibration is necessary if accuracy is to be maintained.

The equipment to be described (see Figs. 1 and 2) was originally intended as a VTVM, but actually has many other uses around the laboratory. Essentially, it is a unity-gain dc amplifier of very high accuracy and stability. The input resistance is very high and the effective output resistance is very low. The most unusual feature of the unit is that no indicating meter is included. Any voltmeter may be connected across the output terminals and will read accurately in volts. This may be a common portable multimeter or a sensitive laboratory voltmeter, depending on the desired accuracy. No readjustment or calibration is necessary when changing meters. The amplifier works merely as a coupling member between a high-resistance source and a low-resistance load.

Since the flat bandwidth is in excess of the audio spectrum, the amplifier may also be used with audio-frequency meters, providing decreased circuit loading without deterioration of accuracy. The square-wave response is excellent, only a very slight overshoot being present, and a 2000-cycle square wave of 25 v. peak-to-peak amplitude being reproduced with no noticeable deterioration. Loading the output with capacities up to 1000 μf does not affect the waveshape. On dc, changing the load resistance from open-circuit to 500 ohms will produce no measurable change in output with capacities up to 1000 μμf cause less than 1% drop. Below 100 ohms the output drops rapidly, due to the limited current-carrying capacity of the output tubes. The drift, after a 1 hr. warm-up, did not exceed .02 v. for a 24-hr. period.

H. R. HYDER, Principal Engineer, Computer Engineering Dept., Bendix Radio, Baltimore 4, Md.

Circuit Description

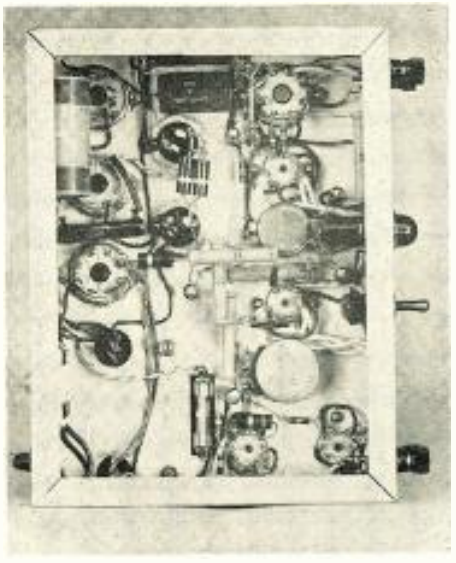
The circuit (Fig. 3) is that of a three-stage amplifier, with a feedback factor very close to unity. The open-loop gain is about 38 db; positive feedback in the second stage increases this to about 80 db.

The first stage is arranged as a differential amplifier. This is about the only practical way to approach 100% feedback in this type of circuit. The differential arrangement has the additional advantage of cancelling drift if the two sections of the double triode are matched. The 6SU7GTY (a specially selected 6SL7GT) is used for this reason. However, substitution of several 6SL7GT's showed only a slight increase in drift.

A constant current cathode load, V2, is used in the first stage in an attempt to make the differential gain as high as possible. The effective impedance is 10 megohms ($R^1 = R_u$). Also, it was necessary to use small individual cathode resistors in the two 6SU7GTY cathodes. Without these resistors, large changes in source resistance would offset the zero, due to contact potential. With the resistances, the source resistance can vary from 10 megohms to zero without changing the balance more than .01 v. It is also necessary to make R2 greater than R1, to equalize the plate currents of the 6SU7GTY, since the second section has no load resistance and runs directly to B+.

The second stage receives its excitation from the plate of V1 through a voltage divider. As a result, the gain from the amplifier

Fig. 2: Bottom view shows component placement



By H. R. HYDER

Amplifier

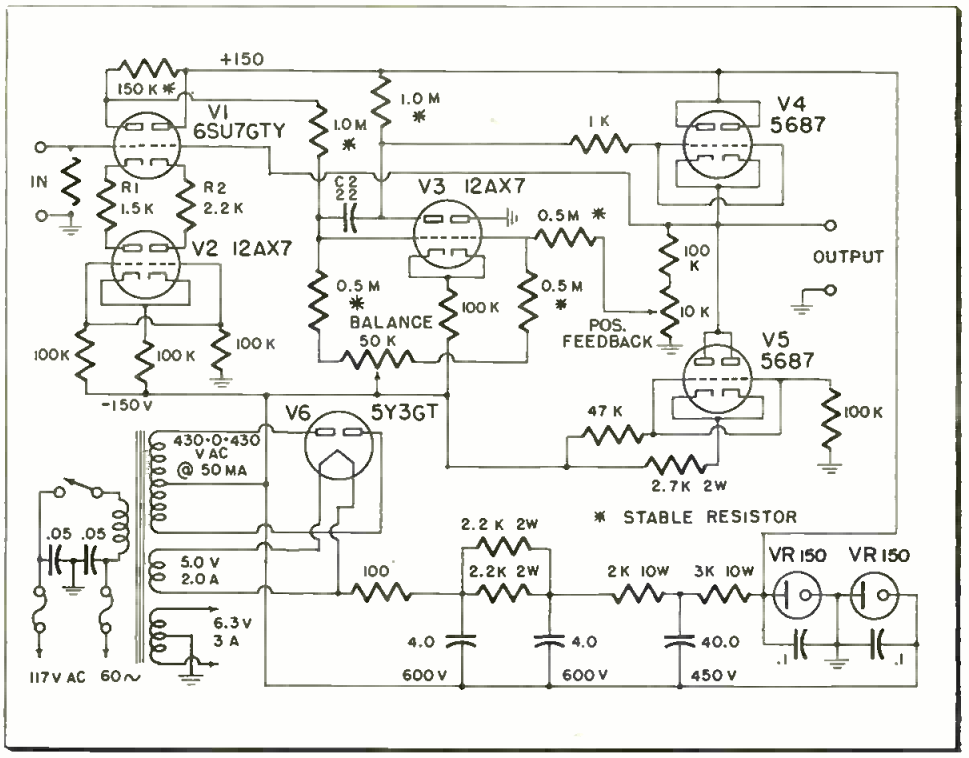


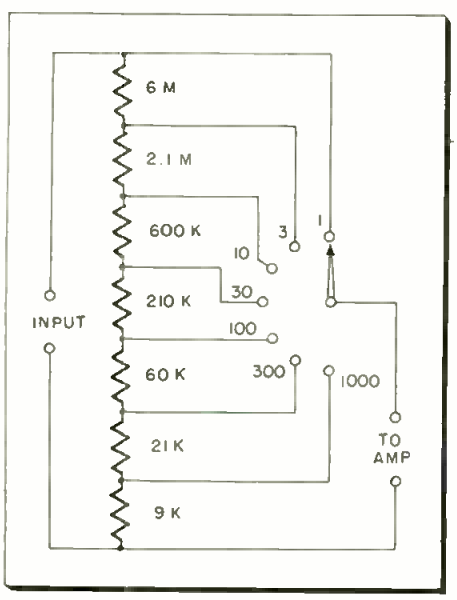
Fig. 3: Schematic diagram of the three-stage amplifier. Feedback factor is close to unity

input to the grid of V3 is about 10. V3 is also a differential amplifier; the second grid is used to introduce positive feedback derived from a potentiometer across the output cathode follower. The adjustment of the positive feedback will be covered later.

The output cathode follower uses both halves of a 5687 in parallel, running at a total cathode current of 20 ma. It is important that a high-perveance tube be used here because of the limited plate voltage available. The use of a constant-current cathode return is particularly beneficial in the output stage, since practically all of the current change of the output stage can flow through the load. If a resistor were used, it would have to be 7,500 ohms, and would always shunt the load. The 5687 dynamic load has an effective resistance of about 50,000 ohms.

The self-contained power supply uses two VR-150 gaseous regulators.

Fig. 4: Constant resistance step voltage divider gives 1v meter a range of 1 to 1000v.



Feedback

It would not be possible to obtain such a high order of performance without the use of positive feedback within the negative feedback loop, giving an effective loop gain of about 10,000 as compared to 800 without the positive feedback.

Another interesting point is that since the feedback factor is not quite —1, due to the imperfect action of V1 and the presence of R1 and R2, the gain of the amplifier can be adjusted to exactly unity by means of an adjustment of the positive feedback control. The easiest way to adjust the positive feedback to the proper value is to bridge the input and output with a dc VTVM and adjust the positive feedback until there is no meter deflection as the input voltage to the amplifier is varied from +25 v. to —25 v., as derived from a battery and potentiometer. It is necessary to readjust the balance after each change of the positive feedback control. In the familiar expression

$$R_o = \frac{1}{\left(\frac{1}{r_p}\right) - \beta A_1 G_M}$$

Where

β = Feedback Factor

R_o = Effective Output Resistance

r_p = Plate resistance of output tube

A_1 = Voltage gain to grid of output tube

G_M = Mutual conductance of output tube

any local positive feedback within the loop merely adds to A_1. R_o is positive only as long as the positive feedback stage is below the threshold of oscillation.

If the positive feedback is carried to the point of oscillation, the feedback factor reverses in sign and the output impedance of the amplifier becomes negative. In this amplifier, the output impedance is always a fraction of an ohm positive. This low output impedance is more apparent than real, however, in that it is only true within the current rating of the output tubes. In other words, you can't measure the internal impedance by loading the output until the voltage drops 50%. Phase correction for stability is by means of C_2. The positive feedback also aids stability, since it is effective only at lower frequencies and therefore provides a step in the high-frequency attenuation characteristic. Of course, due to the direct-coupling and gaseous regulator tubes, low-frequency instability is not a problem.

A constant-resistance step voltage divider is shown in Fig. 4. This gives dc or ac ranges of 1, 3, 10, 30, 100, 300, and 1000 v. with a 1 v. meter across the output.

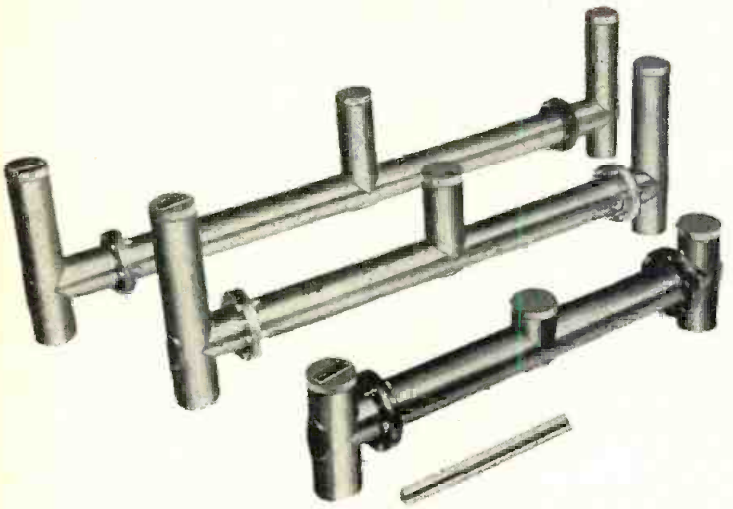


Fig. 1: Three 25 kw VHF filters. Units are producible in reasonable quantities without any deteriation in performance

Step by step design of a high power spurious emission TV transmitter filter is outlined and experimentally verified. Included are 25 kw channels 2-13, 50 kw channels 7-13, and 12.5 kw channels 14-83 low pass filters. Image parameter design with constant- k and m-derived (series and shunt) is used throughout

By W. J. JUDGE

Spurious Emission Filter Design

THE term "Spurious Emission Filter" is, in a sense, a misnomer. Measurements on a large number of TV transmitters have shown that only the fundamental harmonics require attenuation if the FCC specifications on spurious radiation[1] are to be satisfied. Consequently, the spurious emission filter, intuitively a band-pass device, is usually in practice a low-pass or a harmonic filter. Since it must be assumed that the magnitude of the harmonic signal appearing at the transmitter output terminals is a function of the final amplifier only, the spurious emission filter has, as requisites, low fundamental loss and high power handling capacity. This suggests physically large, high-Q elements, which are not usually realized in a lumped circuit. Standard coaxial transmission line elements, however, may be used to construct satisfactory high-power filters for the VHF and UHF TV bands at all existing power levels.

Coaxial line filters can be generally classified as: (a) resonant-line filters, (b) short-line filters. Resonant-line filters, providing adequate harmonic attenuation and utilizing a minimum of elements, are both practical and economical, but they are by nature channel selective and do not readily lend themselves to large quantity production. On the other hand, the short-line filter, in essence a broadband device, has the advantage of being in general non-channel selective and requires no field adjustment, two obvious economies over the resonant-line type. Therefore, it is the short-line filter which will be discussed here. For information pertaining to the resonant-line type coaxial filter, which takes many interesting forms, the reader is referred to the literature[2, 3].

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Coaxial Short-Line Filters

It is desirable to base the design of short-line filters on classical filter theory, and this will be realized if short-line sections can be shown to simulate the requisite elements of the classical filter. From the succeeding brief analysis[4] some necessary relationships are derived.

The input impedance, Ξ_1, of a length, l, of transmission line of characteristic impedance, Ξ_o, is given by

$$\Xi_1 = \Xi_o \frac{\Xi_L \cos \beta l + j\, \Xi_o \sin \beta l}{\Xi_o \cos \beta l + j\, \Xi_L \sin \beta l} \qquad (1)$$

where Ξ_L = terminating impedance

$$\Xi_o = \sqrt{L_o/C_o}$$

$$\beta = \omega\sqrt{L_o\, C_o}$$

Eq. (1) may also be written

$$\Xi_1 = \frac{\Xi_L + j\, \Xi_o \tan \beta l}{1 + j \frac{\Xi_L}{\Xi_o} \tan \beta l} \qquad (2)$$

If the inequality

$$\left| \frac{\Xi_L}{\Xi_o} \tan \beta l \right| << 1 \text{ holds} \qquad (3)$$

and if

$$\tan \beta l \approx \beta l$$

than (2) becomes

$$\Xi_1 = \Xi_L + j\omega L_o\, l \qquad (4)$$

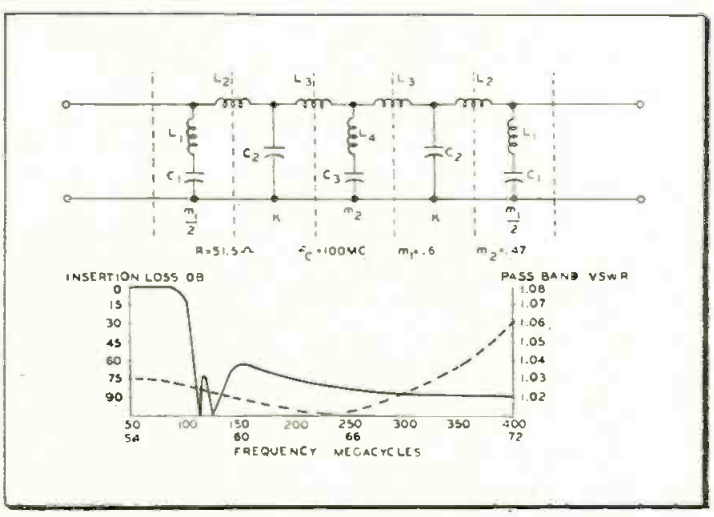


Fig. 2: Channels 2, 3, and 4 theoretical filter rated for 25kw peak power

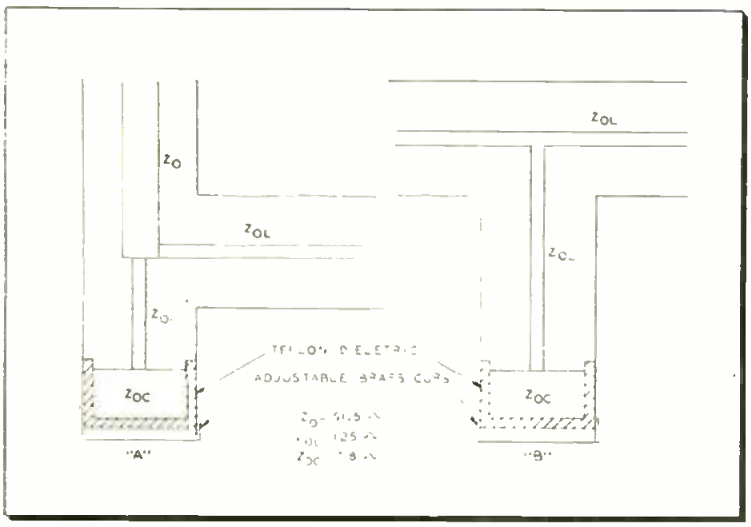


Fig. 3: Coaxial sections. A is terminating half section; B is full section

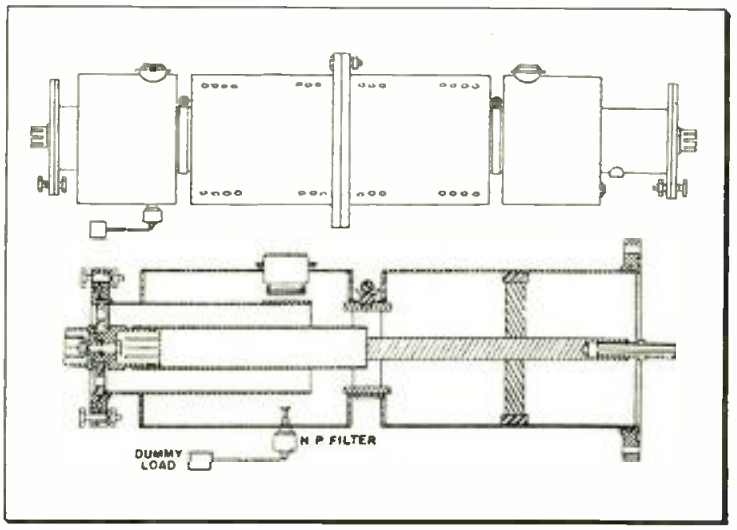


Fig. 4: Damping filter coupled into channels 7-13 50 kw filter

a series inductance plus the terminating impedance.

We can also write (2) as

$$Y_1 = \frac{(1/\Xi_L) + j\,(1/\Xi_o)\tan\beta l}{1 + j\,(\Xi_o/\Xi_L)\tan\beta l} \qquad (5)$$

and if the inequality

$$\left|\frac{\Xi_o}{\Xi_L}\tan\beta l\right| << 1 \text{ holds} \qquad (6)$$

with

$$\tan\beta l \approx \beta l$$

then (5) becomes

$$Y_1 = 1/\Xi_L + j\omega C_o l \qquad (7)$$

a shunt capacitance across the terminating impedance.

For a coaxial line

$$L_o = \frac{\Xi_o}{V} \text{ henrys per cm} \qquad (8)$$

$$C_o = \frac{1}{\Xi_o V} \text{ farads per cm.} \qquad (9)$$

So from (4) and (8), the inductance, L, of a short length of line

$$L = \frac{\Xi_{oL}\, l}{V} \qquad (10)$$

and from (7) and (9)

$$C = \frac{l}{\Xi_{oc} V} \qquad (11)$$

The development of (4) and (7) establishes the design parameters for the short-line filter as (a) characteristic impedances (b) line lengths. The limitation on the parameter (a) is physical, being dependent primarily on the power to be transferred through the section[5]. The parameter (b) effects the stop-band performance with respect to both attenuation and location of spurious pass-bands[2]. The latter occurs for values of $\Theta = n\pi$, when n is intergal and Θ is defined as the phase shift along a line length l, and is given by

$$\theta = \frac{\omega\, l}{V_o} \qquad (12)$$

Values of $\Theta_L \approx 40°$ for inductive lengths and $\Theta_c \approx 20°$ for capacitive lengths have been found practical for low-pass power filters. Θ_L being greater than Θ_c, the first spurious pass-band is generally due to Θ_L and has a width which is approximately equal to $\Theta_c f_c/\Theta_L$. The peak of the pass-band, though, is extremely sharp, and the "width," as defined here, represent points in the spurious pass-band where considerable attenuation still exists.

The discontinuity susceptance present at the impedance transition where the short-line elements of the low-pass filter are joined together has been thoroughly analyzed.[6] The discontinuity is a shunt capacitance and for low-pass filters can conveniently be lumped into the capacitance section, the necessary modification of which is given by[2]

$$\overline{\theta_c} = 2 \text{ arc tan}\left[\tan\left(\frac{\theta_c}{2}\right) - \beta_c \Xi_{oc}\right] \qquad (13)$$

$$\beta_c \Xi_{oc} = 5\, f_c\, D\, C'_d\, \Xi_{oc}\, 10^{-5} \qquad (14)$$

θ_c – the corrected phase angle
D – outer diameter in in.
f_c – cutoff frequency in MC
C'_d – $\mu\mu f$/cm (as per reference #6)

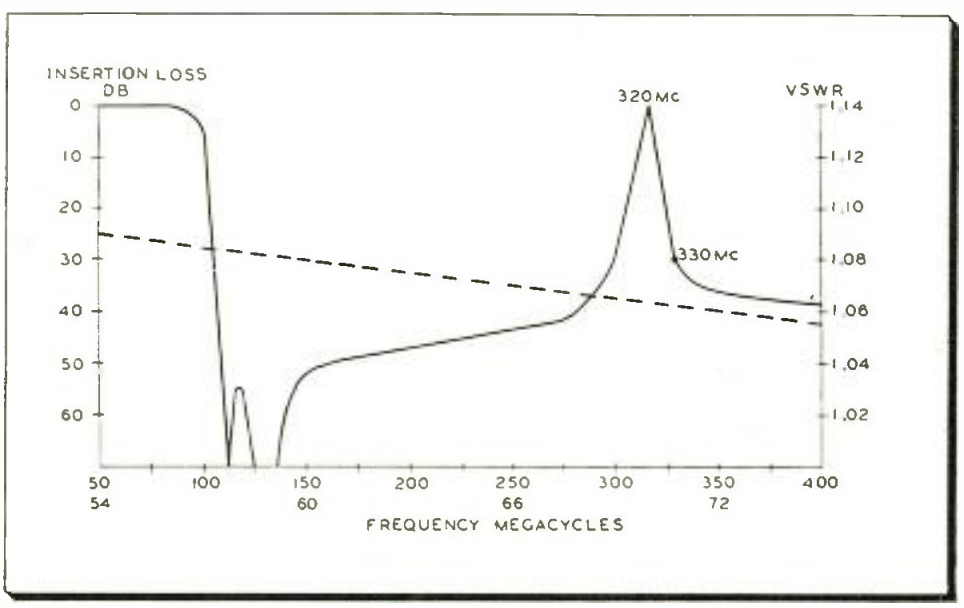
With Eqs. 10 through 14 as a point of departure, the design of a composite low-pass filter can be attempted.

Specifications

On the basis of measurements made on a large number of visual and aural transmitters[7], and in view of possible tightening of future FCC specifications on spurious radiation, realistic minimum values of harmonic attenuation by the spurious emission filter would seem to be: 2nd harmonic—55 db; 3rd harmonic —45 db; 4th harmonic—40 db; 5th harmonic—20 db; 6th and higher—usually very little.

This would provide a system level of at least —80 db on all harmonics. To minimize pass-band insertion loss and effect on transmitter loading, the filter VSWR throughout the

Fig. 5: Measured transmission characteristic of filter seen in Fig. 2



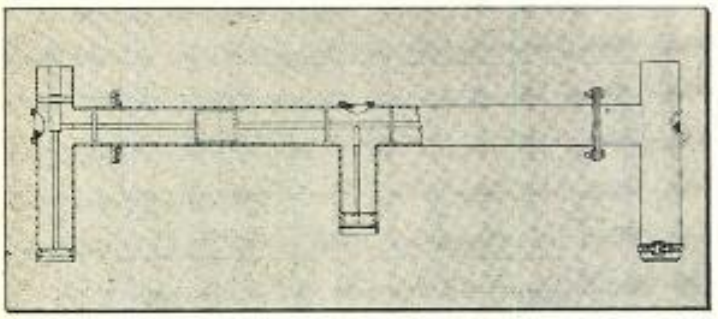


Fig. 6: Construction of composite filter. Convection currents provide cooling

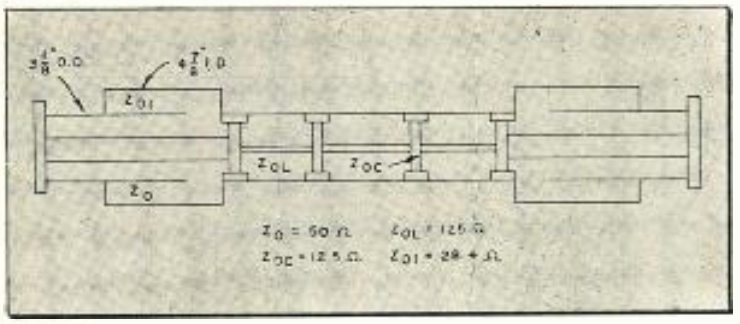


Fig. 7: UHF transmission line low-pass filter. Rating is only 12.5 kw

Filter Design (Continued)

operating channel should be a maximum of 1.1. The heat rise of the filter while passing its maximum rated power should be consistent with transmission line specifications.

VHF 25 KW Filters

The required decreasing attenuation levels for successive harmonics as outlined in the previous paragraph and the 1.1 VSWR specification suggests the use of m-derived sections. If m = .6 terminating half sections are employed, the image impedance of a conventional low-pass ladder filter will be within 5% of its characteristic impedance up to .80 f_c[8]. The VHF TV low-band (54-88 MC) consequently is conveniently[9] handled by two low-pass filters, channels 2, 3, 4, and channels 5, 6, both of which will supply the required harmonic attenuation with a minimum of sections. For the VHF TV high-band, a single filter suffices for channels 7-13.

The first filter discussed is the channel 2, 3, 4 unit which is required to pass a peak power of 25 kw. The lumped element values are calculated by the image parameter method. A cutoff frequency of 100 MC is chosen because the stop-band attenuation is met simply and the 80% pass-band includes channel 4 (Fig. 2).

As the first step in the transformation of the filter to transmission line sections Ξ_{OL} is computed from the phase angle Θ_L which is arbitrarily chosen to position the first spurious pass-band conveniently, i.e., somewhere above the fourth harmonic region of channel 4. A good starting point is to assume L_2 (the largest series inductance) (Fig. 2) responsible for the first pass-band although intuitively it may seem that $2L_3$ will produce a lower frequency pass-band, particularly if the shunt leg $L_4 + C_3$ presents a high impedance at or about the $\lambda/2$ frequency of $2L_3$. It happens that the first pass-band depends on L_2, $2L_3$ and $L_4 + C_3$, so it is necessary in the design of the inductive sections to utilize the smallest possible phase angles consistent with the power requirements. A $\Theta_{L2} = .8$ radians or $\sim 46°$ will develop a pass-band at about 390 MC, so initially,

$$\Xi_{OL} = 6.28 \times 1 \times 10^8 \times .1312 \times 10^{-6}/0.8 = 103\ \Omega.$$

A power requirement of 25 KW suggests either 3⅛ in. or 6⅛ in. transmission line. 3⅛ in. line with a ⅜ in. inner conductor produces a Ξ_{OL} = 125 ohms which is greater than that arbitrarily calculated, but the higher impedance produces a more desirable phase angle per section. Estimation of the heat rise of the line section under full power is attempted by calculating the stable operating temperature of a ⅜ in. copper rod in free space. If use is made of the empirical thermodynamic relationship[10]
where

$$q = UA\Delta t \qquad (15)$$

q = BTU/HR
U = 2 BTU/HR–°F–FT²
A = cross-sectional conduction area
Δt = temperature rise °F

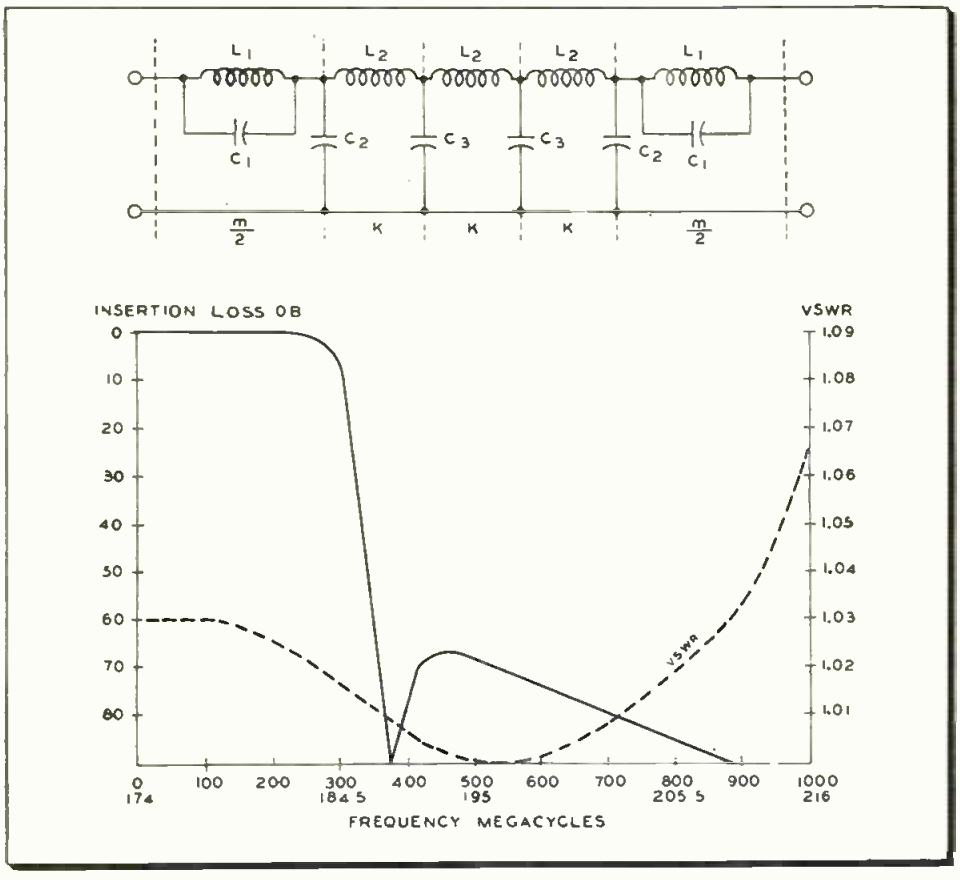
the temperature rise of the ⅜ in. copper rod is computed to be 110°F.

The inverse square law of classical physics suggests that the temperature rise of the outer conductor is proportional to the rise of the inner conductor times the square root of the ratio of the radii, which in this specific case would be 38°F.

If the internal filter sections are silver brazed and teflon dielectric is used, the computed full power operating temperatures indicate that 3⅛ in. line can be rated at 25 kw for VHF short-line filter construction.

Referring to the schematic diagram of Fig. 2, the short-line section

Fig. 8: Shunt m-derived half section as used on 50 kw channel 7-13 filter



lengths for L_2 and $2L_3$ are calculated using Eq. (8) with $\Xi_{0L} = 125$ ohms. The first spurious pass-band due to $2L_3$ is found at 262 MC but this depends, among other things, on the leg L_4 and C_3 shunting a high impedance across the line, which is not the case at 262 MC. The spurious pass-band due to L_2 is calculated as 500 MC. The actual first spurious pass-band, therefore, should lie somewhere between 262 and 500 MC since it depends on mutual impedance relationships between the various short-line sections, and is probably a function of $L_2/(2L_3 + L_2)$.[11] This being the hypothesis, the frequency of the first actual pass-band is estimated as being 346 MC, which is well above the fourth harmonic frequency of channel 4.

The impedance $\Xi_{0c} = 7.8$ ohms provides a satisfactory phase angle for C_2 of 17°. This impedance is realized with a 3⅛ in. line of solid teflon dielectric and an inner conductor of 2½ in. If the dielectric, which has a width of ¼ in. is extended another ¼ in. at each end of the short-line low impedance section (Fig. 10), a voltage breakdown safety factor of 5 to 1 at a 25 kw level is obtained.[12] In addition, the fringing field at the impedance transition is partially in the dielectric, increasing the discontinuity susceptance and lowering the value of $\bar{\theta}_c$ (Eq. 13). As has been pointed out previously, a low value of $\bar{\theta}_c$ is desired, $\bar{\theta}_c$ being the limiting factor on the width of the first spurious pass-band. For this specific case $\theta_c = 13°$, making the pass-band at 346 MC about 20 MC wide. The composite filter construction can now proceed. The legs L_1C_1 and L_4C_3 are of course realized with coaxial tee sections (Fig. 3). The calculation of C_1 and C_2 is straightforward, except that in closing off the outer conductor as indicated in Fig. 3, an additional parallel plate capacitance is added. The latter suggests a simple method for compensation of the effects of mechanical tolerances on the electrical performance of the filter. If the design values of C_1 and C_2 are purposely constructed somewhat less than required, the outer conductor plate can be made adjustable and the filter can be "tuned" for minimum VSWR in the usable pass-band without appreciably effecting the stop-band performance.

Composite Filter

Fig. 6 shows the construction of the composite filter. The inner conductor, except at the terminals, is built of solid copper. Use of solid copper in the low impedance sections permits better conductivity of heat away from the ⅜ in. rods than would occur if hollow copper drums were used. The thermal conductivity of the teflon dielectric is enough to afford a good path to the outer conductor. Additional cooling is supplied by drilling four ¼ in. holes radially spaced through the length of C_2 and locating heavy wire mesh screens on the outer conductor (Fig. 6). Natural convection currents permit the hot air in the filter to escape through the center screen to be replaced by cooler air drawn in through the end screens. Expansion of the inner conductor is allowed along the series bullets located near each flange. The flanges are swivel type affording maximum physical flexibility when mounting the unit in the transmission system. At 25 kw levels, though, it is necessary that the center screen face up to provide the maximum effective convection cooling.

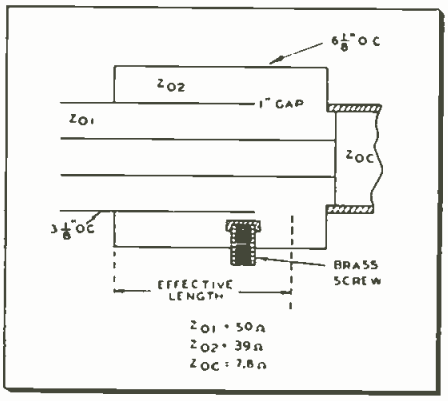
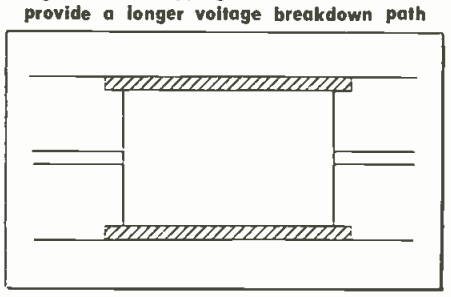


Fig. 9: Coaxial shunt m-derived

Experimental verification of the paper design of the channel 2, 3, 4-25 kw filter was almost completely realized. Its transmission characteristics are given in Fig. 5 where close correlation with the characteristics of Fig. 2 are apparent. The major discrepancy involves the location of the first spurious pass-band which appears 26 MC lower than calculated. However, it was found that removal of the two support beads near the center tee shifted the pass-band out to 335 MC. The support beads could not be sufficiently undercut due to the small diameter of the inner conductor and consequently represent discontinuities (of no effect in the pass-band) which tend to "tune" with the leg L_4C_3 in determining the spurious pass-band center frequency. The beads were replaced and the pass-band left at 320 MC since it did not fall on any specific harmonic frequency. The spurious pass-band width (Fig. 5) is about 25 MC at the 30 db points. The insertion loss at the 5th harmonic frequencies of the channel 3 visual and aural carriers is about 20 db, which is adequate. The target values of 55, 45 and 40 db for 2nd, 3rd and 4th harmonic attenuation, respectively, are met.

Fig. 10: Overlapping of the dielectric to provide a longer voltage breakdown path



The channel 5, 6-25 kw filter is a replica of the channel 2, 3, 4 unit, differing in its linear dimensions.

A single filter serves the VHF high band, channel 7-13, at the 25 kw level. It duplicates the low-band design except that two additional constant-K sections are added giving the symmetrical configuration

$$\frac{m_1}{2} + 2K + m_2 + 2K + \frac{m_1}{2}$$

and a stop-band attenuation which is literally out of sight. A similar stop-band performance could have been achieved on the low-band fiters by the addition of one or two constant-K sections but the filter lengths begin to get excessive and a system attenuation of 80 db does not demand it. It is not inconceivable, however, that some situation may require, say 120 db system attenuation on a specific harmonic. If so, note (Fig. 6) that the end section of the filter may be removed from the main body and as many constant-K sections added as desired.

With reference to heat rise, the power tests for the 25 kw filters were performed on the channel 5, 6 prototype. It may be recalled that the calculated temperature rise was 110°F for the inner conductor. Experimentally, the inner conductor stabilized between 200° and 225°F with an ambient of 95°F under continuous full power operation over a period of 4 hrs. The outer conductor stabilized at 120°F, which was more or less as expected.

Fig. 1 is a photograph of the three 25 kw VHF filters. These units lend themselves readily to production in reasonable quantities without any deterioration in performance. The mechanical tolerances on machined parts are a strict ±.002 in. and on most line lengths ±1/64 in., ensuring uniformity of product.

50 KW Filter, Channels 7-13

If operating temperatures similar

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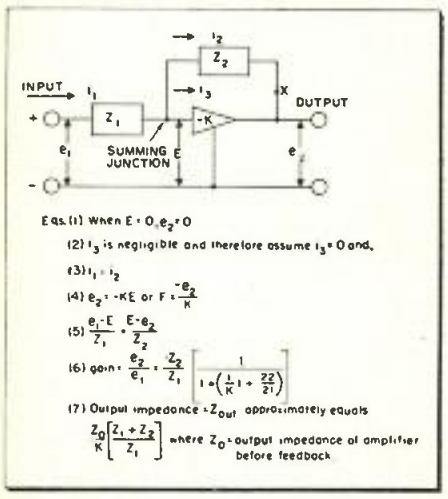
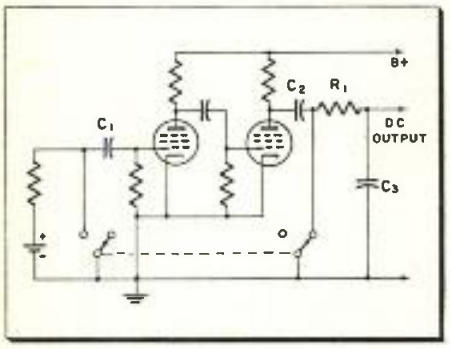


Fig. 1: Block diagram of DC decade amplifier

Fig. 2: Essential elements of chopper amp



Unique arrangement of RC and direct-coupled amplifiers and a chopper stabilizer achieve unusual stability in a DC amplifier. Bandwidth is flat from DC to 100 KC; gain is variable in 20 db steps

By W. G. ROYCE and W. D. MATHEWS

DC Decade Amplifier

BEFORE considering the actual configuration of the DC Decade Amplifier, let us discuss a few properties of the basic system[1], shown as a block diagram in Fig. 1. The amplifier is phase reversing with a gain of −K. This amplifier may, in fact, be composed of several individual amplifiers (as will be discussed later), but this has no bearing on the system equations. The feedback network consists of two impedances, shown as Z_1 and Z_2. These impedances may be resistive, reactive, or a combination, depending upon the desired function of the amplifier.

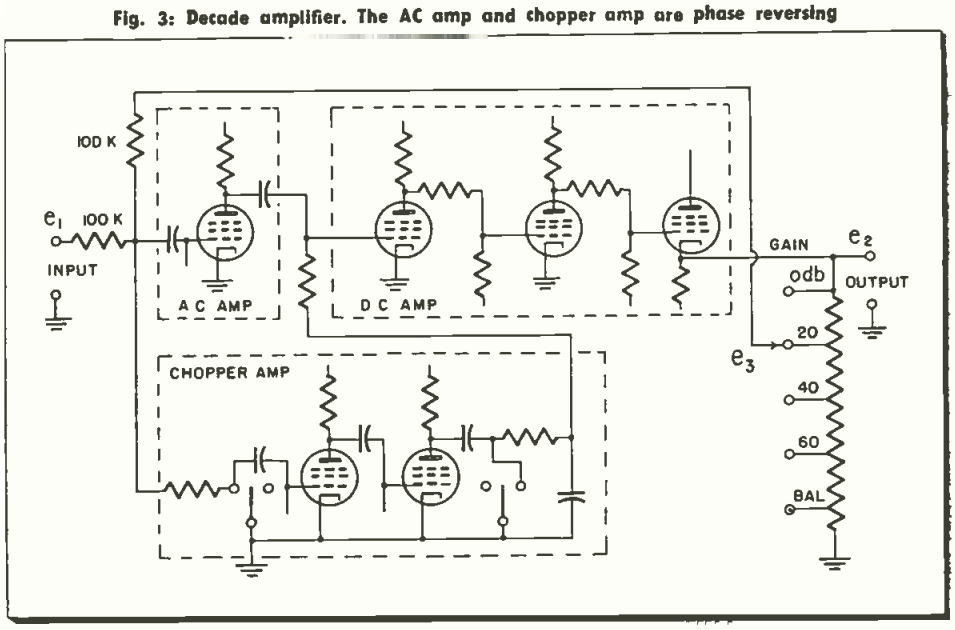
In order to simplify the system equations two assumptions are made. The first is that there is no current flow into the amplifier. The second is that there is no amplifier offset; hence, when the input to the amplifier (E) is zero, the amplifier output (e_2) is also zero.

The first assumption is based upon the usual case in which the amplifier gain (−K) is very large, and the input impedance of the amplifier is very high. If the gain is large, then the output e_2 will be obtained with a very small input E. If a very small voltage is applied across a high impedance, very little current flows. In practice, this current is quite small compared to the input current i_1. To the extent that these conditions are true, two important facts result. All of the input current i_1 must flow through Z_2 as well as Z_1 and i_1 equals i_2.

The second assumption of no offset voltage is important only in removing a constant additive term in the expression of the output voltage. In practical amplifiers the small or zero offset is obtained by adjustment or with special amplifiers.

With these facts we are now ready to determine the gain of the system. Eq. 4, 5, and 6 of Fig. 1 express, respectively, the output voltage of the amplifier, the equality of i_1 and i_2 and their simultaneous solution for the ratio of e_2 to e_1. The voltage E at the summing junction (i.e., where Z_1, Z_2, and the input to the amplifier are joined) is eliminated from Eq. 5 to obtain Eq. 6. We see that the gain is the ratio of the two feedback impedances, modified by the expression in the brackets. The negative sign merely denotes the amplifier phase reversal. The gain is more nearly

Fig. 3: Decade amplifier. The AC amp and chopper amp are phase reversing



W. G. ROYCE and W. D. MATHEWS, KayLab, 5725 Kearney Villa Rd., San Diego 12, Calif.

determined by Z_1 and Z_2 alone when this bracket quantity approaches a value of unity. For this condition the value of K must be very large as compared to the ratio of Z_2 to Z_1. The effect of having a net gain (Z_2/Z_1) less than the internal gain (K) is negative feedback, and the greater the ratio between them, the higher the feedback. It should also be noted that K is a function of frequency which must be considered in determining the net gain for other than mid-band conditions.

Impedance

Let us examine impedance characteristics of this system in considering a practical design. Where K is large compared to the ratio of Z_2/Z_1, the error signal E is very small compared to e_1 or e_2. Since the summing junction is then nearly at ground potential, the impedance looking into the input terminals is essentially Z_1 alone. If we look back through Z_2 toward the summing junction from the point "x" in Fig. 1, we see this impedance as Z_2 alone. The impedance looking into the output terminals is given in Eq. 7 in Fig. 1 for the usual condition of a large value of K. If the input terminals are not connected by an impedance much smaller than Z_1, then this impedance must be added to Z_1.

In summary then, we must have a phase-reversing amplifier with a gain much higher than any desired net system gain. This gain is principally determined by the ratio of two impedances, Z_1 and Z_2. In addition, the impedance at the input terminals is Z_1 and the impedance of the feedback network is Z_2. The impedance at the output terminals is essentially the internal impedance of the amplifier, reduced by the feedback factor (ratio of net gain to internal gain). The DC Decade Amplifier, Model 103, provides maximum flat frequency response. Therefore, Z_1 and Z_2 are resistors shunted only with unavoidable stray and wiring capacities.

When the amplifier must respond to DC signals, several problems arise. With direct-coupled amplifiers there are the usual design complications of simultaneously meeting gain and DC operating conditions. Plus and minus regulated power supplies are also necessary.

Drift and grid current present problems which are virtually insurmountable and which preclude a high performance system. Drift results in offset, that is, an output with no intentional input. This condition is due to several factors, but principally is a result of tube aging and filament voltage variation. The equivalent input offset may be reduced with considerable difficulty to a few millivolts which is still one thousand times the acceptable value. Grid current flowing through the feedback resistors develops voltage which, though small, is higher than can be tolerated.

The only solution to the drift problem is to use a different type amplifier which has very low equivalent input drift. A chopper amplifier fulfills this requirement quite well, and, furthermore, presents no grid current problem. This chopper system then is used as the input portion of the DC amplifier.

