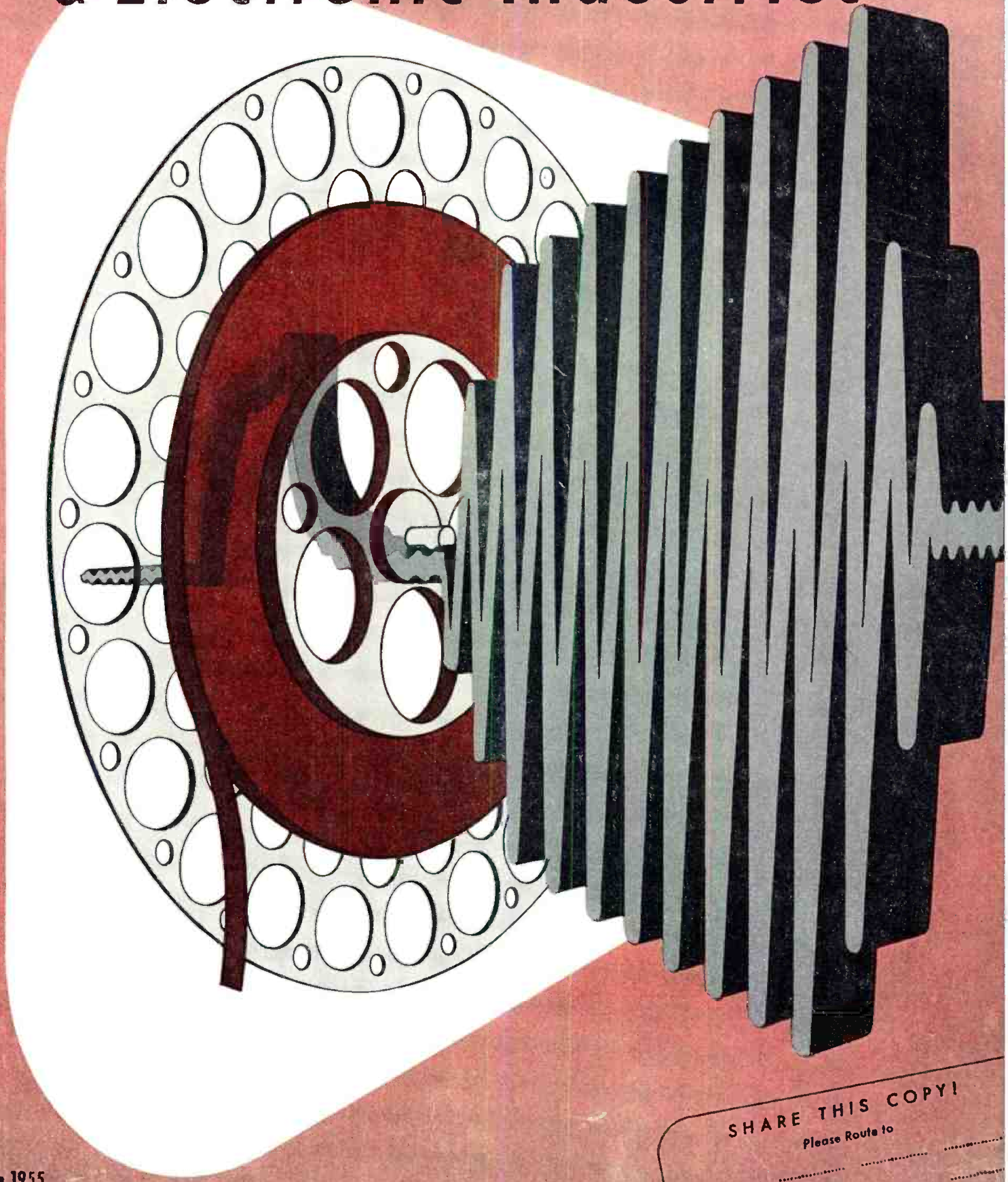
TELE-TECH
& Electronic Industries



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Please Route to

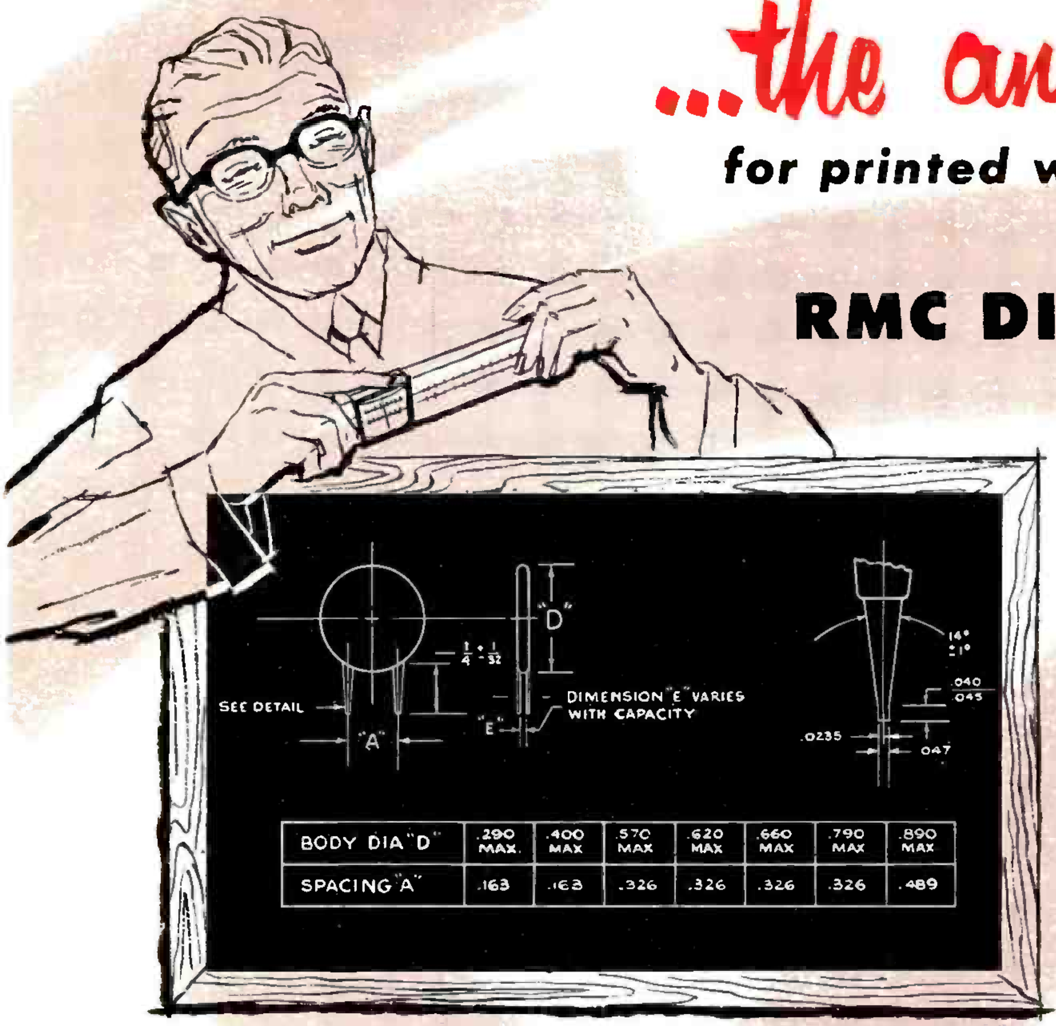
July • 1955

Caldwell-Clements, Inc.

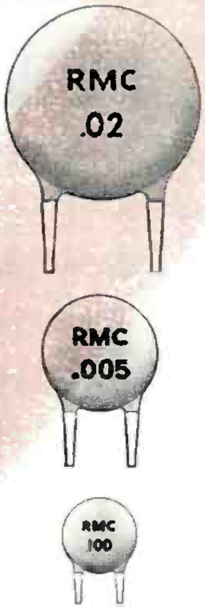
...the answer

for printed wire circuits

RMC DISCAPS®



BODY DIA "D"	.290 MAX.	.400 MAX	.570 MAX	.620 MAX	.660 MAX	.790 MAX	.890 MAX
SPACING "A"	.163	.163	.326	.326	.326	.326	.489



Wedg-loc . . . The exclusive wedge leads on these DISCAPS lock securely in place on printed circuit assemblies prior to the soldering operation. There is no possibility of the capacitors becoming loose or falling out and the soldered connection is always uniform.

Available in capacities between 2 MMF and 20,000 MMF, Wedg-loc DISCAPS can be furnished in temperature compensating, by-pass, and stable capacity types. Suggested hole size is a .062 square.

Plug-in . . . RMC plug-in DISCAPS are designed to simplify production line problems on printed circuits. Leads are No. 20 tinned copper (.032 diameter) and are available up to 1½" in length. Plug-in DISCAPS are manufactured in temperature compensating, by-pass, and stable capacity types and include the mechanical and electrical features that have made standard DISCAPS the favorite of leading manufacturers.

Write today on your company letterhead for expert engineering help on any capacitor problem.

DISCAP
CERAMIC
CAPACITORS

RMC

RADIO MATERIALS CORPORATION

GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Capacitors

TELE-TECH
& Electronic Industries

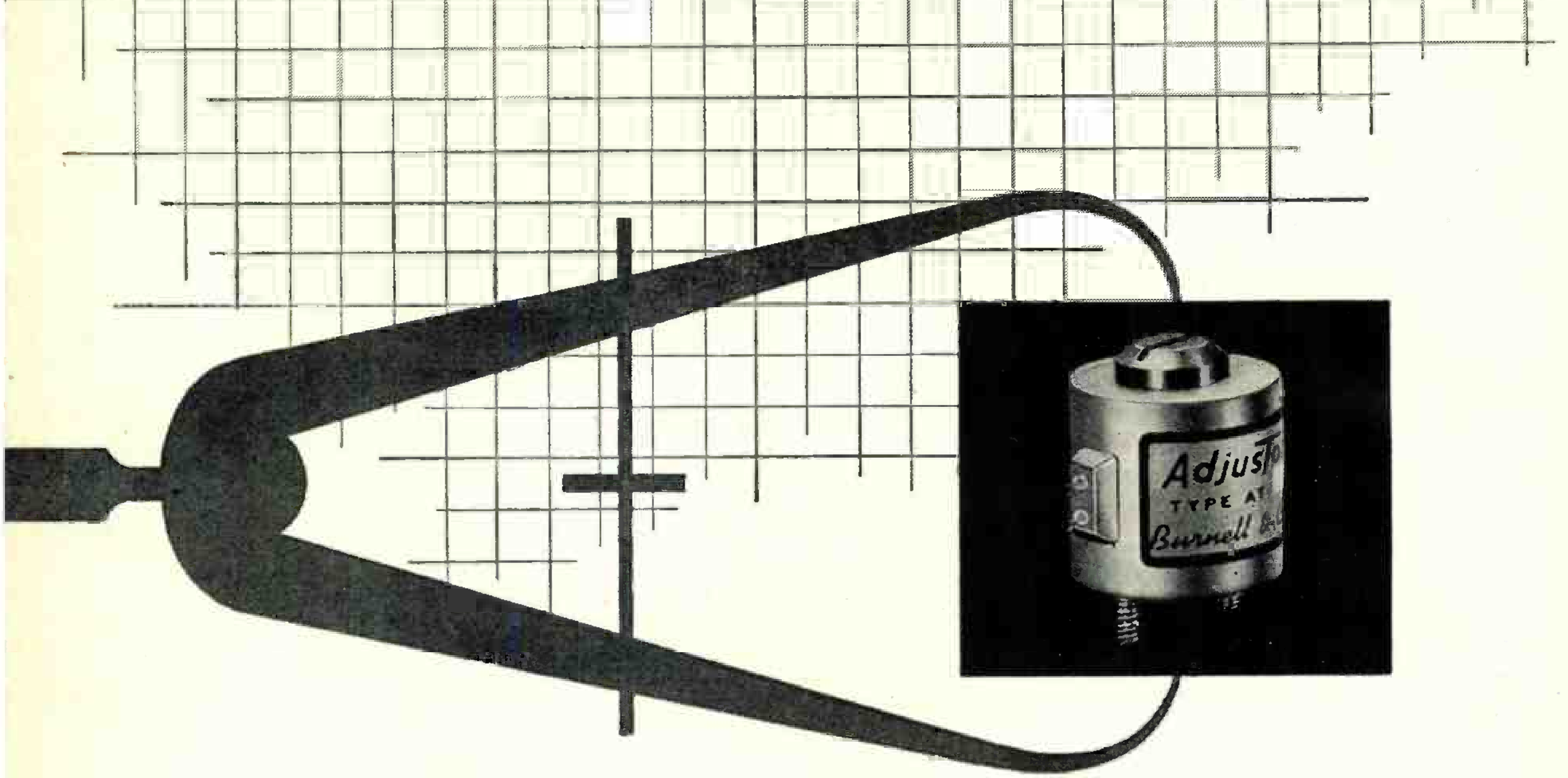
JULY, 1955

FRONT COVER: VIDEO TAPE RECORDING of television programs, symbolized by reel and color TV waveform, holds great promise for future improvements in broadcasting operations. Prototype video tape recorders have been successfully demonstrated in field trials, but further engineering refinement is expected before such units are commercially available. Recent spot check of TV station operators shows optimistic outlook for increased color programs this fall, with growing number making and planning color film or live installations, utilizing existing equipment.

DEPARTMENTS

TELE-TECH & ELECTRONIC INDUSTRIES, July 1955, Vol. 14, No. 7. Published monthly by Caldwell-Clements, Inc. Publishers also of MART and TECHNICIAN. Publication Office, Emmett St., Bristol, Conn. Editorial, advertising and executive offices, 480 Lexington Avenue, New York 17. Telephone PLaza 9-7880. M. Clements, President; M. H. Newton, Assistant to President; John J. Borghi, Vice President and Treasurer; M. B. Clements, Secretary. Acceptance under section 34.64 Postal Laws and Regulations authorized at Bristol, Conn., June 9, 1954. Additional acceptance at New York, N. Y. 75¢ a copy. Subscription Rates: United States and U. S. Possessions: 1 year $5.00; 2 years $8.00; 3 years $10.00. Canada: 1 year $7.00; 2 years $11.00; 3 years $14.00. All other countries: 1 year $10.00; 2 years $16.00. Please give title, position and company connections when subscribing.

AdjusToroiD®



Introducing A LOW-COST ADJUSTABLE TOROID

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- eliminates critical close tolerance capacitors
- high Q
- no external power supply
- truly hermetic sealing
- temperature coefficients same as fixed toroids
- no increase in case diameter
- developed by Burnell, creators of the Rotoroid®

Write for Adjustoroid Technical Brochure A 55

LET BURNELL ENGINEERS SHOW HOW USE OF ADJUSTOROIDS REDUCES EQUIPMENT COSTS

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Teletype: Yonkers, N. Y. 3633

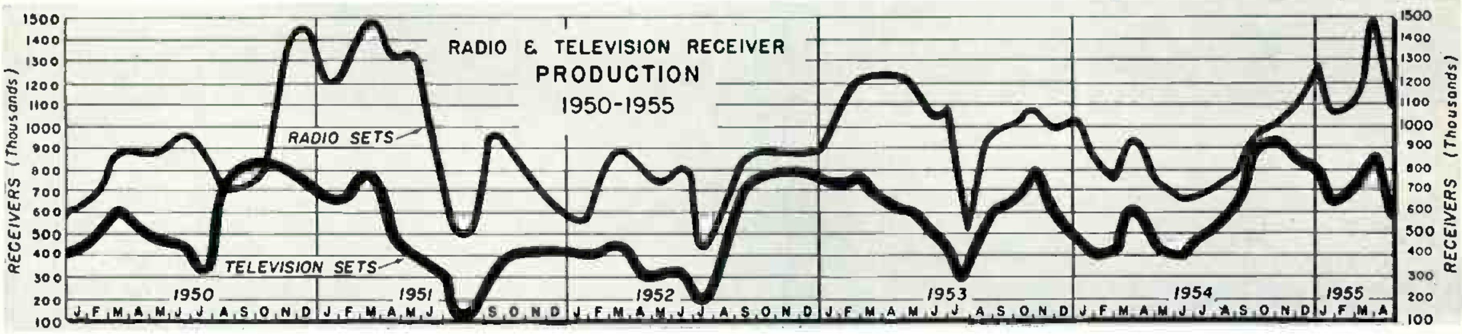
BURNELL & CO., INC.

45 Warburton Avenue
Yonkers 2, New York
Pacific Division: 720 Mission St., S. Pasadena, Calif.

Copyright patent applied for

Facts and Figures Round-Up
July, 1955

ELECTRONIC INDUSTRIES TOTALS



Recorders and Tape Reels

The Magnetic Recording Industry Association of New York in conjunction with the Armour Research Institute reports:

Recorders

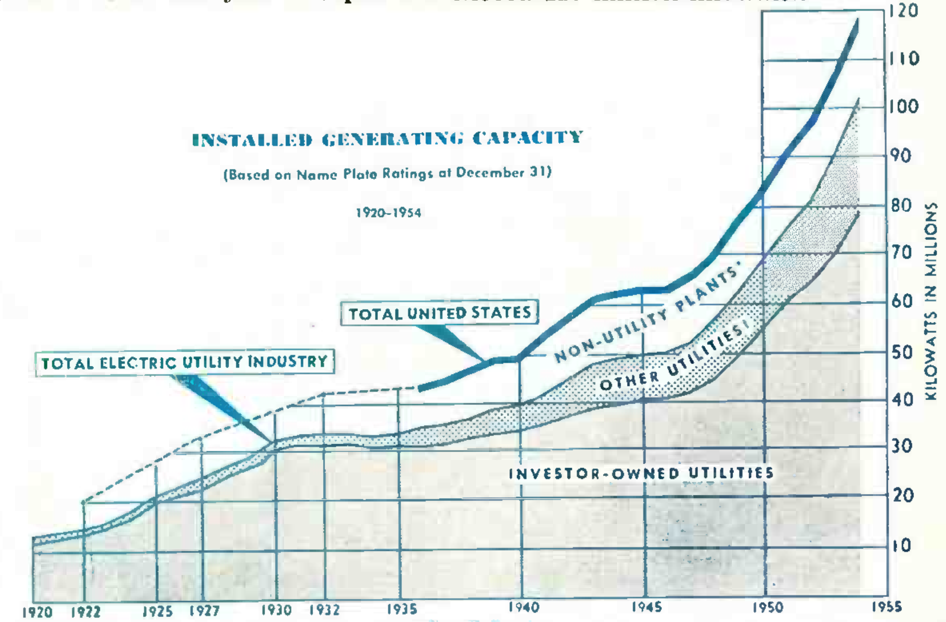
1954 Quantity Sold $300.00 and Under	Previous Years Quantity Sold over $300.00
225,000	10,041

TAPE REELS

Year	3 Inch Diameter	4 Inch Diameter	5 Inch Diameter
1952	—	—	836,605
1953	178,274	79,380	933,084
1954	188,288	159,450	1,555,795

Year	7 Inch Diameter	Tape Capacity In Feet
1952	1,742,630	2,593,119,000
1953	2,284,464	3,351,762,300
1954	3,630,574	5,366,352,000

Chart from the 1954 Statistical bulletin issued by the Edison Electric Institute depicts growth of installed electrical generating capacity in the U.S. from 1920 to 1954. This year's output will exceed 120 million kilowatts.



* Includes capacities of Industrial, mine, and railway electric power plants † Includes cooperatives and government-owned utilities

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in May 1955.

Accelerometers	115,954
Accessory Units, station control	178,996
Actuator Assys, etc.	826,641
Actuators	338,559
Adapters	232,992
Adjusting Sets, dc	33,690
Amplifiers	623,277
Antennas	32,182
Antenna Supports	100,036
Antenna Supports, tower	675,307
Arctic Tower, AF	58,320
Attachments, l-f radio range	218,800
Batteries	4,621,313
Boroscopes	21,572
Bridges, capacitance	40,983
Cable	203,310
Cable, AF	84,492
Cable Assys, AF	69,582
Cable, r-f	1,455,967
Calibrator Sets, frequency	33,098
Capacitors, analyzer	77,527
Capacitors, fixed	31,531
Comparators	39,093
Compasses, pilot standby	45,128
Components, autopilot	78,140
Components, spare parts	557,743
Computers	355,216
Computer Sets	13,922
Control Boxes	28,192
Controls, radar set transfer switch	101,499
Control Systems	1,839,250
Converters	1,095,362
DC Power Drives	821,430
Director Control Mechanisms	728,229
Disconnect Assys and Connectors	75,694
Driftmeters	100,250
Dynamotors	40,000
Dynamotors, Mountings, etc.	246,232

Film, radiographic	1,110,256
Firing Mechanisms	225,959
Generators	184,643
Generators and Cabinets	31,510
Gun Directors	694,980
Headset Assys	187,455
Headsets	1,020,037
Hydrophones and Projectors	192,700
Indicators	1,040,179
Indicators, airspeed	257,207
Indicators, gyro horizon	1,137,371
Indicator, master control, etc.	7,263,695
Kit, CRT	29,700
Kit, grid overlay	54,434
Kit, field change	197,703
Kit, modification	194,955
Kit, modification, radar control	31,762
Line Section	41,909
Meters	113,452
Microphones	562,513
Microwave "Mega-Node"	35,538
Modification, Starters	96,134
Modulators	241,724
Modulators, radar	39,370
Motor Assys	70,705
Motor-Generators	936,526
Motors and Generators	41,147
Mounting Racks	44,022
Mountings	344,830
Multimeters	45,067
Panels, power	166,340
Parts	39,167
Power Supplies	34,152
Radar Set Parts, training	25,000
Radio Sets	39,745
Radiosonde	296,852
Radio Transmitting Sets	2,609,397
Receivers	281,679

Receivers, radio	108,962
Receiver-Transmitters	58,793
Rectifiers	23,750
Regulators, voltage	520,779
Relays, Transformers, etc.	93,326
Resistor-Potentiometers	29,860
Resolvers	126,800
Rotors	38,210
Screens, projection	39,401
Shield Assys	35,395
Simulators	124,523
Spare Parts, radio set	28,161
Starter Generators	812,834
Switch Assys	63,356
Switchboards	31,559
Switches, lobe	255,324
Switches, thermostatic	477,728
Telephone Sets	705,692
Test Equipment	66,399
Test Sets	135,194
Test Sets, radar recording camera	162,527
Test Sets, radar	47,634
Test Sets, radio	83,360
Thermometers, Indicators, Voltmeters, etc.	377,049
Tower, steel, AF	844,800
Transmitters	871,435
Transmitter Sub-Assys	135,080
Transmitting Sets	1,971,513
Tubes, carcinotron	27,355
Tubes, electron	1,922,575
Voltmeters	54,768
Vibrators	49,062
Wire, electric	635,822
X-Ray Apparatus	34,800

Your source for 2K50

REFLEX KLYSTRON TUBES

The new Bendix Red Bank 2K50 is the perfect answer for those who want a thermally-tuned Reflex Klystron tube for K-band operation.

The 2K50 has two primary applications—first, as a local oscillator in small, compact, lightweight, high definition radar and, second, as an oscillator in microwave spectrometers, signal generators and spectrum analyzers.

Because of its thermal feature, the 2K50 may be tuned automatically. Thus, it is ideally suited for difficult locations . . . in aircraft, for example . . . where direct or mechanical tuning is not practical.

Perfection of the complex, ultra-precision 2K50 . . . one of the most difficult electron tubes to manufacture . . . is a tribute to the unique talents of our engineers and production men. It demonstrates why you can depend on Bendix Red Bank for the answer to *any* special-purpose electron tube problem you may have.

MAXIMUM RATINGS

Resonator Voltage	330 volts D.C.
Reflector Voltage	—150 volts D.C.
Tuner Grid Voltage	—50 volts D.C.
Filament Voltage	6.3 ± 8% volts
Gun Cathode Current	28 ma. D.C.
Tuner Cathode Current	10 ma. D.C.

ELECTRICAL CHARACTERISTICS

Heater Voltage (A.C. or D.C.)	6.3 volts
Heater Current	.755 amps.
Thermal Tuning Range	23216 to 24751 Mc/Sec.
Min. Power Output at 23504 Mc/Sec.	8.5 mW.
Min. Power Output at 23984 Mc/Sec.	10.0 mW.
Min. Power Output at 24464 Mc/Sec.	8.5 mW.
Min. Electronic Tuning at Mid-Band	55 Mc/Sec.

PHYSICAL CHARACTERISTICS

• Dimensions: Maximum seated height 2¼" • Base: Small Octal 8-Pin, B8-21, Low Loss Phenolic Wafer • Coupling to Wave Guide: Direct, by means of an insulating fitting • Cooling: Convection • Mounting Position: Any • Cavity: Silver Plated Steel (integral within the bulb) • Bulb: Metal • Output Window: Low loss glass

Manufacturers of Special-Purpose Electron Tubes, Inverters, Dynamotors, AC-DC Generators, Voltage Regulators and Fractional H.P. DC Motors.

Bendix Red Bank — ECLIPSE

DIVISION OF

THE NAME Bendix AVIATION CORPORATION MILLIONS TRUST

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Canadian Distributor: Aviation Electric Ltd., P.O. Box 6102, Montreal, P. Q.

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CIRCULATION NOW 27,000

An increase of 5,000, effective with the January 1955 issue, provides greater penetration of plants, stations and laboratories in the primary markets of the industry—Manufacturing, Broadcasting and Armed Forces procurement.

These are the markets with greatest buying power and greatest expansion, industrially and geographically.

The circulation of TELE-TECH is increasing in two ways:

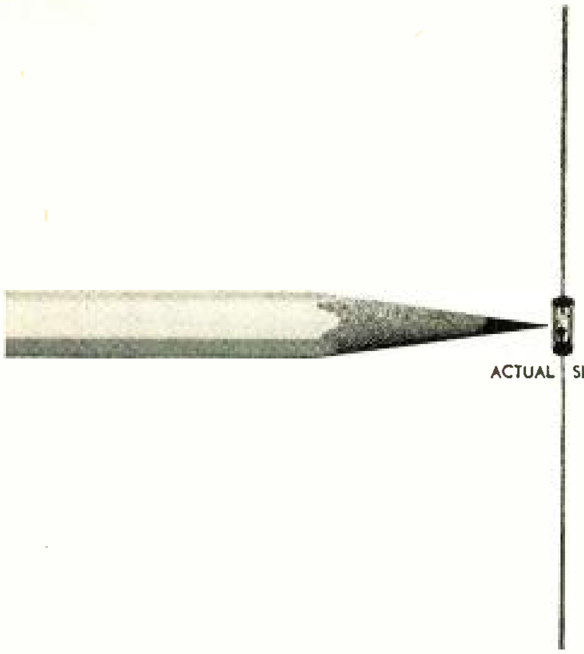
1—Growth of TELE-TECH's Unit Coverage of top-ranking engineers—the magazine's basic readership, preselected for complimentary subscriptions.