The essential elements of the chopper amplifier used in Model 103 are shown in Fig. 2. For simplicity, screen and bias circuits are not included. The amplifier consists of two high gain pentode stages with nc net phase reversal between input and output. That is, when the input grid

(*Continued on page* 154)

Helicopter Instrument Navigation

NAVIGATIONAL aids heretofore developed for fixed-wing aircraft are not satisfactory today for helicopter operations. The helicopter is utilized most effectively in short haul operations at operating altitudes below 2000 ft. above the terrain. It is not only desirable, therefore, but absolutely mandatory in the interest of safety and efficient operations to provide navigational facilities at low altitudes with a high degree of accuracy and reliability. The relatively short trip stage lengths impose a large number of approaches, landings, take-offs, and departures; consequently, continuous and easy to interpret position fixing must be available without interruption.

Within a limited scope, New York Airways has flight tested all of the presently available Federal Airway Aids. At the present time we are not utilizing any electronic Nav-Aid device or system simply because no one system completely satisfies our requirements. We do have four groups presently under consideration.

Group 1—VHF Omni-Directional Range, Distance Measuring Equipment, LF/MF Four-Course Radio Range and LF/MF Non-Directional Beacons. These facilities have the advantage of already being in existence. They require, however, expensive and relatively heavy airborne equipment and the information presented requires interpretation by the pilot in order to find his position.

Group 2—Decca, Loran, Consol and similar systems not available in the major metropolitan areas of the United States. Of these systems, Decca appears to meet best

(*Continued on page* 172)

From a paper delivered to the Radio Tech. Comm. for Aeronautics, April 1955, by Capt. J. E. Gallagher, Chief Engr. and Operation Mgr., N.Y. Airways, Inc.

10th Annual NARTB Engineering Conference

The 3-day technical program at the Conrad Hilton Hotel in Chicago, Ill. will feature the presentation of more than 30 papers, and displays of broadcast products by more than 65 manufacturers

THE 10th Annual Engineering Conference of the National Assoc. of Radio and TV Broadcasters gets under way on April 16 at the Conrad Hilton Hotel in Chicago. The Conference will be running concurrently with the 34th Annual Convention of the NARTB.

The technical program will be broken up into three sessions to deal separately with various problems of the industry. Opening day of the conference, April 16, has been designated "Color TV Day." April 18, the third day of the meeting, will be "Radio Day," and April 19 will be "Television Day."

On April 17, designated "Association Day," management and engineering groups will have joint activities. Features of that program will be the keynote award to be made by NARTB pres., Harold Fellows to Robert E. Kintner, ABC pres. as "the outstanding man of the year in broadcasting." Previous recipients of the award have been David Sarnoff of RCA, William Paley of CBS, and Mark Eldridge of WHAS, Louisville, Ky.

On April 16, "Color TV Day," members will be welcomed by A. Prose Walker, Manager of Engineering, NARTB, and Raymond Guy of NBC. At the midday Engineering Luncheon the featured speaker will be Dr. W. L. Everitt, Dean, College of Engineering, Univ. of Illinois. The evening activities will feature conducted tours of the NBC and CBS color TV studios.

Featured speaker at the "Association Day" luncheon will be George C. McConnaughey, chairman of the FCC. The afternoon session on that day will see a panel discussion on "Freedom of Information," discussing the restrictions on radio and TV coverage of court trials. In late afternoon there will be a discussion meeting with all FCC commissioners. Harold Fellows will act as moderator.

Highlight of "Radio Day," April 18, will be the annual NARTB banquet which will be held that evening. Entertainment will be provided by ASCAP.

1956 NARTB Engineering Conference Committee is composed of:

Willard J. Purcell—WGY, Schenectady, N. Y.—Chairman
Raymond F. Guy—NBC
William B. Lodge—CBS
Frank Marx—ABC
Orrin W. Towner—WHAS, Louisville, Ky.
Phil Headrick—WSJS, Winston-Salem
T. C. Kenney—KDKA, Pittsburgh, Pa.
Carl Noper—WMAR-TV, Baltimore, Md.
A. D. Smith, Jr.—WABD, NYC

A total of more than 30 papers will be presented during the 3-day technical sessions.

COLOR TELEVISION DAY

April 16, 1956— Morning Session

9:00-9:30 A.M. **Welcome to Engineering Conference**—A. Prose Walker, Mgr. of Engr., NARTB. Raymond F. Guy, Dir. of Radio Frequency Engineering, National Broadcasting Company.

9:30-10:15 A.M. **NBC Color Studio**—Chester A. Rackey, Mgr. Audio & Video Engineering and Donald Castle, Asst. Mgr. Audio & Video Engineering. Design, construction and operation of color TV studio design as used in network operation.

10:20-10:45 A.M. **Small Station Color Lighting**—Edward Tong, TV Studio Supervisor, WDSU-TV. Problems encountered in the construction and design of color TV lighting system.

10:50-11:15 A.M. **New Television Transmitter Monitor**—Charles A. Cady, General Radio Company. Discussion of a new type color monitar which will assist the TV transmitter engineer with operation and maintenance problems.

11:20-11:45 A.M. **Lining Up Color Cameras**—NBC Staff. Practical methods of lining up and balancing color TV cameras.

11:50-12:15 P.M. **Problems in the Alignment ment and Use of Color Television Receivers**—E. R. Klingman, TV Engineering, RCA Service Co.

Luncheon

Color Television Day— Afternoon Session

2:30-2:55 P.M. **Compact Plug-In Color Video Equipment**—W. B. Whalley, Senior Engineer, CBS Television.

Harold E. Fellows
President, NARTB

RADIO DAY

April 18, 1956—
Morning Session

10:00-11:00 A.M. **Results of Experimental Remote Control of Directional and High Power Standard Broadcast Stations (Panel)**—A. Prose Walker—Mgr. of Engr., NARTB; Robert Sinnett—WHBF, Rock Island, Ill.; Henry Fletcher—KSEI, Pocatello, Idaho; Ted Kenney—KDKA, Pittsburgh, Penn.; R. E. L. Kennedy—Kear & Kennedy, Consulting Engineers; Donald B. Williamson—Canadian Westinghouse Co., Ltd.

11:05:11:30 A.M. **CONELRAD—Is it Necessary?**—Ralph J. Renton, U. S. Supvr. CONELRAD, F.C.C.

11:35-12:10 P.M. **The Ohms Law Phasor and Its Application to Remote Operation of Directional Antenna Systems**—John Mullaney, Consulting Engr. Discussion of design and operation new type phasor for directional antennas, its ease of adjustment and maintenance.

Luncheon

Radio Day—Afternoon Session

2:30-2:55 P.M. **FM Broadcast Multiplex Equipment Design, Development and Production**—Dwight (Red) Harkins, Harkins and Hershfield, Phoenix, Ariz.

3:00-3:25 P.M. **Automatic Program Log Devices**—S. L. Huffman, Chairman of Board and General Manager Stark Broadcasting Corp. and Clark, Dozer, Manager WCMW, Canton, Ohio. Discussion pertaining to various automatic devices being developed for eventual elimination of existing program log and conventional book-keeping methods.

3:30-3:55 P.M. **Automatic Gain Control Devices in Audio Circuits**—General Electric Company. Discussion of operation of various types of audio gain limiting and level boosting devices.

4:00-4:25 P.M. **Bringing Microphones Up to Date**—RCA.

4:30-5:00 P.M. **Transistors and Their Application in Broadcast Equipment**—Paul G.

3:00-3:45 P.M. **Integration of Color Equipment**—A. F. Inglis, RCA. Discussion of methods for integrating color equipment with existing monochrome equipment. The paper describes methods for switching and distributing color signals and points out a number of precautions that should be taken.

3:50-4:35 P.M. **Techniques of Color Film Reproduction**—H. N. Kozanowsky, RCA. Discussion of several possible methods of reproducing color film and opaques for TV. The paper includes descriptians of projectors and camera systems and several types of multiplexers.

4:40-5:25 P.M. **Color Test Equipment and Test Procedures**—J. W. Wentworth, RCA. Description of a number of test equipment items required for checking and maintaining color studio and transmitter systems. Included is a discussion of methods for using the equipment, together with the general philosophy and measuring techniques required to meet color standards.

A. Prose Walker
Manager of Engineering, NARTB

TELEVISION DAY

April 19, 1956—
Morning Session

9:30-9:55 A.M. **TV Translators**—Ben Adler, Adler Electronics. Design, construction, and operation of translators as proposed in FCC Docket 11611.

10:00-10:15 A.M. **Wireless Microphone System**—A. B. Chamberlain, Chief Engr., CBS Television. Design, installation, and operation of wireless type microphone system to facilitate better audio pickups on certain type TV programs.

10:20-10:40 A.M. **VITEAC**—William B. Lodge, Vice President CBS Television; Frank Cowan, Asst. Dir. of Operations, Long Lines Department, A.T.&T. Committee formed in New York area to resolve pertinent problems relating to the transmission of composite TV signals over the A.T.&T. system.

10:45-11:10 A.M. **Present Knowledge of Propagation in the VHF and UHF TV Bands**—Harry Fine, Chief Applied Propagation Br., Technical Research Division, Office of Chief Engineer, FCC. A view of propagation studies as they affect the extent of VHF ond UHF television service.

11:15-11:40 A.M. **New Developments in VHF Television**—F. E. Talmage, RCA. A new group of transmitters wherein novel method of construction and new circuitry will permit unusual flexibility of installation, and ready increase of power.

11:45-12:15 P.M. **Cost Estimating for TV Station Engrs.**—Rodney Chipp, Director of Engrg. A. B. DuMont Labs, Inc. Yardstick for estimating proposed TV studio and transmitter construction costs before the architect is hired.

Luncheon

Television Day—
Afternoon Session

2:30-2:55 P.M. **Daylight Saving Time Delayed Video Operation**—T. B. Grenier and W. P. Kusack, ABC. Discussion of video delay during 1956 to compensate for daylight saving time in program scheduling.

3:00-3:25 P.M. **Proof-of-Performance Measurements**—James E. Barr, Asst. Chief of Broadcast Bureau, F.C.C.

3:30-3:55 P.M. **Automatic Programming Equipment**—General Electric Company.

4:00-4:25 P.M. **STL Microwave Installations**—P. Onnigian, Chief Engr. KBET-TV, Sacramento, Calif. Discussion of variable factors governing the installation and operation of long-hop studio-to-transmitter links.

4:30-5:00 P.M. **Superior Video Effects**—NBC Staff. New effects which are now possible electronically that will benefit programming and production.

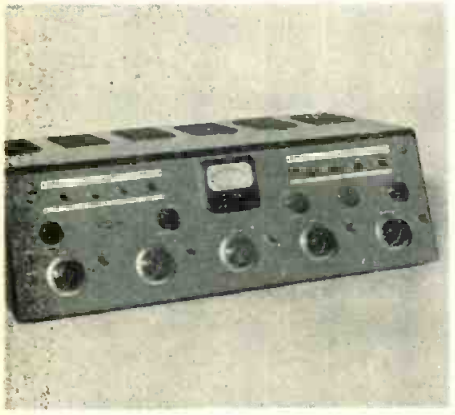
EXHIBITORS

Adler Electronics, Inc.
The Advertising Council, Inc.
M. & A. Alexander Productions, Inc.
Alford Manufacturing Co., Inc.
Allied Radio Corp.
American Research Bureau, Inc.
Ampex Corporation
Andrew Corporation
Associated Artists Productions, Inc.
American Telephone & Telegraph Co.
Berlant-Concertone
The Billboard
Blaw-Knox Company
Caterpillar Tractor Co.
Century Lighting Co.
Collins Radio Co.
Conrac, Inc.
Dage Television Div., Thompson Products Inc.
Dresser-Ideco Co.
Allen B. DuMont Laboratories, Inc.
Elgin Metalformers Corp.
Gates Radio Co.
General Electric Co.
General Precision Laboratories
General Radio Co.
Harry S. Goodman Productions
Gray Research & Dev. Co., Inc.
The Harwald Co., Inc.
Hollywood Television Service, Inc.
Hughey & Phillips, Inc.
Kay Lab, Inc.
Keystone Broadcasting System, Inc.
Kliegl Bros.
Lambda-Pacific Engineering Inc.
Lang-Worth Feature Programs, Inc.
MCA TV, LTD.
Motorola Communications & Electronics Inc.
National Telefilm Associates, Inc.
Nems-Clarke, Inc.
A. C. Nielsen Co.
Phelps Dodge Copper Products Corp.
Philco Corporation
Prodelin Inc.
RCA Broadcast Marketing Division
RCA Engineering Products Division
RCA Recorded Program Services
Radio Television Daily
Raytheon Mfg. Co.
The Rust Industrial Co., Inc.
Sarkes Tarzian Inc.
Schafer Custom Engineering
Screen Gems Inc.
Sesac Inc.
Stainless, Inc.
Standard Electronics Corp.
Standard Radio Transcription Services, Inc.
Sterling Television Co., Inc.
Telechrome Sales Corporation
TelePrompter Corporation
Television Programs of America, Inc.
U.M. & M., Inc.
United Press Association
Unity Television Corporation
World Broadcasting System
Ziv Television Programs, Inc.

New Broadcast Equipment

SPEECH INPUT CONSOLE

212F-1 Speech Input Console is a flexible packaged unit providing complete control over simultaneous broadcasting and auditioning from any combination of 3 of 8 possible inputs, with



provisions for mixing 5 of 12 possible inputs with the addition of 2 preamplifiers. It is supplied with 3 356A-1 pre-amplifiers. Two are used in low level inputs and the third as a booster amplifier in the program channel. Key switches at the low level input terminations allow selection of 2 of 4 possible inputs. **Collins Radio Company, Cedar Rapids, Iowa.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-44)

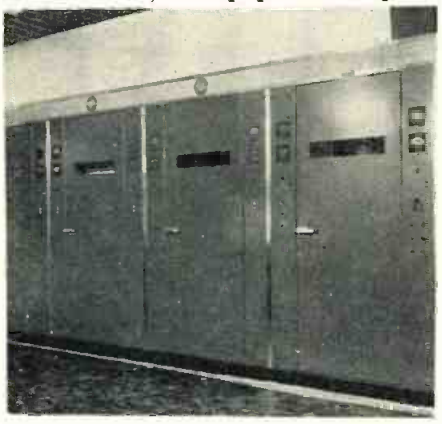
TEST SIGNAL GENERATOR

Portable, Model 1003-A Video Transmission Test Signal Generator generates signals for local and remote performance checking of an entire video, cable, or micro-wave system. It is available as a completely portable, 12¼ in. standard rack mounting unit with a built-in, fully regulated power supply, which produces Multi-frequency Burst, Stairstep, Modulated Stairstep, White Window, and Composite Sync. Signal

will faithfully pass through clamp circuits and thus determine the quality or condition of any portion or the total facilities. **Telechrome Inc., 632 Merrick Rd., Amityville, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-46)

AM TRANSMITTER

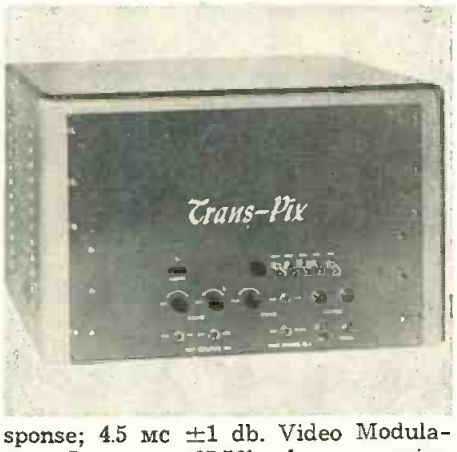
A new concept in AM transmitting equipment, the RCA "Ampliphase" transmitter will be on display at the NARTB Convention. Contained in only four cubicles, "Ampliphase" requires



no underfloor trenches, water cooling systems or external blowers. Besides cutting transmitter floor space, and operating costs by substantial margins; the new equipment does away with half of present power tubes along with bulky components such as modulator transformers, reactors and accessories. **RCA, Engineering Products Div., Camden 2, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-55)

COLOR TV TRANSMITTER

New low power r-f color TV picture transmitter has been designed for use with antenna or cable. New Trans-Pix covers the low frequency TV channels and fulfills the color requirements of differential phase shift and envelope delay. Two models are available. Model 25: Video Input; (two required) ¾ v. p-p composite blanked video. ½ v. p-p composite neg. sync into 75 ohms. 4.5 MC bandwidth. Picture Carrier; 25 w. peak power into 50 ohms. Video Re-



sponse; 4.5 MC ±1 db. Video Modulation; Linear to 87.5% of zero carrier. Differential phase shift; Approx. ±3° at the color carrier. **Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-101)

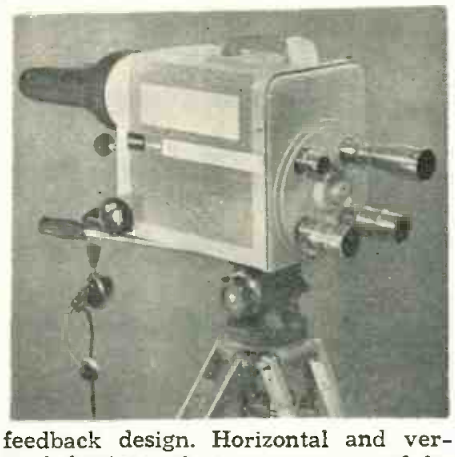
TELESCOPING ANTENNA

One model of a new line of portable antenna masts that will be of particular interest to broadcasters is a vehicular self supporting roof top hydraulic mast for survey and remote pickup work.

This mast is available in extended heights up to 50 ft., and is readily operated by the vehicle's electrical system. The 6 or 12 v. motor and reversible pump supply the power. Control of elevation of the mast's height is by a switch located at the driver's seat. **Andrew Corp., 363 E. 75 St., Chicago 19, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-47)

BROADCAST CAMERA SYSTEM

Model 1935 Broadcast Camera system utilizes a unique video amplifier circuit which provides extreme overall sensitivity combined with broad bandwidth. Video signal processing is performed in the video line amplifier, which includes keyed clamps, aperture correction and high peaking. Video output is capable of a large dynamic range signal without distortion. Horizontal and vertical deflection amplifiers are of

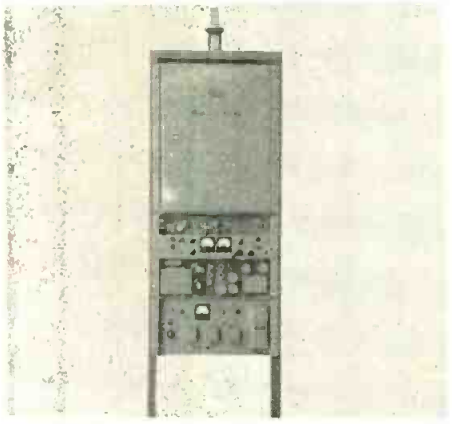


feedback design. Horizontal and vertical driving pulses are regenerated for minimizing the affects of varying pulse width. **Kay Lab, 5725 Kearney Villa Rd., San Diego, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-32)

At The NARTB Show

RACK MOUNTED TV LINKS

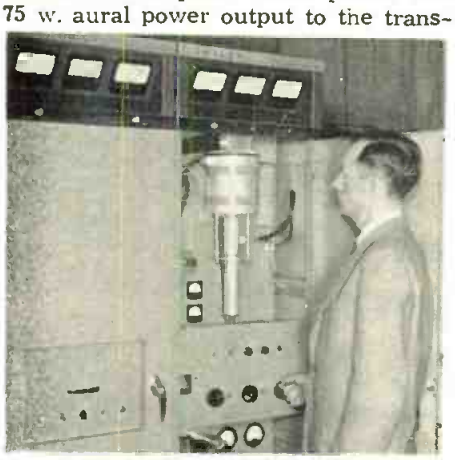
Raytheon's KTR-100 and KTR-1000 series (100 milliw. and 1 w. rf output) are now supplied for standard 19 in. rack mounting. In the rack-mounted installation, a ferrite isolator is used



to eliminate long-line effects with waveguide extensions, thus permitting indoor operation and maintenance of the equipment while the antenna is located outdoors. As an accessory item to the rack-mounted KTR series, a new Remote Alarm Unit, Model 3-270 is also available. **Raytheon Manufacturing Company, Waltham 54, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-43)

TV TRANSMITTER

New low-power TV broadcasting transmitter is designed to meet the needs of small communities. Equipment, which may be operated by one man, consists of a crystal control modulator unit which produces modulated visual and aural TV program carriers; and intermediate amplifier of 20 w. power and a final amplifier providing 150 w. peak visual power and 75 w. aural power output to the trans-



mission line. "Package" includes complete transmission facilities for slides, films and local live shows. **Philco Corp., Gov't. & Industrial Div., 4700 Wissahickon Ave., Philadelphia, Pa.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-42)

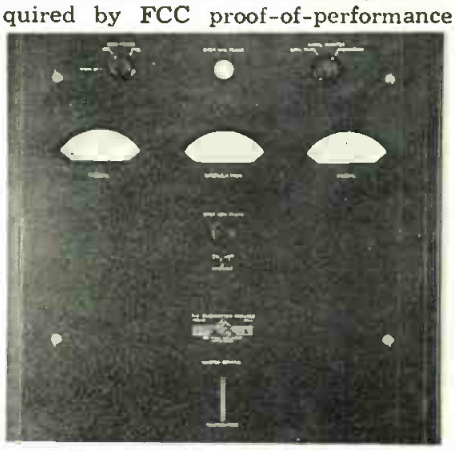
MICROWAVE LINK

Completely new product to be displayed at the NARTB Convention is designated as the Lambda 0.1 Watt Microwave Link for Color. It is actually a companion to the nationally

known 1.0 watt Lambda Link, and is convertible to 1.0 watt. Its frequency ranges from 5.9 to 7.2 Kmc and is available with program channel. Receiver has the same physical appearance as the transmitter illustrated above. **Lambda-Pacific Engineering, Inc., P.O. Box 105, Van Nuys, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-54)

TV MONITOR

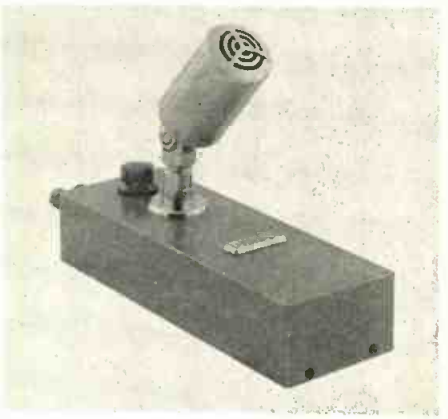
TV Transmitter Monitor provides, in one complete unit, all the functions necessary to meet the requirements of the FCC for monitoring TV transmitters. Instrument will indicate continuously: the frequencies of both the aural and visual transmitters; the difference, or intercarrier, frequency; the FM (swing) of the aural transmitter; and indicate when the swing exceeds a preset value. Audio fidelity measurements on the aural transmitter, as required by FCC proof-of-performance



regulations can be made. Complete inter-carrier demodulation system is provided for off-the-air monitoring. **General Radio Co., 275 Mass. Ave., Cambridge 39, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-48)

REMOTE AMPLIFIER

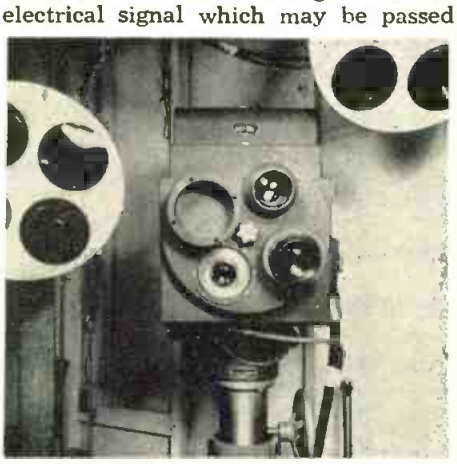
Completely transistorized, single channel remote amplifier, the "Transmote," has five transistors, and a four-stage amplifier including a preamplifier, booster, and a driver. It also has a



push-pull output stage. The amplifier delivers +18 dbm to a 4 db isolation pad, providing a max. line level of +14 dbm. The power supply consists of three 8 v. mercury batteries with an on and off switch incorporated in the headphone jack. Leather carrying case with adjustable shoulder straps which are removable can be obtained. **Gates Radio Co., Quincy, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-41)

COLOR TV PICKUP

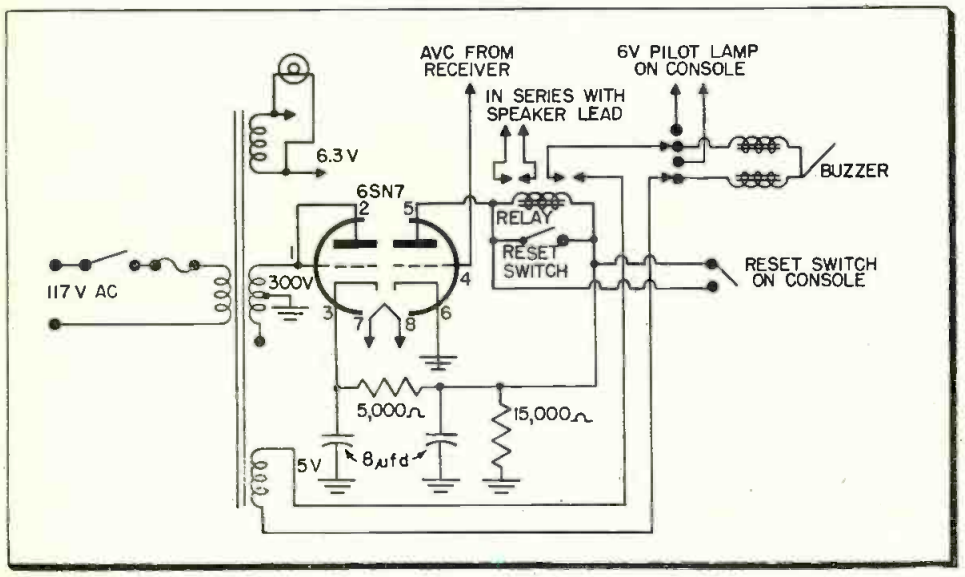
New method of color TV pickup and its application to merchandising techniques, will be demonstrated at the NARTB convention. The "Vitascan" system uses a beam of light from a crt to "scan" persons and objects picking up the reflected scanned light by means of multiplier phototubes. These phototubes then convert the light into an electrical signal which may be passed



on to a standard transmitter for color telecast. A conventional microphone system picks up the sound. **Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N.J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-45)

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency



Redesigned alarm unit is actuated by the AVC action of the station's monitor receiver

Cascaded Turntables

DONALD W. HALL, Ch. Eng'r.
WSSV, Petersburg, Va.

OUR limited control room floor area made the 45 rpm changeover a serious problem. The solution we arrived at is seen in the accompanying photo. Above each of our Gates two-speed CB-14's, we have mounted on a welded frame, a Presto T-15 3-speed table. Each T-15 has a light-weight tone arm fitted with a reluctance cartridge and 1-mil stylus. The turntables are situated on 5-ply motor boards, cushioned with adhesive rubber stripping (⅜ in. width) and the motors are activated with mercury switches. A small night lamp is mounted beneath each motor board.

One T-15 is wired to a separate Gray equalizer with pre-amp and separate turntable channel in our Gates SA-40 console, affording three-table operation. The other T-15 connects to the LP position of a Gray equalizer, eliminating the need for separate channel and amplifiers.

3-speed table is mounted above existing unit

Conelrad Alert Alarm

DONALD M. WHEATLEY, Ch. Eng'r.
WJOY, Burlington. Vt.

AFTER several years of unreliable operation of a thyratron-operated Conelrad alert alarm, the device was ripped apart and, with a few of its components, a simple, efficient device was made. As this alarm works on the carrier interruption principle it could also be used for a carrier failure alarm for a station where studios and transmitter are in different locations.

The relay is a Potter-Brumfield LM11 10,000 ohm relay. The power transformer was a T22R02 although any replacement power transformer could be used. The buzzer is a #611 Edwards 6-8 which can be heard throughout the building.

As this unit is mounted in the control room where we do a lot of announcing, we found it wise to have a warning lamp and reset button mounted on the console. The reset switches are a push to make normally open type.

The alarm is actuated by the AVC action of the monitor receiver. For best operation about 8 to 10 negative is needed. With this amount, when carrier is cut the alarm is tripped, and it has to be manually reset. With a higher voltage the alarm resets itself when carrier is returned. With a lower voltage the alarm can not be turned off.

Increasing Versatility of Linearity Checker

ROBERT J. ROTH, Maint. Superv.
WAVE-TV, Louisville, Ky.

HERE is a simple method by which the television broadcaster can feed a video sweep generator into his video system and quickly observe the resultant waveform either of the whole system or in parts. This signal will pass unaffected by clamp circuit; even those that clamp on the back porch. Equipment needed is a wide band scope, such as the Tektronix 524D, a video sweep generator and the RCA Linearity Checker with slight changes herein described.

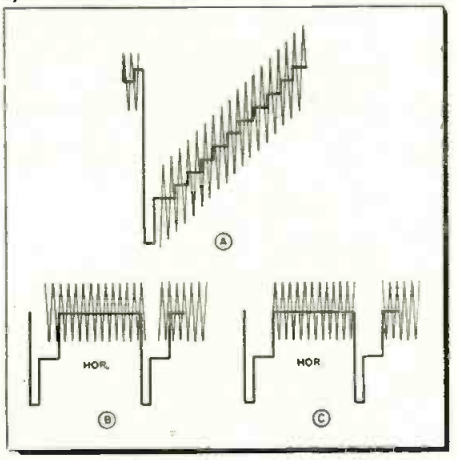
The RCA Linearity Checker MI-34017 develops a series of ten uniform steps progressing from black to white. These steps can be on every line or every tenth horizontal line. On these steps you can superimpose r-f, either internally or from an external source. In addition this instrument furnishes horizontal sync and blanking. Fig. 1a shows a horizontal presentation of its output signal minus blanking.

To use this instrument for checking frequency response the steps are turned off: The video sweep generator is fed into the r-f input. Blanking and sync are added to give a composite signal as in 1b.

If you try to feed this signal through a clamped circuit, the r-f during the back porch interval will cause trouble. The RCA Linearity Checker only gates the r-f out during the sync interval. The following

(*Continued on page* 142)

1A—Checker develops 10 uniform steps, black to white, on which r-f can be superimposed. 1B—With steps turned off, and blanking and sync added. 1C—With r-f gated out of signal



NEW

Compression type—28, 32, 40, 48 and 52 contact connectors. Center engaging screw with wing nut or screw driver slot and spring action contacts—permits easy, quick and reliable engagement and dis-engagement. Receptacle side available for pressurized applications.

40 contact connector "A" style for applications where plug is "live voltage" side.

CINCH MICRO CONNECTORS

Available in two styles for alternate application where either the plug or receptacle side is the "live" voltage side. (Protective Hoods and Cable Clamps Available.)

52 contact connector "B" style for applications where receptacle is "live voltage" side.

Molded of orlon filled diallyl per MIL-P-14D. Contacts gold plated; other hardware is passivated stainless steel. (Multiple polarization available.)

Cinch will design, or re-design components to fit specific needs, and will assist in the assembly of components through proven automation technique.

Centrally located plants in Shelbyville, Chicago, Pasadena, St. Louis.

CONSULT CINCH

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

Fig. 1: Joseph C. McGuire demonstrates his new method of soldering materials

New Soldering Technique

Simple method discovered at the Univ. of California makes it possible to solder a wide range of materials previously handled only by ultrasonic means. Hand grinder and a small abrasive wheel are the only special tools required.

AN unusual new technique which permits soldering such materials as aluminum, stainless steel, glass, and ceramics without special equipment has been developed by the University of California's Los Alamos Scientific Laboratory. The method is expected to affect great savings over the ultrasonic method the Laboratory has been using.

The new method of joining materials hitherto believed impossible to solder by other than ultrasonic means was developed by Joseph C. McGuire of the Laboratory's Chemistry and Metallurgy Division. It requires, in addition to the usual soldering materials, only a hand grinder with an abrasive wheel. The technique was discovered by McGuire during a research project on the use of ultrasonic sound waves in soldering.

To solder these previously unsolderable materials, the grinder is turned on and the abrasive wheel (preferably preheated by grinding metal or the use of heat) is brought to bear on a soft solder such as Wood's metal or 60-40 lead-tin. (See Fig. 2) The soft solder melts and flows onto the surface of the wheel, "loading" it and incidentally making it useless for its customary purpose until it has been trimmed down. The solder-loaded wheel is then applied to the surface to be soldered until a slight amount of abrasion has taken place, using the pressure one would ordinarily use in grinding. (Fig. 1) The heat of friction again melts the soft solder, which flows onto the freshly abraded surface and forms an intimate contact.

After this tinning operation, soldering is done in the usual manner with standard 50-50 lead-tin solder. The other surface is also given the new treatment if it is a material not ordinarily "wetted" by solder. No soldering flux, surface cleaning, or pretreatment is used.

When working with such materials as soft glass, Pyrex, and ceramics, the best tinning is accomplished with a mixture of Wood's metal and 50-50 indium-tin. However, when soldering glass to glass or ceramic to ceramic, it is necessary to use flame or furnace heating to get enough heat to the surfaces to be joined.

The two surfaces need not be of the same material: metals, soft glass, Pyrex, and ceramics may be soldered in any combination. A satisfactory grinding wheel has been found to be a medium grit, ¼-in. diameter by ½-in. long, although the type and size are not critical.

Fig. 2: Abrasive wheel is first loaded with solder

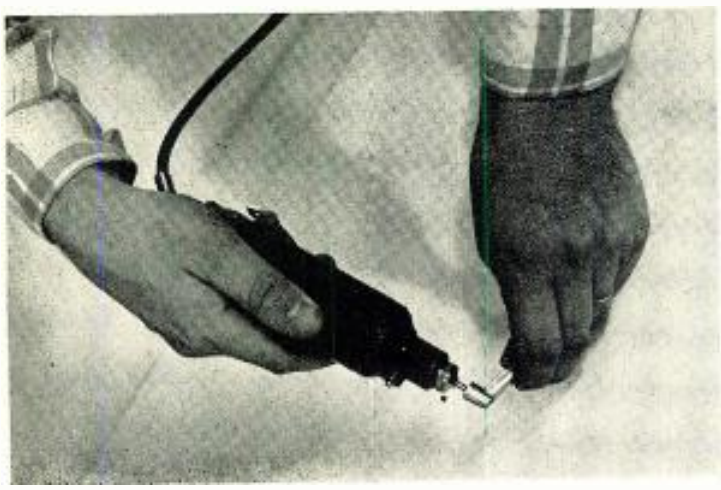
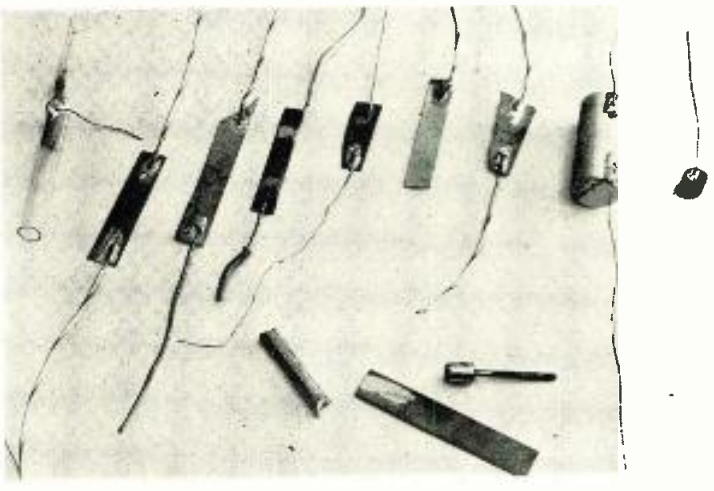
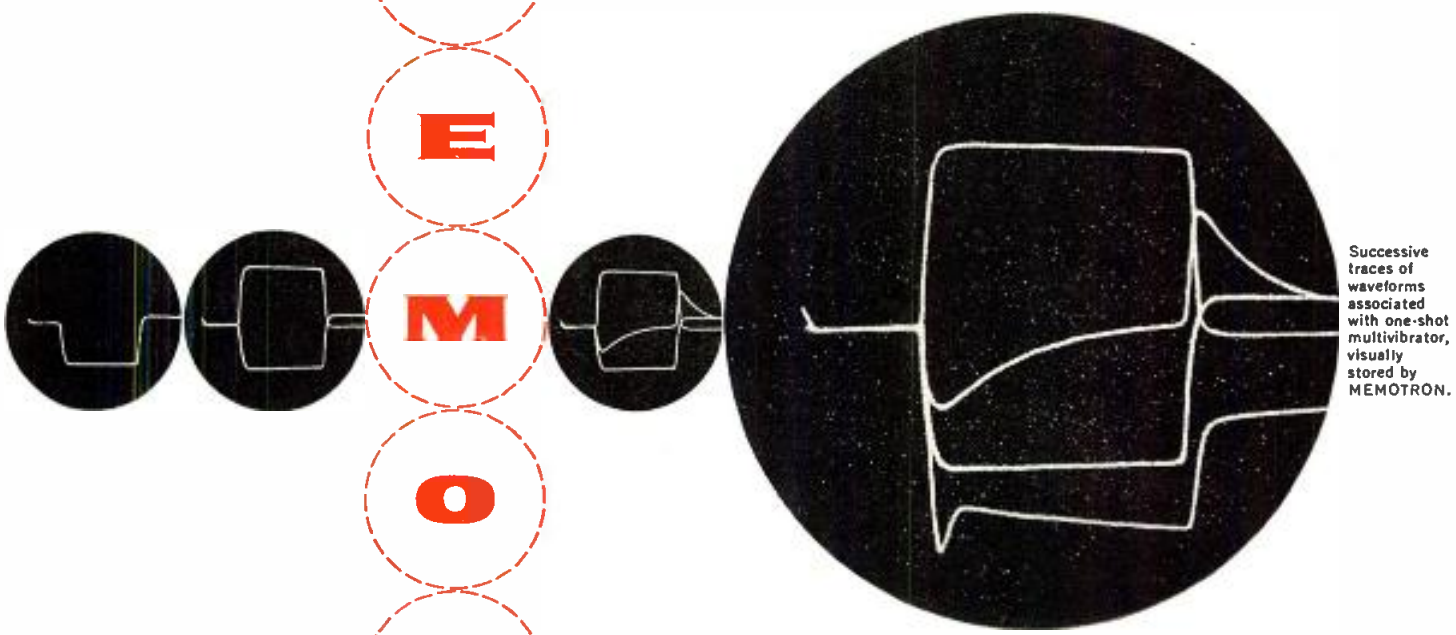


Fig. 3: Solder joints made by the new "grinding" method



HUGHES MEMOTRON



Successive traces of waveforms associated with one-shot multivibrator, visually stored by MEMOTRON.

SAVE VALUABLE TIME. WASTED FILM

Transients need not be photographed unless a file record is needed. When such a record is required, photography is greatly simplified, because all displays occur at a constant, uniform brightness regardless of difference in writing speeds. Therefore, a single camera exposure setting is sufficient.

FOR PERMANENT TRANSIENTS

Now non-recurrent phenomena ("transients") can be held and studied directly on the viewing screen of your oscilloscope. The HUGHES MEMOTRON—first in a new series of direct-display cathode ray storage tubes—captures and retains waveforms visibly until they are intentionally erased.

Since the MEMOTRON will display and retain successive writings, it is ideal for plotting curves. The tube will also store reference lines for convenient data analysis.

Our engineering staff invites your inquiries concerning specific laboratory and industrial applications for these tubes.

MEMOTRON
GENERAL SPECIFICATIONS

RESOLUTION...60 written lines per inch.
WRITING SPEED...From zero to at least 50,000 inches/sec.
BRIGHTNESS...50 foot-lamberts.
USABLE SCREEN DIAMETER...4 inches, minimum.
DIMENSIONS...Over-all length: 18 3/4 inches, ± 1/2-inch.
Bulb diameter: 5 5/8 inches, maximum.
Neck diameter: 2 1/4 inches, ± 3/32-inch.

HUGHES PRODUCTS

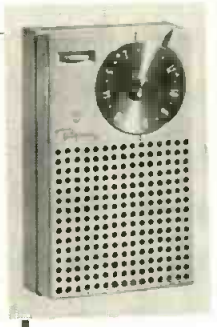
A DIVISION OF THE HUGHES AIRCRAFT COMPANY

For descriptive literature, please write:

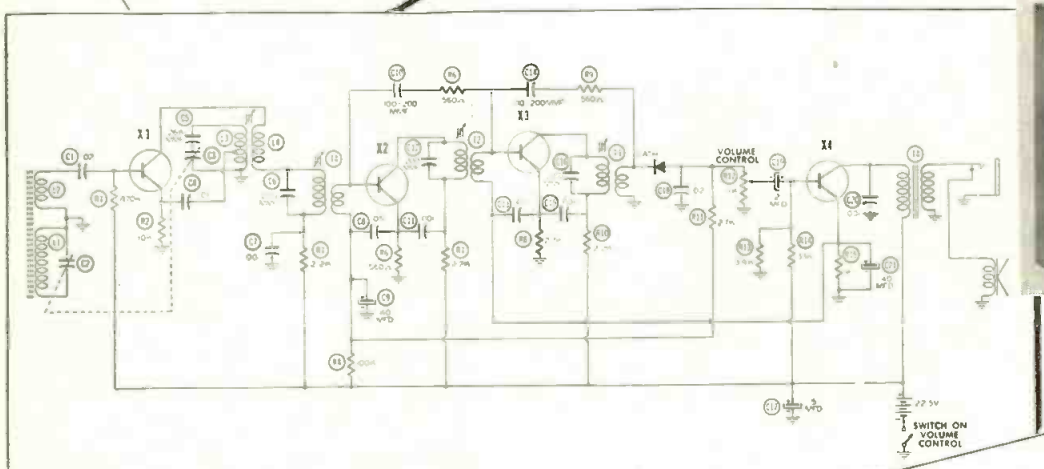
ELECTRON TUBES
HUGHES PRODUCTS
International Airport Station
Los Angeles 45, California

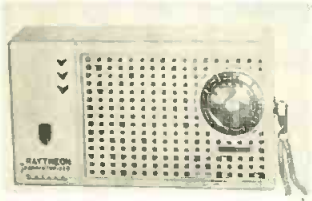
1956 Transistor Portable Design

CBS-COLUMBIA
Model: TR-250
Dimensions: 5½x3¼x1⅝ in.
Weight: 14 oz.
Power Supply: 21.0 v.
Features: optional earphone, plastic case with 3-position handle.