2—Making paid subscriptions available to other engineers in research, design, production, operation and maintenance.

Although currently effective, the increased circulation cannot appear in audit statements until the first half of 1955 is audited.

THE ELECTRONIC INDUSTRIES DIRECTORY

Published annually as an integral section of TELE-TECH in June



ACTUAL SIZE

34 Years of Glass Technology and Skill in Tube Manufacturing is Your Assurance of Stability in CBS Glass Diodes

ENLARGED 9 TIMES

Here's why CBS diodes have uniformly stable electrical characteristics.

1. During manufacture, mechanical pressure of each catwhisker on its crystal is the same.
2. This pressure is locked in permanently by rigid glass-to-metal seals.
3. Humidity and contamination are *sealed out* . . . stability is *sealed in.*
4. CBS glass diodes are rugged. Repeated bending of leads will not break glass.

CBS-Hytron's Commercial Engineering Department will recommend the best in diodes, or tubes, for your applications upon request.

Ask for data on CBS Glass Diodes

Gold bonded computer . . . silicon uhf . . . video detector and harmonic generator . . . and general purpose diodes . . . all available in the new CBS subminiature line.

Quality products through *ADVANCED-ENGINEERING*

CBS

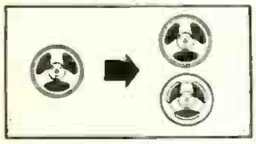
CBS-HYTRON, Danvers, Massachusetts . . . A DIVISION OF COLUMBIA BROADCASTING SYSTEM, INC.

For product information, use inquiry card on last page.

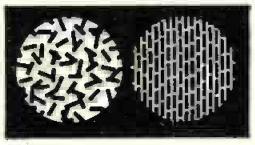
Now...record the *whole* performance... without a break!

YOU'LL GET EVERY NOTE of your favorite concert broadcast, sports event or dramatic program when you put it on new "Scotch" Brand Extra Play Magnetic Tape 190. Half as thick as conventional tapes but made with strength to spare, new Extra Play tape offers *50% more recording time* on a standard size reel. Thus, annoying interruptions for reel change are reduced to a minimum.

"Scotch" Brand's exclusive new oxide dispersion process gives you more brilliant sound, too. By packing fine-grain oxide particles into a neat, thin pattern, "Scotch" Brand has been able to produce a supersensitive, high-potency magnetic recording surface on Extra Play Magnetic Tape. Hear the difference yourself. Try new "Scotch" Brand Extra Play Magnetic Tape 190 on your machine *today*.



EXTRA-THIN. 50% thinner, more potent oxide coating, 30% thinner backing permit more 190 Tape to be wound on standard-size reel. Result: one roll of new tape does job of 1½ reels of ordinary tape.



ELECTRON PHOTO microscope shows the difference! At left, artist's conception of view of old-style oxide coating. At right, "SCOTCH" Brand's new dispersion process lays oxide in neat, fine-grain pattern.

REG. U.S. PAT. OFF. SCOTCH BRAND *Extra Play* Magnetic Tape 190

The term "SCOTCH" and the plaid design are registered trademarks for Magnetic Tape made in U.S.A. by MINNESOTA MINING AND MFG. CO., St. Paul 6, Minn. Export Sales Office: 99 Park Avenue, New York 16, N.Y.

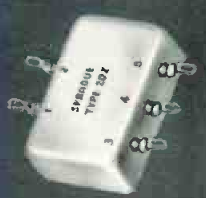
3M COMPANY

choose from this complete line of

MINIATURE PULSE TRANSFORMERS

Type 10Z
tubular pulse transformer

Type 15Z
miniature bathtub pulse transformer



Type 20Z
drawn-shell bathtub pulse transformer

Type 41Z
plug-in pulse transformer

NOW YOU CAN CHOOSE from eighteen standard pulse transformers in four major construction styles, all in quantity production at Sprague. The standard transformers covered in the table below offer a complete range of characteristics for computer circuits, blocking oscillator circuits, memory array driving circuits, etc.

These hermetically sealed units will meet such stringent military specifications as MIL-T-27, and operate at temperatures up to 85°C. Special designs are available for high acceleration and high ambient temperature operation. In addition, the electrical counterparts of each transformer can be obtained in lower cost housings designed for typical commercial environment requirements.

Complete information on this high-reliability pulse transformer line is provided in Engineering Bulletin 502A, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

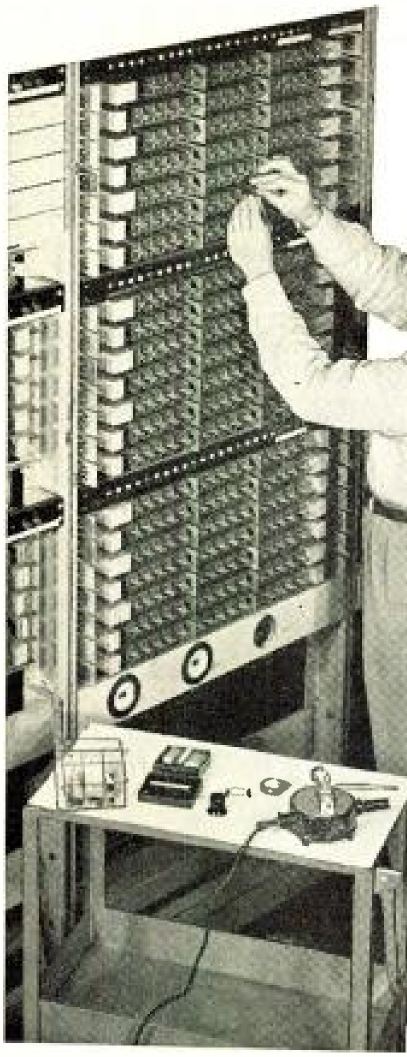
ELECTRICAL CHARACTERISTICS OF SPRAGUE PULSE TRANSFORMERS

Type No.	Turns Ratio	Pulse Width μ seconds	Rise Time μ seconds	Primary Inductance	Leakage Inductance	Repetition Rate	Load and Output	Typical Applications
10Z1	5:1	0.1	0.04	200 μH	5 μH	1 to 2 MC	15 volts 100 ohms	Used in digital computer circuitry for impedance matching and inter-stage coupling. Pulses are of sine wave type.
10Z2	4:1	0.07	0.03	200 μH	20 μH	1 to 2 MC	20 volts 100 ohms	
10Z3	1:1	0.07	0.03	125 μH	12 μH	1 to 2 MC	20 volts 200 ohms	
10Z4	3:1	0.07	0.03	160 μH	15 μH	1 to 2 MC	20 volts 100 ohms	
10Z6	4:1	0.1	0.04	200 μH	6 μH	1 to 2 MC	17 volts 100 ohms	
10Z12	1:1	0.25	0.02	200 μH	2 μH	12KC	100 volts	Blocking Oscillator
10Z13	1:1	0.33	0.07	240 μH	2 μH	2KC	50 volts	Blocking Oscillator
10Z14	7:1:1	0.50	0.05	1.2 mH	20 μH	1MC	25 volts	Impedance Matching
15Z1	3:1	5.0	0.04	7.5 mH	22 μH	10 KC	10 volts 100 ohms	Impedance Matching and Pulse Inversion
15Z2	2:1	0.5	0.07	6 mH	15 μH		40 volts	Blocking Oscillator
15Z3	5:1	10.0	0.04	12 mH	70 μH	10 KC	10 volts	Impedance Matching
15Z4	1:1.4	6.0	0.1	16 mH	15 μH	0.4 KC	15 volts	Blocking Oscillator
20Z1	5:5:1 Push-Pull	1.5	0.25	4.0 mH	0.3 MH		5 volts 10 ohms	Memory Core Current Driver
20Z3	6:1	1 to 4	0.22	18 mH	0.8 MH	250 KC (max.)	21 volts 200 ohms	Current Driver
20Z4	6:1:1	1 to 7	0.25	55 mH	0.3 MH	50 KC (max.)	22 volts 400 ohms	Current Driver and Pulse Inversion
20Z5	3.3:3.3:1 Push-Pull	2.4	0.2	2.8 mH	0.2 MH		2.5 volts 6 ohms	Memory Core Current Driver
20Z6	11:1	6.0	0.2	90 mH	0.2 MH	50 KC (max.)	10 volts 75 ohms	Current Transformer
41Z1	7:1:1	0.50	0.05	1.2 mH	20 μH	1 MC	25 volts	Impedance Matching

Sprague, on request, will provide you with complete application engineering service for optimum results in the use of pulse transformers.

SPRAGUE® WORLD'S LARGEST CAPACITOR MANUFACTURER

Export for the Americas: Sprague Electric International Ltd., North Adams, Mass. CABLE: SPREXINT



He's "fingerprinting" a relay contact

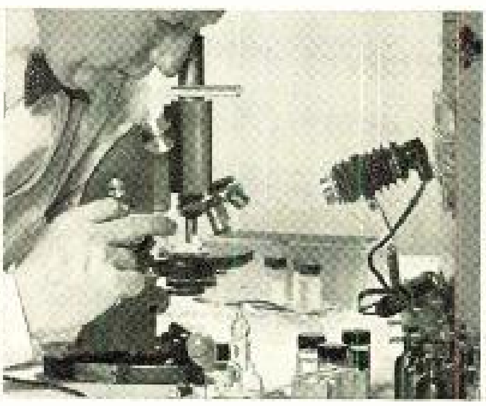
Bell Laboratories microchemists have perfected an ingenious new technique for "fingerprinting" relay contacts, the tiny switches on which a dial telephone system critically depends.

Using a portable test set, a chemist makes a plastic print of a contact. On-the-spot examination of the print with a microscope and chemical reagents quickly reveals the effects, if any, of arcing, friction, dust or corrosive vapors. While the chemist studies the print, urgently needed contacts continue in service. Findings point the way to improve relay performance.

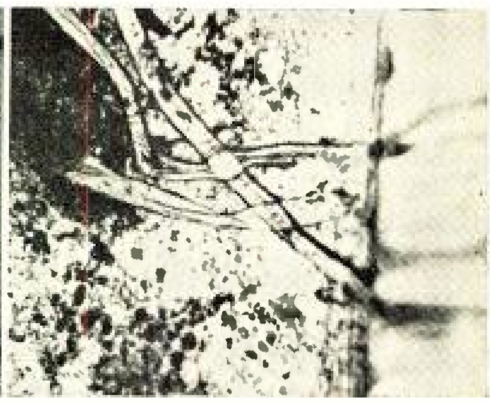
This is another example of how Bell Telephone Laboratories research helps to keep your telephone system the world's best.

Above, Bell Laboratories microchemist applies plastic disc in heated clamp to relay contact. Imprint reveals contours of surface and picks up contaminants, if any. Part of portable test set is shown on table. Contacts, shown in small sketches, are of precious metal fused to base metal.

Preparing disc for microscopic examination. On-the-spot examination may reveal acid, alkali, sulfur, soot or other polluting agents peculiar to an area.



A microscopic look at disc often provides lead to nature of trouble. Unlike actual contact, print can be examined with transmitted light and high magnification.

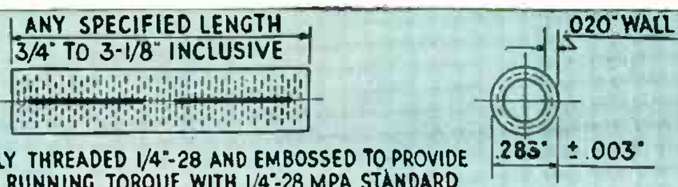


Here the plastic disc has picked up microscopic lint that insulates contact, stops current. (Picture enlarged 200 times.) Traces of contaminants are identified in microgram quantities. Inert plastic resists test chemicals that would damage contact.

Bell Telephone Laboratories

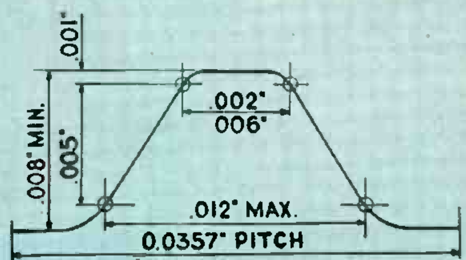
Improving telephone service for America provides careers for creative men in scientific and technical fields

For product information, use inquiry card on last page.



NOTE-:
INTERNALLY THREADED 1/4"-28 AND EMBOSSED TO PROVIDE 2" TO 7" OZ. RUNNING TORQUE WITH 1/4"-28 MPA STANDARD THREAD CORE AS DETAILED BELOW:

THE FOLLOWING MPA STANDARD CORE THREAD FORM DRAWING AND DIMENSION CHART IS THE RECOMMENDATION OF THE CLEVELAND CONTAINER CO. FOR USE WITH TORKRITE COIL FORMS

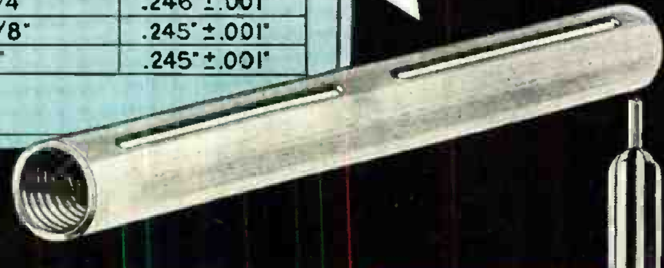


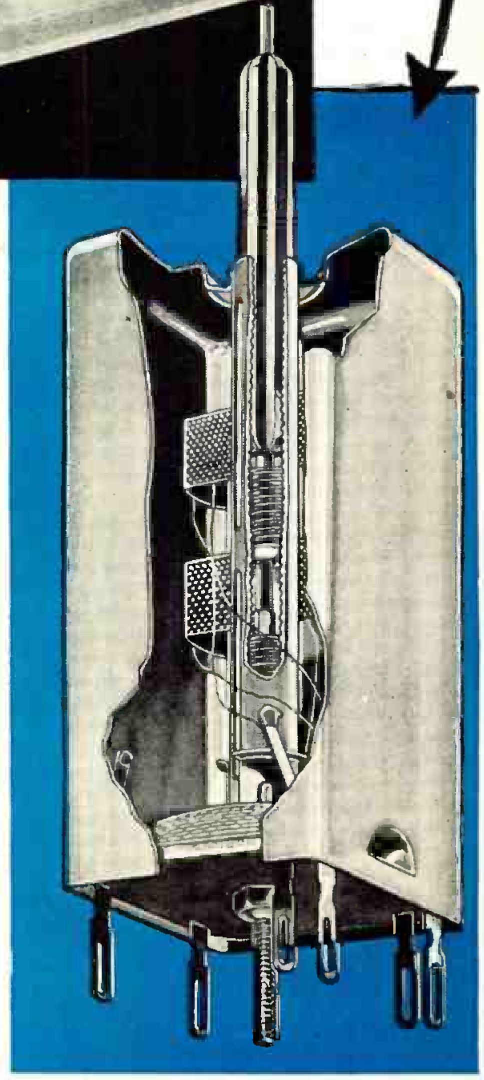
CORE LENGTH	CORE O.D.
3/8"	.249" ± .001"
1/2"	.248" ± .001"
5/8"	.246" ± .001"
3/4"	.246" ± .001"
7/8"	.245" ± .001"
1"	.245" ± .001"

DESIGN

PRODUCT

APPLICATION





TORKRITE

BY THE MAKERS OF CLEVELITE* PHENOLIC TUBING

IMPROVED PERFORMANCE—LOWER PRICE!!!

Torkrite coil forms eliminate torque and stripping problems and are rapidly replacing other coil forms because Torkrite:

- withstands more than required stripping pressure.
- requires no revision other than reduced winding arbor diameter.
- is round and concentric; winds coils at higher speed without wire breakage or fallen turns.
- permits use of lower torque since it is completely independent of stripping pressure.
- recycling ability is unmatched.
- is stronger mechanically because of heavier wall.
- provides 2-7" oz. running torque when used with MPA standard thread core.
- has no holes or perforations thru tube wall which eliminates cement leakage locking cores.
- has smooth adjustment of core without lubricant.
- torque increases less after winding as heavier wall reduces any tendency to collapse and bind core.
- maximum stability results as core cannot move in relation to winding after peaking as it is engaged in internal threads.
- embossings are evenly spaced, with a lead at each end of the form to permit easy insertion of core.

★ ★ ★ ★ ★ ★ ★ ★

Improved Torkrite is now available in various diameter tubes. Lengths from 3/4" to 3-1/8" are made to fit 8-32, 10-32, 1/4-28 and 5/16-24 cores.

★ ★ ★

*Reg. U. S. Pat. Off.

Why pay more? For good Quality . . . Call CLEVELAND!

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6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES:
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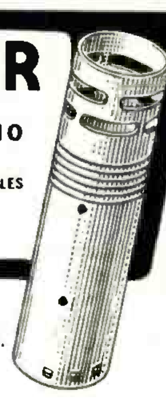
AERASIVE DIVISION at CLEVELAND, OHIO

Cleveland Container Canada, Ltd., Prescott and Toronto, Ont.



Representatives:

NEW YORK AREA: R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND: R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA: PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO
WEST COAST: IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES

For product information, use inquiry card on last page.

Industry's first full year performance warranty on all transistors announced by General Electric

MADE POSSIBLE THROUGH PROVED PERFORMANCE IN RIGID LIFE TESTS

NOW, IN ADDITION to the recently announced price reductions, General Electric provides a full year warranty on its complete line of transistors—the first warranty of its kind in the Semiconductor industry.

CONTINUOUS QUALITY checks and life tests in G.E.'s laboratories and plants, *and in the field*, have proved conclusively the performance superiority and longer life of the G-E transistors. In tests requiring operational stability at temperatures up to 85°C for thousands of hours, G-E transistors have surpassed every specification. The full year warranty is your assurance of this performance.

IN THE LAST 12 MONTHS the list of important manufacturers who have swung over to G-E Semiconductor Products in radio, communications, and other electronic equipment has increased at a startling rate. Why not profit by their successful experience? Now is the time to use all of the many advantages offered by General Electric Semiconductors in the production of your equipment. Especially in view of their recent reductions in price and the new Performance Warranty. For additional information, write today to: *General Electric Company, Semiconductor Products, Section X4875, Electronics Park, Syracuse, New York.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

Save Money, Maintenance and Man-hours!

GET YOUR DC FROM AC

with dependable, long-life

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SELENIUM RECTIFIER

Power-Converting EQUIPMENTS

NO costly, bulky, moving equipment to buy ... no expendable parts to replace frequently ... virtually no maintenance! No wonder Federal's compact, rugged, always-dependable Selenium Rectifier Equipments are the growing answer to DC output requirements ... for industrial power, battery charging and hundreds of other DC applications.

Federal Equipments are ready to connect to your AC source ... ready to deliver uninterrupted DC power wherever you need it and whenever you need it!

Powered by Federal's completely inert selenium rectifiers, the life of Federal Equipments is practically *unlimited*. All are conservatively rated ... with a wide margin of safety to withstand momentary heavy overloads.

If the DC output you need is not in Federal's line of standard power supply equipment, Federal will design and build to meet your specific requirements. Tell us the rating you need ... write today to Dept. E-266.

POWER SUPPLIES–

Industrial, Military, Laboratory

Chucks, brakes, clutches, screens, separators, drums, pulleys, lifting magnets, relays, circuit-breakers, solenoids, DC motors—these are only a few of the wide variety of applications now being successfully served by Federal Power Supplies.

Federal's FTR-3152-AS

Typical of the many standard types ready for shipment

Rated:
115/230 volts, 4.4/2.2 amps.
AC Input: 220/440 volts
3-phase, 50/60 cycles

REGULATED POWER SUPPLY

The FTR-3128-BS is designed to meet the exacting requirements of the aviation industry for a regulated and filtered DC power supply useful for laboratory and testing purposes. Front panel control knob enables continuous selection of any DC output voltage between 22 and 30 volts.

Federal's FTR-3128-BS

Typical of the many standard types ready for shipment

Rated:
22/30 volts, 0/10 amps.
AC Input: 105/125 volts
1 phase, 58/62 cycles

MAGNETIC AMPLIFIERS

Presently used in a wide range of successful applications for Industry and the Armed Forces, such as:

- Voltage Control
- Current Control
- Speed Control
- Position Control
- Temperature Control
- Photoelectric Control
- Counting
- Automatic Regulation

Federal Selenium Rectifiers, in partnership with the right magnetic components, provide Magnetic Amplifiers outstanding for:

Stability • Accuracy • Long Life
High Gain • Fast Response • Low-cost Operation

Federal

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FEDERAL TELEPHONE & RADIO FTR

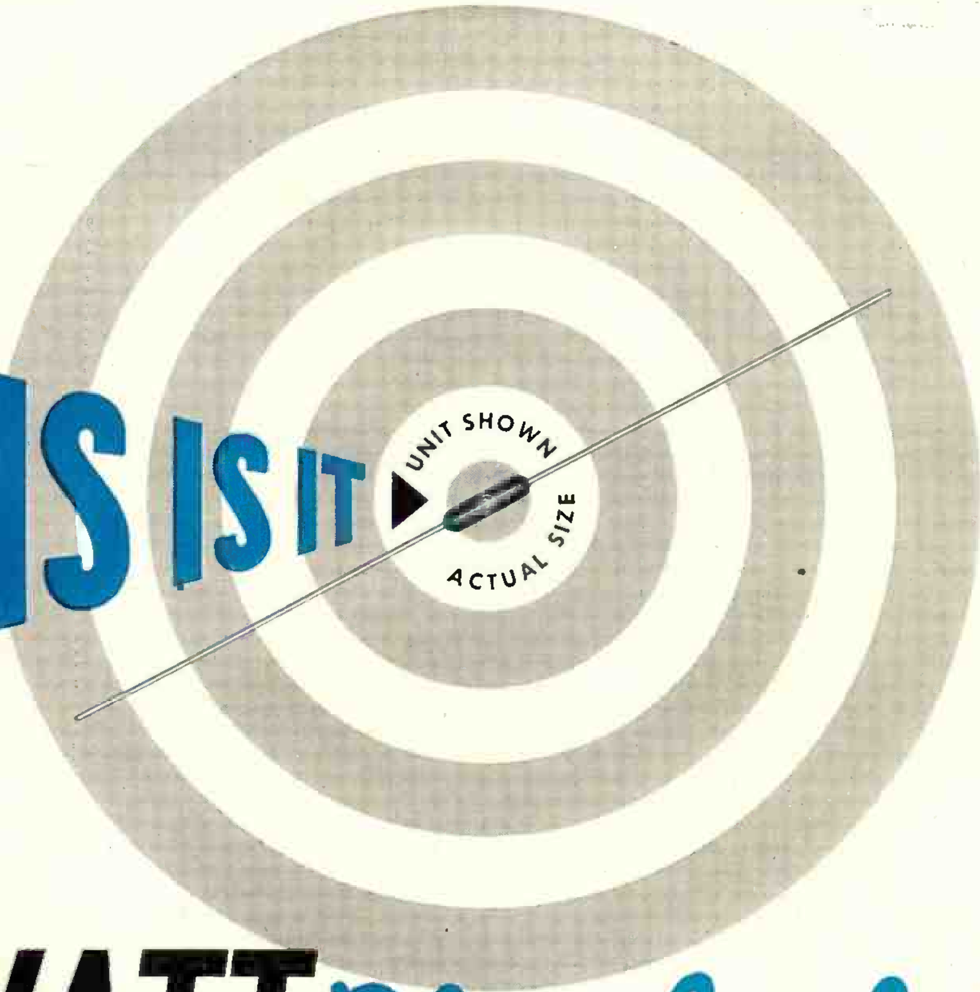
Federal Telephone and Radio Company

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

For product information, use inquiry card on last page.

THIS IS IT



NEW 3-WATT Blue Jacket®

miniaturized axial-lead wire wound resistor

This power-type wire wound axial-lead Blue Jacket is hardly larger than a match head *but it performs like a giant!* It's a rugged vitreous-enamel coated job—and like the entire Blue Jacket family, it is built to withstand severest humidity performance requirements.

Blue Jackets are ideal for dip-soldered sub-assemblies . . . for point-to-point wiring . . . for terminal board mounting and processed wiring boards. They're low in cost, eliminate extra hardware, save time and labor in mounting!

Axial-lead Blue Jackets in 3, 5 and 10 watt ratings are available without delay in any quantity you require. ★ ★ ★

SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS L (inches)	D	MAXIMUM RESISTANCE
151E	3	17/32	13/64	10,000 Ω
27E	5	1 1/8	5/16	30,000 Ω
28E	10	1 7/8	5/16	50,000 Ω

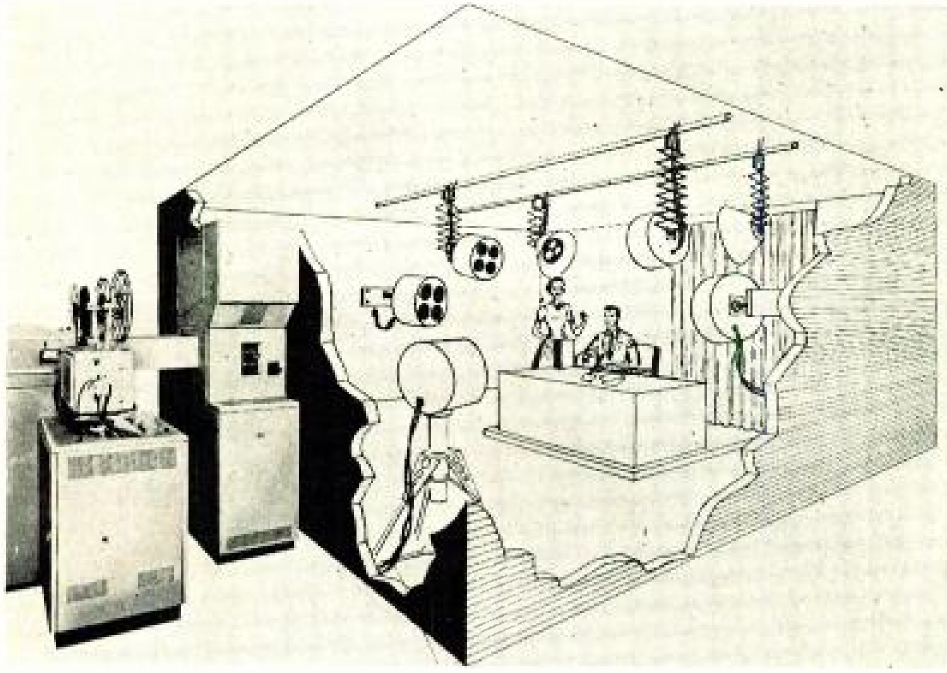
Standard Resistance Tolerance: ±5%

SPRAGUE

WRITE FOR ENGINEERING BULLETIN NO. 111B

SPRAGUE ELECTRIC COMPANY • 233 MARSHALL ST. • NORTH ADAMS, MASS.