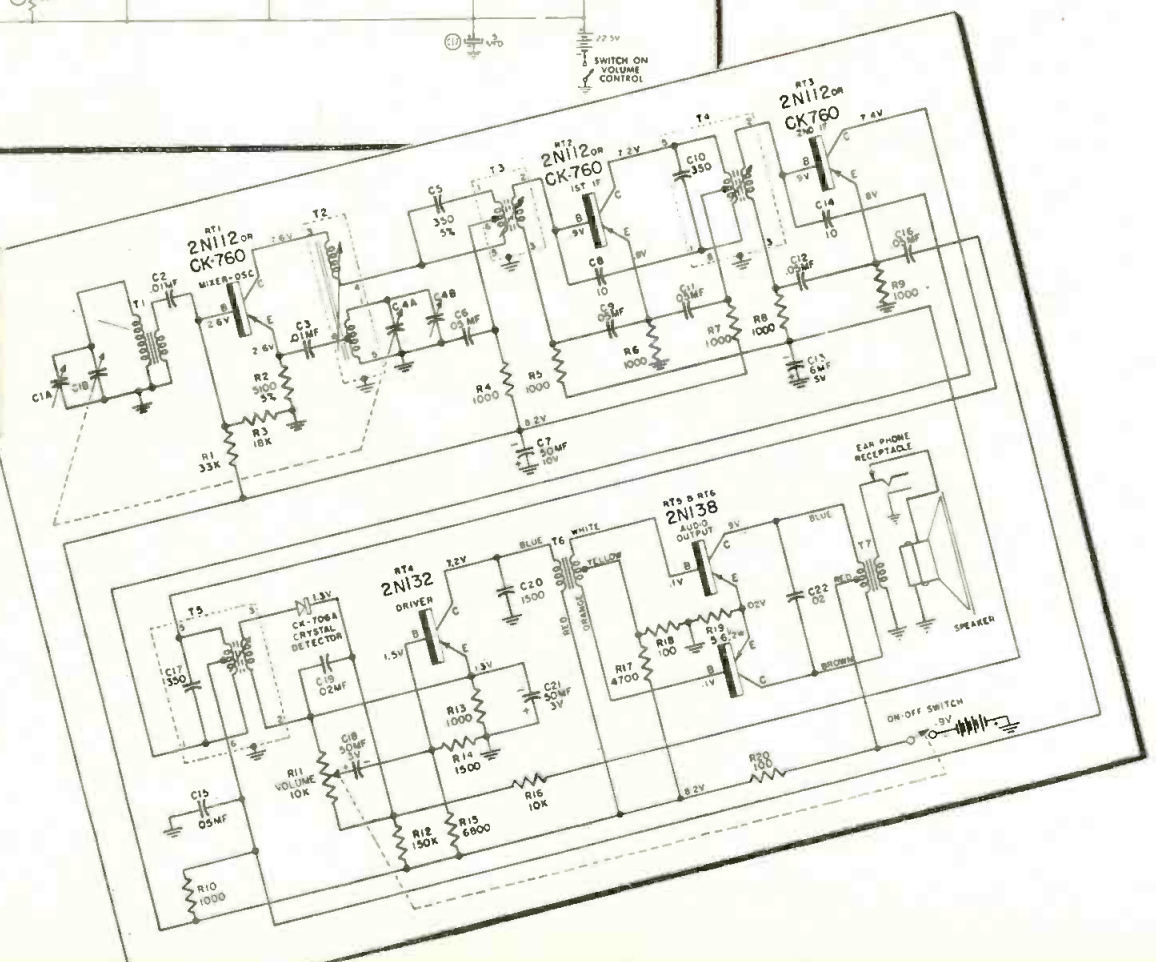


REGENCY
Model: TR-1
Dimensions: 5x3x1¼ in.
Weight: 12 oz.
Power Supply: 22½ v.
Features: printed circuit construction, polystyrene plastic case





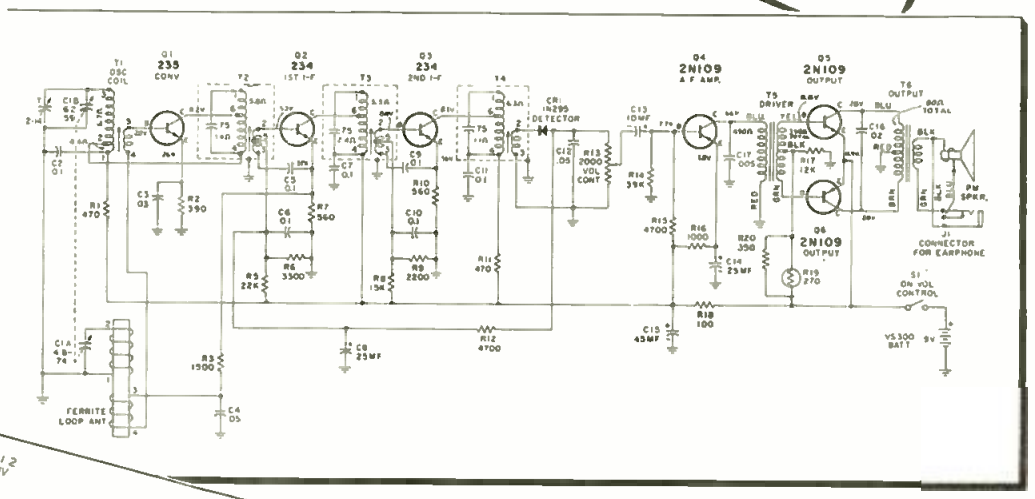
RAYTHEON
Model 6RT1
Dimensions: 6¼x1¾x3⅜ in.
Power Supply: 9 v.
Features: sensitivity—200 µv/m; power output—50 mw; battery life—approx. 150 hrs.; optional earphone

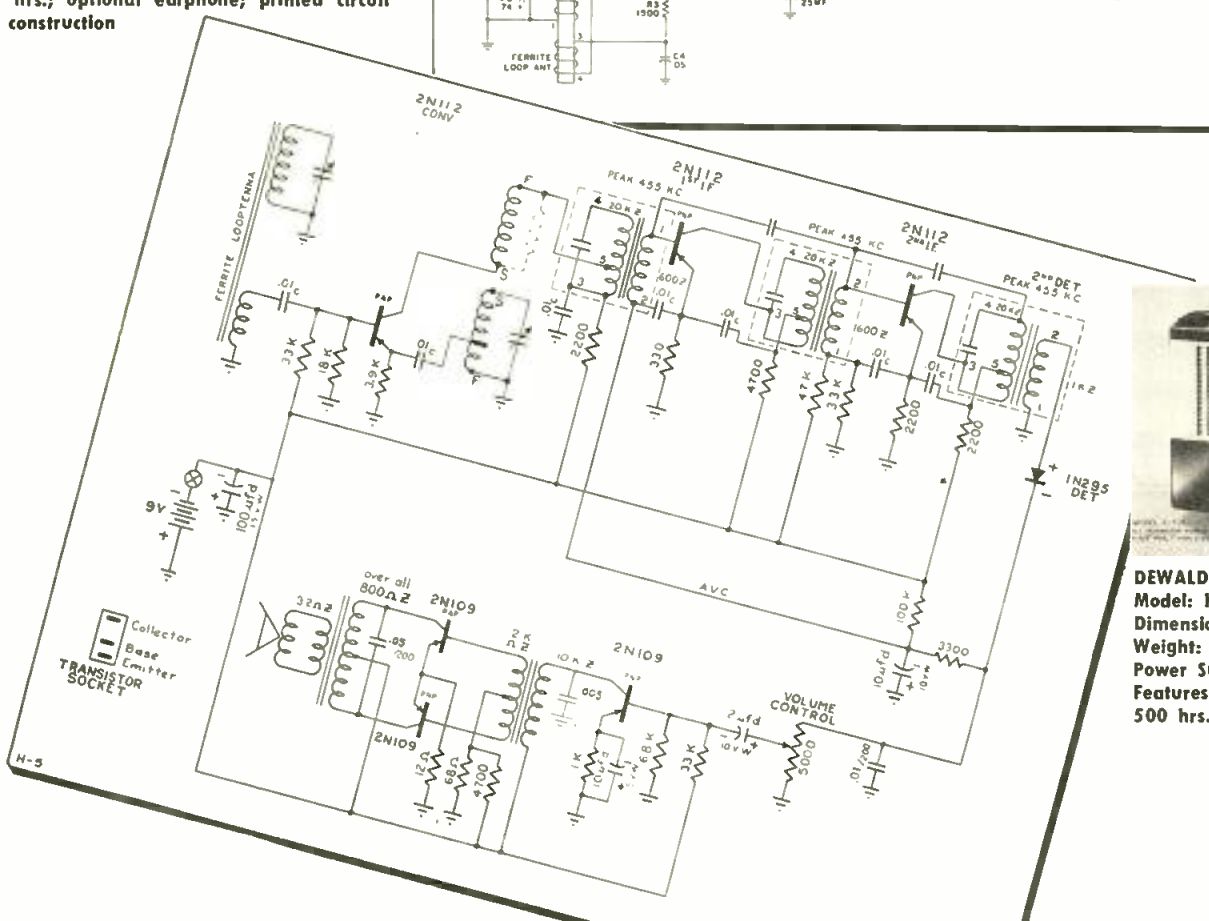


GENERAL ELECTRIC
Model: 675
Dimensions: 5⅝ x 3-3/16 x 1½ in.
Power Supply: 13½ v.
Features: power output—60 mw; printed circuit construction

With the hearing aid field conquered, transistors are now moving into the portable radio market. By year's end, virtually all portables will be transistorized. Here are typical designs

RCA, Model: 7-BT-9J
Dimensions: 3-7/16x5-13/16x1-9/16 in., Weight: 16 oz. Power Supply: 9 v. Features: power output—100 mw; battery life—75 hrs.; optional earphone; printed circuit construction





DEWALD
Model: K-701
Dimensions: 8⅝x7x2½ in.
Weight: 4 lbs.
Power Supply: 9 v.
Features: Battery life—approx. 500 hrs. @ 2 hrs./day

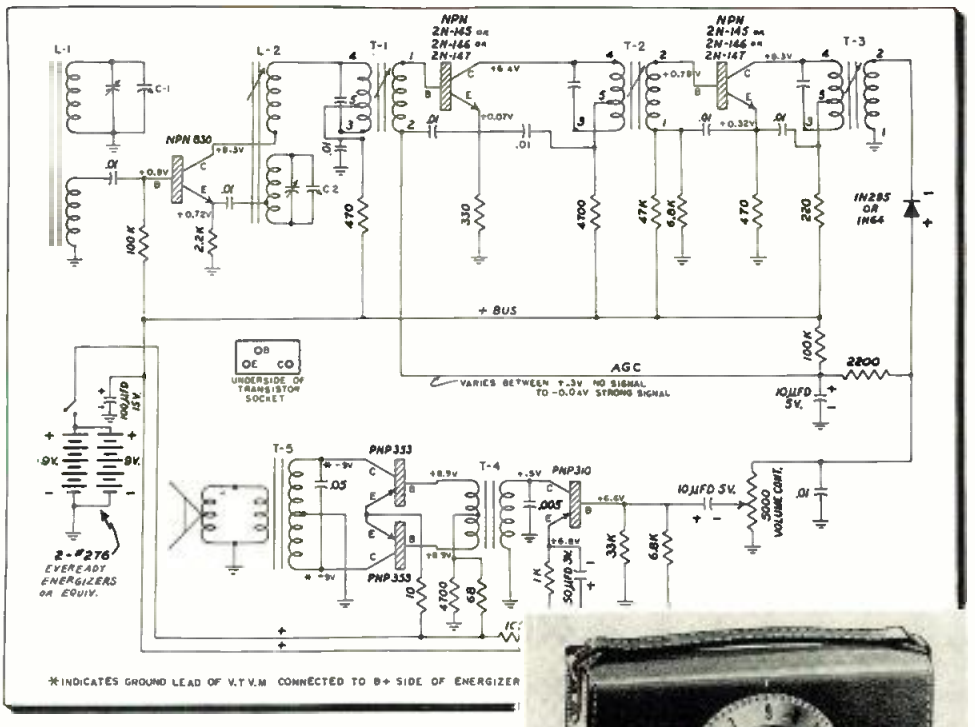
Transistor Portables

(*Continued from page* 101)

CAPEHART-FARNSWORTH

Since the transistor radio described below was undergoing its final modifications at press time, the schematic was not available.

Model: 11P7
Dimensions: 10 x 7⅛ x 3 in.
Weight: 3 lbs., 3 oz.
Power Supply: 2-9v. batteries
Features: 6 transistors, plus diode; power output—¼ watt; battery life approx. 1,000 hrs. at normal listening level



EMERSON

Model: 842
Dimensions: 9⅛ x 7 x 3¼ in.
Power Supply: 2-9 v. batteries
Features: leather case; battery life of 1,500 hrs. under normal use

Lab Standard R-F Voltmeter

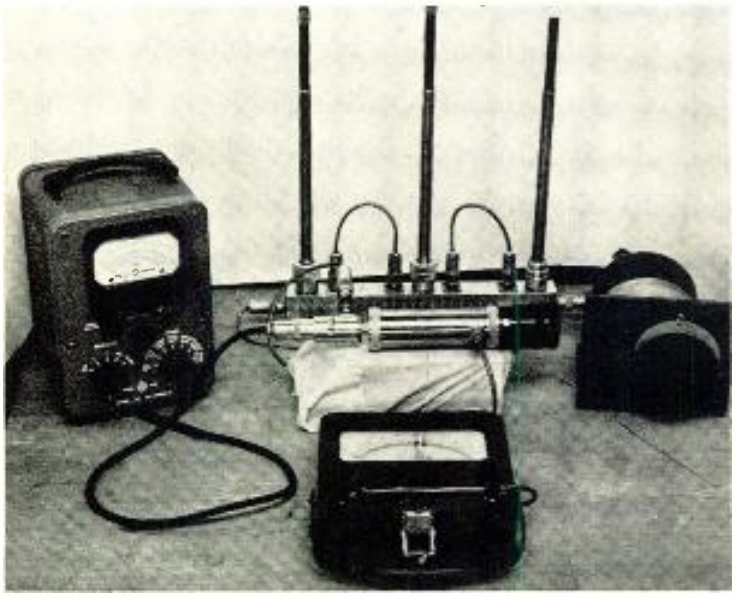
A very stable type of radio-frequency voltmeter, known as an attenuator-thermoelement or AT voltmeter, has been designed by M. C. Selby and L. F. Behrent of the NBS Boulder Labs. Unlike instruments now available, AT voltmeters maintain a calibration stability well within the accuracy of the original calibration, about 1% over most voltage and frequency ranges, for a year or longer.

AT voltmeters can be used to measure r-f voltages from 0.1 to several hundred volts at frequencies up to about 1000 MC. Although r-f voltages within this range can be accurately measured and standardized by other means, it is difficult to find voltage measuring instruments that can hold their calibration for a reasonable length of time, such as a year. Present-day voltmeters using thermionic or crystal diodes are generally not reliable in this respect as laboratory reference standards; even under most careful treatment the uncertainty in their calibration is about 10% and may frequently be as high as 20%.

Experience to date indicates that the most stable elements suitable for calibrated-type r-f voltmeters are thermoelements, waveguide-below-cutoff or capacitive-type attenuators, capacitive voltage dividers, and some well-constructed resistive attenuator pads.

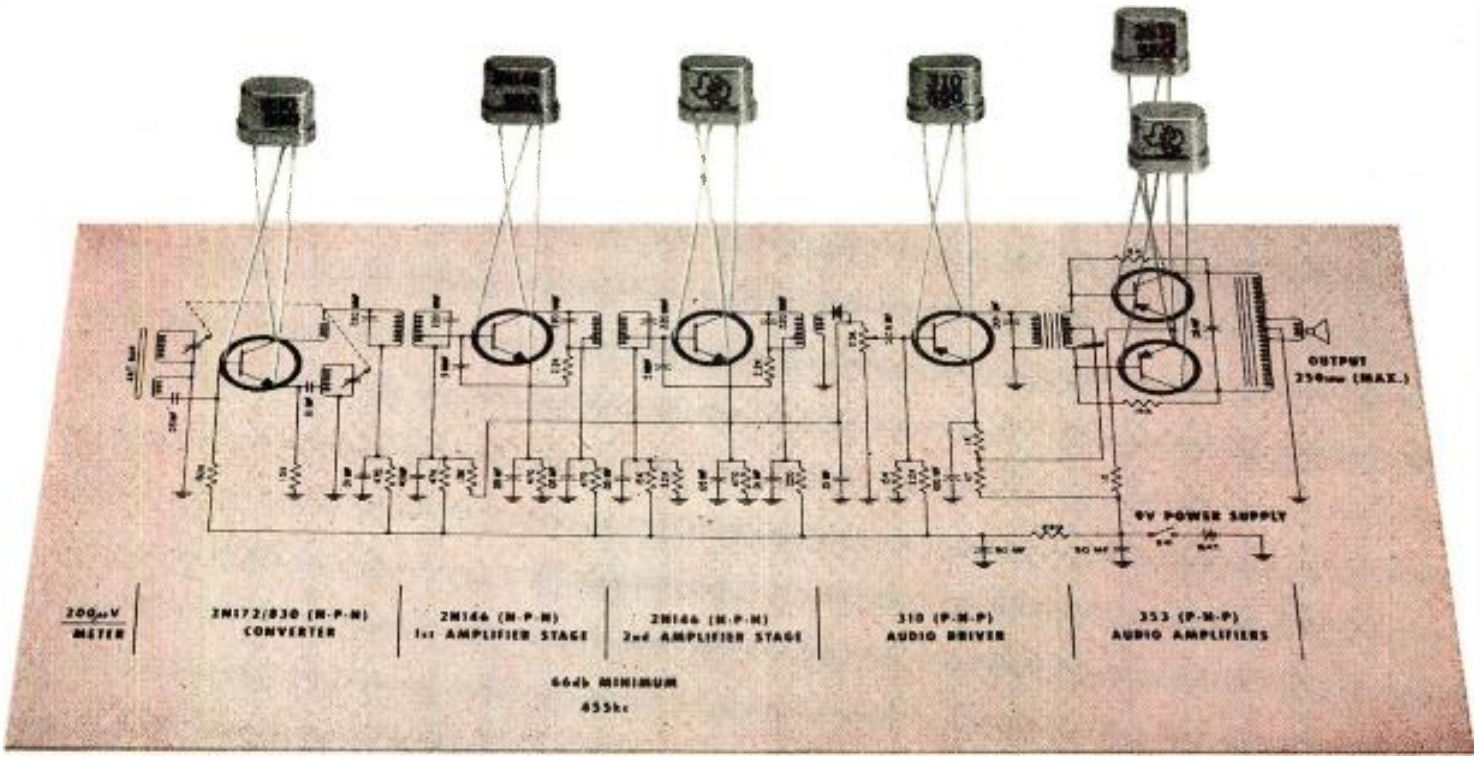
One of the high-frequency AT voltmeters, having superior short-time and long-time calibration stability, consists of a continuously adjustable waveguide - below - cutoff piston attenuator, a thermoelement, and a dc millivoltmeter. It was designed for high voltages at the higher frequencies. The traveling piston of the attenuator houses the thermoelement and a built-in auxiliary r-f probe. This probe is used to calibrate the AT voltmeter in terms of a primary standard bolometer bridge. The bridge output is approximately 1 v., which is insufficient for direct calibration of the voltmeter over an appreciable part of

(*Continued on page* 148)



R-F voltmeter in use at NBS

Performance . . . not promises!



Texas Instruments germanium transistors are used in 85% of the many brands of transistorized radios now being manufactured! Since TI transistors made possible the FIRST transistorized radios 15 months ago, improved mass production methods have rapidly increased performance and decreased prices.

In less than a year and a half, progress in TI transistors and radio circuits has been so swift that the following improvements are now production realities:

	1954	1955
Sensitivity	2000 μv/m	200 μv/m
Operating Voltage	22½V	6, 9, or 12V
IF Gain & Frequency	31db @ 262 kc	35db @ 455 kc
IF Output Capacity (C_{ob})	30-40 μμf	1 μμf
IF Neutralizing Capacity	Selected	Fixed
Audio Output Power	20mw	250mw
Typical IF Transistor Price (In complete OEM kit)	$2.50	$1.75

IN THE CIRCUIT ILLUSTRATED ABOVE:

Left to right: a 2N172/830 germanium N-P-N graded junction converter, two 2N146 germanium N-P-N graded junction IF amplifiers, a 310 germanium P-N-P fused junction driver, and two 353 germanium P-N-P fused junction outputs. This is a typical TI circuit designed for optimum performance.

Your *own* transistorized product development will also benefit from Texas Instruments progress which gives you proven products, immediate availability in production quantities, and economical prices. *First* with transistors in commercial radios, *first* with high gain, low voltage IF transistors, *first* with high temperature silicon transistors . . .Texas Instruments consistently leads the industry in development and manufacture.

LOOK TO TI FOR: GERMANIUM RADIO AND GENERAL PURPOSE TRANSISTORS • SWITCHING TRANSISTORS • SILICON SMALL SIGNAL AND POWER TRANSISTORS • SILICON JUNCTION DIODES

Texas Instruments has produced more radio transistors than any other manufacturer!

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

Du Mont closed circuit system in typical monitoring operation

System manufacturers are looking to '56 as the first "boom" year in the industrial TV field. 5,000 installations are visualized by year's end. Reviewed here are the major systems presently offered.

Part One of Two Parts

Survey of Industrial TV—1956

DU MONT

"Tel-Eye" TV Camera, Type 5359-B

Electrical

Output: Video modulated RF carrier—100,000 μvolts (channels 2-6). Composite video: 0.75 v.

Power Requirements: 110-120 v. ac, 0.43 amps.

Scanning: 60 CPS, vertical locked to line, 15,750 CPS, horizontal.

Optical

Minimum incident light required—15 ft.-candles.

Spectral Response: Approximately same as human eye (using 6198 vidicon).

Mechanical

Dimensions: 10 x 6¾ x 4¾ in.

Weight: 8¼ lbs.

Picture Monitor, Type 5281-B 17-in.

Specifications

Input Signals: Either composite picture signal, black negative, ½ volt minimum amplitude; or video signal, black negative, ½ volt minimum amplitude, and separate negative sync, ½ volt minimum amplitude. Input impedance: 75 ohms.

Output Signals: Same as input. To be terminated in 75 ohms.

Frequency Responses: Video amplifier flat within ±1 db to 6 MC.

Input Power: 117 v., 60 CPS. Approx. 270 w.

Picture Tube: Du Mont Selfocus 17KP4.

Dimensions: 15¾ x 19 x 20⅛ in.

Weight: 80 lbs.

Part II, describing systems offered by additional manufacturers, will appear in the forthcoming issue of Tele-Tech & ELECTRONIC INDUSTRIES.

GENERAL PRECISION LABS

Pleasantville, N. Y.

Television System, Model PD-150

Equipment

1 Camera

1 Control Unit: (including) video chassis, sweep chassis, sync generator, power supply, and control panel.

1 Complete set of tubes including Vidicon.

1 Camera Cable (25 ft.).

Specifications

System: 525 Lines, 60 Fields Interlaced.

Resolution: 500 Lines.

Sensitivity: Acceptable picture at 5 foot-candles

Signal Outputs: Composite Video—1.4V P-P into 75 ohms; Modulated R.F.—0.1v into 75 ohms.

R.F. Output Frequencies: Tunable from 54088 MC, covers Channel 2 through Channel 6.

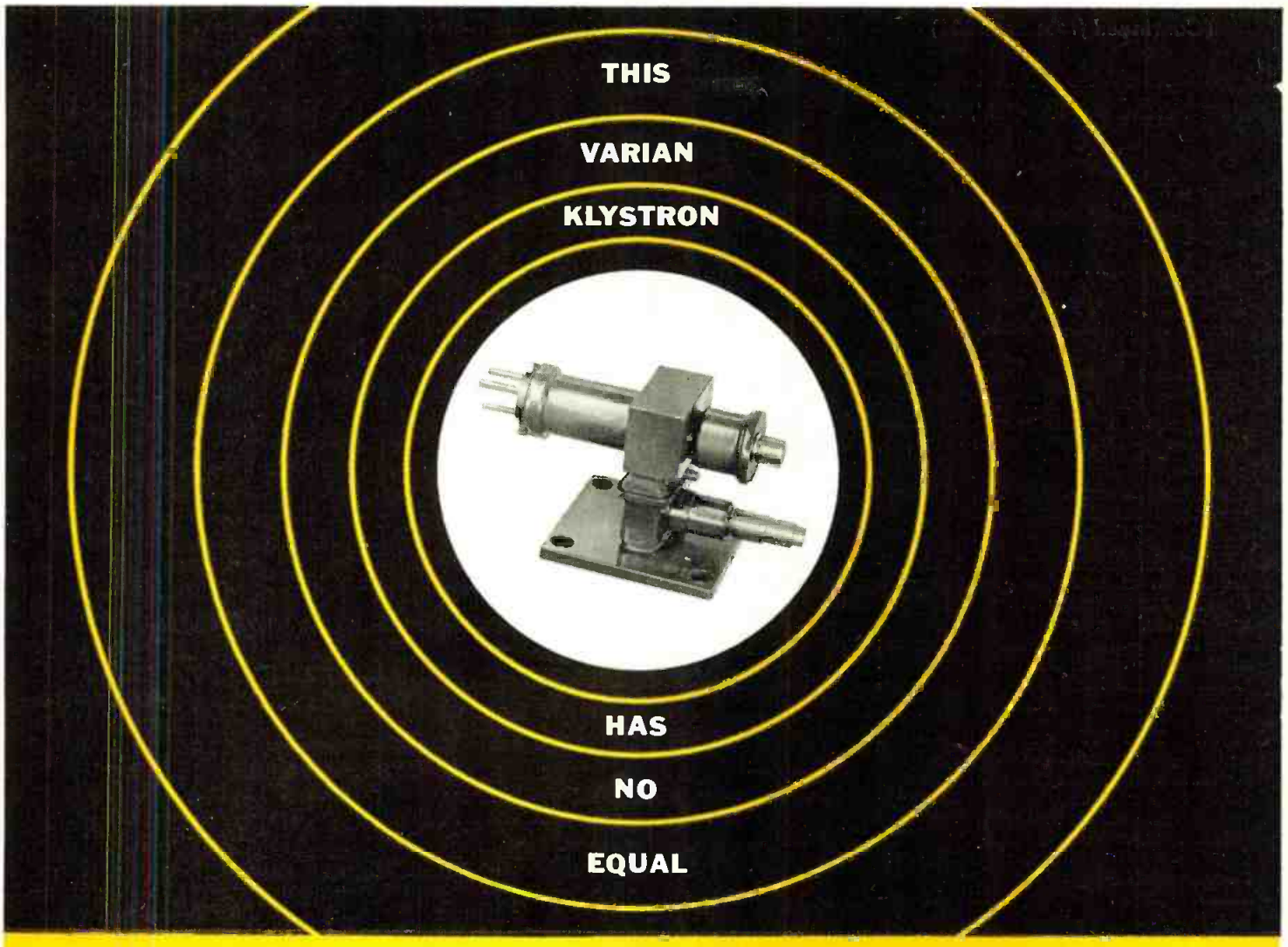
Power Requirements: 105-125v-ac, 60 CPS, 180 W.

Dimensions: Camera—9 x 5¼ in., Control Unit—17½ x 14½ x 8 in.

GPL camera with remote controlled Iris, focus, and indoor pan and tilt. Full 360° viewing.

Basic units of GPL PD-150-1 are 5-lb. camera and portable camera control unit.

where frequency stability is a "must"...



FOR X-BAND RADAR RECEIVERS

IT'S THE LOW COST RUGGED VA-203B . . . most advanced reflex klystron ever developed for radar and beacon local oscillator service. The exclusive brazed-on external tuning cavity provides frequency stability obtainable in no other klystron. This construction provides outstanding stability during shock, vibration and temperature cycling . . . takes punishing 50 to 100 G shocks and provides absolutely reliable operation at high altitude WITHOUT pressurization.

FOR SUPER-RUGGED SERVICE (Shocks to 250 G) . . . Varian offers the VA-201 klystron. This tube is equipped with integral molded silastic leads, is similar to the VA-203B and performs with the same absolute reliability.

ALL THESE EXCLUSIVE VARIAN FEATURES . . . • Unique brazed-on external tuning cavity assures exceptional frequency stability • Reliable operation at low voltage and from poorly regulated power supplies • Negligible microphonics • Slow tuning rate . . . long tuning life . . . single shaft tuner adapts easily to motor tuning • Withstands 50 to 100 G shocks (up to 250 G's for the VA-201) • VA-203B weighs less than 4 ounces. Both tubes mate directly to standard waveguide flanges.

GUARANTEED SPECIFICATIONS

8500 to 9600 mc	VA-203B	VA-201
Resonator Voltage	300 V	300 V
Heater Voltage	6.3 V	6.3 V
Heater Current	0.45 Amp	1.2 Amp
Power Output	20mW, Min	40mW, Min
Electronic Tuning Range	30 Mc, Min	20 Mc, Min
Vibration FM at 10 G	1 Mc, p-p, Max	0.2 Mc, p-p, Max

Get complete technical data and specifications on the outstanding VA-203B and its companion VA-201 . . . finest klystrons made for modern radar. Write to our Applications Engineering Department today.

THE MARK OF LEADERSHIP

VARIAN associates

PALO ALTO 10, CALIFORNIA

Representatives in principal cities

KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES

Survey of Industrial TV

(*Continued from page* 104)

BLONDER-TONGUE LABS

526 North Ave., Westfield, N. J.

Closed Circuit TV

Equipment

Camera, proper (includes F: 1.9 lens) TVC-1-C

Control Generator: TVC-1-CG includes RF Modulator and Video Amplifier (plugged in) TVC-1-M, and 25 ft. interconnecting cable 5250009.

Specifications

System Standards: Horizontal freq.—15,750, CPS nominal, interlaced. Vertical freq.—60 CPS, locked to line, 60 fields/sec., 30/frames/sec.

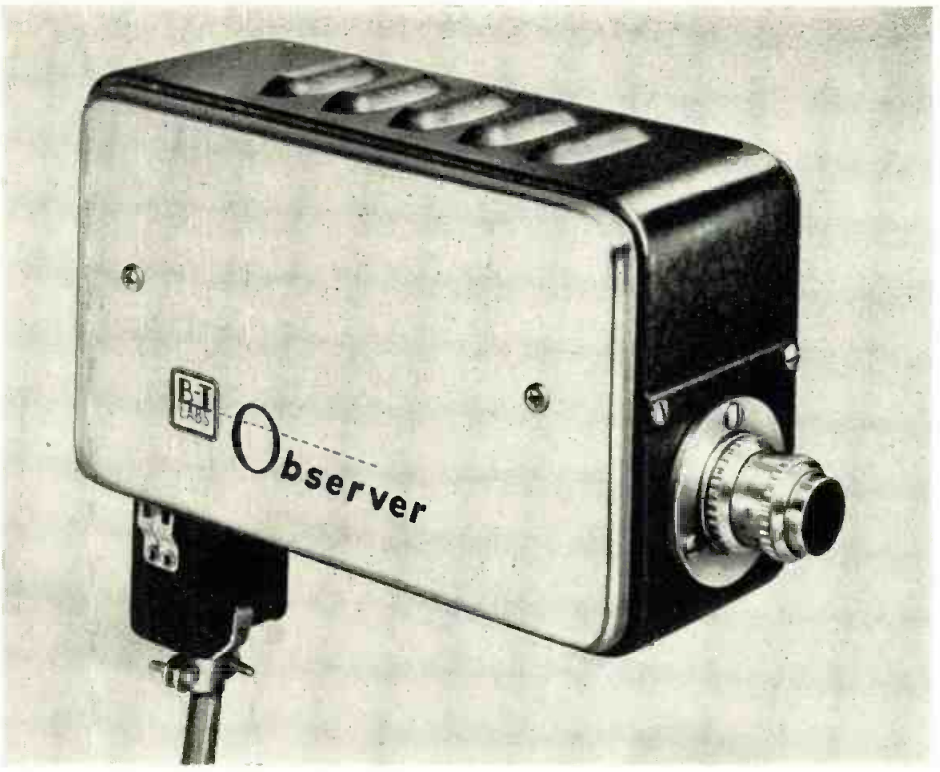
Resolution: Direct video output—more than 500 lines at center of picture. RF output—350 lines max.

Operating Requirements: Scene illumination (with standard F: 1.9 lens)—50 ft.-candles, incident-snow free; 10 ft.-candles, incident-readable. Ambient temp.—max 115°F. at camera; max. 125°F. at control generator. Control cable length, camera to control generator—500 ft. max.

Output: Two 75 ohm impedance, crystal-controlled, double sideband RF outputs at any specified frequency from TV Channel 2 through 13. Output level: 0.9v., RMS. Other frequencies available on special order. One direct, high definition, 75 ohm, 0.5 v. peak-to-peak, video output. All three outputs are available simultaneously.

Polarity: R-F—standard negative modulation. Direct video—negative black.

Dimensions: Camera housing—Height 5⅜ in.; width 4¼ in.; depth 9 in. (10¾ in. including standard lens and focusing knob in rear.) Control generator housing—Height 9¼ in.; width 12½ in.; depth 8⅝ in.



Blonder-Tongue Labs "Observer" closed-circuit color TV camera

GENERAL ELECTRIC

Monochrome Industrial TV System Type TE-3-A

Electrical

Power Input: 105/117/125 v, 50/60 CPS, 650 w, camera and control/monitor; 350 w, each additional monitor.

Standards: 525 line system. 30 frames—interfaced 2:1. Video bandwidth—8.0 MC. Output video—1.5 v, 75 ohms, black negative. Output RF—0.1 v, 75 ohms, adjustable 54 to 88 MC.

Mechanical

TG-2-A Camera: 7 x 5¾ x 9 in.

TH-5-A/TH-6-A Control/Monitor: 25 x 15 x 20 in.

TH-6-A Monitor only: 16½ x 15 x 20 in.

General Electric's closed-circuit color TV monitor

Field Sequential Color Camera Chain, Type TE-1-B

Electrical

Output Signals: Video Bandwidth—15 MC; Output Level (with 40% sync.)—1.4 v. p-p across 75 ohms; Output Polarity—Black negative; Audio Response—150 CPS to 10 KC ±3.0 db; Audio Level—18.0 db max. across 600ω; Intercom Audio Response—150 CPS to 6 KC ±3.0 db; ac Power Input—117 v., 50/60 CPS, single phase 2200 w.

Scanning Standards: Horizontal Freq.—39,690 CPS; Vertical Freq.—180 CPS, interlaced 2:1; Frame Rate—30/sec; Color Sequence—red, blue, green.

Mechanical

Color Camera: 7¼ x 23 x 6¼ in.
Camera Control Monitor: 20¼ x 30 x 20 in.

Power Supply: 48 x 22¼ x 23 11/16 in.

Cable Lengths: Camera to Monitor-Normal: 30 ft. (Up to 1000 ft. with Remote Deflection Unit, Type PX-6-A.) Monitor to Power Supply-Normal: 10 ft. (Up to 500 ft. with special cables.)

Extension Monitor Type TH-3-B

Electrical

Power Input: 117 v., 50/60 CPS, 1000 w.

Video and Synchronizing Input: Field sequential color, utilizing above standards.

Input: High impedance or 75 ohm termination.

Video Input Level: ¼ v. peak-to-peak, including sync.

Video Input Polarity: Black negative.

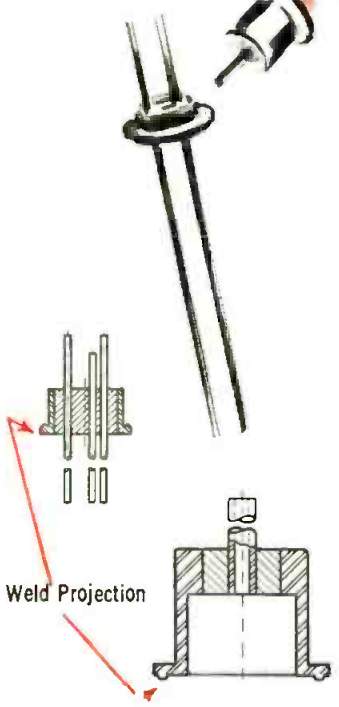
Mechanical

Effective picture size: 12 in.

Approx. Dimensions: 32½ x 23 x 22 in.

easy as . . .

to assemble Hermetic Diode and Transistor Housings



These small, durably constructed units furnish the solution to assembly and procurement problems confronting design engineers and purchasing agents.

A variety of diode and transistor housings are available from Hermetic with weld projections and special metallic finishes to simplify assembly techniques. These units eliminate costly soldering steps—they result in man-hour savings!

The advanced design of Hermetic Transistor Housings provide additional advantages to the engineer and purchasing agent. The internally exposed areas of these parts are of all-glass construction. This construction feature prevents the contamination of a transistor wafer when closure is made after mounting and assures reliable transistor performance, as well as longer shelf life.

Practical designs . . . efficient production . . . technical assistance in the solution of procurement problems—this is just one phase of Hermetic's service to industry.

Write for complete data and catalogs. The film, "THE MANUFACTURE OF HERMETIC SEALS", is now available for company showings. Write for details.

Hermetic Seal Products Company

33 South 6th Street, Newark 7, New Jersey

California Associate: Glass-Solder Engineering, Pasadena

SERVICE AND RELIABILITY ARE OUR MOST VALUED COMPONENTS

New Test Equipment

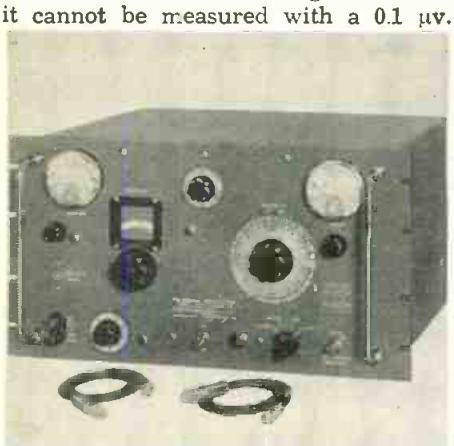
OSCILLOGRAPH-RECORD CAMERA

The only oscillograph-record camera to be specifically designed for use with a 3-inch cathode-ray oscillograph offers full binocular vision, and is self-

supporting. An adapter plate is furnished by which the camera may be easily attached to any three-inch cathode-ray oscillograph having the standard Du Mont rectangular bezel. Rubber viewing hood is easily swung open to allow adjustment of the lens. Camera incorporates a Polaroid-Land back and produces a 2¾ in. x 3½ in. black and white print 60 sec. after exposure. **Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-26)

FM SIGNAL GENERATOR

Frequency deviation accuracy of the new FM Signal Generator, Model 100D, is better than 5% of full scale at 1000 cps over two ranges of 0 to 30 KC and 0 to 250 KC. No reactance tube is used. The absence of multiple tubes eliminates drift caused by excess heat in the r-f compartments. Simplified circuit results in low modulation distortion, low A-M and low hum. Leakage is so low it cannot be measured with a 0.1 μv.



detector. A single tuning range covers the whole band of 27 to 230 MC. An incremental dial permits precise carrier change. **New London Instrument Co., Inc., Union St., New London, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-12)

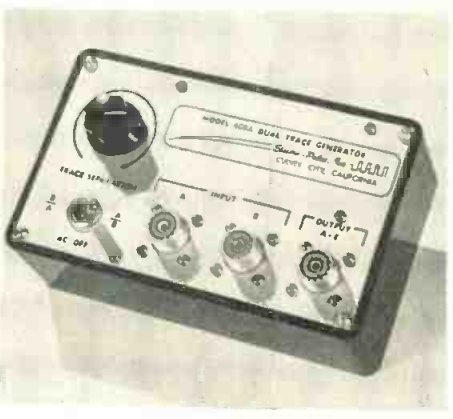
TRANSISTOR VOLTMETERS

The new MV-45A transistor voltmeter (TRVM) duplicates the performance of VTVM's, as far as frequency range (10 CPS-150 KC), voltage range (10 mv-1 kv) and accuracy (2%) are

concerned but provides additional more sensitive voltage ranges, its lowest being 2 μv-10 μv. The instrument is operated from a 6 v. dry cell battery. The MV-45AS is identical with the MV-45A, except that it has a hermetically sealed storage battery with built-in charger, providing over 2,000 hrs. of operation before requiring recharging. **Millivac Instrument Corp., P. O. Box 997, Schenectady, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-49)

DUAL TRACE GENERATOR

The Model 600A Dual Trace Generator converts any standard oscilloscope to a dual input unit by chopper sampling two inputs at a 60 cycle rate. The two signals then appear simultaneously on the oscilloscope, with vertical separation between the two adjustable by a control on the Model 600A. The unit is



particularly useful for comparison or delay, pulse rise time, and waveform amplitude or distortion. Size is 6¼ in. wide x 3¾ in. high x 2 in. deep. **Electro-Pulse, Inc., 11861 Teale St., Culver City, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-25)

VARIABLE ELECTRONIC FILTERS

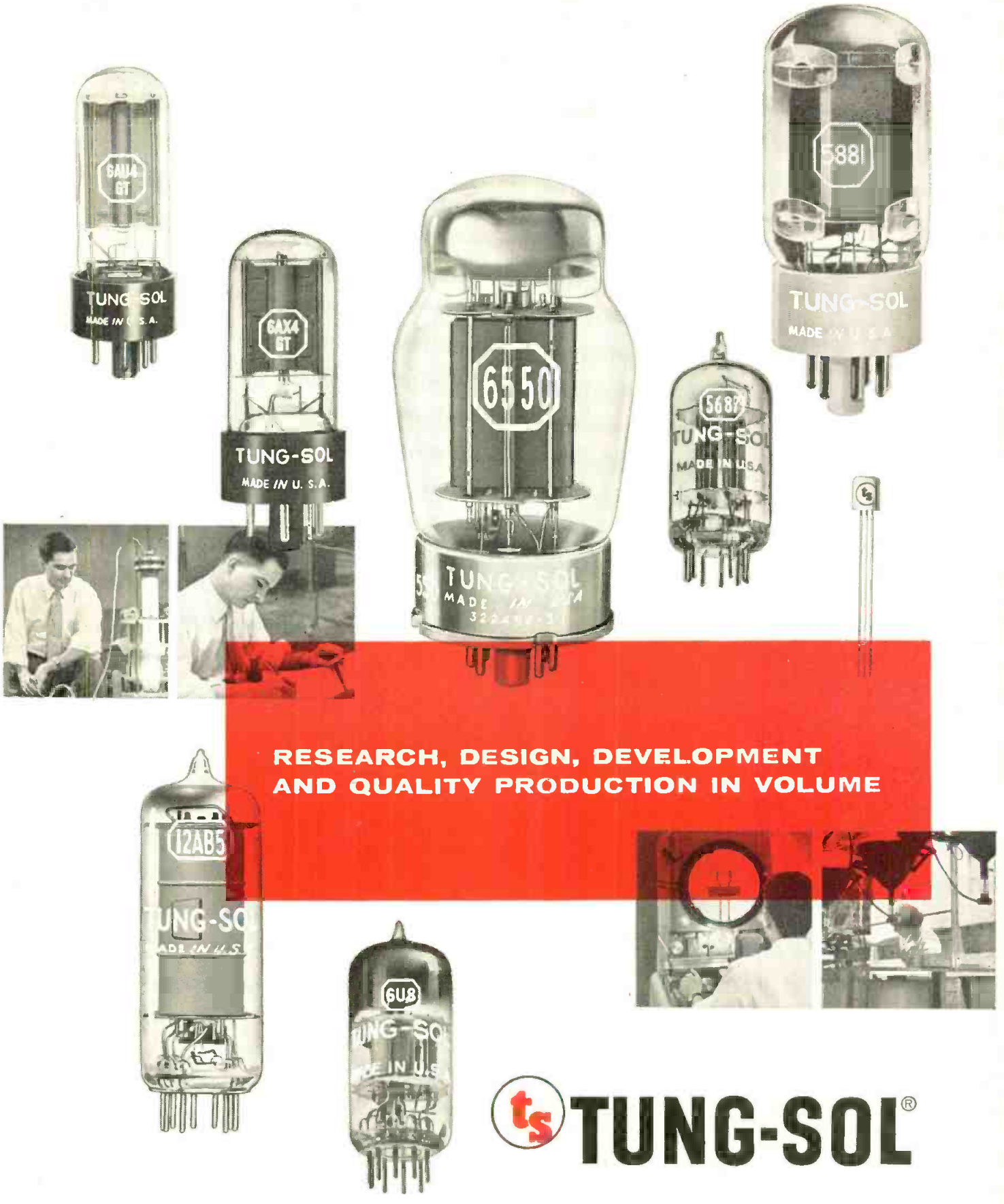
The gain of Models 330-A and 330-M Variable Electronic Band-Pass Filters is unity in the pass band and drops at a rate of 24 db/octave. The use of peak-

ing reduces attenuation at the corner frequencies by 8 db and permits a bandwidth as narrow as one octave. Both high and low cut-off frequencies are independently adjustable from 0.02 to 2,000 cps in the 330-A and from 0.2 to 20,000 cps in the 330-M. Use of 2 electronically regulated supplies reduces internal hum and noise to less than 100 μv. Calibration accuracy is ±5%. **Krohn-Hite Instrument Co., Dept. T, 580 Mass. Ave., Cambridge 39, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-102)

ALL BAND GENERATOR

Model 295X Microvolt and Crystal Controlled Generator meets military requirements and is designed primarily to service receivers in the mobile and aircraft field. Microvolt Generator covers frequencies from 125 KC to 175 MC continuous on fundamentals. Metered output from 0.1 μv. to 100,000 μv. on all ranges. No external attenuator pad required. Crystal Controlled Oscil-

lator 400 KC to 20 MC on fundamentals and controlled harmonics up to 250 MC provides crystal accuracy for frequency checks. **The Hickok Electrical Instrument Co., 10606 Dupont Ave., Cleveland 8, Ohio.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-28)



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WASHINGTON
News Letter

Latest Radio and Communication News, from The National Capital, and Previews of Things to Come

NO LEGISLATION—There is virtually no chance of legislation being enacted on the television situation by Congress as a result of the lengthy hearings and inquiry by the Senate Interstate & Foreign Commerce Committee because of 1956 being an election year. But the Senate committee proceedings may implement the FCC's expediting of its UHF rule making and determination of a revision of the allocations table. The sessions, which have been conducted under the chairmanship of Sen. Warren Magnuson (D., Wash.) have been most educational in regard to the problems of television, both from the standpoint of economics and allocations, to the Senators and their committee staff consultants. The FCC Commissioners and their top staff officials likewise have gained from the interchange of views.

MANUFACTURING REGULATION—Some Senators during the television inquiry by the Senate Interstate & Foreign Commerce Committee have advanced the thought that the FCC to give greater impetus to UHF television should regulate the set manufacturing industry to effectuate the production of UHF converters at low cost. There is virtually no chance of legislation for this expansion of the FCC's regulatory power over electronics and radio-TV manufacturing operations. Past history of the FCC in seeking regulatory jurisdiction over the telephone manufacturing industry where rate regulation is involved produced a plan for this sphere of regulation almost 20 years ago and Congress has never made a move in that direction.

MORE SPECTRUM SPACE—If the current survey of VHF space by the military services should make available more VHF television channels, veteran FCC Commissioner Rosel H. Hyde recently informed key Congressional committees that an important portion of additional VHF space would have to be provided for industrial use of the radio spectrum. He pointed out that the Commission would have to give consideration to the land mobile radio services and also to the manufacturers' radio service. Commissioner Hyde stressed the mobile and manufacturer radio services' demands "are not in any way satisfied by the present allocation" and as the nation's economy develops along the lines of a production line economy it has to have adequate communications facilities.