As We Go To Press...



Multi-Scanner focuses with a lens and mirror through studio wall opening

CAMERA-LESS COLOR TV
Pickup of live color TV pictures, without using a TV camera is now possible by means of the new "Vitascan" color studio scanner system developed by Allen B. Du Mont Labs. The system utilizes a beam of controlled light from a CRT to scan objects of action in a studio and then picks up the reflected light by means of multiplier phototubes. These tubes convert light into electrical signals which may be passed on to a regular color TV transmitter for broadcast. Sound is picked up by a conventional microphone system. The scanning light used here originates in the tall light source section of the "Multi-Scanner" on the left. It is focused by a lens and mirror system through an opening in the studio wall. The barrel-shaped objects in the studio which resemble lights are actually clusters of photo tubes which pick up the red, green and blue light components. The overhead objects which resemble lamp shades are stroboscopic lights. These flash on and off 60 times a second to light the studio during the "blanking" intervals when the scanning light is not working. This "fully lighted dark room" method allows the studio to be lit but prevents the light from interfering with the action of the scanning light.

1955 WCEMA Directory

The 48-page 1955 product list and membership directory of the West Coast Electronic Manufacturers Association has been issued by the association, according to H. Myrl Stearns, president. Over 190 member companies from San Diego to Seattle are listed in the directory, and all products manufactured by members are classified for easy reference.

Copies of the directory are available to purchasing agents and buyers. Requests should be made on company letterheads to Don Larson, WCEMA General Manager, 339 S. Robertson Blvd., Beverly Hills, Calif.

Vitro Developing Guided Missile Systems

Following the U. S. Navy's recent announcement that guided missile ships will join the fleet this year, Dr. G. Russell Tatum, general manager of Vitro Labs., 261 Madison Ave., N.Y.) has disclosed that his company has been engaged for more than a year, under contract with the Bureau of Ordnance, on systems engineering for the U. S. S. Boston and Canberra.

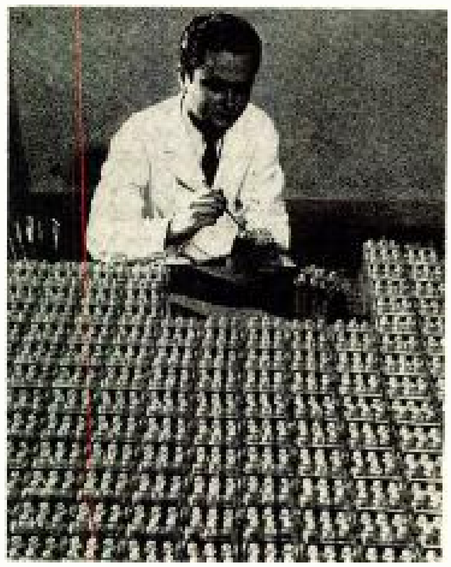
Telecast "Descrambler"

An automatic technique to decode "scrambled" telecasts without paying was described today by the nation's largest manufacturer of electronic equipment for wired TV as "rendering scrambled subscription television completely unworkable and readily susceptible to a new form of 'bootlegging.'"

Milton J. Shapp, president of Jerrold Electronics Corp., of Philadelphia has disclosed that his firm is prepared to file for patents on an electronic "jig saw puzzle solver" that could automatically reassemble any scrambled picture regardless of the method used in encoding.

At the same time, Mr. Shapp revealed the text of a brief filed this week with the Federal Communications Commission, offering a new proposal for bringing toll-TV to the public without the use of scrambled techniques.

Batteries for Missiles



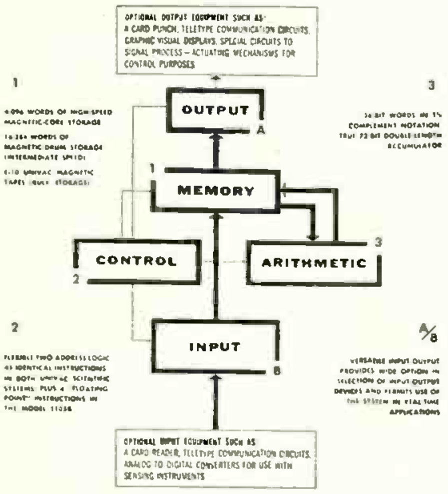
Silver-zinc storage batteries are being mass-manufactured to power secret guided missiles. Despite miniature size (3.43 x 2.79 x 4.78 in. high), these Yardney Electric Corporation units have a nominal capacity of 100 ampere-hours and peak pulse discharge of 2,000 amperes. Although weighing only 43 ounces, the high-capacity Silvercels are designed to withstand stresses up to 1000 Gs.

MORE NEWS on page 18

As We Go To Press . . . (Continued)

New Univacs

Two new Univac-Scientific models have been announced by Remington Rand Inc., incorporating developments making this electronic computer compatible with the company's



commercial Univac, and the recently announced File-Computer.

The new development, which makes it possible for these computers to work together, is the input-output medium, the metal magnetic tape. Previously, the Univac-Scientific operated with a plastic tape which could not be used with the other models.

The Univac-Scientific can now utilize the auxiliary equipment developed for the commercial Univac. Of major interest in this connection is the High-Speed Printer, which prints the results of computations and data reduction at a speed of 600 lines per minute in any desired format.

For the near future, flight simulation and actual flight control are planned for the computer. In-flight data will be transmitted directly to Univac from instruments at the observation point. General storage in the Univac-Scientific has been increased from 17,408 registers to 20,480, through the replacement of 1024 electrostatic registers with 4,096 registers of magnetic core storage.

NARTB Relay Comments

The National Association of Radio and Television Broadcasters has filed a petition with the Federal Communications Commission in the matter of the Commission's rules and regulations governing television auxiliary broadcast stations.

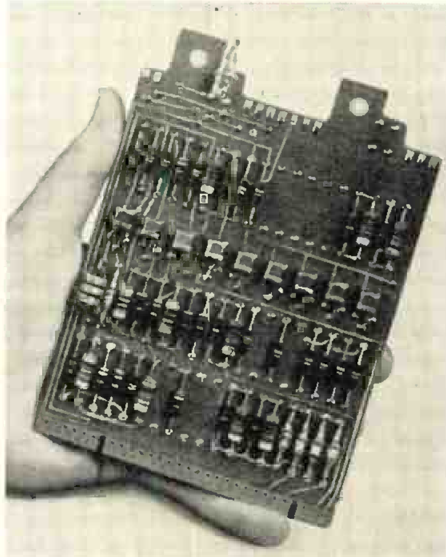
In the petition, it endorsed the Commission's proposals "for a change in the licensing policies and procedures of the Commission whereby the Commission would return to itself the discretion to grant applications for private television inter-city relay stations, notwithstanding the fact that common carrier facilities may be 'available.'"

American Telephone and Telegraph Co., in Feb. 1955, outlined a proposal to FCC "whereby programs of one station would be picked off the air for relay to a second station with this service being provided by common carriers over common carrier channels," the NARTB stated. AT&T said "considerable savings can be realized by this means, estimating that 'the charges in cases involving distances of about 100 to 125 miles between the two television stations probably will average about half of those which would apply for direct connections to the network.'" the Association noted. NARTB's comments endorse this proposal, "but it resubmits that the Commission should, on a case-by-case basis, authorize private inter-city relay stations."

New Lavoie Research Center

Mayor Joseph Scholer cuts ribbon at the opening of the Lavoie Research Center in Union Beach, N. J., as Mr. and Mrs. Stephen D. Lavoie, President and Vice-President look on. At the left are Richard J. Griffith, Manager of the center and August Schmeling, Vice-President, Lavoie Laboratories.

Transistor Computer



Pluggable, printed wiring panel, one of 700 used in IBM's new "608" transistor calculator. Eliminating bulky wiring, the transistors are the nine midget "cans" set across the center of the panel. More than 3,000 are used in the 608. Other devices on the panel include diodes, resistors and capacitors.

New Electronic Color Microscope Demonstrated

Electronic projection of microscopic objects in natural color, using equipment developed by CBS Laboratories, a division of Columbia Broadcasting System, Inc., was successfully demonstrated by Smith, Kline & French Laboratories in Atlantic City at the annual meeting of the American Medical Association. In the demonstration cancer cells were shown in full color on a large screen, magnified 15,000 times.

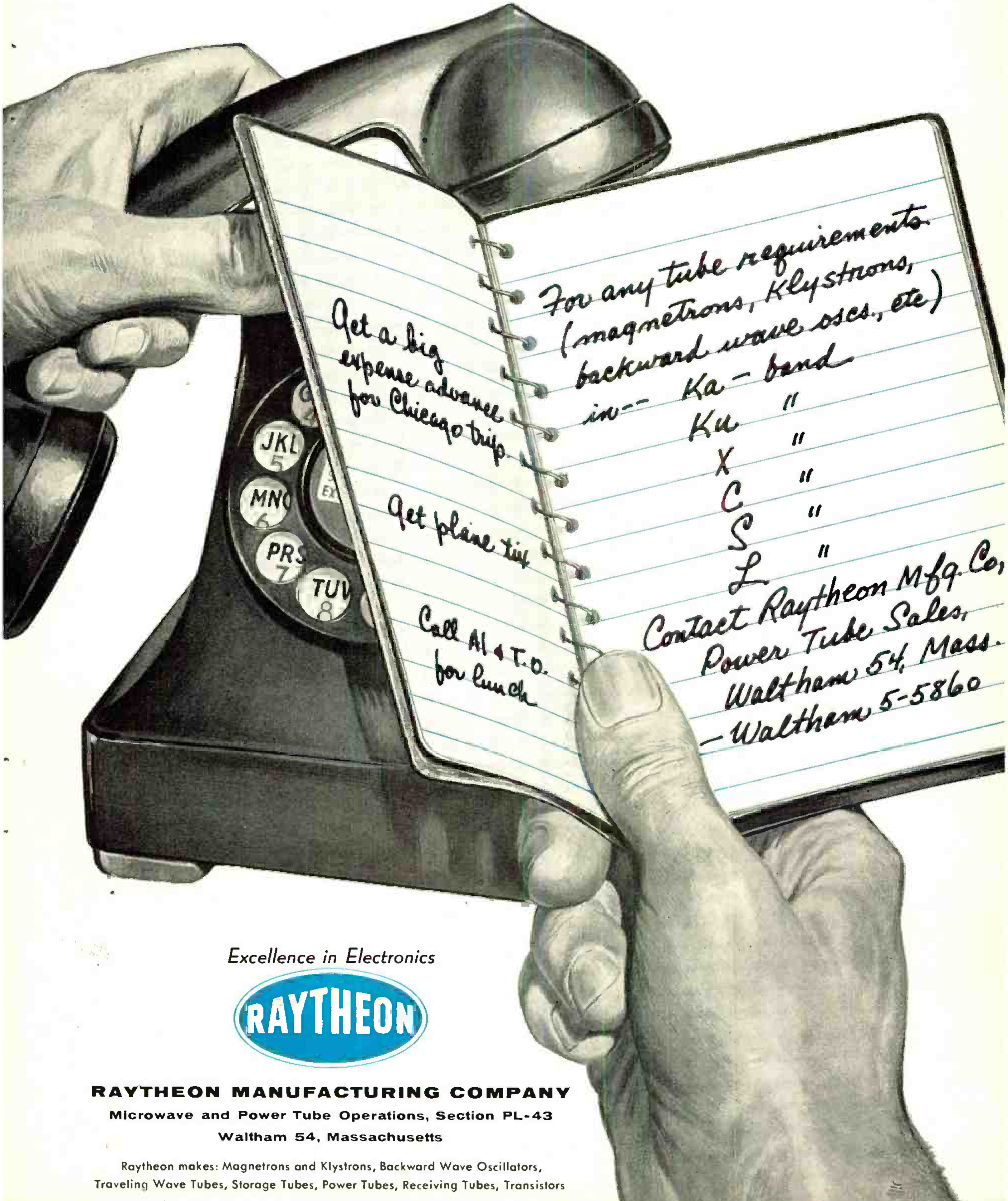
The color program originated at the Hospital of the University of Pennsylvania in Philadelphia, where it was viewed by hospital personnel on a CBS all-electronic color TV receiver and simultaneously by a large audience on big-screen color projectors at the Convention Hall in Atlantic City.

WE Opens New Plant

The Western Electric Company has completed its newest manufacturing facility at Winston-Salem, N. C. Designated the Lexington Road Plant of the Radio Division's North Carolina Works, the plant is now in full operation and will make communications devices for both the Bell Telephone System and the Armed Forces. It is located on a 62-acre site on the city's western boundary.