VOLUNTEER CONTROLS—Excellent results in radio interference control in the industrial and mobile radio field by organized, volunteer committees of private citizens who are affiliated with segments of radio are being obtained. The volunteer citizens' committees were implemented under a plan supported by the FCC Field Engineering & Monitoring Bureau as an extension of the television interference committee program which now includes around 450 TVI groups throughout the country. In the industrial and mobile radio fields, volunteer citizens' committees to control all types of electronics interference have been functioning successfully both in northern and southern California. Similar groups are now being formed in the Dallas-Fort Worth, Tex., New Orleans, Boston, Buffalo, N. Y., and Washington, D. C., areas.

CROSS-SECTION OF ENGINEERS—The Electronic Interference Committees represent a cross-section of radio engineers and technicians from all radio services, including broadcasting, television and industrial heating and medical services, in their respective areas. With their size—an average membership of around 100—, full committee meetings are held only about once a year. The radio interference problems are solved by voluntary efforts of individual members, generally two or three members contacting the interfering radio service with informal conferences solving the situations effectively.

FCC CHAIRMAN—Chairman George C. McConnaughey was continued at the helm of the FCC by President Eisenhower after his original one-year designation by the White House expired March 21. The White House announcement stated that chairman McConnaughey would continue as the Commission chieftain until his term on the FCC expires on June 30, 1957. He started his service as FCC Chairman on Oct. 4, 1954. With Chairman McConnaughey's reappointment, interest now is centered on the reappointment of veteran Commissioner Edward M. Webster whose term expires June 30. Mr. Webster is the engineer member of the FCC with a career of nearly 50 years in government communications and radio but an obstacle to his reappointment is his status as a political independent. President Eisenhower's decision to be available for another term is felt to strengthen Commissioner Webster's chances.

MICROWAVE—The first shared microwave usage in the railroad service has been approved by the FCC in construction permits issued last month to the Southern Railway System, for a total of seven microwave stations spanning a 150-mile route between Georgia and Florida.

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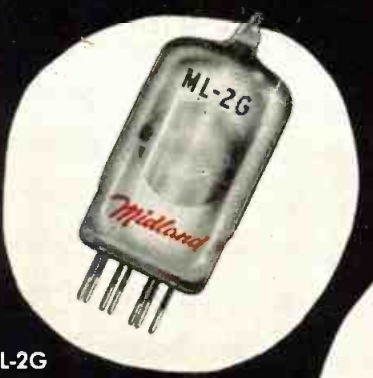
ROLAND C. DAVIES
Washington Editor

ONLY *Glass* CAN DO THIS JOB SO WELL . . .



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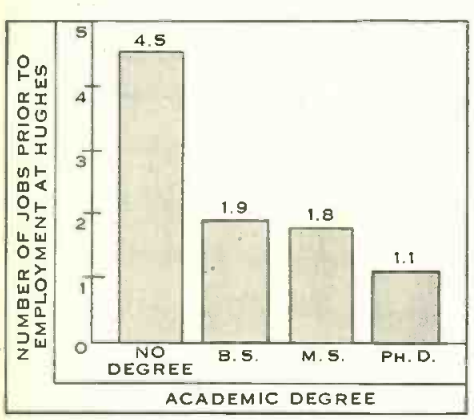
With additional facts cheerfully contributed by their colleagues they have come up with a score of relationships—some amusing, some quite surprising. We shall chart the most interesting results for you in this series.



The above chart represents the number of positions held prior to employment at Hughes—by academic degrees (and by lack of a degree). The Ph. D. has changed jobs the least. Data obtained from a 20% random sample of the 2400 professional engineers and scientists of Hughes Research and Development Laboratories.

Education and Job Change

In our laboratories here at Hughes, more than half of the engineers and scientists have had one or more years of graduate work, one in four has his Master's, one in 15 his Doctor's. The Hughes research program is of wide variety and scope, affording exceptional freedom as well as exceptional facilities for these people. Indeed, it would be hard to find a more exciting and rewarding human climate for a career in science. Too, the professional level is being stepped up continually to insure our future success in commercial as well as military work.

Hughes is pre-eminent as a developer and manufacturer of airborne electronic systems. Our program includes military projects in ground and airborne electronics, guided missiles, automatic control, synthetic intelligence. Projects of broader commercial and scientific interest include research in semiconductors, electron tubes, digital and analog computation, data handling, navigation, and production automation.

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ABSTRACTS & REVIEWS of WORLDWIDE ELECTRONIC ENGINEERING

TELE-TECH & ELECTRONIC INDUSTRIES

International ELECTRONIC SOURCES

PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name	Abbreviation	Publication Name	Abbreviation	Publication Name
Arc. El. Uber.	Archiv der elektrischen Uebertragung	El. Eng.	Electronic Engineering	Onde	L'Onde Électrique
Auto. Con.	Automatic Control	El. Eq.	Electronic Equipment	Phil. Tech.	Philips Technical Review
BC News	Broadcast News	El. Mfg.	Electrical Manufacturing	Proc. AIRE	Proceedings of the Australian Institution of Radio Engineers
Bul. Fr. El.	Bulletin de la Société Française des Électriciens	El. Rund.	Electronische Rundschau	Proc. IRE	Proceedings of the Institute of Radio Engineers
Comp.	Computers and Automation	Eric. Rev.	Ericsson Review	Radiotek	Radiotekhnika (USSR)
Con. Eng.	Control Engineering	Freq.	Frequenz	Rev. Sci.	Review of Scientific Instruments
El.	Electronics	J. BIRE	Journal of the British Institution of Radio Engineers	Tele-Tech	Tele-Tech & ELECTRONIC INDUSTRIES
El. & Comm.	Electronics and Communications	J. IT&T	Electrical Communication (Technical Journal of IT&T)	Wirel. Eng.	Wireless Engineer
El. Des.	Electronic Design	Nach Z.	Nachrichtentechnische Zeitschrift		

Also see government reports and patents under "U.S. Government."

ANTENNAS, PROPAGATION

Passive Reflectors for Radio Waves, by G. Andrieux. "Onde" Jan. 1956. 15 pp. The experimental set-up for plane reflectors of different dimensions used a parapolic antenna and operated at 24,000 MC. In particular the amplification obtained and the effect of these reflectors on antenna coupling was studied. Source 4/6-1

Computation and Construction of Double-Curvature Reflectors, by L. Thourel. "Onde" Dec. 1955. 11 pp. Formulas for the radiation diagram are derived by the diffraction method and these are correlated with formulas derived by geometrical optics, introducing correction computations. Experiments confirm the theory. Source 4/6-2

The Optimum Current or Field Distribution for Surface or Straight Antennas with Continuous Radiation, by A. Heilmann. "Nach. Z." Jan. 1956. 9 pp. The radiation pattern for a continuously radiating structure is computed by representing any current distribution as a final, comparatively small, number of elements in a Fourier series. The maximum side-lobe attentuation for a given beam width and vice versa can be calculated. Broadside and endfire arrays are studied. Source 4/6-3

Phase Relations in the Theory of Receiving Antennas, and Several Applications of the Reciprocity Theorem, by A. Volpert. "Radiotek." Nov. 1955. 10 pp. The article develops a formula for the current in an arbitrary receiving antenna, which is analogous to the one obtained by M. S. Newman in 1935, but takes into account the phase relations between the current and the exciting field of the antenna. A relationship is obtained which specifies the magnitude of receiver antenna re-radiation. Source 4/6-5

Selection of Elements for Isolation Filters in the Operation of an Intermediate Wave and a Long Wave Transmitter on the Same Antenna, by A. Kashel. "Radiotek." Nov. 1955. 11 pp. The article develops a method of designing the components of decoupling filters with a view toward obtaining minimum cost and size while retaining high working efficiencies for both transmitters. Formulas are derived for selecting the filter capacitances; the dependence of the reactive power and the filter capacitances upon the interrelation of transmitter frequencies is analyzed. The effect of filter resistance is investigated and sample calculations are given. Source 4/6-6

Interference Fading Caused by Frontal Discontinuities, by P. Misme. "Onde" Jan. 1956. 5 pp. Geometrical optics is used to explain the fading phenomena. Measurements were carried out between Le Havre and Buron with 4000 MC waves reflected on the water and masked by a hill. The diagrams are shown. Source 4/6-12

Apparatus for the Recording and Automatic Evaluation of Field Strength Measurements, by H. Griese and E. Haberkant. "El. Rund." Feb. 1956. 4 pp. The instrument, developed at the RTI (Radio Engineering Inst., Nuremberg) compares the received voltage with a standard voltage which is automatically attenuated to the received voltage. The attenuator value is recorded on metallized paper, which record is scanned by a series of contacts connected to counters. Source 4/6-14

Ground-to-Air Antenna Uses Helical Array, by V. Zanella. "El." Mar. 1956. 3 pp. Either linear or circular polarization is provided for ground-to-air communication by a multi-element phased helical array. Desired radiation pattern is obtained without impedance matching by use of phase adjustments. Source 4/6-15

Arrival Angle of H.F. Waves—Improved Method of Measuring Waves Reflected from the Ionosphere, by A. Wilkins and C. Minnis. "Wirel. Eng." Feb. 1956. 7 pp. The incident wave is received by two rotating, vertically-spaced, horizontal loop antennas, amplified in two substantially identical receivers using the same beat frequency generator and applied to the two orthogonal deflection plates of a cathode-ray oscilloscope. For a single incident wave, a straight line will appear on the oscilloscope; its inclination is an indication of the angle of elevation. Source 4/6-13

Designing UHF Scatter Transmission Systems, by M. Jacob and S. Vest. "El. Des." Mar. 1, 1956. 4 pp. The data presented enables designers to determine system performance in terms of fading limits, bandwidth capability, and signal attenuation, as well as realistic antenna sizes for maximum gain and diversity considerations. Charts are included to facilitate the calculation. Source 4/6-250

Study of the Influence of Atmospheric Turbulence on Ultra-Short Wave Paths over the Mediterranean, by F. du Castel. "Onde" Jan. 1956. 11 pp. Atmospheric turbulence data are deduced from the behavior of 10, 20 and 70 cm waves transmitted between Corsica and France at various altitudes. A theory connecting the atmospheric turbulence to the wave propagation phenomena is presented. Source 4/6-9

Explanation of the Fading Statistics in Microwave Radio Fields with Unobstructed Paths, by G. Kraus. "Arc. El. Uber." Jan.

FOR MORE INFORMATION ON SUBJECTS REVIEWED HERE

Contact your nearest library subscribing to publications noted. Excellent technical periodical sections are maintained by many large public libraries, engineering universities and electronic companies.

To obtain copies of any articles or complete magazines reviewed here, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request, stating publications of interest, by writing to: "Electronic Sources" Editors, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y. The editors can recommend translation agencies.

To obtain copies of U.S. patents, and research reports on military and government projects reviewed here, send payment indicated directly to federal agency as instructed in section entitled "U.S. Government."

1956. 7 pp. This statistical investigation of fading assumes a high-energy field and a plurality of weaker fields having random phase to reach the receiving antenna. The extent of duct formation is characterized by the power ratio of the weaker fields to the high-energy field. Satisfactory agreement between theoretical and measured results are obtained. Source 4/6-10

Diversity Tests and Study of the Effect of Focusing on Long Line-of-Sight Paths, by P. Rivet. "Onde" Jan. 1956. 9 pp. The results of experimental studies carried out between Corsica and France on fading of 10, 20 and 70 cm waves are reported. It is stated that multipaths transmission and focusing do not account for all observed data; comparatively rapid variations in the diffraction index causing partial reflections and intense focalization need to be considered. Source 4/6-8

AUDIO

The Design of Filters Using only RC Sections and Gain Stages (Part 2), by A. Thiele. "El. Eng." Feb. 1956. 3 pp. The filters described are most useful if variable-frequency cut-off is desired. An accurate 18 db/octave high-pass filter with 40 cycles cut-off and an approximate 18 db/octave filter with variable cut-off (high pass 35 to 100 cycles, low-pass 5 to 14 cycles) are presented in detail. Source 4/6-16

Laboratory Equipment for Quantizing Speech, by V. Allen. "El. Eng." Feb. 1956. 5 pp. The apparatus described was designed to study the effect of distortion on speech signals. A trigger unit quantizes the signal in amplitude and produces a binary output; a quantizing unit produces a time-quantized version of the trigger output. Design and performance details are included. Effect on speech is reported. Source 4/6-17

Normalized Filter Design, by S. Bedrosian and R. McCoy, Jr. "El." Mar. 1956. 4 pp. Examples of 6 normalized filter designs are given. DB of rejection for composite low-pass filters (trial design) may be predetermined from design chart. Source 4/-18

The "Vibrotor," a New Industrial Oscillator for the Frequency Range from 20 cycles to 25kc, by G. Hentschel and S. Schweizerhof. "Freq." Jan. 1956. 8 pp. (First installment.) The Vibrotor consists of an outer ring carrying a number of inwardly projecting permanent magnets. This ring is held for vibrations on a torsionally displaceable rod. A toothed rotor of ferromagnetic material is rotatably mounted inside the outer ring. Rotation of the rotor will cause the outer ring to vibrate at a frequency depending on the rotor speed and the number of teeth. A similar arrangement for linear oscillations is described. The performance of the Vibrotor is compared with other similar oscillators and several designs are discussed. Source 4/6-19

New Directional Moving-Coil Microphones, by R. Gorike. "El. & Comm." Jan.-Feb. 1956. 2 pp. New system incorporates the combined effects of 2 single elements with unidirectional patterns. The combined patterns can be changed by electrical remote control from omni-directional to figure 8 and to reverse or forward cardiod. Source 4/6-251

Stereo Reverberation, by R. Vermeulen. "Phil. Tech." Mar. 1956. 9 pp. Concert halls which are acoustically unsuited for the presentation of concerts can be improved by providing artificial diffuse reverberation. The installation described provides stereo reverberation electro-acoustically by recording on the rim of a magnetic wheel and playing back through a number of play back heads. Source 4/6-252

Design of Magnetic Recording and Reproducing Equipment for Domestic Use, With Special Reference to Stereophonic Reproduction, by M. Martin and D. Smith. "J. BIRE" Feb. 1956. 15 pp. The design criteria of domestic recorder-reproducers and high quality tape reproducers, problems encountered, and practical results obtainable, are dealt with. Stereophonic reproduction in the home is discussed and a practical reproducer described which uses twin-channel tape. Source 4/6-253

CIRCUITS

Non-Linear Distortion in Oscillators with "Inertial Non-Linearity" in the Tank Circuit, by N. Fyodorov. "Radiotek." Nov. 1955. 6 pp. Investigation of an oscillator with automatic regulation, operating within the limits of the slightly non-linear portion of the tube characteristic. Regulation is accomplished by a filament lamp connected in the tuned circuit. Such oscillators contain considerable high harmonics in their output at low frequencies, even when operating in the linear region of the tube characteristic. This parasitic phenomenon is investigated by means of the "small parameter" method. The cause of these higher harmonics is the inertia of the regulating resistance contained in the tank circuit. Simple expressions are given which permit evaluation of the harmonic coefficient and the frequency correction for oscillators of this type. Source 4/6-20

Reproduction of a Rectangular Pulse by an Amplifier with an R-C Filter in the Plate Circuit, by A. Sokolik and T. Agakhanyan. "Radiotek." Nov. 1955. 8 pp. The article derives simple formulas for the calculation of the crest distortion and the zero-line distortion (negative overshoot) when single rectangular pulses are reproduced by an amplifier with an R-C filter in its plate circuit. The transient response function is used to calculate correction factors. The internal impedance of the tube is taken into account. Source 4/6-21

High-Speed Light Pulse Shaper using a 5000 RPS Rotating Mirror, by J. Cladis, C. Jones, and K. Wickersheim. "Rev. Sci." Feb. 1956. 5 pp. Description of a light pulse shaper capable of producing high intensity light pulses whose shape can be controlled within time widths at half-height from 10^{-6} to 10^{-9} seconds. Unit is used to study the response of light detection systems. Source 4/6-22

RC Generators, by H. Voelz (Cont. from Jan. 1956) "El. Rund." Feb. 1956. 4 pp. The transition from a feedback amplifier to a generator is explained and the operation of a bridge-type RC generator studied in detail. Source 4/6-24

Non-Linear Transformations of Complex Signals, by V. M. Wolfe. "Radiotek." Nov. 1955. 13 pp. An analytical method is developed for determining the non-linearity of a 4 pole network through the use of various pulses. Coefficients of non-linearity are derived for rectangular, saw-tooth, triangular, exponential and bell-shaped pulses. Numerical computations are included. Source 4/6-25

Spark Impulse Excitation of Oscillations in the Centimeter Wave Region, by I. Ivanov. "Radiotek." Dec. 1955. 8 pp. A method for spark excitation of oscillations in hollow resonators. The author describes the construction of a resonator, which delivers high frequency exponential pulses to a load, with a pulse duration on the order of 0.1 μsec. in the 8-13 cm. region. The output power of the resonator pulse reaches 10 w. Source 4/6-26

The Effect of Rectangular Pulses of Random Duration and Interval upon a Linear Detector, by V. Tikhonov. "Radiotek." Dec. 1955. 5 pp. A general expression is obtained for the probability density of the load voltage of a linear detector with random rectangular pulses at its input. It is pointed out that empirical methods are required to complete the analytical solution. The analytical method presented points out the correct path for complete solution. Source 4/6-27

Transient Responses of Complex Pulse Systems Comprised of Non-Identical Stages, by S. Krizye. "Radiotek." Dec. 1955. 5 pp. The author examines the transient responses of multi-stage linear pulse systems, composed of non-identical stages of arbitrary form with lumped constants. The article establishes the relation of transient responses of the most general form to simpler particular cases. Fourier integrals are used as the basis for the analytical treatment. Source 4/6-28

Overshoot of the Pulse Characteristic (Response to a Linearly Rising Wave Front) in Circuits with Correction for Rising Wave Fronts, by B. Feizulieyez. "Radiotek." Nov. 1955. 5 pp. The article examines the effect of a trapezoidal voltage pulse on a linear 4 pole network whose transient response is specified. The dependence of the pulse characteristic overshoot of the wavefront of the input pulse is established. Graphs of this dependence are given for a simple correction circuit. Source 4/6-29

A Phase Controlled Oscillator, by P. Davis. "El. Eng." Mar. 1956. 5 pp. Oscillator frequency remains an exact multiple of the line frequency at a constant phase relation to it. It is used for marking a scale of electrical degrees on a line frequency oscillograph display. Theory and design are given. Source 4/6-30

Unity Gain Voltmeter Amplifier, by H. Hyder. "Tele-Tech" Apr. 1956. 2 pp. Design and construction details of a unity gain dc amplifier of high input impedance and an output impedance of less than 1 ohm. The amplifier acts as a coupling unit between the high impedance source and the low impedance load. A 0-1 v. meter, connected across the output, functions as a VTVM, with ranges of 1 to 1,000 v. Source 4/6-254

DC Decade Amplifier, by W. Royce and W. Mathews. "Tele-Tech" Apr. 1956. 3 pp. Unique arrangement of RC and direct coupled amplifiers and a chopper stabilizer achieve unusual stability in a dc amplifier. Bandwidth is flat from dc to 100 kc; gain is variable in 20 db steps. Source 4/6-255

An Electrostatic Pulse Generator, by W. Woods-Hill. "El. Eng." Mar. 1956. 2 pp. Description of a means of generating pulses locked to a drum without the need for electromagnetic pick-up heads. The system uses a screened probe to pick-up r-f which is fed to the drum. Source 4/6-32

Characteristics and Origins of Noise—Part I, by W. Bennett. "El." Mar. 1956. 7 pp. The characteristics of tube, contact, static and ignition, Rayleigh, Gaussian, thermal, amplifier, and quantizing noise are described. Discussion includes bandwidth considerations and effects upon digital tranmission systems. Source 4/6-33

A D.C. Amplifier Stage with One Grounded Input Terminal, by E. Schlosser and S. Goetze. "Freq." Jan. 1956. 6 pp. In this push-pull circuit, the input is applied directly to only one grid while the second tube, having a different characteristic, is controlled by the resulting plate current

in the first tube. A mathematical analysis is presented and good performance is stated. A numerical example is included. Source 4/6-34

The Impedance Transformation of Linear 2-N Terminal Networks, by H. Kleinwaechter. "Arc. El. Uber." Jan. 1956. 3 pp. A variable transformer may be represented by a 2n-terminal network with (n-2) outlets terminated by a variable reactance. The transforming range covered by such an arrangement is the object of the present study. Source 4/6-36

Design Principles of a Silicon Diode Modulator, by N. Moody. "El. Eq." Feb. 1956. 4 pp. Ring bridge modulator, using silicon diodes, has automatic balancing and does not require selection of components. Unit works to at least 100 kc. Source 4/6-37

COMMUNICATIONS

Microwave Relay System Between Saint John and Halifax, by H. Sheffield. "J. IT&T" Dec. 1955. 22 pp. Description of a microwave relay system employing time-division multiplex to provide toll telephone circuits between St. John, New Brunswick and Halifax, Nova Scotia. System planning aspects are given and performance figures outlined. Source 4/6-38

Very-High-Frequency Radio Link Between Puerto Rico and the Virgin Islands, by R. McSweeny. "J. IT&T" Dec. 1955. 10 pp. 150 mc FM system provides telephone and telegraph channels between the islands. H-f radio circuits are used to extend the telephone service to the U. S. Equipment employed is discussed in general terms. Source 4/6-39

Abbreviations in Communication Engineering, by Dr. H. Meinke. "Nach. Z." Jan. 1956. 8 pp. Some introductory remarks are followed by a suggestion for the standardization of abbreviations. Source 4/6-43

A Simple Microwave Discriminator, by C. Colani. "Freq." Jan. 1956. 2 pp. The two slightly different resonance frequencies of a cylindrical cavity can be used for the discriminator, since their polarization is displaced by 90°. The discriminator uses two detectors coupled 90° apart along the cylindrical surface of the cavity; it is fed at the center of one of its circular surfaces. Source 4/6-45

The Power Output of a Self-Excited Microwave Oscillator to a Complex Load, by H. Paul. "El. Rund." Feb. 1956. 5 pp. The Smith chart is used to represent generator-load conditions. The method is illustrated by an example involving a loaded magnetron. Plotting from experimental values and evaluation of the diagram are explained. Source 4/6-46

International Standardization of Characteristics for the Interconnection of Radio Links, Report of the 9th Study Group of the C.C.I.R. Geneva, Sept. 1954, by L. J. Libois. "Onde" Dec. 1955. 13 pp. The provisional standards for time division and frequency division radio link systems and of black-and-white TV signal transmission are set forth, as well as the provisional standards accepted by the C.C.I.F. meeting. Source 4/6-47

Frequency Modulation Noise in Oscillators, by J. Stewart. "Proc. IRE" Mar. 1956. 5 pp. Discussion of noise in oscillator tubes due to the discrete nature of the electron can result in FM by a wide band of Gaussian noise. The theory is applied to fixed-tuned and reactance modulated oscillators and to magnetrons. Source 4/6-256

COMPONENTS

Miniaturized Connectors for Electronic Equipment, by D. Davis. "El. Eq." Feb. 1956. 2 pp. Problems associated with the size and weight reduction of connectors to their present miniature size. Source 4/6-48

Components for Transistor Circuits. "El. Mfg." Mar. 1956. 8 pp. A review of components which were redesigned for transistor circuitry under Signal Corps Engineering Labs' sponsorship. Included are fixed and variable capacitors and resistors, inductors and transformers, sockets, rectifiers, crystals, etc. Source 4/6-285

Tantalum Capacitors, by R. Hovey and S. Fry. "El. Mfg." Mar. 1956. 2 pp. Characteristics and applications of tantalum capacitors. Effects of shelf aging, temperature, and results of an accelerated life test are given. Source 4/6-257

Applications of Bistable Ferromagnetic Elements, by I. Auerbach. "Tele-Tech" Apr. 1956. 3 pp. Bistable ferromagnetic elements offer the advantages of reliability, small size, ruggedness, and low power consumption. This article reviews basic concepts of these elements and indicates telemetering and navigational uses as applied to airborne navigational systems. Source 4/6-258

Life-Test Results On Selenium Rectifiers, by G. Chernish. "Tele-Tech" Apr. 1956. 4 pp. Tests of radio-TV type stacks manufactured by 5 different firms disclose phenomenal variations in shelf life, forward resistance change with temperature, and useful life. Discussion points up the difficulty in predicting individual rectifier performance and the need for derating. Source 4/6-259

Transistorized Computer Amplifiers, by R. Weyrick. "Tele-Tech" Apr. 1956. 4 pp. Summing amplifier and power amplifier, designed for a 400 cycle analog computing system in flight simulators, and utilizing printed circuit construction, are compared for performance and physical characteristics with interchangeable vacuum tube units. Source 4/6-260

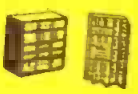
The Reactance of Wound Capacitors with Longitudinally Connected Layers, by H. Heywang. "Arc. El. Uber." Jan. 1956. 16 pp. The effect of inherent inductance and losses in a capacitor structure is derived for variously shaped capacitors. In particular, capacitors made of helically wound strips of foils are considered. Eddy current effects are discussed. Source 4/6-50

The Geometrical Four-Terminal Network Representation of the Double Transformer, by J. de Buhr. "Arc. El. Uber." Jan. 1956. 5 pp. The loss less double transformer is equivalent to a combination of a type of four-terminal network which can not be treated with conventional graphical methods. A geometrical solution for this problem is presented. Source 4/6-51

Temperature Compensating Capacitors, by G. Mistic. "El. Mfg." Feb. 1956. 4 pp. Selection of proper capacitors for desired temperature characteristic. Capacitor design and dielectrics used are covered. Comparison of plastic film and paper capacitors is made. Source 4/6-52

Temperature-Aging Nomographs, by S. Davis. "El. Des." Feb. 15, 1956. 2 pp. Variation of component life with deviation from rated ambient temperature is discussed and nomographs given to aid in the determination of the aging of these components. Source 4/6-53

High Frequency Wide-Band Transformers, by S. Kalikhman. "Radiotek." Dec. 1955. 10 pp. Practical circuits for wide-band transformers are obtained, and the engineering relationships for designing their components derived, on the basis of the well known method of transforming symmetrical filters into non-symmetrical ones. Experimental data is given for actually constructed high frequency wide-band transformers with flat frequency responses, designed for operation in the 0.15-100 mc region. Source 4/6-54



COMPUTERS

The Planning Behind the IBM 702 Installation at Chrysler Corporation, by E. Lindstrom. "Comp." Feb. 1956. 3 pp. An examination of Chrysler's experience in planning for and installing the IBM 702 computor. The basic applications (central inventory control, invoicing and accounts receivable, cost of sales determination, and sales analysis) are discussed. Source 4/6-55

Publications for Business on Automatic Computers: A Supplemental Listing, by N. Chapin. "Comp." Feb. 1956. 5 pp. Publications listed are grouped by subject matter, such as systems analysis, feasibility studies, applications, integrated data processing, storage devices, etc. Source 4/6-56

The Function of Automatic Programming for Computers in Business Data Processing, by R. Rossheim. "Comp." Feb. 1956. 4 pp. A general discussion of training, approximation and experimentation, flow charting, coding, program checking, and testing as functions of automatic programming. Source 4/6-57

A Digital Potentiometer, by S. Dean and D. Nettell. "El. Eng." Feb. 1956. 4 pp. The instrument converts the voltages supplied by a teleprinter perforator tape into binary signals to be used in an electronic computer. Essentially, the signal voltage is automatically compared with a sequence of binary voltages by a suitable switching circuit which also retains the result. Source 4/6-59

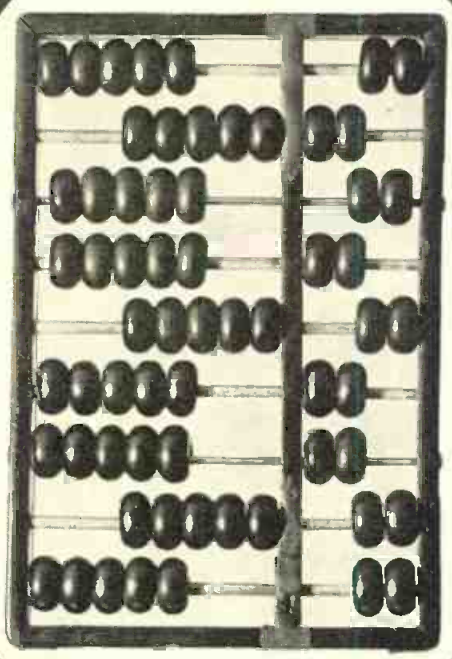
Temporary Storage Elements and Special-Purpose Tubes, by N. Scott. "Con. Eng." Mar. 1956. 6 pp. Theory and application of delay lines, transistor and vacuum tube flip-flops, and special purpose computer tubes. These latter tubes are classified according to their use: switching, coding, and arithmetic. Source 4/6-60

Small-Scale Computers as Scientific Calculators, by J. Carr III. "Con. Eng." Mar. 1956. 6 pp. A survey of small, low priced, general purpose, commercially available computers. Tables give characteristics of the units. Source 4/6-61

Timely Problems in Information Theory, by W. Kallenbach. "El. Rund." Feb. 1956. 1 p. This is a short review of topics treated at the 3rd Symposium on Information Theory held in London in Sept. 1955. Source 4/6-62

Basic Gating Package for Computing Operations, by F. Dean. "El Eq." Feb. 1956. 3 pp. Circuitry, theory, and applications are given for a unit designed to perform a variety of functions in symbolic logic and binary arithmetic. Source 4/6-63

Magnetic Core Circuits for Digital Data-Processing Systems, by D. Loev, W. Miehle, J. Paivinen, and J. Wylen. "Proc. IRE" Feb. 1956. 9 pp. Toroidal ferromagnetic cores with rectangular hysteresis loops and microsecond switching time are used in digital data-processing systems. Three circuits for data transfer are described and



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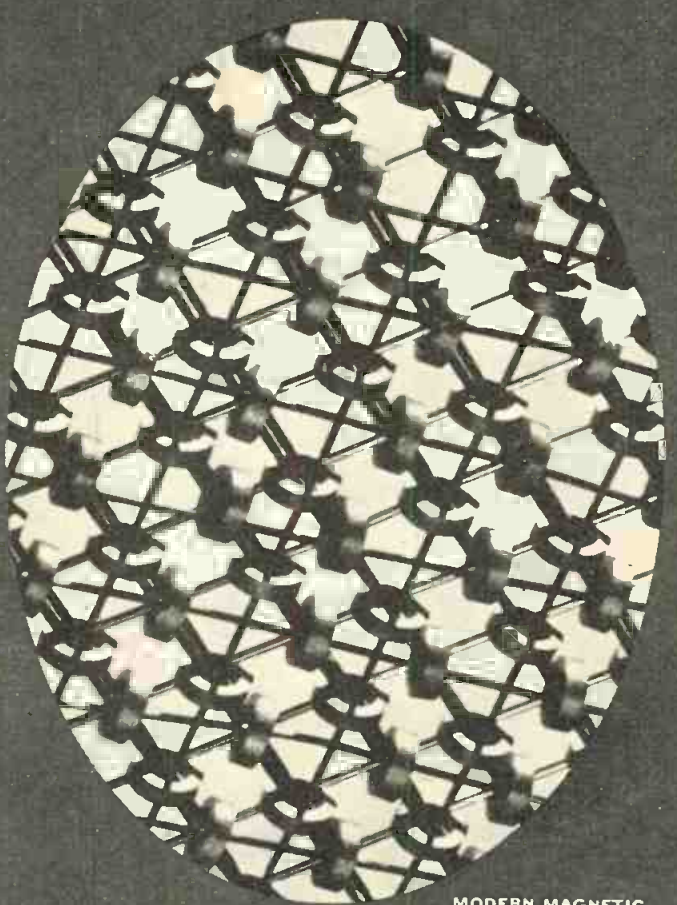

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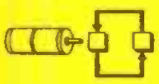
units for performing the functions of storage, control, and logic explained. Source 4/6-64

Principles and Application of Electronic Analogue Computers (Part 1), by P. Heggs. "El. Eng." Mar. 1956. 3 pp. Simple examples of types of analogs are given, together with a discussion of equipment employed. The process of scaling a problem is described and schematic diagrams given illustrating simple computer set-ups. Design considerations for universal analog computers are presented. Source 4/6-65

Digital-to-Analogue Conversion for Graphical Plotters, by M. Bain. "Auto. Con." Feb. 1956. 3 pp. Circuit design details of methods used to modify the input balance circuits of commercial analog type recorders from the conventional self-balancing potentiometer type to the self-balancing Wheatstone bridge. Source 4/6-261



CONTROLS

Fundamentals of Servomechanisms, Servo Series No. 1, by I. Ritow. "El. Mfg." Feb. 1956. 9 pp. Introduction to servos. Discussion of on-off and viscous-damped linear servos. Use in computers is cited. Source 4/6-66

Control in Manufacturing Processes, by J. de Ligny and A. Schaafsma. "Onde" Dec. 1955. 4 pp. Practical aspects of control in large scale manufacturing are treated. Admissible faulty production in % is correlated with the results of sample testing. Source 4/6-67

"Fail-Safe" Gets New Meaning, by W. Rowell and A. Van Rennes. "Con. Eng." Mar. 1956. 3 pp. A continuously oscillating self monitoring technique is used to safeguard control systems. Simple technique is applicable to almost all types of electrical, mechanical, and electronic systems. Source 4/6-68

Nonlinearity in Control Systems. Part II—Methods of Analysis and Synthesis, by R. Kochenberger. "Con. Eng." Mar. 1956. 10 pp. Designers are guided toward more effective and efficient synthesis by the application of correct techniques for analyzing non-linear control systems. A contactor servo problem is used as an illustration of some of these techniques. Source 4/6-69

Use Process Analogs to Prove a System, by R. Bradley. "Con. Eng." Mar. 1956. 1 p. Direct analogs of process lags of electronic control systems permit system study without computers. Source 4/6-70

Digital Methods in Control Systems, by D. Nettell. "El. Eng." Mar. 1956. 7 pp. Description of some of the mechanisms required in a digital control system and a discussion of their merits for various applications. The problem of superimposing digital control schemes on existing facilities is covered. Source 4/6-71

The Role of Response in Specifying Servo Drives, by I. Ritow. "El. Mfg." Mar. 1956. 6 pp. An explanation of how to pick motor ratings and gear ratios. A cut and try method is used, with the yardstick of success or failure being the response. Source 4/6-263

New Signal Handling Techniques Simplify Control Operations for Color TV, by I. Bosinoff, A. Luther, F. Millspaugh, and H. Potter. "BC News" Mar. 1956. 6 pp. Design and application of a processing amplifier which has both simplified and standardized control operations for color TV. Basic circuit elements are 3 plug-in video amplifiers which perform the functions of cable compensation, video amplification, blanking insertion, shading insertion, feedback clamping, linear clipping, gamma correction, and output amplification. Source 4/6-264

The Transfluxor, by J. Rajchman and A. Lo. "Proc. IRE" Mar. 1956. 12 pp. The transfluxor consists of a magnetic core with a nearly rectangular hysteresis loop and 2 or more apertures. It operates by the controlled transfer of flux from leg to leg of the core. Description and application of a representative 2 aperture transfluxor is given. Source 4/6-265

INDUSTRIAL ELECTRONICS

Sampling Procedure on Finished Chassis and Equipment, by H. Knapp and C. Hartmann. "J. IT&T" Dec. 1956. 8 pp. Sampling technique is used to control quality on production line assembly and wiring processes. Classification of defects and levels of acceptable quality are discussed. Paper work necessary for operation of the system is given. Source 4/6-72

The Use of Cold Cathode Counting Tubes for the Control of Resistance Welding, by T. Brady. "El. Eng." Feb. 1956. 5 pp. Two cold cathode counting tubes are used to count, respectively, the cycles of the 50 cycle supply for which the welding current is on and off. Circuit details are given and explained for seam and spot welding control. Source 4/6-73

Pulse Counting Photometer for Microspectroscopy, by W. Thornburg. "Rev. Sci." Feb. 1956. 4 pp. Description of a photometer for recording the absorption spectra of microscopic samples in the visible and ultraviolet regions. Pulsed output of a photomultiplier is counted to measure light intensities. Source 4/6-74

Phase-Shift Control of Thyratrons, by P. Chin and E. Moyer. "El. Mfg." Feb. 1956. 10 pp. This second article covers methods of producing a continuously variable phase shift of voltage, and L-R and R-C bridges, for grid control of thyratron firing. Source 4/6-75

Automatic Inspection of Magnetic-Sound Prints, by J. Stafford. "El." Mar. 1956. 4 pp. Audio signals of the master reproducer and the copying recorder are compared by use of a differential amplifier. Deviation above a desired level between master and copy gives a direct visual error indication. Source 4/6-76

Noncontacting Gages for Nonferrous Metals, by R. Colten. "El." Mar. 1956. 3 pp. Energy is passed through a strip of copper or aluminum and picked-up by a receiving electrode. The amount of energy absorbed by the metal is an indication of its thickness. Stray magnetic effects prevent the use of this system on ferrous materials. Source 4/6-78

Self-Balancing Magnetic Servo Amplifier, by W. Geyger. "El." Mar. 1956. 4 pp. Negative electric and positive magnetic feedback is used to improve single-stage magnetic amplifier performance. Unit has high response speed, linearity, stability, and freedom from drift. Source 4/6-79

Time Generator Gives Direct Readout, by W. Blair. "El." Mar. 1956. 4 pp. This device, producing coded signals to indicate the time over a 24 hour period, is used to apply time signals to magnetic recordings or charts. Signals are produced by an electronic code generator which consists of a series of multivibrators. Source 4/6-80

Sources of Standards, by S. Hubelbank. "El. Des." Feb. 15, 1956. 3 pp. Names, addresses, and activities in standardization are given for 14 organizations. Included are IRE, AIEE, ASESA, ASTM, RETMA, ASESA, and several military groups. Source 4/6-81

The Autosaturated Magnetic Amplifier, by B. Chague. "Bul. Fr. El." Jan. 1956. 43 pp. This is an extensive survey of the principle of operation as well as of the performance data obtained. Experimental studies are reported. Various industrial applications installed during the last 10 years are discussed. Source 4/6-82

Peculiar Corroding Effects on Precision Fuses, by A. Deman. "Nach. Z." Jan. 1956. 2 pp. It was noted that precision fuses are subject to serious corrosion damage. This damage is attributed to the formation of local Ag-Cd elements which cause a rise in the melting temperature. Source 4/6-83

The Phase Comparator, by J. Anderson. "El. Eng." Feb. 1956. 3 pp. The L/R ratio of a coil into which a metallic specimen is inserted is indicative of the elastic properties of the tested specimen, e.g. a spring. The phase comparator relies on this principle for routine quality control testing. Source 4/6-84

Fail-Safe Monitoring, by W. Rowell. "El. Des." Mar. 1, 1956. 4 pp. The technique described virtually eliminates any possibility of an operation failing without warning by periodically checking itself by means of a continuous modulation of the monitoring system. Source 4/6-266

New Plastics Molding Materials, by A. Javitz. "El. Mfg." Mar. 1956. 12 pp. Characteristics and applications of such materials as DAP resins, epoxy molding powders, glass-filled phenolics, glass-silicone compounds, arc-resistant phenolics, and many more. Source 4/6-267

Flexible Ferromagnetic Plastics Materials, by W. Davis. "El. Mfg." Mar. 1956. 3 pp. Properties and applications of these materials. Applications include delay lines, transformers, inductors, and electromagnetic shielding. Source 4/6-268

Low-Cost Process for Printed-Wiring Art Work, by D. Heitert. "El. Mfg." Feb. 1956. 3 pp. Elastomeric coating sprayed on specially treated mylar film is used as a base material for producing art work by a solvent etching method. Source 4/6-77

MATERIALS

Silicone Insulants (Part 1), by J. Hayden. "El. Eng." Feb. 1956. 6 pp. The properties of silicone fluids, silicone resins and silicone elastomers are reviewed and tabulated. The suitability of these substances for various applications is investigated. Source 4/6-86

Operating Characteristics of Plastic-Film Capacitors, by M. Rosenberg. "El. Eq." Feb. 1956. 2 pp. This article describes the use of polystyrene, Mylar, and Teflon as high dielectric films in capacitors. Examples of newly designed specific units are used to describe the advantages of these films. Source 4/6-87

Silicone Insulants, Their Properties and Applications, Part 2, by B. Hayward. "El. Eng." Mar. 1956. 5 pp. Properties and applications of silicone tape, glasscloth, laminates, varnish, rubber, insulated wire, fluids, etc. The outstanding feature of silicones are their good dielectric properties over a wide temperature range. Source 4/6-90

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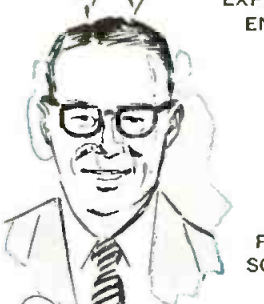

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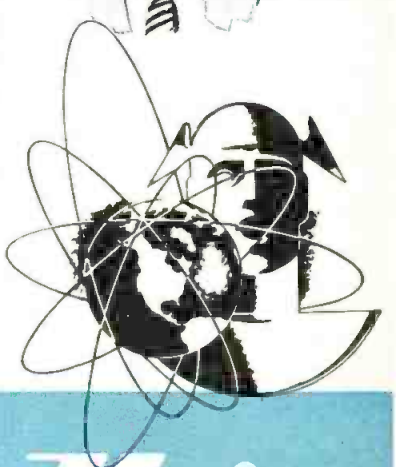

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MEASURING & TESTING

New Apparatus for Establishing the Statistical Distribution of Irregular Electrical Incidents, by J. Grosskopf, K. Kappelhoff, and G. Kopte. "Nach. Z." Jan. 1956. 6 pp. Four apparatus for the automatic statistical evaluation of electrical signal intensities, such as emitted by a radio transmitter, are described. Essentially, either the integrated time interval during which each signal intensity occurs, the intensity range being subdivided into suitable steps, is recorded, or, in another instrument, the integrated time interval for a selected signal intensity range. The two other instruments evaluate graphs. Source 4/6-91

The Frequency Spectrum Analyzer, by H. Fleischer and H. Widdra. "Nach. Z." Jan. 1956. 8 pp. The analyzer was designed for the registration of radio transmitter signals. It is connected to any standard receiver which it automatically tunes to successive stations while a pencil registers the frequency spectrum on a moving wax paper. Frequency, field strength, band width, operating time, type of transmission and frequency shift of the received signal can be read from the diagram thus obtained. Source 4/6-92

Peak Pulse Brightness Photometer, by L. Wijnberg. "Rev. Sci." Feb. 1956. 2½ pp. Unit measures brightness peak of light flashes 0.3 μsec. in duration and 10^{-3} sq. in. in cross-sectional area. Output meter is fully deflected by a transient for 5 seconds. Source 4/6-93

The Recording of High-Speed Single Stroke Electrical Transients (Part 2), by D. Hardy, B. Jackson and R. Feinberg. "El. Eng." Feb. 1956. 5 pp. This survey is concerned with spark-gap, gas-filled tube, and vacuum tube time base generators, various trigger circuits, brightening pulse generators, potential dividers and wide-band amplifiers. A section on photographic technique is included. Source 4/6-94

Magnetic Recording of Electrical Pulses, by R. Ofengenden. "Radiotek." Nov. 1955. 16 pp. Calculation is made of the magnetic flux in the reproducing head when recording a unit pulse. Formulas are given for determining the response time (reproducing head current as a function of the rate of motion of the recording medium), resolving power, and the amplitude of the reproduced pulses for non-contact recording. Experimental results are given for the dependence of the resolving power and pulse amplitude upon mode of recording, magnitude of the lead gap of the head, the clearance between the recording medium and the head, the conditicn of the recording medium. The passage of the reproduced pulses through linear circuits is examined. Source 4/6-95

Automatic Plotter for Waveguide Impedance, by H. Bachman. "El." Mar. 1956. 4 pp. An X-band sweep oscillator, display and control circuits, and a waveguide impedance meter are used to measure impedance automatically from 8.5 to 9.6 mc. Accuracy is 2.5% and 2° for magnitude and phase of the reflection coefficient. Source 4/6-96

Aeroloscope Counts Particles in Gas, by E. Gordon, D. Maxwell, Jr., and N. Alexander. "El." Mar. 1956. 5 pp. Counting is accomplished by receiving on a phototube light energy scattered by particles intercepting a high intensity light beam. Unit classifies particles from 1 to 64 microns in diameter into 12 size groups. Aerosols of concentrations up to 10^4 particles/cc are accepted. Source 4/6-97

A Method for Increasing the Precision of Frequency Analyzers of the Cathode-Ray Indicator Type, by N. F. Vollerner. "Radiotek." Dec. 1955. 3 pp. The article examines a circuit for increasing the precision of cathode-ray indicator frequency analyzers, which results in greater precision because it eliminates frequency scale errors. Source 4/6-99

On the Measurement of the Magnetic Permeability of Metals by Means of Cavity Resonators and the Permeability of Iron in the Region of Ferromagnetic Resonance, by K. Reich. "Freq." Jan. 1956. 9 pp. (Cont. from Dec. 1955.) It is concluded that the reversible permeability of iron in the region of ferromagnetic resonance is independent of the chemical purity, of temperature between 20°C and 200°C and of the orientation of the particles in the magnetic field; it depends strongly on the roughness of the sample surface and the parallel arrangement of the crystal axes. Source 4/6-101

Dynamic Measurements—A Necessity in the Development of High Speed Telephone Systems, by A. Olsson and N. Akesson. "Eric. Rev." No. 3, 1955. 6 pp. A cathode ray oscillograph with 2 dualbeam CRT's is used to analyze dynamic processes, such as contact action, fluctuations of magnetic flux, and crossbar switch action. Source 4/6-102

A Radio Interference Measuring Set Using Point-Contact Transistors, by J. Barry. "El. Eng." Feb. 1956. 5 pp. The set (sensitivity: 1μV in 75 ohms or 15μV in 15K) line timebase of a TV receiver situated in the long-wave broadcast band, is essentially a calibrated superheterodyne receiver operating from 160 kc to 285 kc. Source 4/6-104

Measuring Capacitor Temperature Coefficients, by J. Peyssou and J. Ladefroux. "Tele-Tech" Apr. 1956. 4 pp. Automatic production machine for measuring the TC of precision ceramic capacitors features an operating speed of 1 measurement every 40 seconds. Coefficient accuracy is 2 parts/million; direct capacitance measurement is exact within 0.0038 $\mu\mu$f. Analog computer in bridge circuit is used to provide direct readings. Source 4/6-269

Production Line Cathode-Ray Tube Tester, by W. Treitel and S. Nozick. "Tele-Tech" Apr. 1956. 4 pp. Developed by the military, this tester permits unskilled personnel to completely check all types of CRT's in 50 seconds, including high impedance shorts, gas, focus, cut-off, and emission. Source 4/6-270

Measuring Microwave Impedance With the Reflectometer, by N. Pappas. "Tele-Tech" Apr. 1956. 3 pp. Practical reflectometer permits rapid measurements of reflection coefficient of r-f lines by separation of incident and reflected waves and formation of their ratio. Bandwidth is limited only by the bandwidth of its components. Sweep frequency oscillator permits rapid assimilation of data as a function of frequency. Source 4/6-271

RADAR, NAVIGATION

Navigation Utilizing the Doppler Effect, by L. Hill. "El. & Comm." Jan.-Feb. 1956. 2 pp. A review of the theory and application of the Doppler effect to navigation systems. Source 4/6-272

A Shore-Based Radar, by A. Leconte. "Onde" Dec. 1955. 6 pp. The essential operating characteristics of different stations: Le Havre (Raytheon); Long Beach (Sperry Mark II); Liverpool (Sperry Cossor); Southampton (Decca type 31); Ymuiden (NV Philips) are tabulated. A detailed description of the Dunkirk Harbor installation is presented. Source 4/6-105

Prediction of Pulse Radar Techniques, by W. Hall. "Proc. IRE" Feb. 1956. 8 pp. Simple method of calculating the range performance of a pulse radar leads to more consistent results than do other commonly used methods. Graphs are given which simplify the procedure. Source 4/6-106

Radar Warning Net Uses Centralized Control, by J. Lombardo. "El." Mar. 1056. 3 pp. Dependence on interpretation of radar tracks by individual operators is eliminated by a centralized computer station which, under the orders of the weapons officer, directs intercepting missiles or aircraft to unidentified tracks. System is called SAGE for Semi-Automatic Ground Environment. Source 4/6-107

Improve Radar Operation in Stormy Weather, by W. Offutt. "El. Eq." Feb. 1956. 3 pp. Clutter caused by rain, snow, and large cloud formations is suppressed on a radar viewing screen by the use of circular polarization of the radar antenna. Source 4/6-108

SEMICONDUCTORS

Transistorizing Meacham-Bridge Oscillators, by S. Witt. "El." Mar. 1956. 3 pp. Meacham oscillators provide good long and short time frequency stability at 1 mc, using both junction and point-contact transistors. Source 4/6-109

Industrial SCd Photoresistances, by M. Tabres. "Bul. Fr. El." Jan. 1956. 10 pp. The method of manufacture of photoelectric cells using SCd layers evaporated onto an insulating carrier is set forth and their characteristics described and illustrated. Applications are listed. Source 4/6-111

High-Speed Counter Uses Surface-Barrier Transistor, by E. Gott. "El." Mar. 1956. 5 pp. A 6 mc reversible binary counter is designed using surface-barrier transistors. Unit measures the pulse count variation of successive groups of pulses. Source 4/6-114

Transistorized Regulated Power Supplies, by H. Lowry. "El. Des." Feb. 15, 1956. 3 pp. Shunt, feedback, and emitter type voltage regulator circuits are designed using transistors. This article (Part 1) deals with the first 2 types. Source 4/6-115

A Comparison of the Theories of Vacuum Tube and Transistor Amplifiers, and the Possibilities of Their Generalization, by A. Kulikovsky. "Radiotek." Nov. 1955. 9 pp. The basic precepts of the theories of vacuum tube and transistor amplifiers are contrasted. Generalized circuits are derived and analyzed. Expressions are derived for input admittance, output admittance and transconductance. Typical values are calculated for point contact and plane transistors. Source 4/6-116

Predetermined Scaler Utilizes Transistors and Magnetic Cores, by R. Van Nice and R. Lyman. "El. Eq." Feb. 1956. 5 pp. Predetermined scaler is developed utilizing adjustable "subtracters" and fixed decade scalers. Junction transistors and square loop magnetic cores are used. Source 4/6-117

Junction Transistor—Amplifier Tube, a Comparison, by G. Ledig. "Arc. El. Uber." Jan. 1956. 9 pp. Matrix representation is used to compare the four terminal networks corresponding to a junction transistor and to an amplifier tube. A number of conventional circuits are studied and compared.