MORE NEWS on page 20

Raytheon — World's Largest Manufacturer of Magnetrons and Klystrons



Excellence in Electronics

RAYTHEON

RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PL-43

Waltham 54, Massachusetts

Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Transistors

New Tech Data for Engineers

Resumes of New Catalogs and Bulletins Offered This Month by Manufacturers to Interested Readers

Panel Meters

An engineering data sheet, published by International Instruments Inc., P.O. Box 2954, New Haven 15, Conn., illustrates and describes the model 1145 large side-indicator panel meter. Gives dimensional drawings. (Ask for B-7-1)

Coils

A catalog issued by Moran Electronics Components, Inc., 10502 Wheatley St., Kensington, Md. illustrates and describes technically the r-f solenoid coils and chokes produced by the company—both stock items and those manufactured to client specification. (Ask for B-7-2)

Mixing Panel

Bulletin TR-831, released by the Television Transmitter Dept., Allen B. Du Mont Laboratories, Inc., Clifton, N. J. illustrates and technically describes the company's Type 5305-A audio mixing panel. Presents circuit diagram and performance data. (Ask for B-7-3)

Hermetic Seals

A 4-page folder issued by Advanced Vacuum Products, Inc., 18 Liberty St., Stamford, Conn. gives the dimensions and performance data covering the "Advac" standard type terminals. (Ask for B-7-4)

Germanium Rectifiers

Rapid Electric Co., 2881 Middletown Rd., Bronx 61, N. Y. has issued "Presenting Germanium Rectifiers" describing the company's new rectifiers and giving pertinent engineering data. (Ask for B-7-5)

Colloidal Graphite

Bulletin No. 433, released by Acheson Colloids Co., Div. of Acheson Industries, Inc., Port Huron, Mich. includes technical information, photographs, and charts and describes the use of "dag" colloidal graphite in electronic and electrical applications. (Ask for B-7-6)

Time Delay Relays

Bulletin PB-310, released by R. W. Cramer Co., Centerbrook, Conn., covers adjustable time delay relays for panel mounting, and fixed and adjustable units designed for built-in applications. Includes load circuit operation tables, time ranges, dimensional drawings, etc. (Ask for B-7-7)

Cathode Ray Tubes

A 40-page designers' booklet, ETD-985, issued by General Electric Tube Department, Schenectady, N. Y., provides data on 24 standard GE tube types, and describes facilities to meet specialized customer requirements. (Ask for B-7-8)

Fiber and Plastic

National Vulcanized Fibre Co., Wilmington 99, Del. have released a brochure that shows the industrial designer the property combinations and product uses of "National Vulcanized Fibre" and "Phenolite Laminated Plastic." Illustrates applications and forms. Has general property tables. (Ask for B-7-9)

Electronic Components

Centralab Div., Globe-Union, Inc., 900 E. Keefe Ave., Dept. A-38, Milwaukee 1, Wis. has released its 1955 Catalog No. 29. Printed in two-colors, the 48-page book provides easy indexed reference to the company's five lines of stock components. (Ask for B-7-10)

Threaded End Seals

A data sheet released by Electrical Industries Div., Amperex Electronic Corp., 44 Summer Ave., Newark 4, N. J. presents available threaded barrel flared tubing types, threaded barrel lug types, and grooved flange threaded barrel types of end seals for tubular components. Shows dimensional drawings and type numbers. (Ask for B-7-11)

Oscillographic Recorder

Technology Instrument Corp., 531 Main St., Acton, Mass., has released a 4-page folder covering the Type 550-A dc to 900 cps, multi-channel, direct-writing oscillographic recorder. (Ask for B-7-12)

Electronic Components

The new catalog, "D-55," issued for distributors, service departments, laboratories, industrials, product engineers, and amateurs by Erie Resistor Corp., Dept. S, Erie, Pa. Includes additions to company standard lines. Erie "Teflon" stand-off and feed-thru insulators, sockets, and spaghetti, and various electronic components of Corning Glass Works. (Ask for B-7-13)

Transformers

The new 18-page "GCT" transformer general catalog issued by General Transformer Co., 18240 Harwood Ave., Homewood, Ill., provides a convenient reference key for a detailed selection of a range of transformers in a variety of constructions. Gives mounting, electrical variations and lesser mechanical details. (Ask for B-7-14)

Plugs and Sockets

The 35-page Catalog 20 released by Howard B. Jones Div., Cinch Manufacturing Corp., 1026 S. Homan Ave., Chicago 24, Ill., illustrates and gives technical data covering the company lines of plugs and sockets, barries strips, fanning strips, terminal panels, fuse mounts, etc. (Ask for B-7-15)

Transistor Test Equipment

A new catalog sheet illustrating and describing the transistor test equipment suitable for laboratory and production applications, released by Electronic Research Associates, Inc., 67 E. Centre St., Nutley 10, N. J., gives technical data covering an automatic noise figure meter, a transistor alpha tester, a transistor comparison tester, and a noise figure calibrator. (Ask for B-7-16)

Condenser Microphones

"Technical Information on Condenser Microphones," an 8-page brochure announced by Frank L. Capps and Co., 20 Addison Pl., Valley Stream, N. Y., details the basic construction of condenser microphones, their operational theory, and gives comparisons with other microphone types in chart form. (Ask for B-7-17)

Color Studio Scanner

Bulletin TR-888, issued by the TV Transmitter Dept., Allen B. Du Mont Laboratories, Inc., Clifton, N. J., illustrates, diagrammatically describes, and lists the equipment complement of the Du Mont color studio scanner. Gives electrical specifications and technical details of the complementary units. (Ask for B-7-18)

Precision Electronic Equipment

Catalog No. 52, released by Varo Mfg. Co., Inc., 2201 Walnut St., Garland, Texas, gives engineering data and illustrates the phase adapters, frequency changers, static converters, static inverters, frequency generators, frequency meters, voltage regulators, voltage and frequency sensitive relays, special transformers and reactors, etc. that are made by the company. (Ask for B-7-19)

Electronic-Data Processing

"The Univac System: A 1954 Progress Report," a 12-page brochure issued by Remington Rand Inc., 315 Fourth Ave., New York, N. Y., contains the reprinted address of Luther A. Harr, delivered before the Seventh Annual International Systems Meeting. (Ask for B-7-20)

Transistors and Diodes

Two data sheets released by Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Texas, cover the company's recently announced medium power silicon transistors. Types 951, 952, and 953 that serve as replacements for the discontinued Type X-15, and the new series of 13 types of silicon junction diodes. (Ask for B-7-21)

Data Repeaters

A 6-page folder released by AC Spark Plug Div., Electronics Div. of General Motors Corp., 1925 East Kenilworth Pl., Milwaukee 2, Wis., illustrates, describes and gives technical data covering the functional components of "AC" data repeaters. (Ask for B-7-22)

Electronic Components

The new "General Catalog B4," recently announced by American Phenolic Corp., Chicago 50, Ill., contains the most complete list of "Amphenol" products ever produced. Provides quick reference to thousands of Amphenol components—AN and RF connectors, coaxil cables, "Blue Ribbon," miniature connectors, and the only available listing of "Amphenol" radio sockets and plugs, TV antennas and accessories, and microphone connectors. Available on government or company letterhead. (Ask for B-7-23)

Railroad Radio Equipment

A 21-page booklet, 83-214, released by Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa., describes heavy-duty, railroad radio equipment. Covers the basic requirements of end-to-end, train-to-train, multi-frequency operation, talk-back operating positions, control position intercommunication, and a variety of remote control procedures. Gives equipment ratings, dimensions, weights, and power requirements. (Ask for B-7-24)

Chart

A combination decimal equivalent chart and calendar is available at The Dayton Rogers Mfg. Co., Minneapolis 7, Minn., when requested on company letterhead. Size 9 x 17 in. Dates from July 1, 1955 to June 30, 1956. (Ask for B-7-25)

Storage Seal

A complete data sheet on Humid-trol, a new long-term storage container is offered by Lavoie Laboratories, Inc., Morganville, N. J. Humid-trol provides protection against unstable humidity, dehydration, corrosion, fungi, and other causes of deterioration. Moisture is reduced to a low of 1% and maintained, without variation, over long periods of time. (Ask for B-7-26)

Power Supplies

An 8-page catalog is being offered by New Jersey Electronics Corp., 345 Carnegie Ave., Kenilworth, N. J., which describes "A Sensible Approach to Regulated Power Supply Design." By standardizing the great majority of conventional power supply applications into single and multiple variations of 8 basic ranges, arising out of 2 basic circuit designs, selection of the most flexible and least expensive supply to suit a given requirement is easily done. A full technical description is given for each power supply. (Ask for B-7-27)

Transmitting Triode

A 4-page technical data insert describes the new transmitting triode, PL-6569, by Penta Laboratories, Inc., 312 North Nopal St., Santa Barbara, Calif. Gives operating data and circuit suggestions. (Ask for B-7-28)

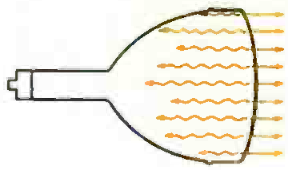
MORE NEWS on page 26

The "Magic-Mirror" Aluminized Picture Tube produces the brightest, most realistic picture ever seen in the American home. The "Magic-Mirror" tube effectively utilizes *all* the light generated by the phosphor screen.

Tung-Sol has developed a unique "fogging" method of backing up the phosphor screen with a mirror-like aluminum reflector. This reflector prevents light radiating uselessly back into the tube. It brings out all the detail of which the receiver circuit is capable. So smooth and true is the Tung-Sol aluminum reflector that mottling, streaks, swirls, "blue-edge", "yellow center" and other objectionable irregularities are eliminated.

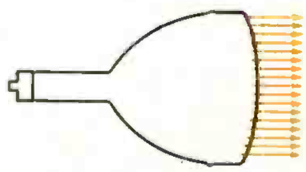
Tung-Sol pin-point-focused electron gun assures a steady, brilliant picture—free from alternate fading and overlighting. Tung-Sol's exacting standards of quality control, manufacture and testing further guarantee the high uniformity and maximum performance of the "Magic-Mirror" TV Picture Tube.

Let the superior qualities of "Magic-Mirror" Picture Tubes add selling advantages to your set.



ORDINARY TUBE—Only *half* the light produced by the phosphor screen is utilized in the picture. Other half radiates wastefully back into tube.

RESULT—A light background within the tube which reduces picture contrast.



MAGIC-MIRROR ALUMINIZED TUBE — Aluminized reflector allows electron beam through. Blocks wasted light from backing up into tube. Reflects *all* the light into picture.

RESULT—Pronounced increase in contrast to make a bright, clear, more realistic picture.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Montreal (Canada), Newark, Seattle.

Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature Lamps, Signal Flashers, Aluminized Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products

For product information, use inquiry card on last page.

Don't be a "Catalog Snatcher"!

Write for your own 2 new additions to Encyclopedia Hermetica—they're Free!

Hermetic Catalogs Now Available
On Vac-Tite* Compression Plugs (No. 300)
And Single Terminal Feed-Thru's And Stand-Offs (No. 400)

Hermetic's two new catalogs are so handy as desk-top references that they'll drive any engineer who hasn't requested or received his copies to "Catalog Snatching"!

These two latest additions to Encyclopedia Hermetica, a continuing catalog series that has become industry's most helpful source of design and purchasing data, provide every significant innovation in hermetically sealed plugs, feed-thru's and stand-offs.

You'll find these two new catalogs indispensable and so easy to use that you'll be able to locate and identify the preferred type needed by its Hermetic part number in second's time. You'd better guard them well against the "Catalog Snatcher" because they contain the most complete line of plugs, stand-offs and feed-thru's ever offered!

*VAC-TITE is Hermetic's new vacuum-proof, compression construction, glass-to-metal seal.

Write for your copies *today*! Also, request Vac-Tite* Compression Multi-Headers Catalog No. 200, MS Series.

Hermetic Seal Products Company

33 South 6th Street, Newark 7, New Jersey

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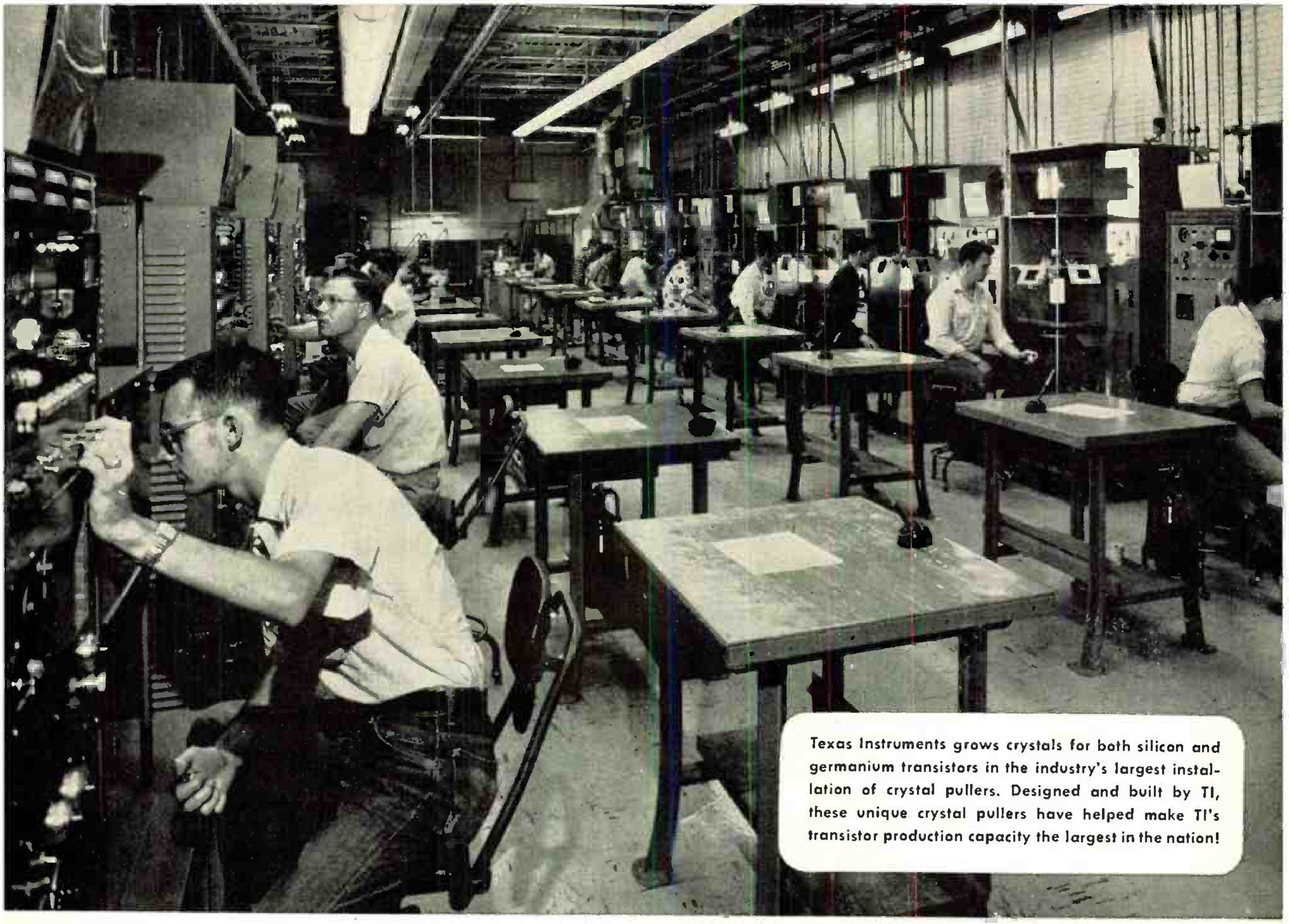
FIRST AND FOREMOST IN MINIATURIZATION



Texas Instruments grows crystals for both silicon and germanium transistors in the industry's largest installation of crystal pullers. Designed and built by TI, these unique crystal pullers have helped make TI's transistor production capacity the largest in the nation!