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Sincerely
Jack

Extensive tables contain the pertinent data describing the linear behavior of these circuits. Source 4/6-118

The Concept of the Hole in Semiconductors, by J. Salpeter. "Proc. AIRE" Dec. 1955. 16 pp. Transmission line and wave filter analogy is used to explain the hole in semiconductors. Source 4/6-119

Analysis of I-F Transistor Amplifiers, by E. Pumper and E. Petrov. "Radiotek." Dec. 1955. 12 pp. The article analyzes several circuits for tuned amplifiers incorporating matched point-contact transistors. The particular features of the engineering design of such systems are compared to the design of vacuum tube amplifiers. The analysis includes: (1) An amplifier with a single tuned circuit; (2) An amplifier with a band-pass filter; (3) A band-pass filter with parallel and series tuned circuits; (4) Comparison and numerical evaluation of the investigated circuits. Source 4/6-120

The Transistor Amplifier, Editorial. "Wirel. Eng." Feb. 1956. 2 pp. The effect of an emitter resistor on the current amplification of a transistor circuit is investigated. It is concluced that such a resistor should be bypassed unless the source impedance of the base circuit can be made sufficiently high. Source 4/6-121

A Silicon Junction Diode Modulator for Use in Junction Transistor Direct-Current Amplifiers, by N. Moody. "El. Eng." Mar. 1956. 7 pp. Silicon diode properties are evaluated in relation to a selected modulator circuit of the ring bridge type. Under the correct conditions, the modulator can convert dc to ac over a range from audio to at least 100 kc. Source 4/6-122

Transistorized Regulated Power Supplies-II, by H. Lowry. "El. Des." Mar. 1, 1956. 4 pp. The emitter-follower type regulator, discussed in this article, has the advantage that the output voltage is not limited by the transistor's voltage rating. Regulation is excellent. Source 4/6-273

Simple Theory of the Junction Transistor, by F. Stieltjes and L. Tummers. "Phil. Tech." Mar. 1956. 13 pp. The theory of the junction transistor is developed in terms of holes, electrons, and diffusion currents. Common base and common emitter circuits are discussed in terms of transistor parameters. Source 4/6-274

High-Gain Transistor Magnetic Amplifier, by E. Stuhlinger, J. Taylor, and D. Anderson. "El. Mfg." Mar. 1956. 4 pp. Circuit used in velocity and zero-velocity error type servo systems has power gain of 10^6 to 10^8 and response time of approximately 1 cycle. Two-stage transistor section is used, with silicon diode discriminator and push-pull magnetic amplifier utilizing selenium rectifiers. Source 4/6-275

Junction Transistors with Alpha Greater than Unity, by H. Schenkel and H. Statz. "Proc. IRE" Mar. 1956. 12 pp. Description of charge-carrier multiplication, avalanche breakdown, and the effect of alpha greater than one in junction transistors. The effects of transistor parameters on circuit performance is given. Source 4/6-276

TELEVISION

Equalization of the Envelope delay in TV Systems, by D. Buenemann. "Arc. El. Uber." Jan. 1956. 9 pp. A graphical method to produce a substantially linear phase shift over the TV frequency band is suggested. This method relies on a series of plotted phase-shift filter characteristics, the filters introducing no attenuation, which are graphically added to the existing phase shift by a trial and error method. Source 4/6-123

TV Receiver with Linear Phase Characteristic, by A. Van Weel. "Onde" Jan. 1956. 9 pp. The schematic circuit diagram of a TV receiver having a 5-stage linear phase shift i-f section is given. Graphs indicate that the selectivity of this simple receiver equals that of an i-f phase-shift compensated receiver, while the picture quality is superior. Source 4/6-124

Compatible Color-Television, Part 2—Comparison of Two Sub-Carrier and N.T.S.C. System, by J. Haantjes and K. Teer. "Wirel. Eng." Feb. 1956. 8 pp. The comparison relates to the effects on the received picture (brightness, color hue and saturation) of various signal distortions, signal-to-noise ratio, and receiver requirements. Source 4/6-126

Microwave Television Radio Relay System, by O. Appelt, K. Christ, and K. Schmid. "J. IT&T" Dec. 1955. 7 pp. Principles covering the design of microwave relay stations used to link TV transmitters in 3 German cities are summarized and brief outlines given of the equipment features and of measuring techniques. Source 4/6-127

Color Television Receiver Design-A Review of Current Practice, by R. Clapp, E. Clark, G. Howitt, H. Beste, E. Sanford, M. Pyle, and R. Farber. "Proc. IRE" Mar. 1956. 25 pp. This review of current practice in color receiver design covers the most common circuits used in commercial receivers. Further circuit standardization is clearly indicated and may be predicted through the next year. It may also be expected that the wide usage of color receivers may revise present performance requirements and in turn introduce circuit modifications. Source 4/6-277

Spurious Emission Filter Design, by W. Judge. "Tele-Tech" Apr. 1956. 6 pp. Step by step design of a high power spurious emission TV transmitting filter is outlined and experimentally verified. Included are 25 kw channels 2-13, 50 kw channels 7-13, and 12.5 kw channels 14-83 low pass filters. Image parameter design with constant-k and m-derived (series and shunt) is used throughout. Source 4/6-278

TRANSMISSION LINES

Physical Problems Encountered in Wide-Band Transmission Systems, by J. Fagot. "Onde" Jan. 1956. 16 pp. The general concepts relating to any wide band transmission system, e.g., TV channels or telephone multiplexing, are developed. The distorting effects, such as dispersion, introduced during the transmission in the repeater stations, feeders, and guides are pointed out. Source 4/6-129

New Diagram for Solving Impedance Transformations, by R. Guill. "Onde" Dec. 1955. 7 pp. The graphical method presented plots the complex logarithm of the reflecting power of a line. This method is held to be superior to the Smith diagram, simplifying the operations involved and providing a large scale representation of the impedances near the characteristic impedance. Source 4/6-130

Carrier-Frequency Equipment for Cables, Overhead Lines and Radio Transmission, by H. Hannemann and H. Piechatzek. "Nach. Z." Jan. 1956. 9 pp. The various possibilities of transmitting telephone messages are investigated with a view to meet the CCIF requirements The equipment necessary for each type of transmission is discussed. Source 4/6-131

Impedance Matching of a Loaded Reactance Having a Resonant Characteristic, by J. Kornfeld. "El. Rund." Feb. 1956. 4 pp. The impedance matching over a required frequency band is studied with reference to a bolometer terminating a shorted transmission line. Calculations for one or two matching-stub lengths are presented. Source 4/6-128

TUBES

Bihelical Traveling-Wave Tube with 50-Decibel Gain at 4000 Megacycles, by W. Klein. "J. IT&T" Dec. 1955. 8 pp. In microwave relay installations using traveling-wave tubes, 2 tubes in cascade are ordinarily used to obtain the necessary 5 w. of power for transmission. The 50 db gain obtained from using a single tube (described) results in a savings in weight, space, and power, with an increase in reliability. Source 4/6-134

Impedance-Frequency Characteristics of some Glow Discharge Tubes, by F. Benson and G. Mayo. "El. Eng." Mar. 1956. 3 pp. The impedances of the 8 glow discharge, voltage regulator tubes tested increase considerably with frequency, while the inductance-frequency curves show a pronounced maximum at low frequencies. The kind of gas used is an important factor in determining the shape of the impedance-frequency characteristic of a tube. Source 4/6-135

Reliable Application of a Tunable Pulsed Magnetron, Part II, by J. Gerling and R. Krogh. "El. Eq." Feb. 1956. 4 pp. The effect upon reliability of the output system to which the magnetron delivers its power. Cooling, pressure, duty cycle, ambient temperature, etc. are covered. Source 4/6-136

Design of a Gas Tube Voltage Stabilizer, by G. Wechsler. "Radiotek." Dec. 1955. 8 pp. Stabilizer design analysis is given in which the following quantities are interrelated: The integral stabilization coefficient of the circuit, the ignition voltage of the voltage regulator tube, its nominal current, the input voltage, and the efficiency of the stabilizer. The maximum and minimum values possible for the integral stabilization coefficient are established for each of the voltage regulator tubes used. Source 4/6-137

Glow-Discharge Tubes—Initial Drift and Running-Voltage/Temperature Characteristics, by F. Benson and L. Bental. "Wirel. Eng." Feb. 1956. 6 pp. A series of measurements indicates that the influence of gas pressure and tube dimensions on the temperature coefficient is negligible and that the operating-voltage/temperature characteristic depends on the cathode material and the gas filling of the tube. Source 4/6-138

The Effect of Space-Charge Capacitance and Non-Linearity of the Tube Characteristic Upon Oscillator Frequency, by G. T. Shitikov. "Radiotek." Dec. 1955. 17 pp. The author examines the reasons for the fact that supply voltages affect oscillator frequency over a wide range of frequencies. It is proven that the capacitance created by the space-charge of the tube is the main unstabilizing factor in the meter-wave and short-wave regions. Methods are indicated for decreasing the unstabilizing influence of the supply voltages under conditions of optimum coupling between the tube and the tank circuit. Design formulas are derived, and experimental material coinciding closely with the design data is cited. Source 4/6-140

Concerning the Calculation of the Amplitude Characteristics of Limiters, by Y. Tsypkin. "Radiotek." Dec. 1955. 4 pp. The amplitude characteristic of a limiter is directly expressed as a function of the dyna-

mic characteristic of the tube. This simplifies the calculations and establishes a relationship between the properties of these characteristics. Source 4/6-141

Design Information on Large-Signal Traveling-Wave Amplifiers, by J. Rowe. "Proc. IRE" Feb. 1956. 11 pp. Large-signal TW amplifier equations have been solved and the results presented for a wide range of the TWA parameters. Source 4/6-142

The Ultra High-Frequency Measuring Diode EA 52, by H. Stietzel. "El. Rund." Feb. 1956. 3 pp. The structural details of the EA 52 disc-type diode rectifiers for frequencies up to 1000 mc are given. Operating characteristics are presented. Source 4/6-143

Disc-Seal Circuit Techniques. Part 2-Microwave Disc-Seal Oscillators, by J. Swift "J. BIRE" Feb. 1956. 17 pp. A simple, basic oscillator circuit is discussed and various design problems covered. Subjects covered which are important in both oscillator and amplifier design are: tuning devices for resonators, electronic efficiency, r-f by-pass elements, tuning curves, and dc circuit requirements. Source 4/6-280

The O-Type Carcinotron Tube, by P. Palluel and A. Goldberger. "Proc. IRE" Mar. 1956. 13 pp. O-type Carcinotrons are backward wave oscillators particularly suitable in applications requiring a tube with a very wide electronic tuning range and moderate power output. A survey of backward-wave operation is covered and design and performance data given for a series of tubes now in production. Source 4/6-281

IRE Standards on Electron Devices: Definitions of Terms Related to Microwave Tubes (Klystrons, Magnetrons, and Traveling Wave Tubes), 1956, by the committee. "Proc. IRE" Mar. 1956. 5 pp. Glossary of approximately 75 terms dealing with microwave tubes. Source 4/6-282

Care and Feeding of the Image Orthicon, by R. Smith. "Tele-Tech" Apr. 1956. 4 pp. TV camera tubes are extremely sensitive and not possessed of an extremely long life. Proper handling and maintenance of these delicate tubes is described. Source 4/6-283

A-C Plus D-C Grid Control of Thyratrons, by P. Chin and E. Moyer. "El. Mfg." Mar. 1956. 8 pp. Grid phase control is accomplished by using continuously adjustable dc in series with a fixed-phase-shifted ac. A number of methods, complete with schematics, are described. Source 4/6-284

U. S. GOVERNMENT

Research reports designated (LC) after the price are available from the Library of Congress. They are photostat (pho) or microfilm (mic), as indicated by the notation preceding the price. Prepayment is required. Use complete title and PB number of each report ordered. Make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress, Photoduplication Service, Publications Board Service, Washington 25, D. C.

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Interaction of Microwaves in Gaseous Discharge Plasmas: Application to the Fundamental Processes in Gases (PB 119110), by J. Anderson and L. Goldstein, Eng'g. Experiment Station, Urbana, Ill. Aug. 1955. 169 pp. Mic $7.80, pho $25.80. (LC) Interaction between microwaves simultaneously propagated through gaseous discharge plasmas, based upon a theory proposed for the similar phenomena of radio wave action in the ionosphere (the "Luxembourg Effect"), is experimentally observed. Source 4/6-144

Recording Radar Signals at Intermediate Frequencies (PB 119143), by J. Ahearn and J. Headrick, NRL. Aug. 1955. 16 pp. Mic $2.40, pho $3.30. (LC) Design and construction of a system that records both transmitted and received radar pulses at an i-f of 30 mc over a bandwidth of 18 mc. Pulse lengths of ¼ to 1μ sec. are accommodated. Each echo pulse is identified with the particular transmitted pulse that was its origin. Source 4/6-148

Research on Hollow Dense Electron Beams (PB 119118), by L. Harris, Minnesota U. Sep. 1955. 53 pp. Mic $3.60, pho $9.30. (LC) Research on the problem of producing and focusing hollow dense electron beams. Some properties of magnetically shielded systems are derived, and a design method for a toroidal electron gun to act as a beam source is outlined. Behavior of hollow beams in radial electrostatic fields is summarized. Source 4/6-149.

Solid Delay Line Developments for Ground Radar Equipment (PB 119001), by A. Feiner, USAF. Aug. 1955. 19 pp. Mic $2.40, pho $3.30. (LC) Developments in the field of solid delay lines for moving target indication. Also included are the advantages of solid delay lines over mercury delay lines, a discussion of the origin of spurious responses in a solid delay line, and future plans for development in this field. Source 4/6-150

Theory of the Supersonic Delay Line (PB 119089), by V. Hughes, MIT. Sep. 1945. 69 pp. Mic $3.90, enl. pr. $12.30 (LC) Gives the equivalent circuit of the transmitter and receiver crystals and develops 2 theories of the wave pattern in the propagating medium. These theories are applied to the determination of the proper size of the receiver crystal, an estimation of the spreading of radiated energy, a computation of how the output voltage will vary as delay time is varied, and a computation of the loss in output voltage due to wave pattern. Source 4/6-151

Antenna Scanning Problems in Radio Astronomy (PB 118991), by R. Spencer, USAF. Sep. 1955. 42 pp. Mic $3.30, pho $7.80. (LC) Antenna design for radio astronomy is approached from 2 viewpoints: the amplitude diffraction pattern and aperature amplitude illumination are a pair of Fourier transforms; and the antenna is a transducer between object and image and acts as a bandpass filter for the spatial frequencies in the object. Source 4/6-152

Research in Physical Electronics. Quarterly Report No. 11, for the Period 15 Mar. 1955 to June 1955 Under Contract AF 19(604)-524 (PB 118863), by H. von Foerster and L. Goldstein, Eng'g. Experiment Station, Urbana, Ill. July 1955. 67 pp. Mic $3.90, pho $10.80. (LC) High speed oscillography and microtime analysis, and gaseous electronics. Subjects include: TW tubes, secondary electron multipactor, circularly deflected beam analyzer, wave propagation in ionized media, interaction of electromagnetic waves, and magneto electron resonance phenomena. Source 4/6-170

Precision Magnetic Field Regulation Using Nuclear Magnetic Resonance (PB 118698), by F. Hadden, MIT. Dec. 1950. 222 pp. Mic $9.90, pho $34.80. (LC) Nuclear magnetic resonance as an element in feedback control systems to regulate magnetic fields. Block and schematic diagrams are given. Source 4/6-165

Frequency Characteristics of Acousto-Electrochemical Effects: The Electrokinetic and Polarized Gas Electrode Effects (PB 119052), by F. Saunders, E. Yeager, and F. Hovorka, Western Reserve U. Sep. 1953. 63 pp. Mic $3.90, enl. pr. $12.30 (LC) Topics include: Research in Ultrasonics; Effect of Supersonic Waves on Hydrogen Electrodes; Thermodynamics of Supersonic Waves; and Electrochemical Effects on High Frequency Sound. Source 4/6-168

Effect on Surface Conditions on Characteristic of Rectifier Junctions (PB 118808), by N. Holonyak, Jr., Eng'g. Experiment Station, Urbana, Ill. Dec. 1954. 76 pp. Mic $4.50, pho $12.30. (LC) Junction fabrication, characteristics, and geometry. Theory of junction voltage and current. Source 4/6-173

Exact Treatment of Antenna Current Wave Reflection at the End of a Tube-Shaped Cylindrical Antenna (PB 118719), by E. Hallen, Cal. Tech. Mar. 1955. 42 pp. Mic $3.30, pho $7.80. (LC) Current distribution, electromagnetic field, theory of reflectors, and mathematical equations and solutions for cylindrical antennas. Source 4/6-174

Network Synthesis by Impulse Response for Specified Input and Output in the Time Domain (PB 118805), by F. Hil, MIT. July 1953. 67 pp. Mic $3.90, pho $10.80. (LC) Electrical network synthesis, theory of pulse forming, and time study. Source 4/6-218

On the Theory of Junction Transistors (PB 118889), by R. Middlebrook, Stanford U. Dec. 1954. 145 pp. Mic $7.20, pho $22.80. (LC) Qualitative physical principles and first order mathematical theory of junction transistors. Source 4/6-175

Computing Machine Components Program. Eighth Quarterly Progress Report for Apr-June 1954 (PB 118715), NOL. Apr. 1955. 36 pp. Mic $3.00, pho $6.30. (LC) Work done on magnetic film research, ferroelectrics (including barium titanate), h-f circuitry, and ferromagnetic resonance. Source 4/6-176

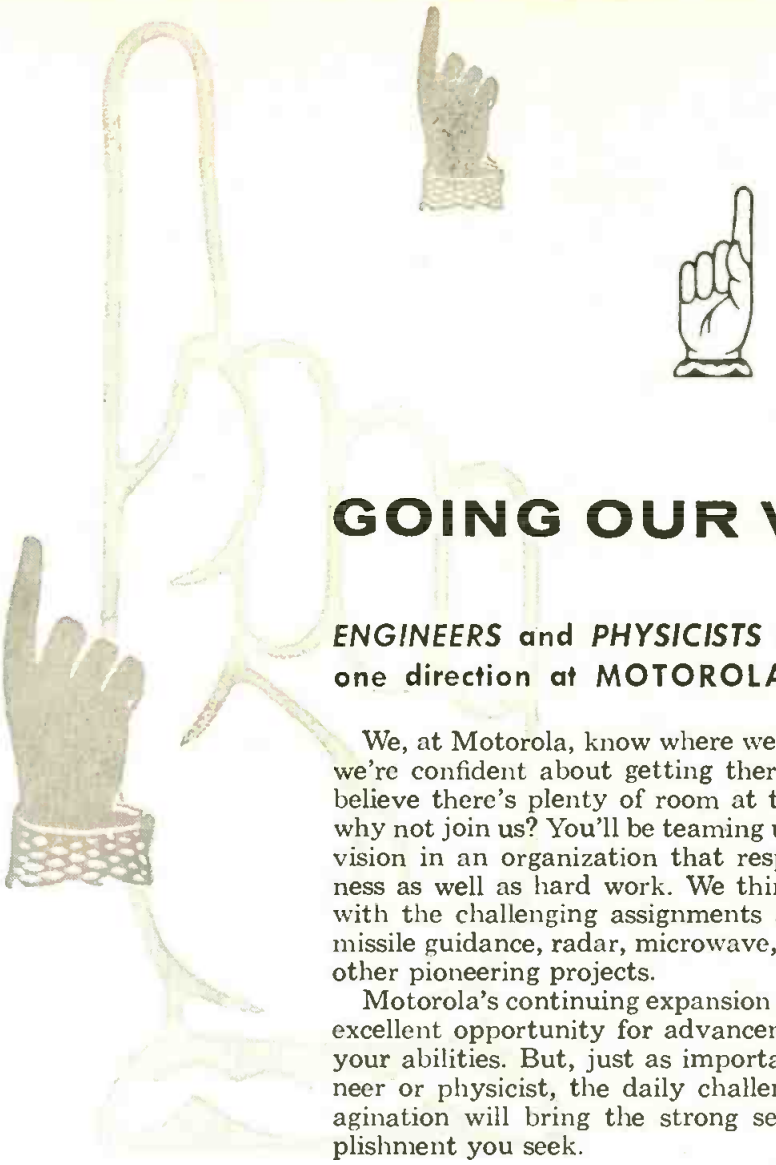
Transatlantic Frequency-Modulation Experiments (PB 118806), by L. Arguimbau, J. Granlund, E. Manna, and C. Stutt, MIT. Sep. 1954. 51 pp. Mic $3.60, pho $9.30. (LC) An investigation of the possibility of establishing a radio link of local broadcast quality over an ionospheric path by using a special FM receiver designed to combat 2-signal and 2-path interference. A frequency shift modulation system is also described. Source 4/6-177

Computer Components Fellowship No. 347. Quarterly Report No. 7, Second Series, Apr. 1, 1955 to June 30, 1955 Under Contract CLMAF19/604/-943 (PB 118861) Mellon Institute. Aug. 1955. 83 pp. Mic. $4.80, pho $13.80. (LC) Printed Circuits: Circuit Fabrication via Vacuum Evaporation; High Temperature Resistors; Surface Measurements. Electroluminescence: Thermoluminescence Measurements; Dielectric Imbedded Phosphor Films; Chemically Deposited Films. Source 4/6-178

Experimental Investigation of Factors Involved in Sonic Listening (PB 118987), by R. Maninger, Columbia U. Feb. 1945. 34 pp. Mic $3, pho $6.30. (LC) Analysis, detection, and measurement of underwater sound. Hydrophone tests and Sonar listening devices are covered. Source 4/6-179

Magnetic Particle Clutch and its Application to Servomechanisms (PB 111782), by W. Jones, NRL. Nov. 1955. 24 pp. 75¢. (OTS) In a unique application of clutches as the prime mover in a servomechanism, it was found that the clutch shows advantages over a servo motor of comparable rating because the control power is smaller, the torque is linear with control current, and time of response can be made shorter than that of a servo motor. Source 4/6-180

Full-Wave Reversible-Polarity Half-Cycle-Response Magnetic Amplifiers (PB 111747),



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by C. House, NRL. June 1955. 32 pp. $1. (OTS) A full-wave magnetic-amplifier which gives an output that is reversible in polarity or phase is presented in detail. Some considerations of the circuit as a suppressed-carrier modulator are presented with waveform shapes and fidelity characteristics. Source 4/6-181

Broadband Dual-Mode Circular Waveguide Transducer (PB 111790), by R. Tompkins, NRL. Nov. 1955. 8 pp. 50¢. (OTS) Transducer is designed to couple 2 orthogonal TE^{11} circular waveguide modes to separate rectangular ports. Junction has application to mode multiplexing, circular waveguide ferrite devices, circular polarization, and as a circular waveguide magic-T. Source 4/6-182

Active Filter (PB 111787), by G. Jensen and J. McGeogh, NRL. Nov. 1955. 10 pp. 50¢. (OTS) Active filters have been operated at 100 kc, 1 mc, and 10.5 mc. Filter can extract a cw signal buried 37 db below noise level. Source 4/6-183

On the Mechanics of Magnetic Amplifier Operation, NRL. Jan. 1951. 28 pp. 75¢. (OTS) An elementary quasi-mechanical approach is used to demonstrate a new theory of magnetic amplifier operation to known circuits. New circuits predicted by this theory are demonstrated and found to have characteristics far superior to those of other magnetic amplifier circuits. Source 4/6-185

Analysis and Design of R-C Phase Shift Oscillator Networks, NRL. June 1950. 120 pp. $3. (OTS) Harmonic content, frequency deviation, and frequency stability in R-C phase-shift oscillators are investigated by means of general equations derived from 3 and 4 section network types. Design curves are given for obtaining optimum values of these characteristics. Source 4/6-186

Evaluation of the Rho/Theta Transponder System (PB 111776), by D. Crippen, J. Herman, and M. Yost, CAA. June 1955. 89 pp. $2.25. (OTS) Transponder design, transponder radar beacons, and Rho/Theta Transponder including S-Band-reply airborne equipment. Source 4/6-188

Optical and Photoconductive Properties of Silicon and Germanium (PB 111748), by E. Burstein, G. Picus, and N. Sclar, NRL. July 1955. 46 pp. $1.25. (OTS) Discussion of (a) those properties which are intrinsic to the elemental semiconductor; and (b) those which are due to impurities in the lattice. The addition of impurities is shown to have an important effect on the electrical and optical properties of these materials. Energy levels, photoresponse, and practical considerations relating to the use of photoconductors is given. Source 4/6-190

Frequency Divider From 100 kc to 60 cps (PB 118964), by D. Makow. July 1955. 19 pp. Order from National Research Council of Canada, Ottawa, Canada. 25¢. Description of a chain of frequency dividers from 100 kc to 60 cps employing regenerative modulation. Source 4/6-191

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D.C.

Frequency System, #2,735,001. Inv. R. Witters. Assigned Collins Radio. Iss. Feb. 14, 1956. Circuit for removing AM from a combined AM-FM signal consists of first and second mixers, both using the same local oscillator, a third mixer with its associated local oscillator, and a fourth mixer. The input signal goes into the first and third mixers: the output of the third mixer is filtered and enters the second mixer, whose output is also filtered and sent into the fourth mixer which also receives the output of the first mixer. Source 4/6-192

Sync Separator and AGC Circuits for TV Receivers, #2,735,002. Inv. E. Keizer and M. Kroger. Assigned RCA. Iss. Feb. 14, 1956. In a receiver adapted to receive and demodulate signals which include a recurrent pulse component, AGC is used to control amplifier gain in such a direction as to maintain a given level differential between the synchronizing pulse tips and the limiting level. Source 4/6-193

Receiver for Multiplex Signals, #2,735,003. Inv. H. Peterson. Assigned RCA. Iss. Feb. 14, 1956. In a receiver of carrier that is amplitude modulated by one signal and frequency shift keyed by another signal, the upper and lower AM sidebands are separated from each other and from the carrier and combined in a common output circuit for utilization as one signal. The separated carrier is applied to a frequency shift receiving circuit. Source 4/6-194

Disabling Circuit, #2,735,012. Inv. W. Werth and R. Miedke. Assigned Collins Radio. Iss. Feb. 14, 1956. In a frequency divider of the harmonic oscillator type, a disabling tube, in series with the grid resistor of the divider tube, is made to conduct when the input oscillator fails, throwing part of the supply voltage across the grid resistor. Source 4/6-195

Apparatus for Rapid Measurement of Real and Imaginary Parts of Admittance or Impedance, #2,735,064. Inv. B. Salzberg. Iss. Feb. 14, 1956. A voltage independent of the network under test and another voltage whose phase and amplitude are dependent upon the network under test are fed into a non-linear heterodyne mixer, producing a dc voltage related to the real component of the network. The phase relationship between the first and second voltages is then shifted 90° and fed into a second nonlinear mixer to obtain a voltage related to the imaginary component of the network. Source 4/6-196

Filter Circuit for Remote Control Installation, #2,734,173. Inv. G. Zug. Assigned Landis & Gyr, A. G. Iss. Feb. 7, 1956. Equations are given for filter circuits which pass audio frequencies with minimum attenuation in either direction and maintains electrical separation of power circuits at power frequency. The 3 passive filter circuits are used to maintain audio frequency communication between 2 power circuits which must be kept separate because of phase, frequency, or potential differences. Source 4/6-200

Galvanometric Device and Circuit, #2,734,166. Inv. D. Hooker. Assigned R. T. Moloney. Iss. Feb. 7, 1956. Resistance changes in a test set-up are indicated by placing the galvanometer deflection coil in the plate circuit of a triode and using the changes in resistance to change the voltage applied to the tube. This gives a deflection on the meter indicitive of the resistance change. Source 4/6-202

Signal Responsive Circuit, #2,734,134. Inv. A. Beard. Assigned RCA. Iss. Feb. 7, 1956. In a pentagrid converter, screen grid draws substantially zero current with cutoff voltage applied to first control grid, current of intermediate magnitude with a tube conductive voltage applied to both control grids, and current of high magnitude with conductive voltage applied to first grid and cutoff voltage applied to second grid. Input circuit causes this effect. Source 4/6-203

Device for Generation of Pulses, #2,732,527. Inv. G. Emanuelsson. Assigned Telefonaktiebolaget L M Ericsson. Iss. Jan. 24, 1956. Short pulses having high amplitude are produced by applying rectified h-f voltage of opposite polarity to 2 unbalanced series inductance circuits. Source 4/6-204

Automatic Amplitude Balance Control System for Hyperbolic Navigational Receiver, #2,732,549. Inv. W. Frantz. Assigned Sperry Rand. Iss. Jan. 24, 1956. Pulses transmitted from a master station and a slave station charge 2 condensers in proportion to the strength of the received signal. The charge is picked up by a relay and used to vary the gain of the receiver during the reception of one or the other of the pulses, keeping the pulses substantially equal in magnitude. Source 4/6-207

Electronic System for Correlating Phase-Modulated Signals, #2,732,548. Inv. W. Brockway. Iss. Jan. 24, 1956. Output signal generated when 2 pulses are produced simultaneously is compared with a reference signal, on a 'scope, to give a visual indication of phase displacement. Source 4/6-208

Automatic Frequency-Control Circuit, #2,732,494. Inv. J. Bridges. Assigned Zenith. Iss. Jan. 24, 1956. Synchronizing the frequency of a periodic wave generator with incoming synchronizing pulses is done by feeding positive pulses derived from the generator and the negative sync pulses into an amplifier. Current pulses, obtained in accordance with the phase relationship between the derived and sync pulses, are integrated and used to control the frequency of the generator. Source 4/6-209

Pulse Generator, #2,732,497. Inv. R. Hancock, Assigned Northrop Aviation. Iss. Jan. 24, 1956. A separate and different time constant is connected to each cathode of a multi-cathode glow tube. A potential, connected to all the time constants, fires the cathodes in order of their time constants. Changes in plate current flow are differentiated to give output pulses. Source 4/6-210

Linear Predictor Circuits, #2,732,424. Inv. B. Oliver. Assigned Bell Labs. Iss. Jan. 24, 1956. In a TV transmission system, TV wave is delayed 1 TV field time plus ½ a TV line time, and delayed 1 field time minus ½ a line time. Combined samples are compared to a standard for deriving an error signal for transmission to a receiving point. Source 4/6-212

Color Television Matrix System, #2,732,425. Inv. D. Pritchard. Assigned RCA. Iss. Jan. 24, 1956. Prescribed signal frequencies are caused to have predetermined phase relationship to any signal developed at common cathode terminal of a matrix amplifier circuit. Source 4/6-213

Improved Amplifier-Detector Circuit, #2,732,492. Inv. D. Sunstein. Assigned Philco. Iss. Jan. 24, 1956. Circuit provides large change in output for relatively small changes in input signal by cascading amplifier stages and combining outputs of associated detector stages. Source 4/6-214

Electronic Storage Arrangements, #2,732-493. Inv. G. Baker. Assigned British Telecommunications Research. Iss. Jan. 24, 1956. Switching arrangement assures that the responding device for receiving information from its individual storage device is always assocated with the same portion of the storage capacity of its corresponding storage device. Source 4/6-215

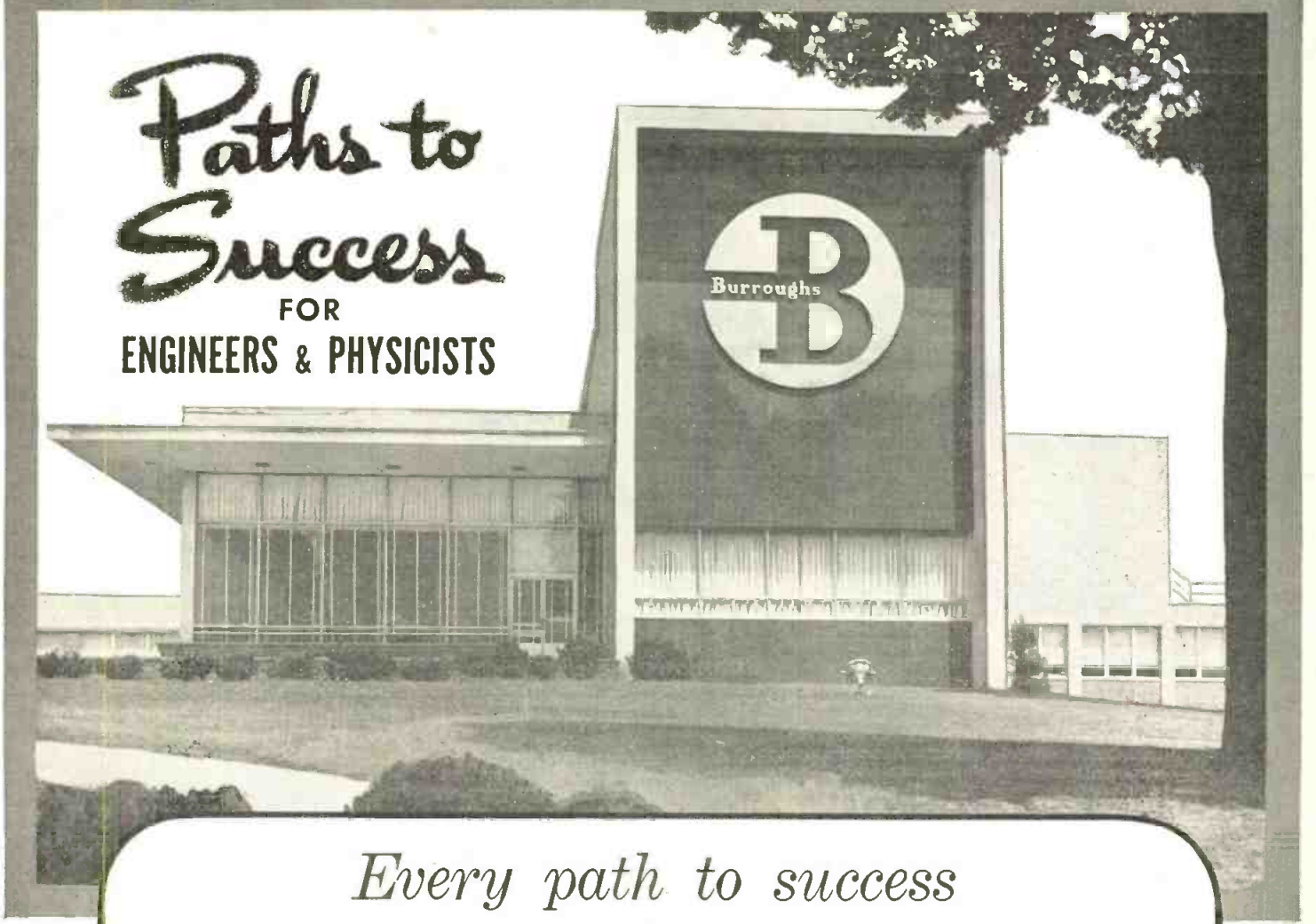
Voltage Limiter, #2,732,494. Inv. O. Hall. Assigned U. S. Gov't. Iss. Jan. 24, 1956. Cold cathode gas tube is used to supply a constant voltage in the absence of input signal and a second output voltage in the presence of a positive input signal. Source 4/6-216

Multichannel Communication, #2,729,791. Inv. C. Estes. Assigned IT&T. Iss. Jan. 3, 1956. A coding device of the electron beam type is operated at twice the sampling repetition rate to form a code pulse group in half the time allotment per channel in a multichannel signal wave. Code group stretcher expands the digit spacing of the condensed code pulse group. Source 4/6-217

Paths to Success

FOR

ENGINEERS & PHYSICISTS



Every path to success

. . . each highway to achievement . . . must have a beginning and what better place to start than right here . . . in the new ultra-modern multi-million dollar Research Center which is only one of three erected in the immediate area within the past 3 years.

Located on Philadelphia's Main Line, within sight of historic Valley Forge, Burroughs multi-unit Research Laboratories are less than an hour by train or car over express highways to Philadelphia where cultural and educational facilities of known merit are available to engineers interested in advance study at The University of Pennsylvania, Drexel Institute or Temple University during the evening hours.

Naturally, a retirement program and other benefits for you and your family are part of Burroughs Progressive Employment Policies. So, too, is association with outstanding men in the business machine field.

Looking to future expansion, Burroughs invites inquiries from those qualified as:

ELECTRICAL ENGINEERS • PHYSICISTS • ELECTROMECHANICAL ENGINEERS

MECHANICAL ENGINEERS • TECHNICIANS • MECHANICAL DESIGN ENGINEERS

. . . in the following fields — Control Computers, Pulse Circuitry, Digital Computers, Optical Devices, High Speed Mechanisms, Guided Missiles, Solid State Circuitry, Electronic Packaging, Electrographic Recording Devices.

Burroughs

CORPORATION

RESEARCH CENTER

PAOLI, PA., NEAR HISTORIC VALLEY FORGE

Send Complete Resumé to

M. E. JENKINS

PLACEMENT MANAGER

For Interview at Your Convenience

New Tech Data for Engineers

Resumes of New Catalogs and Bulletins Offered This Month by Manufacturers to Interested Readers

Antennas

Comprehensive 100-page, illustrated, color catalog contains product description and engineering data of over 500 antennas, antenna systems and transmission line designed and manufactured by the Andrew Corp., 363 E. 75th St., Chicago 19, Ill. (Ask for B-4-101)

Radiation Processing

"High Voltage Electron-Beam Processing" (Bulletin E) is an authoritative survey of radiation machines and their application in chemical processing, sterilization and industrial research, published by High Voltage Engineering Corp., 7 University Rd., Cambridge 38, Mass. (Ask for B-4-102)

Silicon Rectifiers

8-page catalog published by Sarkes Tarzian, Inc., Rectifier Div., 415 N. College Ave., Bloomington, Ind., contains illustrations and specifications for the firm's line of silicon rectifiers. (Ask for B-4-103)

Time Delay Relays

Bulletin TD 402, available from the A. W. Haydon Co., Waterbury, Conn., describes operation and specifications of the 6400 Series dc, 11400 ac, and 24300 Series 400 Cycle Time Delay Relays. (Ask for B-4-104)

Ceramics

12-page catalog describing ceramic research, production, and application is available from Ceramic Sales, Raytheon Manufacturing Co., Waltham 54, Mass. (Ask for B-4-105)

Tone Signaling Units

Bulletin available from Hammarlund Manufacturing Co., Inc., 460 W. 34th St., New York 1, N. Y., contains specifications, description, and application data for audio-tone signaling units, tone generators and frequency selective receivers. (Ask for B-4-106)

Radiotelephone

Ring-bound catalog containing illustrations, descriptions and specifications of radiotelephone equipment manufactured by Kaar Engineering Corp., Middlefield Rd., Palo Alto, Calif., is now available. (Ask for B-4-107)

Cold Fabricating Laminate

Brochure entitled "A Laminate For Automation" describing new high insulation-resistance XXXP phenolic, paper-base laminate designated G-E Textolite (R) cold punch 11570, is available from G-E, Laminated and Insulating Products Dept., Dept. PRL-1, Coshocton, Ohio. (Ask for B-4-108)

Phase Meter

Bulletin from Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y., illustrates and describes Phazor Phase Meter Model 200A. (Ask for B-4-109)

Focus Coils

Syntronic Instruments, Inc., 170 Industrial Rd., Addison, Ill., has released a revised catalog page picturing and describing Types F33 and F10 focus coils for 2⅜ in. and 1½ in. neck diameters. (Ask for B-4-110)

Computing Service

New 7-page brochure explaining the complete services offered for all—simulation, computing, data reduction, and data processing by the J. B. Rea Company, Inc., 1723 Cloverfield Blvd., Santa Monica, Calif., is available. Written explanations are further clarified by descriptive diagrams showing the flow of data. (Ask for B-4-135)

Tools

Most effective cutting speeds for carbide tools, machine tool hp requirements, carbide tool geometrics, and other tech. topics are covered in a new 66-page metalworking catalog issued by Carboloy Dept., G-E, Detroit, Mich. (Ask for B-4-111)

Sun Batteries

"The Use of Selenium Photocells and Sun Batteries," a 58-page handbook published by International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif., is available at a cost of $1.50 per copy. Tech. information and over 35 illustrations describe applications and devices in which sun batteries and other photocell products are successfully employed. (Ask for B-4-12)

Laminated Plastic

Uses of Formica's S-52 laminated plastic forming material are described in a new colorfully illustrated, 4-page, booklet published by The Formica Company, Cincinnati 32, Ohio. (Ask for B-4-13)

Voltammeter

Model A—40 ranges, millivoltmeter, voltmeter, ammeter, and milliammeter, a product of Sen Dur Manufacturing Co., 3225 N. Sheffield Ave., Chicago, Ill., is described in 4-page bulletin now available. (Ask for B-4-14)

Rheostat Potentiometers

Comprehensive data on construction, specs., ratings, and outline drawings of switches, shafts, etc., of Type 2W—2 w. rheostat potentiometers are contained in 4-page bulletin from International Resistance Co., 401 N. Broad St., Philadelphia, Pa. (Ask for B-4-15)

Selenium Rectifiers For Printed Circuits

"Information Bulletin M1," from the Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J., describes selenium rectifiers designed for use in printed circuitry. (Ask for B-4-16)

Soft Soldering

Bulletin 561, from McDowell Electronics Inc., 117 Woodside Ave., Metuchen, N. J., contains photos and description of Model 3KW-9 radio frequency power generator designed as a laboratory induction heater. (Ask for B-4-17)

High-Reactance Busway

Construction and application of the Type CL high-reactance busway are described in detail in bulletin GEA-6469 issued by Advertising & Sales Promotion, Distribution Assemblies Dept., G-E, Plainville, Conn. (Ask for B-4-18)

TV Color Tube Chart

TV color tube chart, illustrating the workings of most popularly used tubes, and TV picture tube comparison wall chart have been published by Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y. (Ask for B-4-19)

Electrolytic Capacitors

Barco, Inc., Box 1222, Milwaukee, Wis., has available complete listing of the 42 types of ultra-miniature electrolytic capacitors, including test charts and a cross-reference table, in their Catalogue CS-33. (Ask for B-4-20)

High Temperature Terminals

Bulletin No. 553, of the American Lava Corp., Chattanooga 5, Tenn., supplies complete information on a new line of high temperature terminals. (Ask for B-4-21)

Record Heads

Attractive 4-page bulletin from Librascope, Inc., 808 Western Ave., Glendale, Calif., describes head and record heads, and magnetic drums for air-borne data-handling systems, computer memory systems, and for lab. testing. (Ask for B-4-22)

Data Tables

Paper labels, 2 in. x 17 in., lacquer-coated and self-adhesive are described in bulletin and price list from Timber Top Products, P.O. Box 14, Freeport, N. Y. (Ask for B-4-23)

Ceramic Capacitors

Comprehensive 20-page catalog (616), from Cornell-Dubilier Electric Corp., S. Plainfield, N. J., illustrates and describes all "standard" or popular ceramic capacitors manufactured by the company. (Ask for B-4-24)

Feed-Thru Capacitors

Tech. data and illustrations of minature paper dielectric hermetically sealed feed-thru capacitors are contained in 4-page engineering bulletin (No. 271-2) issued by The Gudeman Co., 340 W. Huron St., Chicago 10, Ill. (Ask for B-4-25)

Accident Prevention

Third Edition of Accident Prevention Manual for Industrial Operations, a 1341-page encyclopedia of safety, is available at a cost of $13.50, from the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill. (Ask for B-4-26)

Computing, Analysis Facilities

Bulletin R-16, from the Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill., describes the Computing and Data Analysis Facilities at Cook Research Laboratories. (Ask for B-4-27)

Electron Tube Directory

Publication of an "Interchangeability Directory of Industrial-Type Electron Tubes," (Form 1D-1020A), and a "Picture Tube Replacement Directory," (Form KB106) has been announced by RCA Tube Division, Harrison, N. J. (Ask for B-4-28)

Power Tetrode

Eitel-McCullough, Inc., San Bruno, Calif., has published a data sheet on the new Eimac 4X250F radial-beam power tetrode. Also available is the new Eimac Field Engineers sheet. (Ask for B-4-29)

Magnetic Tape Recorders

Description of portable, battery-operated, spring-motor magnetic tape recorders, with built-in VU meter is contained in a 4-page folder available from Amplifier Corp. of America, 398 Broadway, New York 13, N. Y. (Ask for B-4-30)

Electronics Laboratory

Electrical Testing Laboratories, Inc., 2 East End Ave., New York 21, N. Y., has available a new bulletin covering its recently expanded electronics laboratory now equipped to operate in the microwave region. (Ask for B-4-31)

Precision Glassware

A 4-page, 2-color brochure featuring the use of precision glassware for electronic applications has been released by Wilmad Glass Co., Landisville, N. J. (Ask for B-4-32)

Capsular Elements

Full engineering specs. and dimensions, of Ni Span C Capsular elements for the aircraft and instrument industries, are tabulated in the 8-page, 2-color bulletin (AV2001) available from The Bristol Co., Aircraft Components Div., Waterbury 20, Conn. (Ask for B-4-33)

Core Testing

Burroughs Corp., Electronic Instruments Div., 1209 Vine St., Philadelphia 7, Pa., offers an interesting 8-page bulletin, "Pulse Pattern for Testing Cores." Bulletin describes core testing, illustrates core testing systems, and discusses test specifications. (Ask for B-4-134)

See Century's Booth at the NARTB Show in Chicago

Key-Base-Eye-Cross-Back-Lights *†FRESNELITES *Minisize 3" lens 100 watt up to the Jumbo 20" lens 10,000 watt instrument. Also 6"–8"–10"–12"–14"–16". The 500 to 5,000 watt range.*

Fill Lights SCOOPS *Wide angle spread at short range. Elliptical Alzak Floodlights. 500 to 2,000 watt sizes. Handle for universal directional movement. Rugged diffuser frames.*

Setlights STRIPLIGHTS *of varying lengths with light centers to fit. Numerous lamp wattage. 100 to 300 watt Alzak reflector. Trunion allows for immediate angular focus from floor or overhead. Unitized diffuser holder insures immediate insertion.*

Gobo Pattern Light *†LEKOLITES *Elliptical Spotlight with grooved slot to enable rapid insertion of metal pattern (Gobo) for special projection effects.*

Follow Spot 3KW LEKOLITE *High powered–lightweight–rugged–flexible–mobile. Built-in iris shutter for circular shaping of beam. Rapid lens changer from spot to flood. All handles externally controlled at convenient location.*

Wide-wide Projection System PROJECTORAMA *High power 5,000 watt lamp-optics arranged to deliver 1½" image at 1" distance. Self, silent air cooled system. Standard slide holder or special. Now installed at Metropolitan Opera; also San Francisco Opera.*

Wireways CONNECTOR STRIP *Provides a series of receptacles for lighting equipment mounted along either horizontal or vertical pipe. Minimizes use of loose tangling cable leads.*

Control Systems *†C-I SYSTEM *Industry's standard in the preset type of lighting intensity control. Sub-mastering and scene switching feature provides independent or simultaneous control of the various lighting sequences. Low cost maintenance.*

*†**Magnatrol** *Century has incorporated into the preset type lighting control, the latest developments in the field of magnetic amplifiers. Dimmers are available in a variety of capacities from 1KW to 25KW.*

C-lector *Century's new preset switching system consists of three units: the master controller, the console and the relay and breaker cabinets. No major alterations in your existing system is required to install this remote control multi-scene switching system. Manual auto transformer switchboards built to specification.*

Color Filters CINEMOID *is a long-lasting non-inflammable plastic color medium available in 44 shades. Buy it direct from Century, sole U. S. Distributor.*

Literature T-V Lighting Aids with accompanying catalog and data sheets will be mailed to all signators applying at the booth.

Century Lighting, Inc.

521 West 43rd Street, New York 36, N. Y.

1820-40 Berkeley Street, Santa Monica, Calif.

Century lighting equipment is engineered lighting equipment

*U.S. Patented †U.S. Trademark

Electronic Industries' B. F. Osbahr checks Airborne Instrument Lab's 2000-MC equipment

The heaviest snow storm in years, news of mergers, and the earth satellite program were the highlights of the four-day engineering show

At The 1956 IRE Show...

A raging snowstorm, the worst to hit New York City in 8 years, was the backdrop for the opening of the annual IRE show on March 19th. Two and three-foot-high drifts, which tied up transportation and kept many out of town visitors close to their down town hotels, caused a drop in opening day attendance that threatened briefly to force an extension of the show.

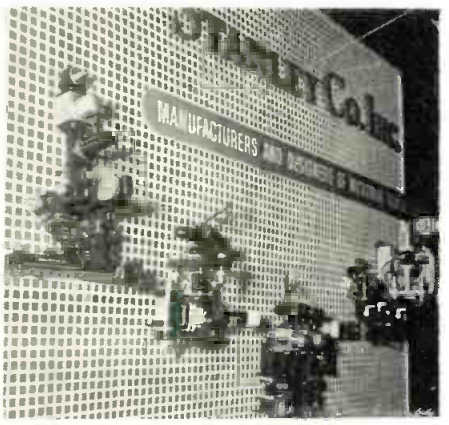
The storm abated at the end of the first day, and attendance soared. At an Exhibitor's Committee meeting on Tues., March 20th, a recommendation that the show be extended an extra day was voted down. It was pointed out that despite the poor weather, attendance on the opening day was off only 20%.

In the elections for new officers of the Exhibitors' Committee, Frank Marble, vice-pres. for sales of Boonton Radio, was elected chairman.

Announced concurrently with the opening of the show was the new merger of Airborne Instruments Lab. and Compagnie Generale de Telegraphie Sans Fil (C.S.F.) of France to form Intercontinental Electronics Corp. Ownership of the new corporation is also shared by American Research and Development Corp., Banque de Paris et de Pays Bas and J. P. Morgan & Co.

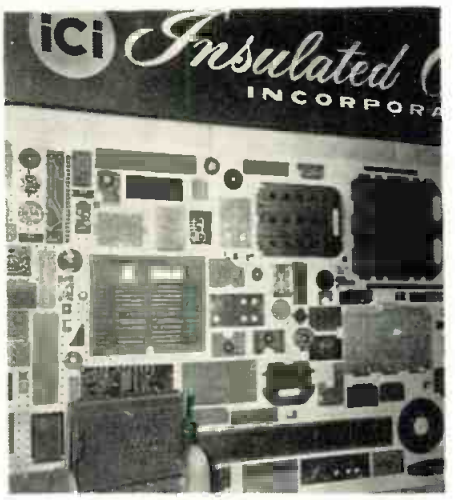
Highpoint of the week's activities was a panel discussion by a group of four scientists from the Naval Research Lab on the aims and problems of Project Vanguard, the earth satellite program. An SRO crowd attended the meeting at the Waldorf-Astoria Hotel and heard a description of the launching procedure and the problems that will be faced in tracking the satellite as it revolves around the earth, and the radio telemetering equipment that will be employed to transmit the atmospheric and cosmic ray information picked up by the satellite.

Hughes exhibit featured the USAF GAR-1 Falcon air-to-air radar-guided supersonic missile



Budd-Stanley & Co. featured microwave diplexers and multiplexers made in 1-piece castings

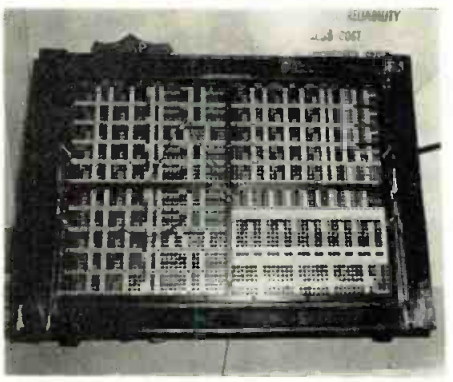
New tubes using 12 v. plate supply were introduced by Tung-Sol for auto radio production

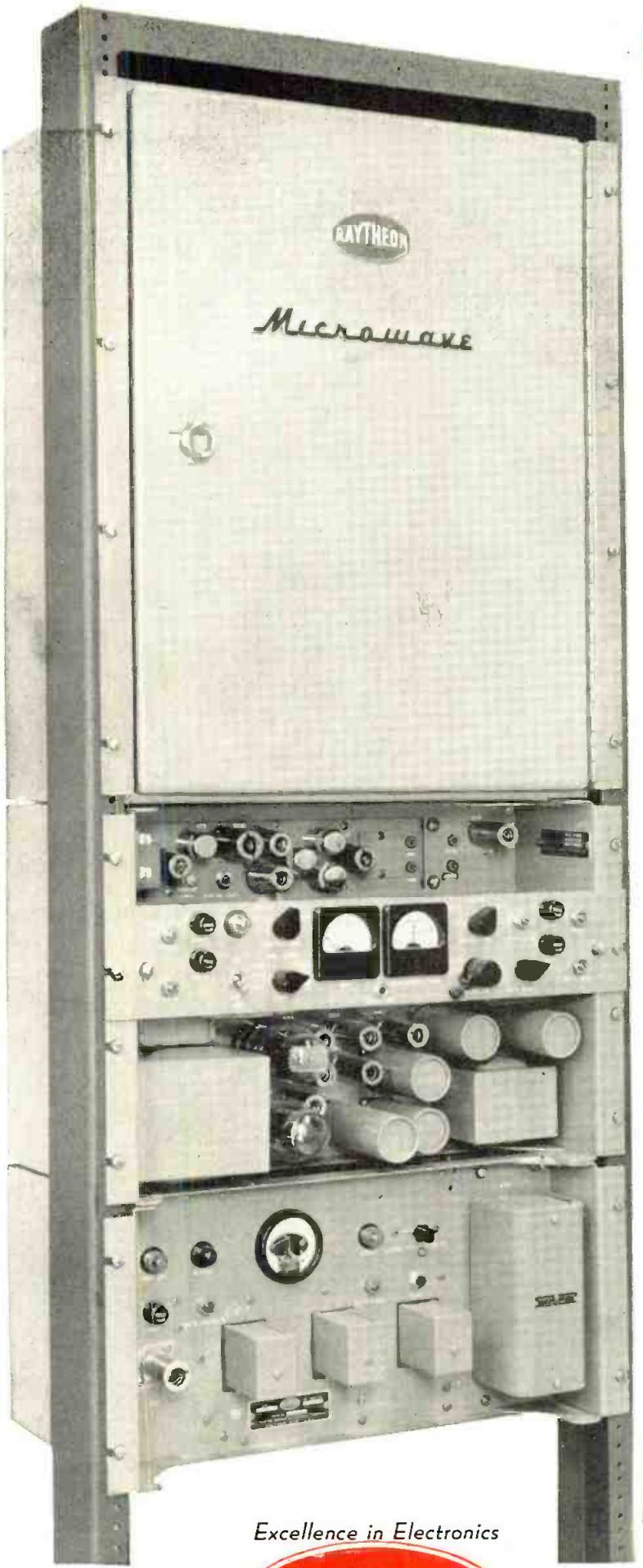


Printed circuits, in all shapes and sizes, were seen at Insulated Circuit's exhibit

American Electronics' unique slip-ring-less alternator uses rotating skewed pole pieces

3600 ckt completely shielded analog computer patch panel seen at Aircraft Marine Products





NOW AVAILABLE

RAYTHEON KTR SERIES TV MICROWAVE LINKS FOR RACK MOUNTING

To meet your need for permanent TV relay installations, Raytheon now provides its famous KTR series links for fixed as well as portable use. Retaining all of their fine performance features, the KTR-100 and KTR-1000 (100 mw and one watt) are now available rack mounted for the 6000 and 7000 mc bands.

A new accessory system offers remote control of important transmitter and receiver functions and also includes an alarm circuit. Both rack-mounted and portable units can be operated with waveguide extensions. A ferrite isolator eliminates long-line effects, thus permitting indoor operation and maintenance of the entire equipment, with the antenna system separated from the radio equipment by as much as 100 feet.

In nearly 200 television stations*, Raytheon KTR links provide monochrome or color with simultaneous program audio transmission at lowest cost with greatest reliability. With the addition of rack mounted units, Raytheon now serves you with the most complete line in the industry.

PORTABLE KTR UNITS FOR REMOTE PICK-UPS

The ultimate in simplicity and portability, Raytheon KTR equipment for portable use consists of only four compact units with a total weight of 162 lbs. Portable units are available for all bands – color or monochrome with audio channel – if desired.

*Names on request.

Excellence in Electronics

RAYTHEON

For complete information, please write Dept. 6120.

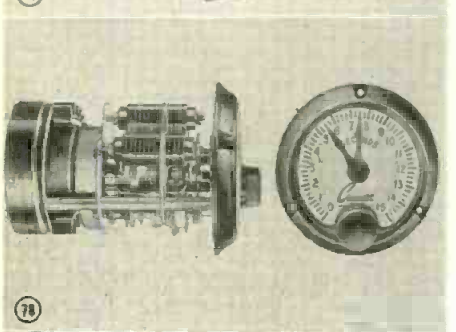
RAYTHEON MANUFACTURING COMPANY

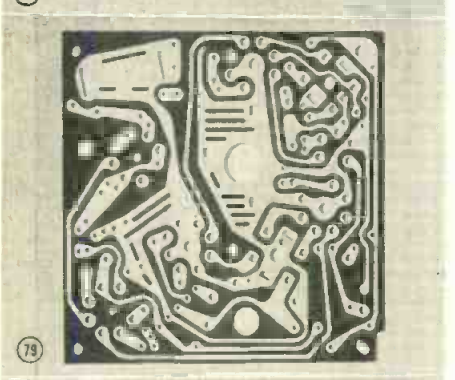
A-3012

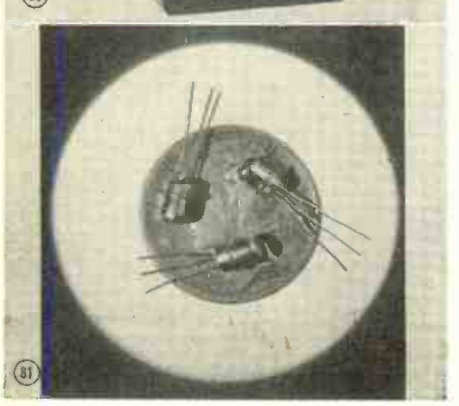
Equipment Marketing Department, Waltham 54, Mass.

See Raytheon's exhibit at Booth 10, NARTB Show

New Products Seen At The IRE Show







Components and equipment introduced for the first time at the Institute of Radio Engineer's Show in New York City, N. Y.

76—Magnetics, Inc.
Tape wound core with improved aluminum core box enabling cores to withstand temps. of at least 450° F.

77—Industrial Test Equipment Co.
Automatic Hi-Pot Tester Model A, for production testing of slip rings, commutators, synchros, transformers, etc.

78—R. W. Cramer Company
Time Delay Relays capable of maintaining repeat accuracy within ± .25% of full scale.

79—General Electric Company
Plastic laminate for automatic production of electronic equipment utilizing printed circuits.

80—Donner Scientific Company
Model 1200 Sine Wave Generator. Generating pure sinusoids from 1 cps to 1 mc in 6 decade ranges.

81—Philco Corporation
M-1, alloy junction, transistor. Low power p-n-p device composed of germanium and indium, designed for hearing aids.

82—Superior Tube Company
Narrow neck disc cathode with diameter of ceramic disc .365 in. ± .005 in. Outer diam. of tube is .121 in. ± .001 in.

83—Westinghouse Electric Corp.
Silicon rectifier capable of handling several kw. of power. New diodes have typical forward voltage drop of 0.7 v. at 8 a., and cell temp of 190° C.

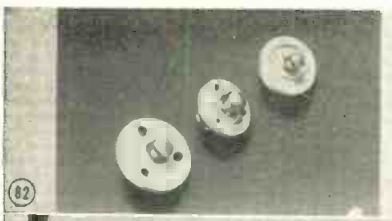
84—Barry Controls Inc.
Shock and vibration isolators and new mounting bases designed for improved reliability protection in jets.

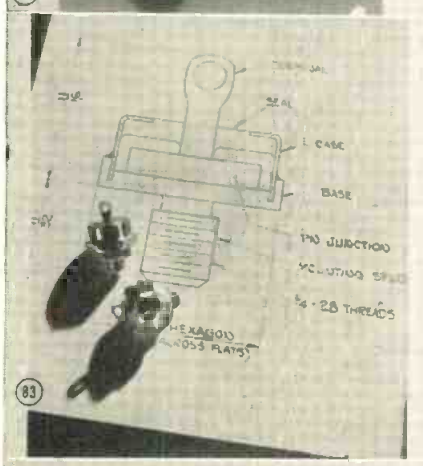
85—Burroughs Corporation
High Frequency Pulse Generator #1050. Output is ½ sine wave pulse with adjustable width from .03 to .07 μsec.

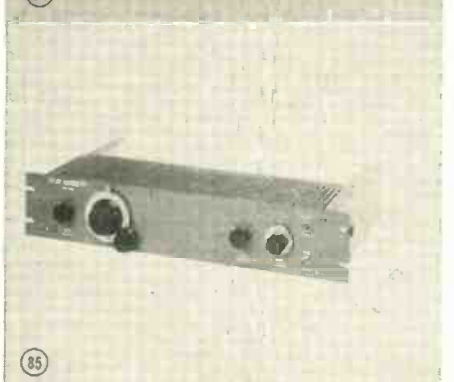
86—Tech-Master Corp.
Hi-Fi FM tuner, with automatic frequency control and temperature compensation of oscillator circuit.

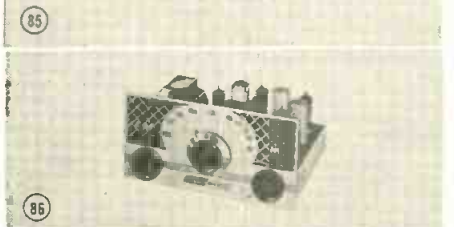
87—Land-Air, Inc.
Subminiature AM and FM receivers individually constructed as three compact modules.

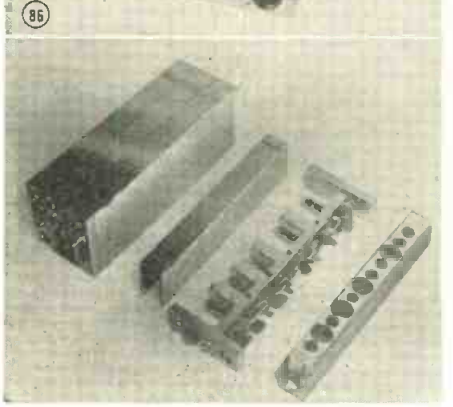
(*Continued on page 157*)











Senior Positions for

Electronics Engineers

Advanced Electronics Systems Staff expands at Lockheed

An important expansion in the Advanced Electronics Systems Staff has created new positions for senior engineers in a wide range of fields.

To the career-minded engineer, three aspects of the work are significant:

1) Assignments cover virtually every type of aircraft and weapons system; 2) personal initiative is welcomed and encouraged under the Staff's philosophy of operation; 3) the Staff is undergoing continuous expansion because of the growing importance of its work.

Senior positions are open in the following fields:

RADAR Duties involve developing requirements and specifications after extensive analysis for various radar, display and data handling systems. Monitoring developmental programs is also an important aspect of this position.	**FIRE CONTROL** Duties involve developing requirements of airborne fighter-to-fighter and fighter-to-bomber fire control systems and monitoring programs leading to actual systems to meet the requirements. Strong experience in computer techniques is required.	**NAVIGATION** Duties involve developing requirements for advanced, self-contained, high accuracy doppler and inertial systems and implementing programs to obtain these systems. Extensive experience in airborne navigational systems is required.
ANTENNA DESIGN Duties involve developing requirements for communication navigation and radar antenna systems and participating in design of the systems. Most of the development work in this field is performed at Lockheed Laboratories.	**COUNTERMEASURES** Duties involve developing requirements and monitoring programs for advanced electronic countermeasure systems, including receivers, analyzers and jammers.	**COMMUNICATIONS** Duties involve developing long-range communication and data link systems, studying meteorological and atmospheric features and guiding antenna design.

TO ENGINEERS ATTENDING THE I.R.E. CONVENTION

Engineers attending the I.R.E. convention are invited to contact Lockheed representatives at the convention hotel, PLaza 3-9944 or PLaza 3-9945.

Moving Allowances—Generous travel and moving allowances enable you and your family to move to Southern California at little or no expense.

Scientists and engineers interested in performing advanced electronic systems work on diversified projects are invited to write E. W. Des Lauriers, Dept. EE-29-4. Please include your home phone number.

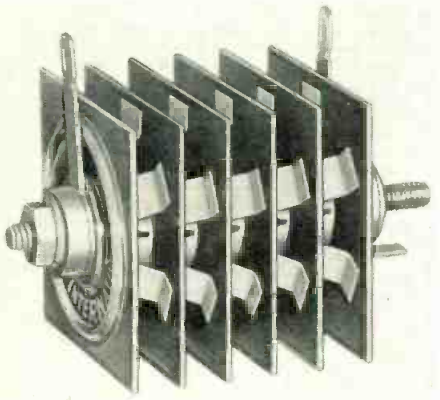
LOCKHEED
AIRCRAFT CORPORATION
California Division
BURBANK **CALIFORNIA**

RADAR SEARCH PLANE
Assignments for senior engineers are on advanced models of this type of aircraft, fighter interceptors and A.S.W. patrol bombers.

New Electronic Components

SELENIUM RECTIFIER

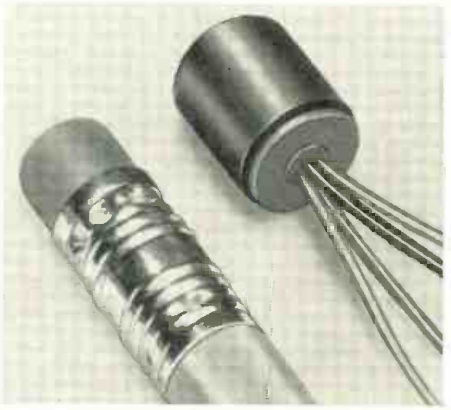
A new selenium TV rectifier series utilizing a new concept in surface contact while retaining the reliable "center support" construction used since the inception of selenium rectifiers, has



been announced. This new type of construction, called "AirKore," features a unique open-spaced 6 contact spring which provides greater contact area and a uniform temperature rise across the surface of the rectifier plate. The design permits optimum circulation of air around the plates, through the core and spring itself. **Product Information Dept., International Rectifier Corp., El Segundo, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-24)

TRANSFORMERS

Deci-Ouncer Transformers (DOTs for short) are miniature units (.03 cu. in. in volume) which will operate at 100 times the power level of similar sized units of conventional structure with the



same distortion level. They have 30% greater efficiency than conventional transformers, are sealed hermetic for max. life, and have excellent frequency response. Eight standard DOT types cover virtually every application at 100 mw level. It is down only 1 db at 200 cycles. It has winding resistance of 850 and 125 ohms. **United Transformer Co., 150 Varick St., New York 13, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-17)

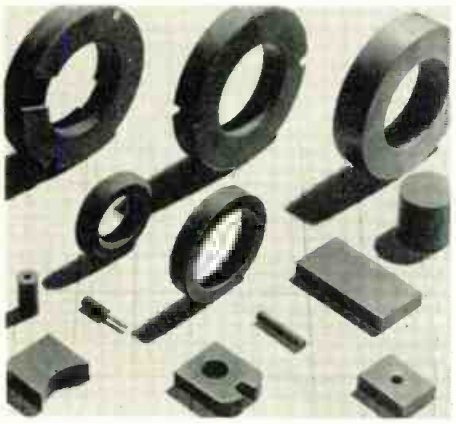
VARIABLE INDUCTOR

The inductance range of new variable inductor for use in low-frequency tuning applications has been extended to 1000 henries and higher. A tuning variation of ±10% of the nominal in-

ductance is achieved by use of the Adjustoroid principle. Units are hermetically sealed and meet the requirements of MIL-T-27 specifications. The total inductance range is achieved within one turn of adjusting knob. Case size is only 1 9/32 in. diameter by 2 in. length. A simple screwdriver adjustment varies the inductance. **Burnell & Co., Inc., 45 Warburton Ave., Yonkers, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-105)

CERAMIC MAGNETS

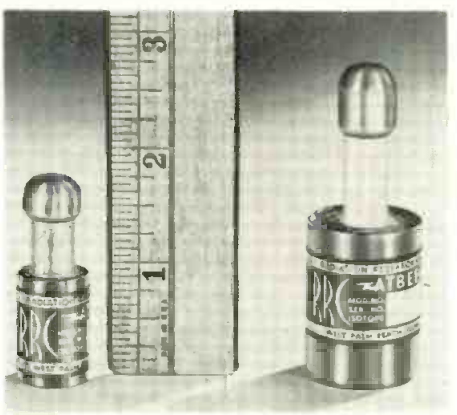
Low cost, ceramic permanent magnet material combines adequate energy product with high coercive force, low residual induction, and exceptional resistance to demagnetization. Known as Stackpole Ceramagnet permanent magnets, units retain their energy when used without "keepers" or under other closed-circuit conditions, and in the presence of strong opposing fields. Electrical resistivity is 6×10^{10} ohms/cm cube. Made of non-critical, barium and



iron oxides, the new permanent magnets are classified among the hard magnetic materials. They weigh 4.85 gms/cm^3. **Electronic Components Div., Stackpole Carbon Co., St. Marys, Pa.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-104)

ATOMIC BATTERY

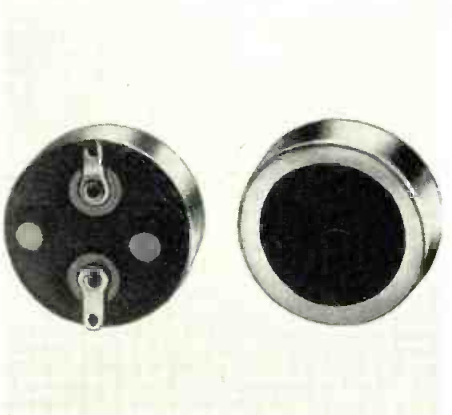
A single cell atomic battery which is smaller than 1½ v. flashlight battery, converts nuclear energy directly into electricity through a special, solid dielectric. The ATBEE delivers 17,000 v. per cell with a max. current of one millimicroampere. It measures 1 in. in diameter, 1⅜ inches in height and weighs 5 oz. Models F-10 and F-50, consist of a 2 or a 10 MC strontium-90 source of beta particles, an electrode which collects these beta particles, and



a solid insulator which allows penetration of the high speed beta particles but prohibits any reverse flow of low energy particles. **Radiation Research Corp., 140 E. 59th St., New York City.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-107)

SEALED SWITCH

Complete protection against water, dust, chemicals and explosion; long life, up to one million cycles under rated load; precise calibration; versatility and high capacity in small size, are among the advantages claimed for a new snap-action, sealed switch. Inherent in the design of the flat-stamped "W" element is automatic stressing and calibration when it is fixed to its mounting base. The absence of knife edges or rolling springs assures consistent "on" and



"off" points throughout the life of the switch. Other advantages include wide stress distribution, also wide contact gap. **Electra Manufacturing Co., 4051 B'way, Kansas City, Mo.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-106)

now selenium rectifiers

designed *for printed circuits!*

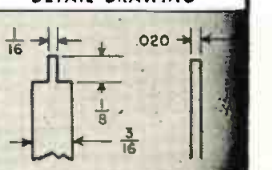
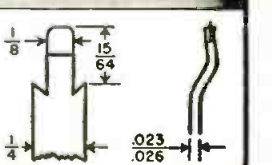
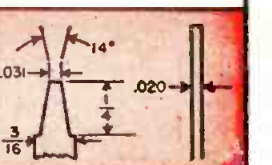
Four output ratings from 65 to 150 milliamps, and a choice of three terminal styles, are now available from Federal to meet your printed circuit requirements.

The new terminal designs cut your assembly and soldering costs . . . permit rapid *automatic* or *manual* insertion into printed circuit boards.

Terminal shoulder stops keep the rectifier plates off the board. Result: rectifier cooling is improved and extra board area is freed for additional printing!

And, as with all Federal selenium rectifiers, *you can count on* their long life, high output voltage, low temperature rise, excellent humidity resistance, and UL acceptance.

TERMINAL TYPES

TYPE	DESCRIPTION	DETAIL DRAWING
a	**Square Tipped**—for light-gauge printed circuit boards up to 1/16" thick.	
b	**Snap-In**—for 1/16" printed circuit boards subject to vibration or inversion. Terminals lock rectifier in place.	
c	**Tapered**—for maximum ease of insertion in heavy-gauge printed circuit boards up to ⅛" thick.	

	FEDERAL PRINTED CIRCUIT RECTIFIERS											
FTR No.	1266	1279	1265	1308	1444	1357	1297	1445	1400	1383	1494	1495
DC Output ma (maximum)	65	65	65	65	65	75	75	75	100	100	100	150
AC Input V (rms maximum)	130	130	130	130	130	130	130	130	130	130	130	130
Terminal Type	A	B	A	B	C	A	B	C	A	B	B	B

Federal

A DIVISION OF I T & T

For more information on Federal Printed Circuit Rectifiers phone NUtley 2-3600, or write Dept. F-966A.

Federal printed circuit rectifiers can be designed for your application in ratings up to 195 volts AC and 600 milliamps DC

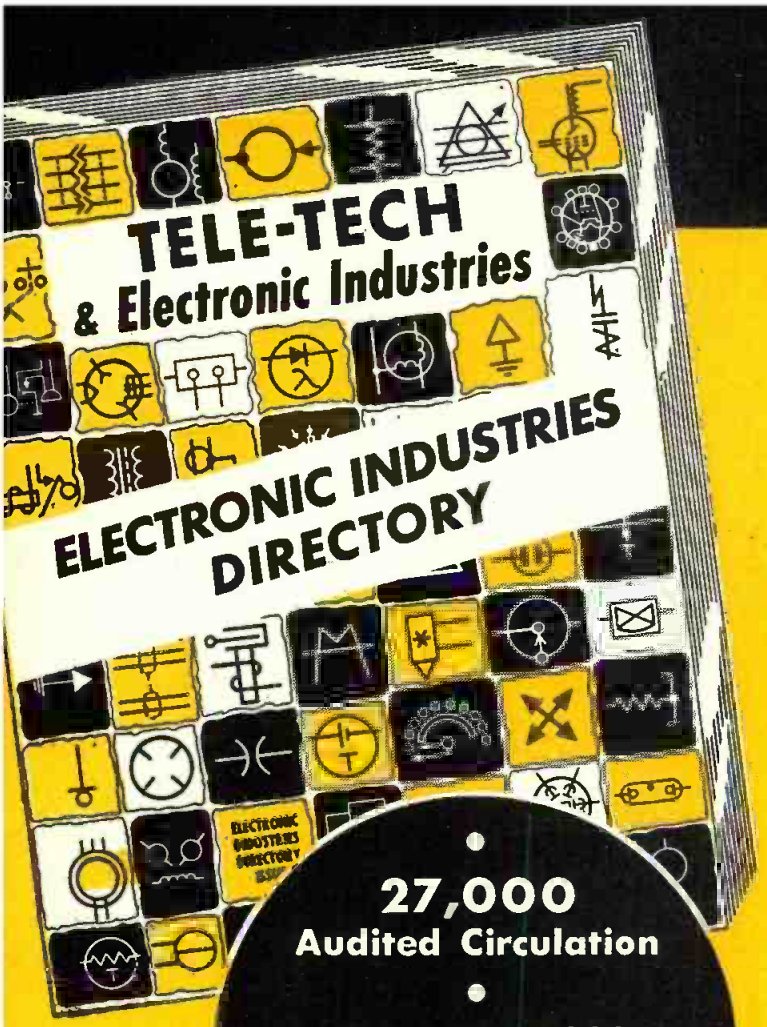
Federal Telephone and Radio Company

A Division of INTERNATIONAL TELEPHONE AND TELEGRAPH CORPORATION

COMPONENTS DIVISION • 100 KINGSLAND ROAD • CLIFTON, N. J.

In Canada: Standard Telephones and Cables Mfg. Co. (Canada) Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., New York

Keep your product buyers with the



Published Annually in the

JUNE issue of

TELE-TECH & Electronic Industries

- **Established storehouse of vital data and sources for top engineers in the electronic industry.**
- **Most complete and accurate, brought up to date each year.**
- **No other information source can match this directory, nor is any as convenient or practical to use.**

27,000
Audited Circulation

Lists over 4,000 manufacturers

over 2,000 product categories

Directory features include:

- **PRODUCT FINDING INDEX**
- **PRODUCT LISTINGS (These two sections save time by listing thousands of products with symbols for each, followed by manufacturers' names, addresses and symbols showing types of products they make.)**
- **BRAND & TRADE NAME INDEX**
- **DIRECTORY OF CONSULTING ENGINEERS**
- **DIRECTORY OF ENGINEERING SOCIETIES**
- **DIRECTORY OF ELECTRONIC DISTRIBUTORS**
- **DIRECTORY OF ELECTRONIC REPRESENTATIVES**
- **ALPHABETICAL LIST OF MANUFACTURERS**

Because it is so carefully designed for maximum usefulness, the "ELECTRONIC INDUSTRIES DIRECTORY" gives maximum effectiveness to the advertiser of electronic products. It is the most comprehensive and practical directory in the electronic engineering field. It helps your selling because it is referred to constantly by TELE-TECH's 27,000 readers, including the men with responsibility for initiating projects, specifying and purchasing products like yours. Top engineering personnel, purchasing agents, etc. keep the June Directory issue at hand from one year to the next. Your ad, therefore, is your assurance of being on hand when they are ready to buy!

"THE MAGAZINE ENGINEERS READ FIRST!"

before the industry's most influential directory used the year 'round!

CUT COSTS, SPEED UP SALES CONTACTS
With the exclusive LOCALIZER INDEX!

How it works for you!

Paid Localizer Listings localize your selling. This is a sales-building, cost cutting feature because it provides quick and direct contact between local buyer and seller—between the purchaser and the manufacturer's branch office or local representative. Localizer ads cut down on correspondence, phone calls, and red tape, increase inquiries, speed service to customer, for everyone who takes advantage of them.

How to advertise with Localizer Listings

Immediately under your firm name, listed free in either the Alphabetical List of Manufacturers, Distributors, or Representatives, you can purchase space at the low cost of $30 for the first inch, $25 for each additional inch, to include the items of information shown in the sample listings at the right. Note how convenient and important they are. Note too, how easily the buyer can locate the local office or Rep nearest him. Manufacturers may also use space in the Directory of Distributors to show at the end of each state their distributors in that state.

Get maximum sales impact

Display advertising coupled with your Localizer Listings is the surest way to achieve maximum product identification among the greatest number of buyers in the $8 billion electronic market. The ELECTRONIC INDUSTRIES DIRECTORY keeps your product on display so it will be seen and purchased—all year 'round!

FREE ALPHABETICAL LISTINGS

In the alphabetical index of 4,000 manufacturers listings are free to all electronic manufacturers.

EXECUTIVE & SALES PERSONNEL

Listings for manufacturers' executive and sales personnel may be followed by brand names, list of products, branch or regional offices. These are paid listings.

REPRESENTATIVES

Alphabetical arrangement of cities in Localizer section makes it easy for buyers to find local representatives. These are paid listings.

Dover Publications 1780 Bdwy New York NY
Dow Corning Corp Midland Mich
Dow-Key Co Warren Minn
Downing Crystal 191 Shaffer Ave Westminster Md
D & R Ltd 402 E Gutierrez Santa Barbara Calif
Drake Co R L 18 E Central Ave Miamisburg Ohio
Drake Electric Works 3656 Lincoln Chicago 13 Ill
Drake Mfg 1713 W Hubbard St Chicago 22 Ill
Telephone CHesapeake 3-4462
General Manager—H Ken Foute
Director of Sales—Verne E Smith
Chief Sales Engineer—Harry Wasielo
Products
Dial light sockets—miniature lamp assembl
signal lights—jewels
Representatives
Atlanta 6-R—Henry W Burwell Co Inc 1133 I
DeLeon Ave N W ELgin 7517 Covers Ala
Ga-Miss-NC-SC-Tenn
Boston 16-R—Gerber Sales Co 48 Pearl St Broc
46 Mass 8Eacon 2-2425
Detroit Mich—Grant Shaffer Co 14241 Fenkell
8Roadway 3-5390 Covers Mich
Ft Wayne 5-R—Walter W Bieberich 2817
Dr KEnmore 2928 Covers Ind
Kansas City 2 Mo-R—Myers-Young-Forristal Inc
Main St JEfferson 7221 Covers Kansas-Mis
Cleveland O-R—The Geary Sales Company
Henry Rd
Los Angeles 5-R—Radio Products Sales Co 150
Hill St

LOCALIZER LISTINGS FOR DISTRIBUTORS AND REPRESENTATIVES

EXECUTIVE & SALES PERSONNEL

Names may be listed here to quicken sales contacts.

LINES CARRIED

May be listed here to show the availability of certain brands or types of products.

AREA SERVED

May be defined in order to reach and serve more outlets in this expanding field.

NEW YORK. Cont'd
Sanford Elect 157 Chambers DI 9-0550
State & Co 2755 Webster LU 4-0614
Stan-Burn Radio 1697 Broadway CO 5-8138
Sun Radio 122 Duane BA 7-1840
Superior Radio & TV 800 W 20 CH 7-1234
President—Nathaniel K Herbert
Vice Pres & Gen Mgr—David Harris
Vice Pres chg Sales—John M Meyer
Controller—Stanley S Jones
Credit Mgr—Michael Haggerty
Chief Counterman—Wm Bullock
Warehouse Mgr—James O Smith
Principal Lines Carried
Amphenol • Astatic • Atlas • Belden • Copi
CBS-Hytron • Centralab • Cornell-Dubilier •
eready • General Electric • Hallicrafters • I
Jensen • JFD • Kester • Littelfuse • Mallo
Masco • Merit • National Union • Radi
RCA tubes • Recoton • Regency • Shu
Simpson • Sprague • Taco • Ward • Web
Weller
Area Served
Through its store and warehouse in New York
perior Radio serves TV-electronic customers i
ports of the country. When you get it Fro
perior," your selection is facilitated and
service expedited by a comprehensive catalog
ing the major lines handled.

MAKE YOUR SPACE RESERVATIONS—NOW!

AN INEXPENSIVE SALES PUNCH

Localizer Listing Ads are avail able by the inch—first inch $30 each additional inch or fractio thereof, $25.