ORDER FROM THE WIDEST LINE OF SEMICONDUCTOR DEVICES

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N-P-N AND P-N-P GENERAL PURPOSE TRANSISTORS

PHOTOTRANSISTORS

GROWN JUNCTION TETRODES

HIGH SPEED SWITCHING TRANSISTORS

WRITE FOR LITERATURE

TI mass production means transistors today . . . not "available soon"

You get immediate delivery . . . in the quantity you need . . . when you order transistors from Texas Instruments. Mass production methods mean *no waiting* for silicon or germanium transistors . . . and at low prices! Only from TI can you get high temperature silicon transistors. Only from TI can you get *product-proved* germanium radio transistors. With the industry's largest transistor production capacity, TI can meet your delivery requirements – whether you need radio-type transistors by the hundreds or hundreds of thousands!

Texas Instruments low cost germanium radio transistors are used in the *first* transistorized consumer product – a high performance pocket radio on sale across the nation. High temperature silicon transistors (stable to 150° C), produced only by TI, are already being used in important military and commercial applications.

Each TI semiconductor product is glass-to-metal hermetically sealed . . . thoroughly aged and tested . . . to assure successful performance and long range reliability. The nation's leading manufacturer of transistors, Texas Instruments is your most experienced source for semiconductor products.

TWENTY-FIFTH YEAR OF PLANNED GROWTH

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9, TEXAS

Introducing...

the Eimac

4X250B

Radial-beam power tetrode

- ***Higher Power***
- ***Easier Cooling***
- ***Longer Life***

ACTUAL SIZE

4X250B, a new, superior radial-beam power tetrode by Eimac—originators of the famous 4X150A—is now available. Unilaterally interchangeable with the 4X150A in practically all applications, this amazing new bantam for modulator, oscillator and amplifier application from low frequencies into UHF, offers these advantages:

HIGHER POWER—Electrical advances permit an increased plate dissipation rating of 250 watts, plate voltages to 2000 volts and doubled plate power input capabilities of 500 watts.

EASIER COOLING—Development of the Eimac integral-finned anode makes cooling so easy that only one-third the air-pressure and one-half the cubic feet of air are required. Forced air is unnecessary during standby periods.

LONGER LIFE—A newly designed, highly efficient oxide cathode and increased temperature tolerances, coupled with Eimac-developed production and testing techniques enable the 4X250B to meet the most critical standards. New techniques in grid production, high vacuum outgassing and product evaluation are among the features that insure uniform incomparable quality and more hours of top performance.

The small, rugged, versatile 4X250B is now available for existing sockets or sockets of yet-to-be-designed equipment demanding optimum quality and performance.

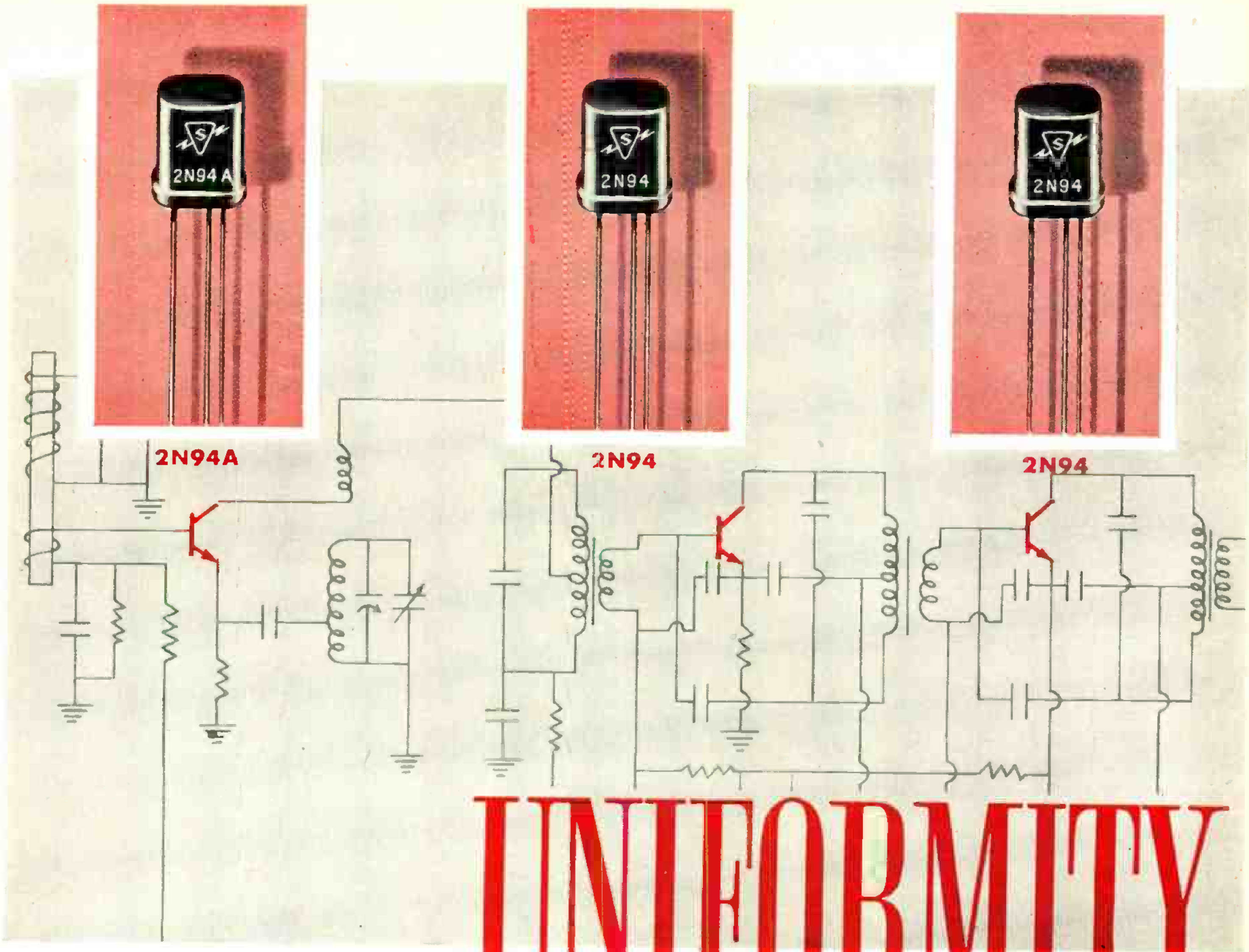
TYPICAL OPERATION
(per tube, frequencies to 175mc)
4X250B radial-beam power tetrode

	Class C CW FM Phone	Class C AM Phone	Class AB RF Linear
D-C Plate Voltage	2000v	1500v	2000v
D-C Screen Voltage	250v	250v	350v
D-C Grid Voltage	-90v	-100v	-60v
Zero Sig D-C Plate Current	—	—	50ma
D-C Plate Current	250ma	200ma	250ma*
D-C Screen Current	12ma	10ma	5ma*
D-C Grid Current	22ma	23ma	0ma*
Peak RF Grid Voltage	114v	125v	60v*
Driving Power	2.5w	2.9w	—
Plate Power Input	500w	300w	500w*
Plate Power Output	400w	240w	325w*

*Maximum Signal

For further details contact our Technical Services Department.

EITEL-McCULLOUGH, INC.
SAN BRUNO • CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes



UNIFORMITY

...for more gain from stage to stage without preselecting

For your broadcast applications, Sylvania high frequency transistors Type 2N94 and 2N94A offer higher gain without preselection by stage. Production is simplified; performance is more stable; servicing problems are minimized.

Low collector capacitance and ease of neutralization account for this important advantage. In a typical broadcast application, the addition of a single 10 μμf capacitor in the collector circuit of IF and RF stages provides adequate neutralization.

Uniformity is obtained through exclusive construction techniques permitting close production control.

In computer applications Sylvania Transistors offer quick recovery time for high speed switching and provide higher gains at higher operating currents.

High Frequency Transistors
Type 2N94 (3 mc alpha cutoff)
Type 2N94A (6 mc alpha cutoff)
featuring
- high gain
- high uniformity
- low collector capacity
- ease of neutralization

Low Frequency—High Gain
Type 2N34 (PNP)
Type 2N35 (NPN)
—for low to medium power use. Gains up to 40 db in grounded emitter circuit

High Power—Low Frequency
Type 2N68 (PNP)
Type 2N95 (NPN)
—increased power ratings—to 2.5 watts. Use for high current, low voltage applications (6—24 volt power supplies)
Type 2N101 (PNP)
Type 2N102 (NPN).
Similar to types 2N68 and 2N95 without cooling fins. Power dissipation 1 watt.

For complete information on Sylvania Transistors write to Department G40R.

"Another reason why it pays to specify Sylvania"

SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, Montreal

LIGHTING · RADIO · ELECTRONICS · TELEVISION · ATOMIC ENERGY

For product information, use inquiry card on last page.

Electronic Industries News Briefs

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

AL D'URSO, formerly sales manager at **SARKES TARZIAN, RECTIFIER DIV.**, is leaving the company to open up an electronic jobbing house in Towson, Md. The company will be called **VALLEY ELECTRONICS, INC.** and will be located at 1735 East Joppa Road, Towson, Md.

ANN DELL'ANNO, of Sudbury, Mass., has been named editor of **RAYTHEON MFG. CO.'s** monthly publication, "Raytheon News." Miss Dell'Anno has been assistant editor of the paper since Oct., 1953. She succeeds the late Riley J. Hampton, founding editor of the prize-winning industrial employee newspaper.

BENDIX AVIATION CORP., Teterboro, N. J., has announced the first successful airplane flights with all-transistor-equipped automatic navigation and landing systems in place of vacuum tubes.

BURROUGHS CORP. is constructing a new building near Paoli, Pa., to accommodate the rapidly accelerating research and development program in electronics, particularly devices for the armed forces. The building will have 28,500 sq. ft. of floor space and will be erected on a newly-acquired 104 acre tract.

CBS-HYTRON, sales and engineering staffs, serving the Midwest area, will be housed at a new address, 4935 West Fullerton Ave., Chicago 9. The telephone number remains National 2-1425.

CORNELL-DUBILIER ELECTRIC CORP. has announced the formation of a "Printed Wiring Division" at South Plainfield, N. J. It will be devoted exclusively to the design, development and manufacture of printed circuitry.

DAGE ELECTRIC CO., INC., Beech Grove electronics firm, has announced a recent expansion of its sales and executive offices, and production facilities, providing over 1000 sq. feet of added floor space.

DR. GEORGE SHELTON of the **NATIONAL BUREAU OF STANDARDS** has received the Silver Medal for Meritorious Service from the Dept. of Commerce just prior to announcing his retirement after 25 years of service at the Bureau. The award was presented to Dr. Shelton in recognition of outstanding and original contributions to the technology of ceramics.

ELGIN NATIONAL WATCH CO., who recently purchased three Western electronic manufacturers, **ELGIN-NEOMATIC, AMERICAN MICROPHONE CO.**, and **ADVANCE ELECTRIC AND RELAY CO.**, was welcomed to the West Coast at a dinner in the Los Angeles Town House sponsored by the West Coast Electronic Manufacturers Assoc.

ETHAM THOMPSON, who was a former engineer at Delco, has become president of a new company, **INLAND ELECTRONIC CORP.**, 500 Rathbone, Aurora, Ill. The company is producing and specializing in test instruments.

GENERAL ELECTRIC CO. has announced plans to double the size of its new microwave research laboratory on Stanford University land at Palo Alto, Calif. In addition to constructing 10,000 sq. ft. more floor space, G.E. will double its number of employees from 70 to 140 by the end of the year.

GENERAL PRECISION LABORATORY, INC., 63 Bedford Road, Pleasantville, N. Y. and **THE GONSET CO.**, 801 South Main St., Burbank, Calif. have been elected to membership in the Radio Technical Commission for Aeronautics (RTCA).