TELE-TECH
& Electronic Industries

480 Lexington Ave., N. Y. 17 • PLaza 9-7880
Chicago: 201 N. Wells Street • Randolph 6-9225
Los Angeles: Chris Dunkle & Assoc., 3257 W. Sixth Street • DUnkirk 7-6149
San Francisco: Chris Dunkle & Assoc., 3077 Turk Street • EXbrook 2-0377

New Plant Equipment

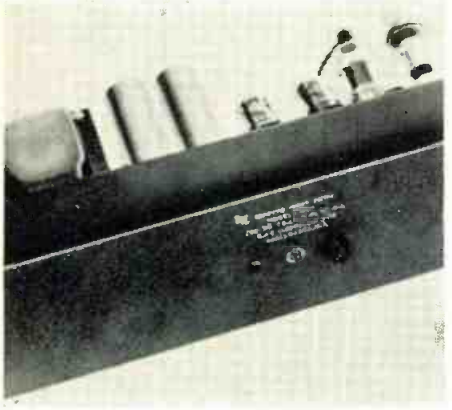
OPTICAL-TYPE ANALOG

The Baldwin Piano Company is now manufacturing 13-digit and 16-digit optical angular position encoders of high accuracy, small size, light weight, and rugged construction which repre-

sent an innovation in precision analog to digital conversion. The 16-digit encoder, weighs 9 lbs., 2.88 oz. The high-precision 16-digit cyclic binary code disk is of glass, on which the binary code pattern is applied photographically. The encoder functions with an accuracy of ±10 sec. of arc. **Encoder Division, The Baldwin Piano Company, 1835 Gilbert Ave., Cincinnati 2, Ohio** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-97)

POWER SUPPLY

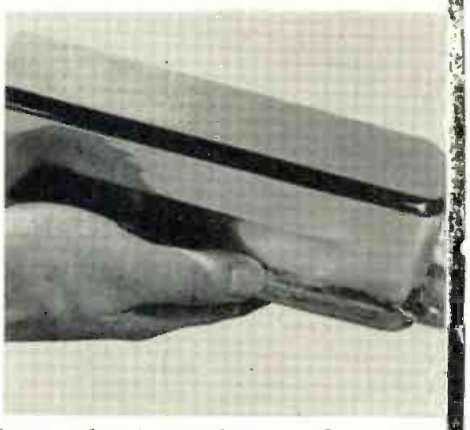
This photomultiplier power supply provides better than 0.1% line and load regulation without the use of a chopper or a standard-cell reference. Long-term stability is better than that required for most applications, and ripple is less than 1 part in 50,000. The output voltage provided can be any 200-volt range from 1000 to 2000 volts dc. Output current rating is 5 ma. Stability and regulation are achieved through the use of a



heavily-pre-loaded, high-gain regulator operating from a relatively "stiff" rectifier. Reference tube is operated in a selected constant region **NJE Corp., 345 Carnegie Ave., Kenilworth, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-82)

ULTRASONIC CLEANING EQUIPMENT

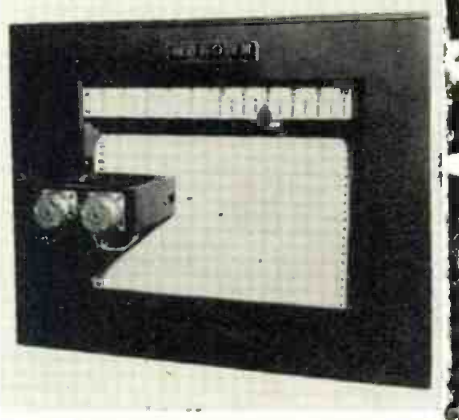
Hermetically sealed ultrasonic power transducers and improved generators operating at 40 kc make it possible to apply ultrasonic energy to metal clean-



ing applications. The transducers can also be used for other processes in liquids which benefit from ultrasonic energy, such as quenching, plating, pickling, descaling, and dyeing. Generator-transducer combinations are available, with radiating areas of 30 sq. in. to 8 sq. ft. Cost of the complete equipment ranges from $23.00 per sq. in. of radiating surface down to $14.00 per sq. in. **Branson Ultrasonic Co., 194 Richmond Hill Ave., Stamford, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-92)

STRIP CHART MARKER

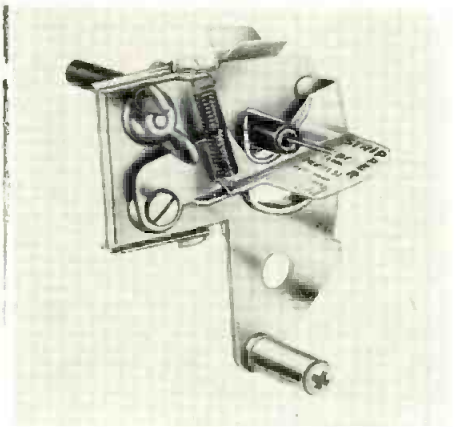
The RI-3 IDENTICHART permits the remote selection of numbers or letters to be printed on strip charts. The print wheel on the unit can have 8, 10, 12, 18 or 24 positions, with the position being selected from a remote point, then caused to print for the purpose of identifying events on the recorder chart. The unit does not interfere with or ob-



scure the recording procedure. It can be made to operate on any ac or dc voltage from 24 to 110 v. Other models are available for printing time, serial numbers, etc. **Royson Engineering Co., Hatboro, Pa.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-83)

ROTARY CABLE STRIPPER

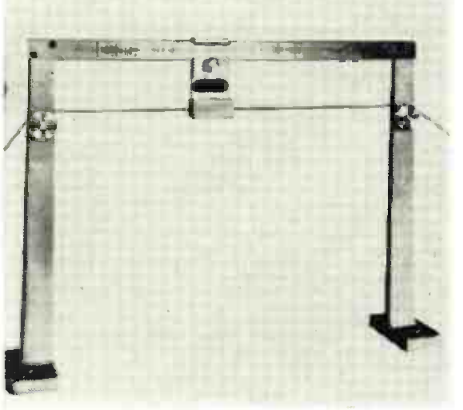
Model S-1 Rotary Stripper for coax cables and other non-metallic tubing up to ½ in. diameter. The B-T Stripper is machined from heavy gauge steel and employs a standard single edge razor



blade for the cutting action. Depth of cut and degree of spring tension may be varied thru simple adjustments. A measuring scale on the unit assures that the correct amount of insulation and braid is removed. Blonder-Tongue's compact Cable Stripper lists for $3.75. **Blonder-Tongue Laboratories, Inc., 526-536 North Ave., Westfield, N.J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-62)

PRESTRIPPING HEATER

This highly efficient pre-stripping heater designed to facilitate the stripping of plastic and other types of insulated wire by heating only that section of the insulation which is to be stripped, is priced at $129. F.O.B. factory. It functions through effecting an expansion of the insulation, which causes the wire to strip freely and renders uncritical the adjustment of the stripping and cutting blade. Full ad-



justment, for various lengths of wire, is made possible by a thumb screw locked rider on a calibrated scale. **Stakwhite Company, Tyler Park Station, Box 634, North Bergen, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-87)

New Products

MICROPHONE SYSTEM

The M-14 is a scientific instrument designed to measure sound pressure beyond the dynamic range of normal commercial microphones. It has been applied to the measurement of high explosive blasts, drop forges, horns and sirens, and the analysis of noise characteristics of jets and missiles. Because of its compact size, ⅝ in. diam., 3 in. long, it can be mounted inside heating and ventilating systems, on the trucks of railroad cars, or flush with the skin on airplanes for wind turbulence measurement above speeds of Mach 1. Microphone base contains printed circuitry for maximum shock resistance. **Altec Lansing Corp., Dept. TT-1, 9356 Santa Monica Blvd., Beverly Hills, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-35)

HAND-SIZE MICROPHONE

A new hand-size, broadcast quality, microphone with a built-in transformer to give high impedance required in hi-fi equipment, has been developed by American Microphone Co. The microphone has a frequency range of 40 to 15,000 cycles, weighs 6 ozs., and measures 4⅜ in. It is the first such instrument to be equipped with the new Cannon XLR "quiet" connector, which eliminates clicks and crackles when the microphone is carried. D-300 Series microphones are also available in 50 or 250 ohms impedance. **Elgin National Watch Co., Elgin, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-40)

PULSE POWER CALIBRATOR

New method for measuring the power of radio frequency pulses involves, essentially, a notch-wattmeter display, but all reliance upon a precalibrated condition is eliminated; a comparison scheme free of error caused by changes in voltage gain, input voltage fluctuations, paralax, or electronic instability about an operating point is provided with comparison circuits and bridge circuits energized by r-f power of the same frequency as the signal to be measured. Technical characteristics of the PCX-1 — Frequency range, 925 to 1225 MC; Accuracy, ± 0.5 dbm; Power input range, — 10 dbm to + 63 dbm; Input pulse width range, 0.5 to 10 μsecs; Input impedance, 53.5 ohms; Notch width, 15 μsec.; Trigger output Amplitude, 10v 50 ohms or 50v 500 ohms; Pulse recurrence frequency, 100-2000 pps; Sweep durations, 200 μsecs. (long), 20 μsecs. (nominal) (short); Power, Input voltage 115v ± 10%, line frequency 45 to 66 cycles. **General Communication Co., 681 Beacon St., Boston 15, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-129)

New Products

TAPE RECORDERS

New 1956 walkie tape recorders include one model, The Duplex, with a built-in loudspeaker for reproduction to room-size audiences. A subminiature basic amplifier and transistorized

bias oscillator make possible this advance without sacrificing battery life. Another model, Triplex, incorporates the addition of a VU meter and 600 ohm zero level output for line feeding. An economy model, the Simplex, consists of the basic recorder-reproducer without loudspeaker. **Broadcast Equipment Specialties Corp., P.O. Box 149, Beacon, N.Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-131)

PERSPECTIVE CONTROL

For TV production, the Tewe-Motivefinder permits visualization and control of the picture and perspective. It always provides the constant and correct proportions in accord and with the corresponding focal length of the camera lens used. Even before focusing the camera, it is possible to determine: the most suitable focal length to be applied, the proper camera position for

specific focal length, the necessary focal length for any given distance. It is priced at $39.50 including metal neck chain and leather case. **Ponder & Best, 814 N. Cole Ave., Hollywood, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-134)

CHILTON COMPANY enters electronic publishing through purchase of

TELE-TECH & ELECTRONIC INDUSTRIES

. . . publication gains vast new dimension.

The union of two great names, Chilton, and TELE-TECH & ELECTRONIC INDUSTRIES marks the beginning of a new and important dimension for this outstanding publication in the electronic field. As a result of this change in publishing affiliation (effective with the March issue), the vast publishing resources and facilities of the Chilton Company will extend many added benefits to advertisers and their agencies, as well as the top engineering personnel who receive and read TELE-TECH & ELECTRONIC INDUSTRIES regularly.

The Chilton Company is continually expanding its publishing activities. With the recent purchase of three publications, it now boasts a roster of fifteen publications (in diversified fields) which have contributed to the technological and business advancement of our country. In addition to TELE-TECH & ELECTRONIC INDUSTRIES, several other Chilton publications cover industries in which electronics is playing a bigger and bigger role. "Automotive Industries," for example, covers a $14 billion market for parts and materials, including more and more electronic equipment which is being employed by the industry. "Iron Age," one of Chilton's oldest and most renown publications, reaches metalworking executives who buy equipment and materials at all stages. Here, too, the role of electronics is coming to the fore. The same holds true in the field of optics which is becoming more integrated and inter-related with the electronic industry through the use of television in the field of electron optics. Chilton covers this field with "The Optical Journal and Review of Optometry."

Editorial meetings consisting of shop talk between the large staffs of these and other Chilton publications will facilitate the interchange of ideas and invaluable technical information on new and diversified applications of electronics in design, engineering and manufacturing in many different fields. The dissemination of this information through the pages of TELE-TECH & ELECTRONIC INDUSTRIES will be of tremendous value to every engineer reader, manufacturer and advertiser. For it will enable them to continue their progress by keeping abreast of rapid developments in their field and others as well. Yes, Chilton Company's vast resources of capital and personnel will help strengthen the editorial quality and depth which has made TELE-TECH & ELECTRONIC INDUSTRIES a leading force in the electronic industries.

The publication headquarters will be continued in New York City, at the same location, and the present organization will be maintained. Messrs. Clements and Caldwell continue as publishers; Osbahr, Editor; Reed, General Sales Manager.
Chilton Company, with headquarters in Philadelphia, has one of the largest and most modern printing plants in the country. Beginning with the May issue, TELE-TECH & ELECTRONIC INDUSTRIES will be printed in Philadelphia. It is expected that this transfer of the printing operation will effect many economies and efficiencies which will benefit advertisers. At the same time, the magazine's high quality of printing will be maintained.

All readers can be certain that the Chilton Company brings to TELE-TECH & ELECTRONIC INDUSTRIES the publishing forces and know-how which spell editorial quality and accomplishments which will continue to make it the leading editorial force in the electronic industries. Advertisers can expect an even more alert, interested audience for their sales messages.

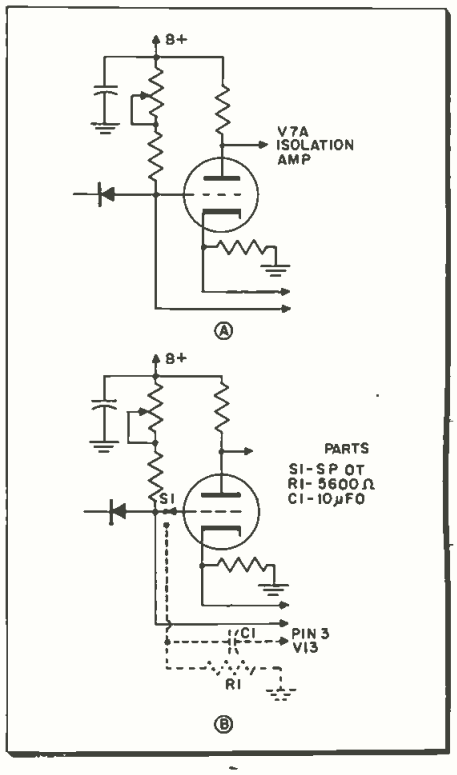
TELE-TECH & ELECTRONIC INDUSTRIES

A Chilton Publication — 480 Lexington Avenue, New York 17, N. Y.

Cues for BROADCASTERS

(*Continued from page* 96)

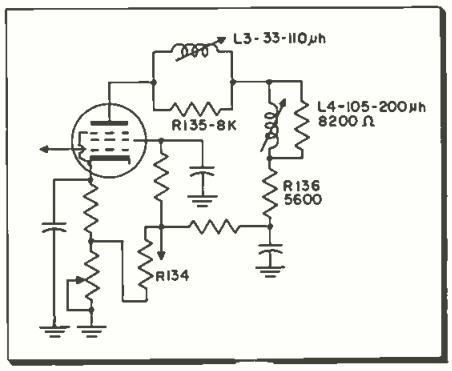
simple changes were made to gate the r-f from the back porch. Since the steps are turned off for this, we changed the step amplitude control (R122) to a type that would take a SPDT snap switch. When the step



Modification to gate r-f from back porch

amplitude control is advanced, the checker operates as before. This switch serves to feed pin 2(V7A) with the usual pulse or one taken from the blanking circuit. The modification is shown in Fig. 2B.

Now, with the step amplitude off, the output of the linearity checker is shown in 1c as opposed to 1b. The

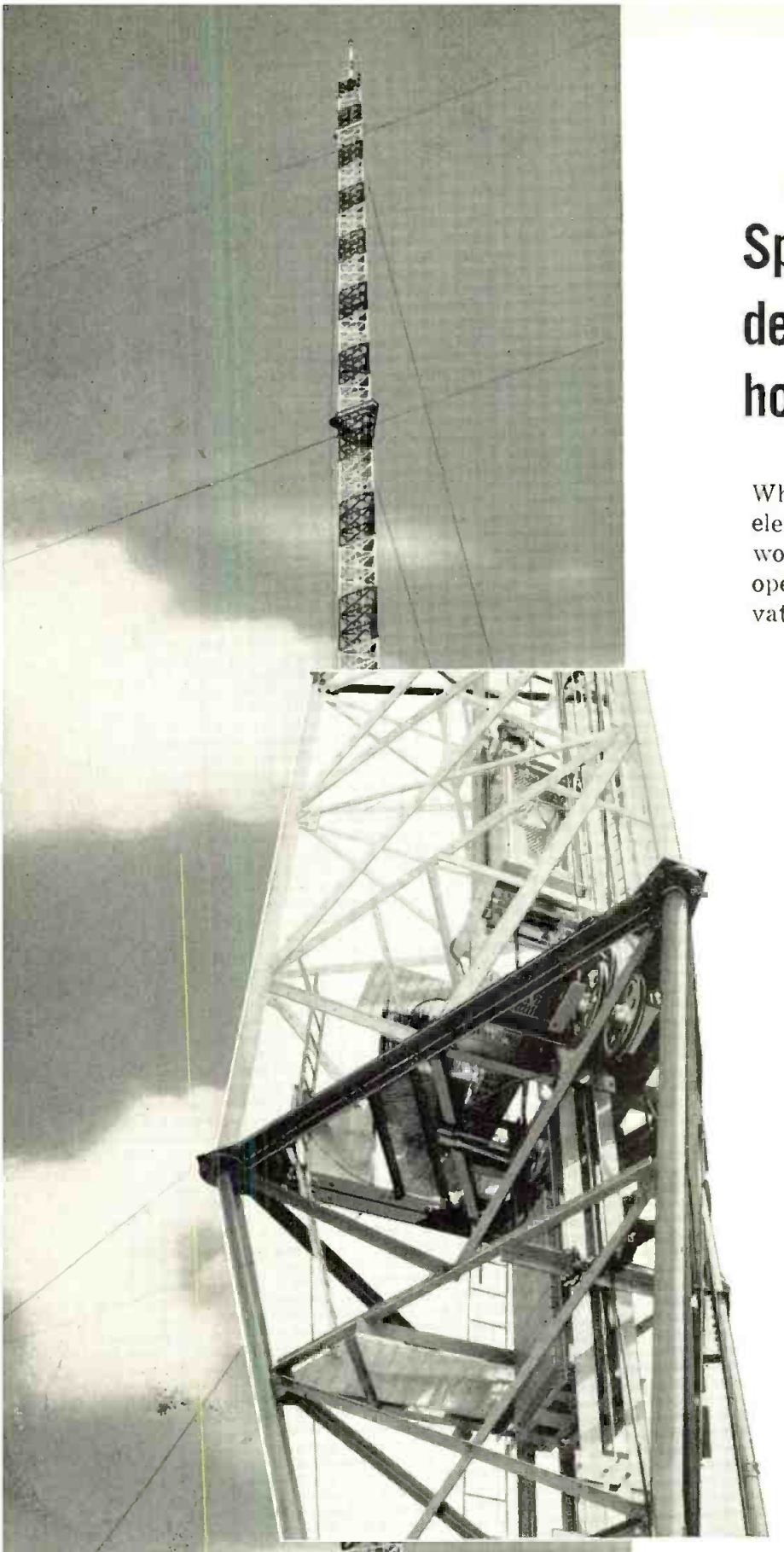


Changes made to approach a flat response

r-f is gated out for the entire blanking period and the signal will pass readily through the video system.

Since the linearity checker was not designed to have a flat response

(*Continued on page* 144)



Special TV Tower designed by BLAW-KNOX houses automatic elevator

When WWJ-TV, Detroit, wanted an automatic elevator in their new tower, Blaw-Knox went to work on the design of the tower . . . in close co-operation with the manufacturers of both the elevator and the control system.

The result is this tremendous triangular tower . . . 14 feet on each side, 1063 feet high and weighing 265 tons . . . with special structural features to rigidly support both the 102 foot antenna and the automatic elevator.

Ready accessibility to any part of the tower up to the 980 foot level is provided by special design, completely enclosed automatic elevator. It can be stopped by the operator at any level by means of low frequency inductive carrier control. In addition an auxiliary pushbutton station, located at the lower landing, permits manual control at that point. The two controls are interlocked so that only one can be operated at a time. A telephone provides ground-to-car communication.

The advanced design and fabrication of this tower for WWJ-TV typifies the kind of service which Blaw-Knox offers you . . . to meet *your* specific requirements.

For more complete information on all types of Blaw-Knox Antenna Towers, write or phone for your copy of Bulletin No. 2417. Or send us your inquiry for prompt service, specifying height of tower and type of antenna.

BLAW-KNOX COMPANY
BLAW-KNOX EQUIPMENT DIVISION
PITTSBURGH 38, PENNSYLVANIA

Elevator-Marshall Elevator Company, Pittsburgh, Pa.
Control system—Union Switch & Signal Division of Westinghouse Air Brake Company, Wilmerding, Pa.

BLAW-KNOX **ANTENNA TOWERS**

Guyed and self-supporting — for AM • FM
TV • microwave • communications • radar

Cues for Broadcasters

(Continued from page 142)

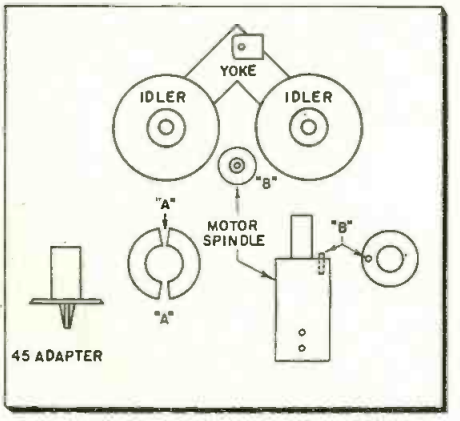
over the range of the video sweep generator the following changes were made to V27 RF amplifier to approach a flat response. L3 and L4 were changed to variable types; R135 to 8K; R136 to 5600 and a new resistor shunted across L4 (8200). See Fig. 3. R134 affects the response curve so we found it best to leave it full on. Also be careful not to overload with the sweep generator. After making the above changes to V27 we produced a test signal with a response flat to 8 MC. This is good enough for all practical purposes.

With this test signal the entire video system can be checked for frequency response in a few seconds.

Reducing WOW of 45 RPM Gates Spindle

LUIGI BIANCO, JR., Ch. Eng'r.
WADK, Newport, R.I.

SOME users of the Gates C-B-4 desks will find that slippage between adapter and spindle causes



Two slots are cut in the 45 adapter

45's to WOW and start slow. By cutting two slots (A) in the 45 adapter, and setting a small pin (B) into the motor spindle to engage these slots, both WOW and slow starts will be eliminated.

NEW BOARD MEMBER

Wm. J. Barkley, v.p. and director of Rust Industrial Co., Inc., has been elected to the board of directors of Nuclear Corp. of America

Green Light For Toll TV Seen Nearing Decision

The likelihood that subscription TV will get at least a temporary trial can be deduced from recent statements by Federal Communication Commission members and other parties interested in the problem.

FCC member Robert E. Lee came out bluntly last month with the statement, "Let's try the system and allow the public to decide."

Such a solution would get the FCC out of the rather uncomfortable position in which it presently finds itself. They would, in effect be simply rubber-stamping the public's reaction.

Despite the heavy pressure from subscription TV proponents, the FCC has until now been reluctant to permit this trial because it could be construed as an abdication of its functions. However, the arguments for toll TV have now gained weight with the results of a Tele-Census survey recently conducted in Los Angeles which showed that 65.9% of the public would pay $1 for a showing of a "first quality movie, first run Broadway play or premium sports event."

24-Hr. TV Programming Planned For Las Vegas

Television station KSHO-TV, Las Vegas, Nev. plans to go to a full 24-hr. telecasting schedule to fit what station owner, Moritz Zenoff, calls "the 'round-the-clock living of Las Vegans."

A contract has been signed by the station with Kay Lab to furnish one of the most unusual installations of its kind in the country. The installation will consist of two complete stations, including duplicate transmitter, live, film studio and video equipment. The two transmitters which will be used alternately to provide continuous 2-hr. operation will be housed in the same room with the console and film chain.

One operator, positioned at a special console, will control two live cameras, one film camera, three film projectors, slide projector and all audio equipment.

NARTB Publication

The third edition of a "Political Broadcast Catechism" has been completed by the legal department of the National Association of Radio and Television Broadcasters and is being mailed this week to all member stations. Included in the material are the recent decisions made by the FCC in the field of political broadcasting.

New Portable Electronic Piano

Working on an entirely new principle, a new electronic piano which weighs only 75 lbs., and can be handled easily by one man, has been developed by Benjamin F. Miessner, of Miessner Inventions, Inc., Morristown, N. J.

The strings used in the conventional piano have been replaced by vibrating reeds, one for each note. When the reed is struck, as when the piano key is hit, the vibration emitted is received by a variable capacitance pick-up and used to frequency modulate an oscillator. The ensuing signal, after detection and amplification, sounds amazingly like a piano.

Its possible uses are unlimited. Imagine taking your piano to a party or, better yet, imagine "little Janie" practicing in silence, while you listen to your favorite hi-fi recordings. An infinite variation in tonal effects are available, sharp and brilliant or sustained and mellow piano, or perhaps a harpsicord. A simple addition changes the tone to that of an organ, without altering the basic operating principles of the instrument.

This new stringless instrument may be the first of a long line of electronic musical instruments with the inherent advantages of low weight, bulk, and cost, silence, if desired, and the ability to remain permanently tuned for many years.

Commercial models, licensed under Miessner patents, are now being produced by Wurlitzer and by Bernhardt's Furniture Ltd. of Canada. Available in a number of models and sizes, the cost of the basic unit is less than that of an accordian, retailing from $250 to $350.

Reflectivity Meter

(*Continued from page 79*)

human eye. Since the screen is observed visually it is desirable to have an instrument with the same response as the eye. A black bakelite tube, 4 in. long and threaded on the inside for baffling, limits the field of view to about one square centimeter on a plane 2 in. from the end of the tube. This permits small areas to be observed and also prevents specular, or direct, reflection of the image of the light source on the surface into the photomultiplier. A sighting range permits the area to be observed to

be located in front of the tube.

Stable dynode voltages are provided by two 300-v. batteries. A potentiometer in the voltage divider is used to vary the sensitivity and to compensate for battery aging. The instrument has been used daily for three months with little adjustment required. The voltage per stage is kept above a minimum of 30 v. to insure linearity of response[2].

The output of the 1P21 is amplified and the contrast is read on a panel type microammeter by noting the percent change in reading due to writing on the dark trace tube screen. A phone jack is provided so that external amplification and recording is possible.

Stability

A differential amplifier was selected to provide stability against battery aging and filament emission changes. Results of a circuit analysis of the differential amplifier showed the output to be directly proportional to the transconductance of the amplifier tubes. It was found that the signal level obtained with a 1P29 phototube as a detector required high g_m tubes. Two type 12AX7 vacuum tubes were used with their triode sections in parallel to obtain this high g_m together with low B+ battery drain. With a 1P21 photomultiplier as a detector the g_m of the type 1T4 is sufficient. These tubes can have battery operated filaments thus making the device suitable to field applications where no power line is available. For such applications the sensitivity of the 1P21 is sufficient to enable lower wattage, battery supplied lamps to be used instead of the line operated 15 watt lamps shown in Fig. 1.

In order to obtain a more versatile instrument for laboratory use, the 1P21 and the 12AX7 amplifier are used. A 90-v. battery provides plate voltage. Dark current and ambient light current are balanced with potentiometer in the plate circuit. This arrangement provides a device with a wide range of sensitivity and a stable, linear response.

The lighting system for reflectance measurements consists of three 32-v. 21 candlepower lamps in series with a potentiometer which is used to adjust the voltage across the lamps to exactly 96 v. This voltage is read on the panel microammeter using a voltage multiplier and a full wave bridge. A d.p.d.t. switch permits checking the voltage periodically on the meter which is indexed at the correct reading. In this manner adjustment can be made for gross er-

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Reflectivity Meter

(*Continued from page* 147)

rors in line voltage, and a standard intensity and color of illumination is obtained. The lamps may be extinguished and the instrument can be used with external illumination as, for example, in transmittance measurements.

Housing

The instrument, as shown in Fig. 2 and 3, is contained in a box measuring 8 x 8 x 8 in. which is mounted on an adjustable tripod. The photomultiplier, amplifier, and controls are mounted on a chassis attached to the rear panel and, since an octal plug makes all electrical connections to the chassis, the instrument can be easily disassembled for servicing by simply removing the rear panel.

The panel microammeter requires no special calibration. As mentioned above contrast measurements are made relative to the blank screen of the dark trace tube. Diffuse reflectivity as well as absorptivity of any surface may be determined relative to commonly accepted standard surfaces such as magnesium oxide for 100% diffuse reflectance and lampblack or black velvet for 100% absorption.

The instrument can be used in many applications to detect and measure small variations in illumination, color tones, or optical properties of materials especially where small areas are involved. With an external counter rapid counting of small or even of transparent objects is possible since the instrument will respond to very small changes of the input light signal. Besides its versatility, the device is inexpensive, easily operated, and has a relatively long life.

References

1. Soller, Starr, and Valley "Cathode Ray Tube Displays" Vol. 22 *M.I.T. Rad. Lab. Series,* McGraw Hill Book Company, Inc., New York (1948).
2. Engstrom, R. W. "Multiplier Phototube Characteristics" *J. Opt. Soc. Amer.* Vol. 37, pp. 420-31, June 1947.

R-F Voltmeter

(*Continued from page* 102)

the frequency range in question. Because of the intentionally introduced high insertion loss of the attenuator, at 5 Mc for example, it is necessary to apply more than 300 v. to the voltmeter for a sufficiently large out-

put of the thermoelement, whereas 1 v. would be adequate at 900 MC. The probe provides means to calibrate the voltmeter with 1 v. or lower at all frequencies. An r-f receiver is connected to the probe output, and a standardized r-f voltage applied to the AT voltmeter. The receiver indication is noted at the minimum attenuator setting. The r-f voltage is then increased to a value V_0 at which the millivoltmeter is indicating a calibration reference output of the thermocouple. Attenuation in the AT voltmeter is then increased to reproduce the original indication on the receiver. With both the change in attenuation and the standardized voltage known, the magnitude of V_0 applied to the AT voltmeter is computed. Only one voltage level, V_0, needs to be calibrated at a given frequency; all other voltages at this frequency in the range of the instrument are then accurately known.

Another design, having relatively close electrode spacing, behaved over part of its range like a continuously adjustable capacitive attenuator and required extensive calibration. Its voltage range was about 100 to 1. Single AT meters, utilizing both the capacitive and the waveguide-below-cutoff ranges as well as the range of the thermoelements, will have an over-all voltage range of 1000 to 1 at all frequencies in question. The upper voltage limit would diminish with increasing frequency; for example, it would be about 900 v. at 100 MC and about 300 v. at 500 MC. Nomographs designed for the AT voltmeters enable their quick application, either as reliable transfer standards or as working instruments.

Still another design is the capacitive "single-frequency" r-f voltmeter. The essential difference between this design and those described in the previous paragraphs is a fixed capacitive attenuator. Although designed for a single frequency, it may be calibrated and used over a range of frequencies.

Several AT voltmeters may be required to cover the entire voltage and frequency range of some of the VTVM's on the market because their response is frequency sensitive, except in the case employing resistive pads. However, construction is relatively simple and quite economical. AT-voltmeter input impedance approaches that of commercial VTVM's except when resistive pads are used.

AT voltmeters are particularly suitable and at present practically indispensable, as secondary reference standards for any laboratory requiring voltage accuracies better than 10%.

Summer Workshop In Technical Writing

Tufts University, Medford, Mass., with the active cooperation of the Society of Technical Writers, is offering the first of an annual series of Summer Workshops in Technical Writing. Dr. Paul H. Flint, of Tufts will give the course.

Inquiries should be directed to Director of the Summer School, Tufts University, Medford, Massachusetts or to Chairman, Public Relations Committee, Society of Technical Writers, P. O. Box 22, Newton Centre 59, Mass.

Filter Design

(*Continued from page* 89)

to those observed on the 35 kw filters are to be realized at 50 kw, the coaxial line diameters should be increased. Intuitively, therefore, it is only necessary to scale up the 3⅛ in. VHF high-band filter to 6⅛ in., but closer investigation reveals that the shunt elements of the series m-derived sections are inconsistent with the larger line diameter. Lowering Ξ_{OL} of the shunt sections is an apparent solution, but this lowers the frequency of the first spurious pass-band objectionably.

A satisfactory solution can be obtained by utilizing shunt m-derived terminating half sections in the symmetrical ladder structure

$$\frac{m}{2} + 3K + \frac{m}{2}.$$

Fig. 9 illustrates the physical realization of the shunt m-derived half section as used on the 50 kw channel 7-13 spurious emission filter. The effective impedance of the series leg $L.C_1$ (Fig. 8) must be duplicated by the outer conductor coaxial cavity for proper operation of the filter. The correct cavity impedance Ξ_{02} is calculated as 25 ohms,[13] and its length should be $\lambda/4$ at 375 Mc (the frequency of maximum attenuation for the m = .6 section). It is convenient, however, to construct the cavity from standard transmission line, 3⅛ in. and 6⅛ in.; consequently the Ξ_{02} value of 39 ohms is obtained, which, it will be seen, is not fatal. Since Ξ_{02} is given as 39 ohms, Eqs. (16) and (17) may be equated and tan θ is found to equal .685 at 195 Mc. This places the quarter-wave resonant frequency of the 39 ohm cavity at 447 Mc. If the resonant frequency is raised to 490 Mc and an adjustable capacitive slug inserted across the cavity mouth (Fig. 9), the proper pass-band impedance is obtained by adjusting the slug for minimum filter VSWR. Furthermore, the slug has much

more effect on the cavity resonant frequency than its pass-band impedance, the result being that when minimum pass-band VSWR is achieved, the actual resonant frequency of the capacitive loaded cavity is 385 MC, close enough to 375 MC for proper stop-band performance. Needless to say, the slug also provides a convenient method for "tuning out" mechanical discrepancies. The 1 in. gap at the cavity mouth is chosen on the basis of arc over requirements.

In the balance of the channel 7-13 50 KW filter (Fig. 4) $\Xi_{OL} = 125$ ohms and $\Xi_{oc} = 7.8$ ohms are again used, except that over-lapping of the dielectric is carried to greater lengths because of the higher voltages involved. Consequently, calculation of the exact value of θ_c is so difficult that the correct lengths of the low impedance sections are finally obtained by cut-and-try. The inner conductor is constructed of silver plated brass, its expansion being allowed along the center bullet.

Furthermore, the inner conductor is physically anchored with the outer conductor at the teflon sleeve of C_2 by a teflon pin held in place externally with a hose clamp. Additional inner conductor lateral support is supplied by anchor insulator bullets at the filter terminals. The brass tuning slug has a teflon cup on the end which protrudes into the cavity, providing a long arc over path.

The damping filter, shown coupled into the 5394-A input cavity (Fig. 4) is a lumped element high-pass filter with a cutoff frequency of 300 MC, its stop-band insertion loss in the region 174-216 MC being greater than 40 db. The purpose of the damping filter is to provide sufficient loading on the line feeding the 5394-A so that the VSWR on harmonics is restricted to 20 to 1, precluding the possibility of harmonics arcing over the spurious emission filter or the input feed line. The impedance of the input cavity being much greater on harmonics than in the channel pass-band, adequate loading is obtained by light coupling with no noticeable effect on the pass-band VSWR.

As expected, the stable operating temperature of the 50 kw filter under full power is approximately the same as the full power temperature of the 25 kw design.

Each of the three constant-K sections is convection cooled by perforating the outer conductor (Fig. 4). The first spurious pass-band appears 200 MC lower than calculated, but not low enough to cause trouble. This discrepancy apparently has to

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Filter Design

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do with the height of the capacitive sections and is discussed in the section on UHF filters. The pass-band peak is over 10 db down which may be due to moding inside the filter proper.

UHF Filters

The 50 kw design is applicable to UHF. Three filters, having a power rating of 12.5 kw and respective cutoff frequencies of 800, 1000 and 1190 MC cover the seventy channel UHF television band. Due to its lower power rating, the UHF filter (Fig. 7) becomes physically quite simple. The only variations from the 50 kw design lie in the closer approximated outer conductor cavity impedance and the 12.5 ohm Ξ_{oc}. With reference to the latter, the higher impedance was originally chosen to give the capacitive short-line sections additional length since the major part of the calculated capacity at 7.8 ohms was supplied by the impedance discontinuity. However, an additional spurious pass-band relatively close to the cutoff frequency has been observed on these filters which is hypothetically a function of the physical height of the capacitance short-line section. If the section is viewed as a foreshortened quarter-wave stub support on a high impedance line, the attenuation of the composite filter will depend only on its series elements at the resonant frequency of the stub supports, and when impedance relationships are optimum throughout the filter, a spurious pass-band of low attenuation exists. This hypothesis has been experimentally verified by changing the impedance of the capacitance sections with a resultant shift in the spurious pass-band center frequency. Like the pass-band due to the inductive lengths, this additional pass-band is extremely sharp at the peak and narrow at the base. On the 1000 MC cutoff filter which operates on channels 37-59, the peak of the additional pass-band was observed at 1725 MC at an attenuation level of 25 db, disrupting an otherwise 60 db stop-band extending from 1250 to over 3000 MC. The channel 60-83 filter, $\varepsilon_e = 1190$, has a 30 db peak at 1825 MC. Both filters use $\Xi_{oc} = 12.5$ ohms and, fortunately, the pass-band being discussed lies between the second and third harmonic regions of the respective operating channels of the filters. A reversion to 7.8 ohms was necessary on the channel 14-36 filter ($\varepsilon_e = 800$ MC) to

shift the 25 db spurious pass-band from 1650 MC (12.5 ohms) to 1375 MC, just below the third harmonic of channel 14.

The channel 14-36 filter passed 15 KW of peak power continuously for 4 hrs. with a resultant outer conductor heat rise of only 25°F.

Insertion in System

A filter with a VSWR $\leq$ 1.1 will contribute little to the VSWR of the TV transmission system in the operating channel of the transmitter (the maximum possible system VSWR being equal to the product of the VSWR's of all the components in the system). Theoretically, therefore, the filter can be inserted anywhere in the transmission system. In practice, location of the filter directly at or close to the transmitter output terminals provides two obvious advantages: (a) the filter need not be pressurized, a distinct mechanical design economy, thus natural convection cooling replaces costly blowers and associated interlocks; (b) adverse effect of high harmonic VSWR on transmitter test equipment and indicators is more conveniently eliminated.

References

1. F.C.C.C. Docket #10353.
2. *Very High-Frequency Techniques;* Radio Research Lab., Harvard University; McGraw-Hill 1947; Vol. II, Chapters 26 and 27.
3. Ragan, G.; *Microwave Transmission Circuits;* McGraw-Hill 1948.
4. Cuccia, C. & Hegbar, H., *RCA Review* Dec. 1947, p. 743.
5. We are discussing power filters here. Obvious limitations which are inconsistent with power design occur when the parameter approaches either extreme.
6. Whinnery, Jamieson, Robbins; *Coaxial Line Discontinuities,* Proc. I.R.E., Nov. 1944.
7. Towlson, H., *Report to RETMA Subcommittee TR4.1 on TV Transmitters* Spurious Radiation.
8. Since mechanical discrepancies will exist, a theoretical design VSWR = 1.05 should produce a VSWR $\leq$ 1.1 in practice.
9. The term "convenient" has a double meaning. A more complex structure could have been designed to cover channels 2-6 with VSWR $\leq$ 1.1 and adequate stop-band attenuation. By keeping the filter design simple, development and consumer costs are minimized.
10. Faires, V. M., *Applied Thermodynamics;* Macmillan 1947; p. 428.
11. Guesstimate of the center frequency of the first spurious pass-band:

$$f_{ra} = \left[262 + (500 - 262)\left(\frac{L_2}{2L_3 + L_2}\right)\right] = 346 \text{ MC}$$

12. Pim, J. A., The Electrical Breakdown Strength of Air at UHF; *Proc. I.R.E.,* 1949.
13. The calculation of the correct cavity impedance proceeds as follows: For the lumped filter, the impedance of the leg L_1C_1

$$\Xi = j\frac{\omega}{\omega_c} mR/1 - \frac{\omega^2}{\omega_c^2}(1 - m^2) \qquad (16)$$

and for a short circuited transmission line of length

$$< \frac{\pi}{2}$$

$$X_L = j\,\Xi_0 \tan\theta \qquad (17)$$

Letting $X_L = \Xi$ and f = 195 MC (mid-frequency of VHF high-band)

$$\theta = (195/375)\frac{\pi}{2}$$

and $\Xi_0 = 25$ ohms.

Equipment Specialist Exam

The U. S. Civil Service Commission has announced an examination for Equipment Specialist to fill positions paying from $3,670 to $11,610 a year in the Department of Defense and other Federal agencies in Washington, D. C., and vicinity.

Areas of specialization include aeronautical, electrical and electronics. Experience should include analytical, administrative, technical, or supervisory capacities.

File applications with the Board of U. S. Civil Service Examiners, Department of the Navy, Washington 25, D. C.

Decade Amplifier

(*Continued from page* 91)

has a positive going signal, the output plate also becomes more positive. Because of the RC coupling at the input and between stages, no appreciable grid current flows into the summing junction. In addition, DC drifts in the tubes cause no voltage variation. The chopper is a double pole, double throw type, driven at 60 CPS. One pole is used for input chopping, the other for the output, so connected that the output capacitor (C_2) is shorted to ground when the input grid is open, and vice versa. Under no-signal, equilibrium conditions, the input contacts do nothing. On alternate half cycles capacitor C_2 is connected to ground, charging it to the static plate voltage of the output stage. Except for negligible leakage C_2 remains charged to this voltage during the other half cycles when it has a path to the filter, R_1—C_3. Half of the time the input voltage to the filter then is zero, and during the other half it is equal to the plate voltage of the output stage, less the voltage drop in C_2. With no input the drop in C_2 equals the plate voltage, and no signal is applied to the filter.

Now assume that a positive DC signal is applied during the time the input contacts are closed. This signal is represented as a battery and current-limiting resistor. No signal reaches the amplifier, and the voltage of C_2 is unchanged. This condition remains until the contacts switch. At this time the input grid and output plate go more positive. C_2 now charges to the higher voltage while the input to the filter is shorted. At the end of this half cycle the input grid returns to normal, as does the output plate. However, the input to the filter is not zero. It sees the normal plate voltage of the output stage, less the drop in C_2 which

is now greater, resulting in a negative input. During the next half cycle the output plate voltage will again be higher than normal if the positive DC signal is still present. Had the input signal been negative, the output plate voltage would have been lower than normal during the charging period of C_2. This would have caused a positive input to the filter in the same manner as before. In this system the output polarity (DC) is opposite the input polarity. This is due to the particular choice of chopper connections and number of stages. The function of the filter is to remove the ripple from output voltage. The particular choice of the time constant R_1—C_3 is determined by other factors in the system.

The general requirements of the System as a whole are as follows:

1. Flat, stable response from DC to approximately 100 KC.
2. Net gain variable in 20 db steps from 0 to 60 db.
3. Equivalent input DC drift not greater than ±10 μv.
4. Equivalent input hum and noise not greater than 25 μv RMS.
5. Output capability of ±35 v. and ±20 ma.

Let us consider the various types of amplifiers which will meet certain requirements and their arrangement into a composite system. A direct-coupled amplifier with a power tube as an output cathode follower will meet the output requirements and provide high gain with the required bandwidth. The chopper amplifier has sufficient DC gain with low drift to override drift in the direct-coupled amplifier, provided it is used ahead of the DC amplifier. Since the chopper system must be used ahead of the DC amplifier, its poor frequency response could drastically limit the over-all response. This situation can be corrected by coupling AC signals around the chopper amplifier. In practice we use an RC-coupled amplifier stage which also adds to the high frequency gain of the system. A premium type low-noise pentode is used for this stage, making the 25 μv. hum and noise specification practical. The gain switching will be discussed later.

The essential elements of the complete system are shown in Fig. 3. Both the AC amp. and chopper amp. are phase reversing. The DC amp. has two stages of gain and a cathode follower output, hence no net phase reversal. Thus, with either the AC or chopper amplifiers in series with the DC amplifier, the required over-all phase reversal is accomplished. DC and very low frequency signals follow a path through the chopper

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Decade Amplifier

(*Continued from page 155*)

amplifier into the grid return of the DC amplifier. Low and high frequency signals pass through the AC amplifier into the grid of the DC amplifier. Coupling time constants of the AC amplifier and the chopper filter constant are so adjusted in value that a smooth cross-over in gain results. The two 100 K resistors shown near the summing junction are the feedback resistors.

Gain Control

The gain control functions in this manner. Assume first that the switch is in the 0 db position. We then have the case of two equal feedback resistors (i.e., $Z_2 = Z_1$) and unity gain. Now suppose the gain switch is set at the 20 db position as shown. The resistors of the attenuator are so proportioned that with the 100 K loading of the feedback resistors e_3 will be 1/10 of e_2 on the 20 db tap, 1/100 of e_2 on the 40 db tap, and 1/1000 of e_2 on the 60 db tap. When e_2 is equal to e_3 (0 db position), the gain from e_1 to e_2 and e_3 is unity (disregarding polarity), that is, the equilibrium condition with equal feedback resistors is e_3 equal to e_1. This condition remains regardless of the ratio of e_2 to e_3. On the 20 db position, e_3 equals e_1, but e_2 is ten times e_3, and the net gain from e_1 to e_2 is ten. Similarly, the net gain is increased on the other taps.

The question may arise as to why this method of gain switching is used rather than varying the ratio of the feedback resistors. Switching the feedback resistors results in two distinct disadvantages. Constant input resistance is desirable and 100 K is a good, practical value which does not present much difficulty with noise and stray capacity. In this situation only the remaining 100 K can be increased to obtain higher gains. With a net gain of 1000 (60 db), a resistor of 100 megohms is necessary, an extremely high value considering stray shunting capacities. The other factor is stabilization. With equal feedback resistors e_3 is reduced by two at the AC amp grid when the input is shorted. Opening the input terminals doubles the AC amp input. With a 100-megohm feedback resistor on the 60 db position this signal could vary with input impedance by a factor of 1000. The amplifier could be made stable for such a condition, but its bandwidth would be very poor. The auxiliary medium impedance attenuator has eliminated both disadvantages.

A balance position is provided on the gain switch which sets the gain at approximately 80 db and simultaneously switches a meter across the output. For minimum amplifier offset it is occasionally necessary to adjust the internal DC conditions due to the inevitable tube and component changes. With the gain set at 80 db the feedback is sufficiently reduced to permit observation of the balance adjustment effect.

Stabilization

Stabilization is always a problem in multi-stage feedback amplifiers. A stage amplifier is one which has no tendency to oscillate or exhibit a pronounced "ringing" with some signals. It may or may not have a constant (flat) gain vs. frequency, but it will not have severe peaks or dips in its response curve. Assuming negligible power supply impedance, the low frequency stability is governed by the selection of the input and output time constants of the AC amp and the filter on the chopper amplifier. These are not affected by the net gain and so remain fixed. In this amplifier fixed high frequency networks are used in the AC amp and the first stage of the DC amp. The compensation is of the feedback type. In other words, high frequency feedback is used around the individual stages. The gain switch selects the required compensation for the remaining stage.

Stable, low-noise operation cannot be achieved without using good power supplies. Both the positive and negative supplies are vacuum-tube regulated and inter-referenced to reduce drift. They are exceptionally free of ripple and fluctuations due to line bounce and hence contribute to the low noise of the amplifier.

1 John R. Ragazzini, Robert H. Randall and Frederick A. Russell, "Analysis of Problems in Dynamics by Electronic Circuits", Proceedings of the I.R.E., pp. 444-452, May, 1947.

IRE New Products

(*Continued from page* 132)

Ace Engineering & Machine Co., Inc.
Special enclosures having anti-magnetic properties achieved by coating the structure with ferrite powders.

Alpha Metals, Inc.
Indium 99.99+ pure; also special alloys of Indium/Gallium, Indium/Aluminum, etc. in the form of cubes, spheres, discs, wire and cylinders.

Alpha Wire Corporation
Electronic wire, cable and Alphlex Tubing including sizes #30 through #000, up to 30 solid and tracer combination colors.

(*Continued on page* 158)

IRE New Products

(*Continued from page* 157)

American Brass Company
Fabricated metal parts, including radio tube base pins, eyelets, ferrules, clips, terminals, etc.

Bendix Radio
Communications and navigation equipment for commercial and military aviation, plus the 1956 Ford auto radio utilizing printed circuits in mass produced quantities.

Diamonite Products
Custom-made electronic components of High Alumina Ceramic materials, plus Diamonite ultra-speed cutting tools.

Driver-Harris
Enameled alloy wire, KARMAR, having resistance of 3200 ohms/per ft., and drawns to .0005 in. diameter.

Allen B. Du Mont Laboratories, Inc.
Wide line of systems for industrial TV and mobile radio communications equipment, including Image Orthicon pick-up system.

Dynamics Corp. of America
Production models of a new series of high-precision, single axis gyros and accelerometers for use in guided missile and air-borne gun-fire control systems.

Electrical and Physical Instrument Corp.
Millimicrosecond rise-time square pulse generators, 10 mc scalers, 10 mc wideband amplifiers, and EPIC fast pulse transmission equipment.

General Electric Company
Seven new semiconductor devices: 4 transistors, 2 silicon rectifiers, and a silicon double based diode.

General Dry Batteries, Inc.
Several new industrial mercury batteries for electronic testing devices, transistor radios, and other equipment.

Gulton Industries
Self-recording accelerometer, potentiometer accelerometer, low-voltage and high-reliability ceramic capacitors.

Helipot Corporation
Standard lines of precision components, with four new single-turn precision potentiometers, and other new products.

International Resistance Co.
Five-watt high temp. power resistor, Type PW-5, featuring rectangular design with axial leads.

Litton Industries
Portable electronic computer of typewriter size, using 300 w. with 110 v. Priced in the $10,000 range.

Markem Machine Company
Color banding machine for high speed, semi-automatic marking of wire lead components with up to 6 color bands.

Oak Manufacturing Co.
Switch styles for low capacity application, plus slide, pushbutton, lever and solenoid operated switches.

PIC Design Corp.
Precision instrument stock parts and associated components. Gears, speed reducers, differentials, etc.

PROBLEM #2

Design a miniaturized 400 cycle filament transformer for airborne operation. Transformer to operate in an ambient temperature ranging from —55° C to +100° C. The maximum allowable temperature rise to be 60° over ambient. Dimensions cannot exceed 2-7/8" high, by 2-7/16" wide, by 2-1/2" long, nor can the weight exceed 2 pounds. The primary source to be 115V, with primary insulation for 500 V RMS hipot. An electrostatic shield is required between the primary and secondary. The secondary is required to deliver 10 amperes at 5 V, (C.T.) ±3%, have a total maximum capacitance of 60 micromicrofarads to other windings, shield, and core, and be able to stand a high potential test of 21,000 V, RMS, @ 60 cycles. Construction to be in accordance with applicable parts of MIL-T-27, grade 2, Class B. The above are given as maximum dimension and minimum performance requirements, greatest possible improvement in size, weight and performance requested.

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Filament transformer, Fosterite impregnated

Primary:	115V, 380 to 1600 cps Hipot at 1000V, RMS, 60 cps
Electrostatic shield grounded to core.	
Secondary:	5V, C.T., ±1/4% @ 10 amp. Hipot at 25,000V, RMS, 60 cps for one minute Distributed capacitance to other winding, shield and core: 50 micromicrofarads.
Temperature Rise:	30° C
Ambient temperature range:	—55° C to +100° C
Weight:	12 ounces
Dimensions:	H: 2-1/4" + 3/8" terminal W: 2-3/16" L: 2-1/2"

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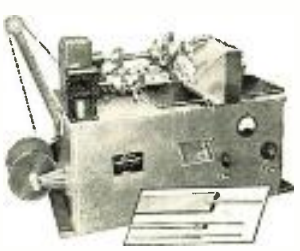

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Tube Tester

(*Continued from page 78*)

complicated indicator and measuring circuitry which would defeat the original intention of this device. Therefore, only a bias high enough to cut off any tube was used and this modified test indicates gross faults, such as stray emission.

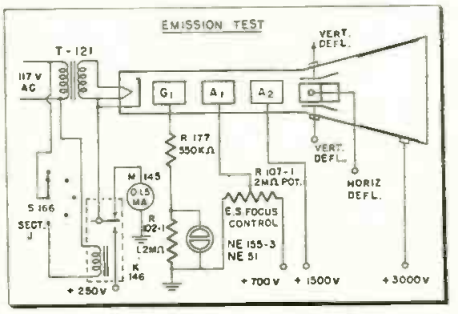

Fig. 12: Testing for tube emission

The emission test. Fig. 12, indicates electron gun condition by measuring the tube cathode current under zero bias conditions. A milliammeter in the cathode circuit, marked with a good-bad scale, serves as the indicator. A protective time delay relay cuts off the tube under test after approximately two seconds, to prevent possible burnout and other tube damage.

The CRT tester described in the article is being manufactured by American Television Mfg. Corp., 5050 N. Broadway, Chicago, Ill.

Bistable Elements

(*Continued from page 75*)

In studying the application of a new component, it is often better to think of the fundamental characteristics of the device rather than try to establish analogies or to force the device to match up with already existing components. Some investigators have found difficulty in analyzing the BIMAG element since electronic education has been steeped primarily in voltage considerations. The BIMAG element is a current device and lends itself to current-flux analysis rather than voltage-resistance analysis. Transistors are also low-impedance current devices and a marriage between the transistor and the BIMAG element is a natural one. Many startling developments have already resulted from this combination. The BIMAG element provides memory and stability, and the transistor the power for switching the tiny cores. There are no critical requirements on the transistor, and in fact the combination with the BIMAG element greatly stabilizes transistor circuits.

Now a few comments on typical

circuits. Vacuum tubes are used only for driving the cores and not for performing arithmetic or logical operations; diodes are needed only for isolation. For these reasons the reliability of such equipment is intrinsically great. BIMAG building blocks can be combined to yield adders, multipliers, counters, cycle distributors, and the other basic components required for the design of complete arithmetic units of a typical computer. For completeness, a few basic circuits are briefly reviewed.

Fig. 3 illustrates symbolically a typical magnetic shift register. The BIMAG elements denoted by circles are coupled together by single diode transfer loops. The odd and even cores are each laced with an advance winding that is alternately pulsed. The data, or information, is stepped or shifted through the register by transferring the contents of the odd cores to the even cores, and then from the even cores to the odd cores by alternate excitation of the advance windings.

Fig. 4 illustrates the application of the conditional transfer loop to the shift register to provide a parallel read-out and storage. In this case, when the odd cores are interrogated by the T_3 signal, the data is transferred to the cores shown above the shift register. This particular conditional transfer loop utilizes a split-winding circuit which isolates the BIMAG elements from each other, except when a signal is present in T_3, and therefore enables the transfer of information selectively from one set of BIMAG elements to another, as shown in this shift register application.

Fig. 5 illustrates a more complex logical circuit which is a combination of more elementary circuits. This particular circuit performs the function of logical AND, or that of a gate. The truth table indicates that a gate will produce an output only for the combination of a AND b. This circuit consists of two cores and requires a cycle of three pulse times. The output occurs at the first pulse time of the cycle succeeding the one in which information is inserted.

The E core is preset to the ONE state at T_1, and the F core is interrogated for output c at this time. Inputs a and b can occur at T_2, and at T_3 transfer between the E and F cores takes place. If a occurs and b does not, no output can occur at T_1. If b occurs and a does not, the transfer at T_3 will present an output at the next T_1. If both a and b occur, the transfer at T_3 will be prevented and an output will occur at T_1. Thus

(*Continued on page* 162)

Bistable Elements

(*Continued from page* 161)

an output occurs only for both a and b and the circuit performs the logical AND function.

Airborne Applications

Let us now turn our attention to a few typical airborne problems such as telemetering and navigation. In telemetering, the basic problem is the collection of a large number of low-level transducer signals from various parts of an airplane or missile to indicate the performance of the device under operational tests and make them available for later analysis. These transducer signals are generally amplified, sampled, and converted to one of a number of types of modulation for transmission to the receiver, which demodulates and records the information for later interpretation. It is also possible to record data within the test device on magnetic tape and later interpret the data.

The BIMAG element, magnetic amplifier, and transistor combination provide an excellent approach to this problem. For example, magnetic amplifiers have been demonstrated that can amplify signals as low as 10^{-18} watts. Magnetic switches or distributors have been built to sample data at rates in excess of 100,000 cps. An analog-to-digital converter can be built with transistors or magnetic cores. The necessary buffers for collecting, storing, and organizing the data for transmission is easily realized with BIMAG elements. Once the data has been transmitted over a radio link to the receiver, it can be collected and stored, or can be operated upon directly to provide the necessary scale factor corrections, or other simple computations can be performed before the data is recorded for later examination. It is equally possible that this data can be collected and the computations performed while the information is being recorded.

The navigational problem lends itself to a similar approach. Here, a greater computation problem exists than found in telemetering. We have examined this problem in detail and found that an entire navigation system can be readily "magnetized." Another technique that might be needed in this application, that is if direct flight control were desired from the input data, would be a power amplifier for driving servomechanisms. This also has been accomplished.

In conclusion, the concepts of a

new component, the BIMAG element, have been presented—a component that is made up of non-aging iron alloys and copper wire, neither of which age appreciably by comparison with some of our better known electronic components today. The BIMAG approach makes possible the realization of airborne control systems with techniques that resist environmental failures far more than do their vacuum tube counterparts. The advent of the BIMAG element opens the airborne control field for miniaturization with lower power consumption and a higher degree of reliability than heretofore possible. It should not be inferred that the BIMAG element is a panacea; there are limitations to the applications of this device just as with all other electronic components. But it appears that the great reliability, long life, low power, and excellent operating characteristics under extreme environmental conditions make the BIMAG element a device that requires careful consideration, particularly as applied to airborne control systems which have a need for the most desirable properties that can be offered.

Temperature Coefficients

(*Continued from page 71*)

For specially accurate non-automatic operation, connecting the capacity meter to a single capacitor by hand offers a temperature coefficient measuring accuracy of 1 ppm.

The heart of the machine is a compact analog computer operating as a capacity meter. It consists of three multiplier stages and one adder stage combined in a bridge circuit with the capacitor under test. The bridge output actuates a synchro and oscillator arrangement to obtain required readings. See Fig. 2.

The four computer stages include: Circuit 1, a multiplier network whose transformation ratio is a linear function of the impedance of the capacitor under test; Circuits 2 and 3, steatite variable capacitors in circuits which multiply by a variable coefficient; Circuit 4, for adding the three output voltages of the preceding circuits.

Computer Circuit

The computer of Fig. 2 is capable of solving the following linear equation:

where $U = (r_1 + r_2 + r_3)\,E$.

U = output voltage of adding circuit.

(*Continued on page 164*)

Temperature Coefficients

(*Continued from page* 163)

r_1 = Circuit 1 transformation ratio.
r_2 and r_3 = Circuit 2 and 3 transformation ratios, which are linear functions of the angle defining the position of the rotor.

E = input voltage common to the three multiplier circuits.

On balance, U = O. The equation is written:

$$r_1 + r_2 + r_3 = 0,$$

which is a linear relation between the change of capacity under test (r_1), and the rotations of the variable capacitors (r_2 and r_3). The two displacements of the two variable capacitors are thus linear functions, respectively, of the active admittance and reactive admittance of the capacitor under test.

Table I
Temperature Coefficient Standardization Table (Based on International Electrotechnical Committee presentation)

Temperature Coefficients x 10^{-6}	Tolerance per °C x 10^{-6} 1A	1B
+100	±15	± 30
+ 33	±15	± 30
0	±15	± 30
— 33	±15	± 30
— 47	±15	± 30
— 75	±15	± 30
—150	±15	± 30
—220	±15	± 30
—330	±25	± 40
—470	±35	± 70
—750	±60	±120

To each admittance variation, $\Delta j\omega C$, of the unknown capacitor, X, there corresponds a complex error voltage which, after high frequency amplification followed by a frequency change (the i-f being 50 cps) and 50 cps amplification, is applied to two motors driving the rotors of the variable capacitors. Motor M_1 of the capacity block (Circuit 2) receives only the reactive component, and motor M_2 of the resistance block (Circuit 3) receives the active component. This result is obtained by means of a 50 cps 90° phase shifter connected to the control of motor M_2. The stopped condition of the motors corresponds to a zero complex error voltage, and the dials then show the changes of capacity (direct reading capacity meter) and of resistance (direct reading megohm meter), respectively, for the capacitor under test.

The input coil, L_1, common to the three multiplier circuits, is connected to the terminals of a 472 kc genera-

tor, HF_1, delivering a balanced voltage, E, of 50 v.

A generator, HF_2, delivers a voltage at 522 kc required for frequency changing. Superimposed on HF_1 voltage, it produces 50 cps beats in a synchronizing block in which a servomechanism constantly maintains this beat frequency in synchronism with that of the line. (This equipment may be modified for 60 cps operation.) The line voltage and the 50 cps voltage proportional to the error voltage are applied simultaneously to the two windings of the two-phase motors driving the variable capacitors.

For simplicity, the effect of stray impedances has been ignored in this description. It can be shown that they cause errors in measurement less than one part in 10^5. It may be noted in the above equation for output voltage, only capacity ratios enter, stability of the high frequency voltage and linearity of the amplifiers having no effect on the final result.

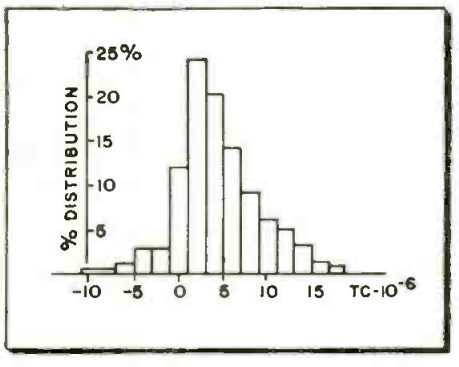

Fig. 5: % distribution vs. temp. coefficients

A noteworthy observation is that this measurement instrument is a kind of combined capacitance bridge and transformer network. No active elements such as tubes can jeopardize circuit stability. As the amplifier is a null detector, the stability of its gain is of no consequence. Also, the multiplying and adding circuit inductances are grounded at their mid-points. The effect of stray capacitance variations between the feeders and ground is thus negligible, although it would be very important if an oscillating circuit were used for measurement.

Machine Construction

As shown in Fig. 4, in addition to the computer the machine comprises 3 measurement positions and an indexing table to shift the capacitor position, plus a closely regulated oven and data notation desk. See layout in Fig. 3.

Each of the three measurement positions consists of two flexible electrodes fixed to a steatite support and carrying at their ends sintered nickel-silver contacts for connection to the capacitors under test. These electrodes are also connected by means of coaxial cables to network 1 of the analog computer, through a precision switch which connects each of the 3 measurement positions in turn. These measurement positions are surrounded by a grounded metal shield.

The capacitors under test are mounted on a cast alloy platform carrying 24 jigs holding one capacitor each. A driving mechanism moves the platform 15° every 40 secs. to bring 3 new capacitors into contact with the 3 measurement positions. During these 40 secs. the automatic switch connects the 3 measurement positions to computer terminals, and the cycle is repeated. When a capacitor has completed its cycle, it has been subjected to 3 measurements (259°C, 90°C and back to 25°C) at a rate of one capacitor every 40 secs.

A semi-circular oven, comprising an air-heating section, a hot stabilized section, and an air-cooled section, subjects the capacitors to their temperature cycle. The "cold" positions are temperature stabilized through room air conditioning. The "hot" position is kept constant at 90°C within 0.5°C by a thermistor temperature control. Furthermore, the hot position is checked by a sensitive thermistor bridge.

A specially designed data notation desk avoids any error of identification. A chain carries measurement cards, and is driven synchronously with the rotating platform. Every time a fresh capacitor arrives at the measurement position, the corresponding card replaces the preceding one in front of the marking window, eliminating accidental operator error. Pilot lights show which of the 3 measurements is being performed. At the end of a cycle, it is only necessary to remove the last capacitor and last card at the same time. The temperature coefficient is very easily calculated immediately by means of an adding machine and nomograph, and the capacitor placed on a rack, sorted according to its TC.

Each of the machine's two working points employs one operator; one inserts the cards on the translation chain, reads the capacity meter computing dial, and makes data recordings at the places indicated by the pilot lights; the other operator places the capacitors on the jigs of the revolving platform, and calculates the TC with the aid of a nomograph based on the equation:
where:

(*Continued on page* 166)

Temperature Coefficients

(*Continued from page* 165)

$$TC\ (ppm) = \left(\frac{10^{-6}}{\Delta\theta}\right)\left(\frac{K}{C}\right)\left(\frac{L_1+L_3}{2}-L_2\right)$$

$\Delta\theta$ = temperature difference between "cold" and "hot" positions.
K = multiplier to transform dial figures into uuf.
L_2 = "hot" reading.
L_1 = first "cold" reading.
L_3 = second "cold" reading.
C = a) for TC within ±100 ppm, C is nominal capacity of units being tested at ±1% or ±2%.
b) for TC below −100 ppm, C is actual capacity of unit previously measured with a Q-meter.

This second operator then sorts the capacitors in accordance with measurement results.

Of course, it would be easy to equip this measuring system with simple, additional automatic controls to make it efficiently operable with one operator only. Even with the existing design, by rotating the measuring positions 45°, the equipment may be operated by one operator, except that measuring time per unit would then increase from 40 to 65 secs.

Based on prototype tests and actual production experience since late 1954, it is apparent that the machine's accuracy and dependability are of a consistently high order, having proven most valuable in stepping up the production of precision ceramic capacitors. Fig. 5 shows how close tolerance groupings were achieved with a batch of 4000 ceramic capacitors. The production control of such batches is greatly facilitated by the TC measuring machine described here.

The U. S. subsidiary of Compagnie Generale de Telegraphie Sans Fil is the American Radio Co., 445 Park Ave., N. Y. 22, N. Y.

Selenium Rectifiers

(*Continued from page* 69)

a stack whose forward resistance has doubled after only 3500 hrs. of operation. Makes B and C both indicate a levelling off at the 5000 hr. mark after increasing 100% from initial forward resistance. Brand D turns out somewhat better than E, although decidedly inferior to the other makes represented.

Temperature

For the lift test plotted in Fig. 6, samples of the five leading brands were run at 100% rated dc load and voltage, as detailed above. However, the ambient temperature was adjusted until the cells reached their

maximum rating of 85° C. The entire test is almost a duplication of the previous one, from the standpoint of proportionate results, except that make E goes to pieces—literally. After only 2600 hrs., his units have doubled their forward resistance, and many of them fail. The record shows that 6 out of 20 samples popped violently between 1500 and 2000 hrs., their plates loosening up in disarranged fashion.

Only one other unit failed during this test. After 300 hours, a stack made by C arced over and burned out—obviously an isolated defect.

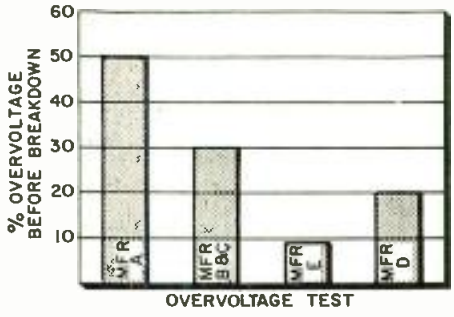

Fig. 10: Performance of five leading brands under conditions of overvoltage

Although, after completion of the run, the coating on all samples representing D appeared blistered to an alarming degree, no failures resulted from the constant cell temperature of 85° C.

However, when the 20 blistered samples underwent a vibration check, 16 failed almost at once, indicating that permanent harm had indeed been done by the sustained heat. In marked contrast, no samples of A failed the vibration test. As a matter of fact, only one sample of each remaining brand failed the shake test.

Current Overload

The next set of curves depicts samples of the five leading brands running for 5000 hrs. at 110% of rated dc load. All other ratings were maintained at 100%. The current overload was chosen to simulate that condition which could accrue with an increase in supply-line voltage from the nominal 117 v. level.

It is apparent at once that even a 10% current overload causes an appreciable degradation of the aging characteristic. After 5000 hrs. of continuous operation, units manufactured by A increase their forward resistance almost 100%. Manufacturer E, according to Fig. 7, turns out cells whose voltage drop doubles within the first 1000 hrs. Moreover, the record shows that many of his stacks break down completely. Before the life test was half over, 11 out of 20 samples made by E had arced through and failed.

Continuing our examination of Fig. 7, we observe that brand C gives an interesting performance. Instead of paralleling B, as in Fig. 5, his curve traces an individual course which indicates that the forward resistance is still climbing at the 5000 hr. mark. For make B, only 4000 hrs. are required to double forward resistance under overload.

But it is really manufacturer D who surprises us. Instead of soaring under the 10% current overload, the voltage drop of his cells increases only by approximately the same factor affecting brand A. Moreover, only 2 failures occurred in the D group, while B and C experienced 4 and 5 breakdowns, respectively. Manufacturer A sustained one failure during this test.

Tests at Maximum Ratings

Fig. 8 illustrates the most rugged (but very necessary) test of all. In this case, the selenium rectifiers are placed in a humidity chamber and then operated at 100% voltage, load and temperature. So that conditions of humidity absorption often encountered in the field may be thoroughly checked, power to the units under life test is interrupted periodically. The cells are allowed to cool off completely, remaining thus for 24 hrs. while the humidity level is maintained. Then power is re-applied for 100 hrs., after which the cooling cycle is repeated.

As might be expected, manufacturer A displays the best performance of the leading five. Cells made by B and C compare with each other favorably, though considerably inferior to brand A. Make D turns out relatively poorly in humidity, while the stacks of manufacturer E fail so frequently after 100 hrs., that the power to his panel is interrupted permanently at that point. The 5000 hrs. plotted in Fig. 8 represent actual operating time, exclusive of the many 24-hr. outage periods.

It is not surprising that humidity causes an increase in the failure rate of all brands. Even manufacturer A sustained 3 failures during this life test. These, however, did not occur until after 3500 hrs., while brand B by that time had chalked up 5 breakdowns, some occurring as early as 2000 hrs. Manufacturer C likewise sustained 5 failures, but these all took place before the 2000-hr. mark was reached.

As for those cells made by manufacturer D, failure rate was definitely

(*Continued on page* 168)

Selenium Rectifiers

(*Continued from page 167*)

discouraging. By 1800 hrs., 9 out of 20 units had broken down completely, with only 6 surviving the 5000 hr. run.

Derating

Early in this article, it was mentioned that derating the radio-type selenium rectifier would bring surprising returns, from the standpoint of life and performance. Fig. 9 depicts this point nicely. To make the illustration complete, reference should also be made to Fig. 5—the life test at rated load.

For the derated life test, dc output current was restricted to 75% of the recommended maximum. Potential input to the units came from a regulated source of 120 vac. All stacks were of the line-voltage variety, rated at 130 v. input.

Once more, manufacturer A outstrips his competition. After 5000 hrs. of constant operation, forward resistance has increased by only 50%. Even brand E shows a marked improvement when derated. Now his cells require the full 5000 hours before doubling their forward resistance. The remaining makes reveal similar improvement.

Limiting the dc output current of course performs a two-fold function. In addition to bringing about a direct reduction in cell temperature, it also retards the flow of RMS current, thereby further reducing the temperature. Thus, the advantage of limiting rectifier load current to some value less than maximum rating, is of a very significant order.

Overvoltage

Fig. 10 illustrates the performance of the five leading brands under conditions of overvoltage. Essentially, this test consists of raising the applied ac potential until one or more cells arc over and rupture the barrier layer. The load is disconnected, but the capacitors remain in the circuit to furnish a constant back emf to the selenium plates.

Although rated at only 130 vac, manufacturer A evidently produces stacks capable of withstanding almost 50% overvoltage before puncturing. Due to the resultant increase in reverse current, however, cell temperature soars very quickly and the inherent characteristics of the stacks vary quite radically.

Turning now to the section plotted for manufacturer E, we observe failures at less than 10% overvoltage.

As a matter of fact, the record shows that some of his units failed at only 5% overvoltage. Makes B and C both required about 30% increase to break them down, while D sustained failures at only 20% beyond ac input rating.

While some may question the merit in such a test, in view of the fact that radio-type cells are rarely subjected to large doses of overvoltage during service, it is felt that this method gains further insight into the quality of cell structure. It is considered highly significant that the brands which stand up best to overvoltage usually make the best rectifiers. This fact has been established consistently, with few exceptions.

10,000 Hr. Run

Our final life test, plotted in Fig. 11, depicts the results of a special 10,000 hr. run. As a rule, tests of this duration are performed only infrequently on radio-TV cells—mainly when new makes are introduced to the industry, or a new process has been developed. Examining the performance of manufacturer A, we find forward resistance completely levelled off after 8000 hrs. At the 10,000 hr. mark, B and C have also levelled off in voltage drop. Make D is still climbing—in a very gradual manner, however—while E's forward resistance has soared hopelessly.

As for the number of failures in this lengthy test—which, incidentally, was run at 100% of all ratings—A had 2 occurring at around 6500 hrs., while B had 3 between 5000 and 6000 hrs. Makes C and D had 5 and 8 failures respectively during the latter period. 50% of the samples selected for E broke down under 6000 hrs.

As has been demonstrated many times, manufacturer A is undoubtedly in a class by himself. Indeed, there may be some question as to whether his quality need be so high for radio-TV applications. Make E, on the other hand, would be a poor choice for equipment manufacturers turning out a quality product.

This discussion covered the five leading brands only. A few of the smaller firms, it is true, produce radio-type stacks far superior to brand E. None, however, approaches the level of excellence enjoyed by A or B.

Because quality variations among even the five leading makes are so broad and devious, the selection of one or more sources of selenium rectifiers for radio-TV applications becomes a hazardous undertaking, indeed. Only by actual life-testing can dependability be assured.

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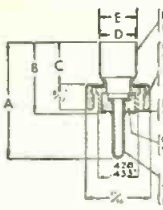

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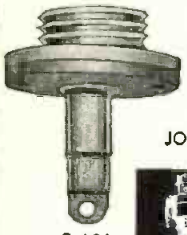

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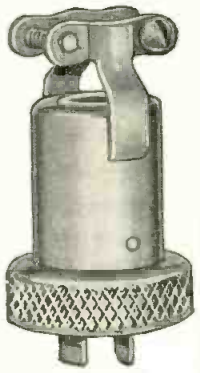

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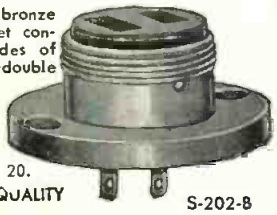

S-202-8

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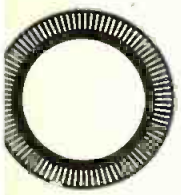

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News of MANUFACTURERS' REPS

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Manufacturer of hermetic terminals seeks reps in the following areas: Upstate N. Y.; Fla., Ala., Ga.; Denver; Northern Calif. (Ask for R-4-1)

M. K. Widdekind Co., Seattle, Wash., has been appointed exclusive rep in the Northwest territory for Foto-Video Laboratories, Inc., Little Falls, N. J.

Brimberg Associates, 1028 Conn. Ave., N. W. Wash. D. C., is a new firm engaged in engineering sales rep of and consultation for electronic manufacturers in the instrumentation and systems fields. Firm covers District of Columbia, Dela., Md., and Va.

Lester L. Dunscomb has joined the staff of **Ridley Associates**, manufacturers reps of Chicago, Ill.

Sid Levin & Associates, Cleveland, Ohio, has appointed Max Bauer as sales engineer to contact electronic parts distributors and original equipment manufacturers in Ohio, Western Pa., W. Va.

Don V. Hamilton Co., Minneapolis, Minn., has been appointed regional sales rep, for the William Brand Co., Willimantic, Conn., in N.D., S.D., Minn., and Western Wis.

Automatic Switch Co., Orange, N. J., has announced the appointment of **Koontz-Wagner Electric Co., Inc.**, South Bend, Ind., as authorized stocking distributors of ASCO solenoid valves.

Lincoln Sales Corp., Baltimore, Md., has been appointed distributor for the TV and broadcast receiver div. of Bendix Aviation Corp. in Md., the Delaware peninsula, and northeastern W. Va.

Rush S. Drake Associates, Seattle, Wash., has been appointed to represent Allen B. Du Mont Laboratories, Inc., Clifton, N. J., in the Northwest for the sale of cathode-ray oscillographs and electronic instruments and other technical products.

J. T. Hill Co., San Gabriel, Calif., is now representing Non-Linear Systems, Inc., Del Mar, Calif., in Calif., Ariz., Nev.

Appointment of the **Robert E. McClendon Co.**, E. Albuquerque, N. M., as an authorized Kollsman Instrument Corp., Elmhurst, N. Y., engineering sales rep. has been announced.

Martin Laughlin, Lexington, Mass., has been named a sales rep for the Warner Electric Brake & Clutch Co., Beloit, Wis. He will cover Vt., Conn., western Mass., and eastern N. Y.

Charles L. Thompson Ltd. have been appointed reps for western Canada by University Loudspeakers, Inc., White Plains, N. Y.

Clayton J. Heller, Marshall, Mich., has been named rep for the sale of mobile equipment in all of Mich., except the Upper Peninsula, by Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

James Vibrapower Co., Chicago, Ill., has appointed the **G. M. Cole Co.** as their industrial sales reps in Ill. and Wis.

Members of the **Empire State Chapter of "The Representatives" of Electronic Products Manufacturers, Inc.** re-elected to office for 1956: John L. Stone, president; Gordon LeRoy, vice-president; Marshall Ball, secretary; and Joseph S. Marsey, treasurer.

William L. Power has joined the staff of **R. C. Nordstrom & Co.**, Birmingham, Mich. He will call on jobbers and industrials in Mich.

J. J. McBride Sales Co., factory reps, have appointed Lou Lysak to the sales force. The firm also announces a move to new headquarters at 328 E. Burlington St., Riverside, Ill.

John A. Green Co., Dallas, Tex., has been named exclusive sales engineering rep for Tenney Engineering, Inc., environmental equipment, to cover Tex., Okla., Ark., and La.

Appointment of **M. J. S. Electronic Sales Ltd.**, Ajax, Ontario, as exclusive engineering and distributing reps for all of Canada has been announced by Shielding, Inc., Riverside, N. J.

J. K. Dooley Co., Seattle, Wash., has been appointed Pacific Northwestern reps for ORRadio Industries, Inc., Opelika, Ala. Territory includes: Wash., Ore., northern Idaho, western Mont., and Alaska.

Appointment of **R. C. Metzler & Associates** as sales reps to serve customers in the Buffalo and Syracuse areas has been announced by the Fielden Instrument Div. of Robertshaw-Fulton Controls Co.

Wes Alderson has been appointed by General Dry Batteries, Inc., Cleveland, Ohio, as the company's manufacturers rep in the Los Angeles area.

Bud Radio, Inc., Cleveland, Ohio, has announced the appointment of **Tenatronics, Ltd., Ontario,** as exclusive Canadian reps for distribution and stocking of Bud products for customers in Canada.

Helicopter Navigation

(*Continued from page 91*)

the requirements of a helicopter Nav-Aid. Decca, being an area coverage system allows any desired track or series of tracks, including delay paths and holding patterns, to be followed.

Group 3—Airborne Radar. Such equipment is now heavy but light weight equipment is under development for helicopters. Airborne Radar, free from ground installations, appears to have positive value as a secondary navigation and approach aid.

Group 4—Visual Aids. Within an area of limited practicability, special ground lights may make it possible to conduct safe and reliable helicopter operations. The disadvantages of visual aids are the large number required, the problem and costs of obtaining ground sites, and the cost of erection and continued maintenance.

The limited operational evaluations conducted to date with basically fixed-wing navigation systems have shown that a definite need exists for a true and completely compatible system for helicopters, one that would meet the following general criteria:

1. Helicopters must utilize separate traffic lanes in the lower altitudes, (below 2000 ft.). An altitude separation line between rotary and fixed-wing aircraft would be desirable.

2. High frequency helicopter operations require a very conservative use of airspace. The 10 mile airway width should be reduced to a 3 mile width for designated helicopter airways.

3. A time or spacing separation must be provided for flights proceeding along identical flight paths.

4. In major terminal areas the width of a helicopter airway should be in the order of 1 mi.

5. In major terminal areas it appears necessary to reduce altitude separation of aircraft to at least 500 ft.

6. Development of automatic electronic air traffic control equipment.

7. The let-down aid should be designed for operation in congested areas with high obstructions close-in.

8. Utilize one aid for enroute navigation and let-down procedures.

9. The let-down aid should be capable of holding a given approach flight track within a permissible deviation of plus or minus 100 ft. from the centerline.

10. Helicopter approach to landing under complete instrument conditions should be in the order of a 7° angle at a forward speed of 40 knots or lower and at approximately 500 ft. per minute.

11. Current developments of radar for collision warning apply to helicopter operations. A range of 10 mi. appears adequate for helicopter operations.

12. Development of accurate air speed indicators and altimeters.

13. The ANC standards of separation should be revised to recognize the unusual flight characteristics of the helicopter and to permit the development of suitable Nav-Aids and air traffic control procedures. Finally, while the true helicopter navigation system will undoubtedly require the development of new devices, every consideration should be given to the use of proven available equipment.

Image Orthicon

(*Continued from page 73*)

teristic will illustrate the means employed. The output curve for any I.O. tube is a linear function of light input up to a certain point. From this point on, the output is shown as not increasing (Fig. 6).

It must be borne in mind that this curve is a "static" characteristic and does not indicate the dynamic operation for cases where the peak highlights or whites in a normal scene rise to values above the knee. Due to electron redistribution, what happens here, in effect, is a shift of the slope of the curve to a new line where the peak highlights just rise to the flat portion.

This shift of the slope of the output vs. illumination curve may be called the "AGC Characteristic" of the I.O.

It is possible to adjust the operating range of the tube by means of the lens stop so that high lights in which detail is desired are set to the knee of the curve on the lowest illuminated scene in a series of scenes. Then no essential change in camera output occurs when the camera is focused on a scene having higher brightness values. Such a scene is immediately detected by the presence of halo, seen as black above the shoulders of the subject in Fig. 8.

Although this method of operation relieves the camera control operator of making continual readjustments and permits the lighting man greater margin of adjustment of lighting at some saving of his time, it is a very

(*Continued on page 174*)

TELE-TECH ADVERTISERS— APRIL, 1956

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Image Orthicon

(*Continued from page* 172)

uneconomical way to operate a camera tube.

The operation of the target depends on conduction through the glass neutralizing the charge difference between the mesh (image) side of the glass and the beam side. This conduction takes place by ionic means. Sodium ions (positive) migrate through the glass and neutralize the charge as they move from the mesh side to the beam side. Once this charge has been neutralized by this migration, there is no force present to cause them to return to their starting points. Since the initial required resistivity of the glass target has determined the quantity of ions available we have a "bank account" of a certain size upon which we can draw. When the total quantity available decreases, the time required to neutralize the charges increases—which is another way of saying that the resistivity of the glass increases. When this phenomenon takes place, a charge potential drop exists through the glass target after a scan and we have a "sticky" tube. As the supply of free ions further diminishes, the time required to completely neutralize this image increases. When the process has proceeded far enough the tube becomes unusable and has to be retired from service.

From the foregoing, it is evident that any type of operation which results in the use of more than the minimum required quantity of ions to produce an acceptable picture is a waste of our original bank account. It behooves us then, to adopt every means of conserving this supply.

First, be sure the cameras always are capped when not in use. Second, adjust the lens stops on *each* camera so that peak highlights just reach the knee of the curve. If this adjustment results in "crowding" of the blacks so that background information is lost, increase the illumination on these darker areas by "spotting" them. Third, because the available charge potential increases with the target potential, it is important that this latter be set at not more than 2.0 v. for the 5820 type tube. Higher target potentials result in a greater rate of charge utilization with consequent shortening of life.

These requirements for conservation of the available target life modify the operation of the camera only to the extent that we use the so-called AGC characteristic as a safety factor backstop. We must, for economy, insist that lighting be closely controlled to brightness ratios of less than one stop on the lens, or a ratio of less than 2/1 between scenes. The closer the control the better.

So far in our discussion we have been considering the camera alone. When we talk of image reproduction, we must take into account the entire system. This includes the camera chain, the remainder of the studio system, the transmitter, the propagation medium and the receiver and picture tube. How much signal contrast range can we accommodate through all of these media?

A cursory glance at the I.O. characteristic would indicate a contrast range of 100 to 1 was available. However, because of masking of blacks in the lower light region by dynode blemishes, noise figure etc., the effective signal-to-noise ratio of the tube is quoted at 35/1 for the 5820. This is our starting point.

In the channel output signal adjustment we impose another set of limitations. If we set a value of unity, or 100% for peak white, and a value of set-up of 5% (the minimum value in the FCC standards), we have reduced our available range to 100/5 or 20/1. If we assume ideal conditions of transmitter amplitude response linearity, and a low noise signal path, we arrive at the receiver with this maximum ratio of 20/1.

The average picture tube's grid drive characteristics reveal that it has, between essential beam out-off and the bloom point voltage, a ratio of only 7 or 8 to 1. At the expense of linearity in the black region, we gain from this low ratio to a screen brightness ratio of 15 or 20 to 1 after making allowances for the masking effect of room light. This is the best we can do for the system as a whole.

What effect do these limitations have on the adjustment and operation of the camera tube? If we ignore the contrast range limitation and illuminate our sets for the full artistic range of the eye, we come up with a contrast range which exceeds the capability of the system. It may even, and often does, exceed the range of the camera at normal beam, target, and lens settings. The camera control operator, being a conscientious man who hates to see the gray scale squashed at the black end with a resultant "muddy" picture, is liable to advance his target setting, and/or open up the lens to get the detail in the blacks. This will result in excessive charge currents in the target and shorten the tube life.

The only correct means of over-

(*Continued on page* 176)

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Image Orthicon

(*Continued from page 174*)

coming this situation is to increase the light in the dark areas so as to reduce the contrast range. Let me be specific. This extra light should fall only on these dark background areas and not on any of the subjects who might move into these areas during the scene. This imposes restrictions on the type, size and location of the lights used and might at times be tricky. Here is where the use of a good brightness meter pays dividends. With this instrument, it is easy to measure the actual contrast range that the camera sees.

A simpler, less quantitative, but adequate means of checking is to locate a standard RETMA chart on set and check the gray scale with the normal set lighting Fig. 5. A clean RETMA chart is printed with a contrast range of 30/1 from white to black. If the normally adjusted camera accepts this range from the chart and looks muddy in the darker background areas of the set, then these areas have too low a brightness and should be lightened. In actual practice, a clean RETMA chart should be used on the set to adjust the lens stop. The lens should then be set to the point where the white on the chart just starts to drop in level. Points of higher reflectance in the scene will not go above the knee far enough to cause excessive charge currents.

Summary

Let us summarize the requirements for good contrast range of a received picture.

1. A setting so designed and illuminated as to have a brightness (contrast) range of 20 or 25 to 1 maximum.

2. The cameras adjusted for the following conditions:

a. Target voltage of 2 volts above cutoff.

b. Beam (bias) control set to the point where the peak whites reach maximum. This is the point at which the whites just discharge.

c. The lens stop adjusted to the point where these peak whites just limit at the knee of the curve.

Under these conditions a good picture must be obtained. Since by now the principles of proper camera adjustment are so widely known in the industry, most cameras are normally correctly adjusted, and the difficulties in producing a good picture in the home are the result of forgetting our limitations on initial scene contrast range.

There is one type of picture which may look excellent on our monitors but which never looks good on the average home receiver. This is the image of the human face against a black background. The trouble here arises from the lack of good DC insertion in the receiver. Due to this lack, the picture tube background or bias point shifts in accordance with the average signal. Because the average signal is a small portion of that of the over-all image, the bias shifts so that the black area comes up to a gray value and the facial tones run up to the blooming region. You can reduce the brightness setting on a receiver under these conditions and when the background becomes black the face will again have detail. The only means of avoiding the poor effect of the receiver image is to include enough lighted area in the background to insure a relatively large average signal.

Adherence to these fundamentals will enable the user to obtain the maximum in reliability and life from his image orthicon tubes, together with consistent and high grade image quality.

Fig. 7: Removing the camera lens turret

Fig. 8: Key to correct camera operation is seen in shadow above object's shoulders

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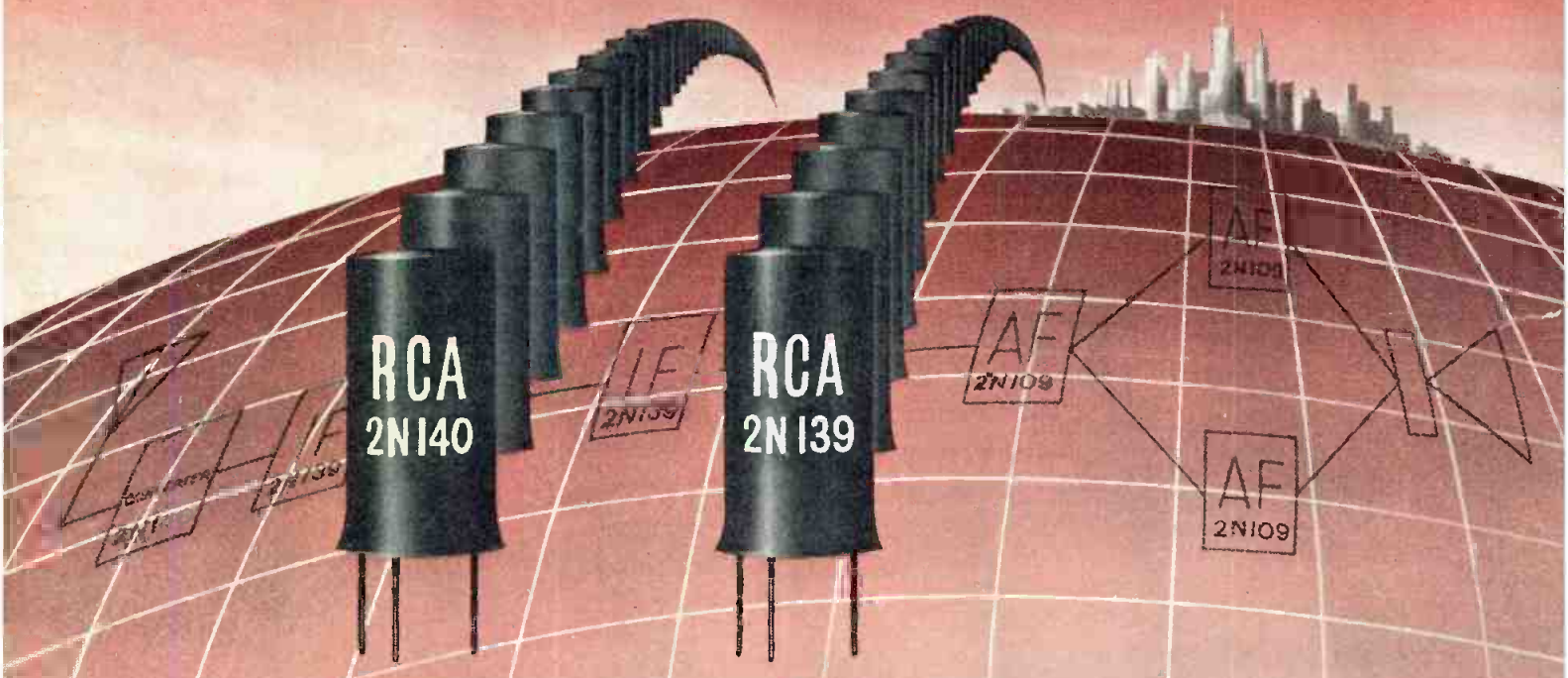

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Operating Temperature (°C)	50	70	70
Typical Operation†:	**Class B Amp.**	**455-Kc IF Amp.**	**Converter**
DC Collector Volts	—9	—9	—9
DC Emitter Ma	—2††	1	0.4
Useful Power Gain (Approx. db)	33	30	—
Useful Conversion Power Gain (Approx. db)	—	—	27
Typical Noise Factor (Approx. db)	—	4.5	—
Power Output (mw)	160*	—	—
Parameters and Characteristics:			
Feedback Capacitance (uuf)‡	—	9.5	9.5
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Base Resistance (ohms)‡	—	75	90
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