INDUSTRIAL HARDWARE MFG. CO., INC., 109 Prince St., N. Y. 12, manufacturer of electronic components, is negotiating to acquire additional companies situated in the Midwest.

INTERNATIONAL BUSINESS MACHINES' Model 701, an electronic data-processing machine, will soon begin turning out daily weather charts at the Joint Numerical Weather Prediction unit (JNWP) at nearby Suitland, Md. Meteorologists say it is the most significant advance in weather prediction in the past 30 years.

MERIDIAN METALCRAFT, INC., of Whittier, Calif., engaged in the development and manufacturing of rigid waveguide devices and precision sheet metal fabrication, has announced the completion of their new plant located at 8739 So. Millergrove Drive, Whittier, Calif.

MINNEAPOLIS-HONEYWELL REGULATOR CO., and **RAYTHEON MFG. CO.**, have entered into a joint undertaking to engineer and market new large, highspeed electronic data-processing systems for use in business and government. The project will be carried out through the formation of a jointly-owned corporation, to be known as **DATAMATIC CORP.**

MOTOROLA, INC., in their first quarterly letter to their shareholders for 1955, stated that transistors will revolutionize the design of car radio, and announced that they will come out early in 1956 with their first transistorized car radio models.

MR. BENJAMIN FOX, president of **ELCO CORP.**, Philadelphia manufacturer of tube sockets, shields and Varicon connectors, is on an extended business tour of Europe.

NATIONAL VULCANIZED FIBRE CO., of Wilmington, Delaware, leading producer of vulcanized fibre and laminated plastics, will introduce two new products—a rubber fibre with a completely new set of properties, and an epon resin, high-pressure laminate offering great possibilities in the electrical and electronic field particularly in printed circuitry.

NEUMADE PRODUCTS CORP., a pioneer in the equipment industry, has moved their New York offices to new and more spacious quarters. The company is now located in the Fisk Building, 250 West 57th St., N. Y.

NORDEN-KETAY CORP., will conduct their manufacturing operations in two completely integrated manufacturing divisions; one, the Precision Components Division, which manufactures precision servomechanisms and other electronic components, and the other, the Instrument and Systems Division, which manufactures precision instruments and automatic control systems.

OTTO PASCHKES, President of **ASTRON CORP.**, East Newark, N. J., leading manufacturer of electronic components, has revealed preliminary details of a vast new expansion program. A substantial amount of additional working capital has been made available to the corporation by a public offering of stock in the corporation.

RAYTHEON MFG. COMPANY has begun construction of a 203,874 sq. ft. plant in Melrose Park, Ill., as the nucleus of manufacturing and warehousing facilities the company expects to later expand on a 624,000 sq. ft. site.

RAYTHEON MFG. CO., of Waltham, Mass., has completed arrangements to purchase the large plant and property in Tewksbury and South Lowell, which was formerly the **SOUTH LOWELL ORDNANCE PLANT** later occupied by Davis Aircraft Co.

ROLLINS CORP., 117 Schley Ave., Lewes, Del., has changed their name to **ROLLINS ELECTRONICS CORP.** The company feels that the new style better describes their manufacturing facilities.

SERVO CORP. OF AMERICA recently celebrated the second anniversary of its Profit Sharing and Benefit Plan.

STATION KFDM-TV, Beaumont, Texas, was interconnected with the Bell Telephone System's nationwide network of television facilities recently.

SYLVANIA ELECTRIC PRODUCTS INC., for the 6th consecutive year, has signed a contract with the Columbia Broadcasting Company to sponsor the Goodson-Todman Productions' "Beat the Clock" television program.

SYLVANIA ELECTRIC PRODUCTS INC. is increasing by 50% the size of its new electronics laboratory nearing completion in Waltham, Mass. The new Waltham laboratory will house Sylvania's Missile Systems Laboratory, now located temporarily in Whitestone, N. Y., and the Engineering Laboratories now in Boston.

SYNTHANE CORP., manufacturer and fabricator of thermosetting laminated plastics for industrial use, has started construction of a new wing to their plant at Oaks, Pa. This will add a total of 8000 sq. ft. to the existing plant area of 167,000 sq. ft.

TECHNOLOGY INSTRUMENT CORP. of Calif. has announced the expansion of its operation with the opening of its new modern plant at 11020 Sherman Way, No. Hollywood.

THE AMERICAN THERMOMETER DIVISION of **ROBERTSHAW-FULTON CONTROLS CO.**, producer of automatic control devices for home and industry, has been re-designated the **AMERICAN CONTROLS DIVISION.** The division is located in St. Louis.

THE G. E. HEAVY MILITARY ELECTRONIC EQUIPMENT DEPT., Syracuse, N. Y. has been given a Certificate of Co-operation citation by the U. S. Foreign Operations Administration for technical assistance to nine European countries in installing and maintaining complex radar defense systems.

THE METAL POWDER ASSOC., 420 Lexington Ave., N. Y. 17, recently announced the first scholarship winner in powder metallurgy. The award was presented to Donald C. Larson of the Univ. of Wash., who is in his junior year, and majoring in metallurgy. The $500 award applies to the 1955-56 school year.

THE SCHOOL OF DENTAL MEDICINE, Harvard Univ., has purchased an RCA electron microscope so powerful that it can enlarge a dime on the scale of a disk having a diameter of more than three miles. The school will utilize the microscope for research applications in the study of cell structure and metabolism.

THE WESTERN UNION TELEGRAPH CO., has acquired a one-third interest in **MICROWAVE ASSOCIATES, INC.**, of 22 Cummington Street, Boston, it was announced by Walter P. Marshall, President of Western Union and Dana W. Atchley, Jr., President of Microwave.

UNITED SHOE MACHINERY CORP., 140 Federal St., Boston, Mass., has recently made available a new eyelet exploration kit, containing small quantities of each eyelet in United Shoe's standardized eyelet line.

WALSCO ELECTRONICS CORP. has become the exclusive distributor for all products produced by Chase Mfg. Co., it was jointly announced recently by officials of both firms. Walsco will stock and act as sales representative of the widely known Pioneer Chassis Punches, the Ham-R-Press, and Knurl-Tite wrenches.

WELWYN ELECTRICAL LABORATORIES, LTD. (England) and **WELWYN CANADA LTD.**, have announced the formation of a new American company to handle the sale of Welwyn products on a national basis. Operations of the new company are effective as of 1955. Both companies are engaged in the manufacture of high stability precision resistors.

WJRT, Flint, Mich., has signed a contract for affiliation with the **CBS-TV** network effective this September. WJRT plans to inaugurate operation late this summer on channel 12 with maximum power of 316,000 watts.

NOW AMPEX Frees Your Staff for Other Duties

New

AUTOMATIC BROADCAST PROGRAMMING SYSTEM

a new concept in radio . . .

Here's a major step in radio progress — pre-taped programs precisely cued to pre-taped announcements for continuous automatic broadcasting for anything from 15 minutes to 15 hours. Two Ampex 450 tape reproducers are operated alternately, automatically cued by sub-audible trigger signals, automatically time-corrected every 30 minutes. And it's a versatile system, that can be operated with conventional broadcasts at any time.

a new time-saving system . . .

Just push a button and you automatically release your staff announcers for other duties. You can actually extend your broadcast day without increasing your staff. "Flubs" are eliminated and sponsors are better satisfied. You can use your own material or buy programmed segments from commercial sources. You'll save time — save dollars with Ampex.

Signature of Perfection in Sound Equipment

AMPEX CORPORATION

Write today for further information to Dept. U-2286

934 CHARTER STREET, REDWOOD CITY, CALIFORNIA

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TELE-TIPS

AUTOMATION may find its first really extensive applications in the chemical industry according to R. A. Schlegel, Minneapolis-Honeywell specialist. This industry is currently one of the heaviest investors in automatic equipment. Chemical manufacturers buy about one out of every five automatic industrial instruments sold.

DEADLY WASTE PRODUCTS from atomic plants may soon be used to sterilize water-borne sewage and put to many other beneficial uses, according to the Corp of Engineers' Research Laboratories, Fort Belvoir, Va. Research by other agencies points to the possibility of using gamma-radiation in waste to sterilize drugs, antibiotics, to preserve meat, etc., without activating or leaving residual radiation.

MINIATURE ELECTRONIC COMPONENTS and automatic production instruments were the two fields analyzed by Elgin National Watch Co. in its recent diversification program. More than 200 individual companies were examined before acquisitions identified as Neomatic Inc., American Microphone Co., and Advance Electric & Relay Co. were chosen.

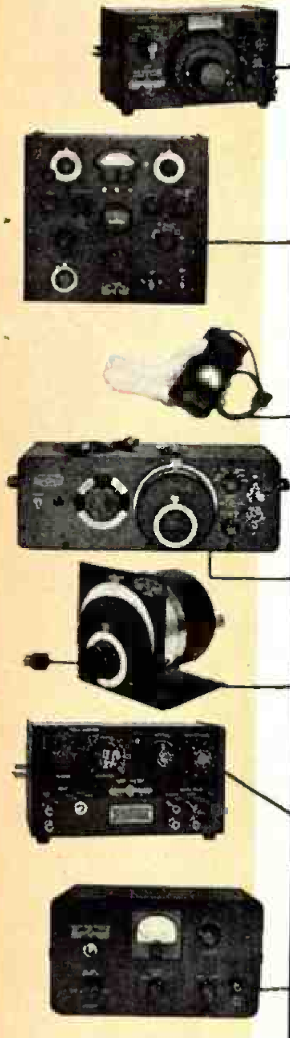
PURE AND PERFECT slivers of iron have been produced by the Westinghouse Research Laboratories. These crystals, as much as two inches long and 0.001 of an inch thick, are now large enough to facilitate a realistic study of the material. Unlike ordinary iron, the "whiskers" reveal no defects in structure and have a tensile strength of 1,000,000 per square inch. The next step by Westinghouse will be to find ways to utilize the unusual properties it possesses.

PULSE TRANSFORMERS manufactured by Jefferson Electric Co., Bellwood, Ill. have been reduced in size to 2.5 grams weight and ⅜-in. cube dimension. It takes 181 of them to the lb. Previous units weighed

(*Continued on page 32*)

OSCILLATORS . . .

20 Cycles to 2000 Mc



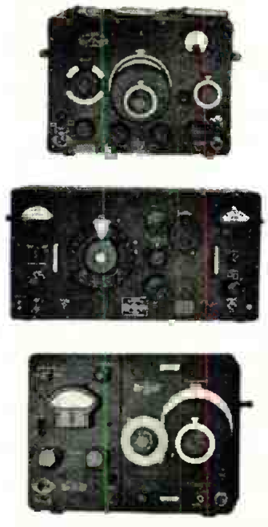
	Type	Frequency Range	Loaded Output/ Open Circuit Volts	Nominal Load Impedance	Harmonic Distortion	Additional Features
Audio and Low Frequency	**1210-B RC Oscillator, $140**	20 cycles – 0.5 Mc (sine or square waves)	80 mw/7v; 40 mw/45v; 0-30v peak to peak, square waves	600Ω; 12,500Ω; 2,500Ω	<1.5%; <2.5%	Multi-purpose lab signal source — converts to Sweep Oscillator with 1210-P1 Discriminator and 908-P Synchronous-Dial Drive.
	1301-A Low-Distortion Oscillator, $495	20-15,000 cycles (27 fixed frequencies)	18 mw/6.6v; 100 mw/30v	600Ω balanced or grounded; 5000Ω grounded	<0.1%	Drift not greater than 0.02% per hour after first 10 min. — frequency range extends to 2 cycles with 1301-P1 Extension Unit.
	1302-A Oscillator, $420	10-100,000 cycles	40 mw/10v; 20 mw/5v; 80 mw/20v	600Ω balanced; 300Ω grounded; 5000Ω grounded	<0.5%; <1%	Output Voltage Constant ±1.0 db.
	1303-A Two-Signal Audio Generator, $1450	(1) 20-20,000 cycles (2) 20,000-40,000 cycles (3) Two signals separately adjustable (4) Two signals with a fixed difference	Normal-10 mw/5v; High-1 w/50v	600Ω grounded	<0.2%; <1%	Ideal for intermodulation distortion testing — drift less than 7c in first hour, completed in 2 hrs. — output constant within ±0.3 db.
	1304-B Beat-Frequency Oscillator, $555	20-20,000 cycles; 20,000-40,000 cycles	1 w/50v	600Ω balanced or grounded	<1%	Converts to Sweep Oscillator with 908-P — high stability, low hum.
	1214-A Unit Oscillator, $66	400, 1000 cycles (2 fixed frequencies)	200 mw/80v	8000Ω grounded or ungrounded	<3%	Has built-in power supply unlike most Unit Instruments.
	1307-A Transistor Oscillator, $88	400, 1000 cycles (2 fixed frequencies)	6 mw/2v	600Ω	<5%	Battery operated, with output meter — small and compact.
	723-C and D Vacuum-Tube Forks, $185	400 or 1000 cycles (2 models)	50 mw/31v max.	50, 500, 5000Ω	<0.5%	Frequency accuracy to ±0.05% — max. drift 0.2% occurs first 30 min.
Medium and High Frequency	**700-A Wide-Range Beat-Frequency Oscillator, $750**	50 cycles — 40 kc; 10 kc — 5 Mc	0.1 w/10-15v	3500Ω pot.	<3%	Log. frequency calibration, high voltage, and frequency stability — has incremental frequency control.
	1330-A Bridge Oscillator, $525	400 cycles, 1000 cycles; 5 kc — 50 Mc	0.75 w/12v; 1 w/10v	50Ω; 20-80Ω	<3%	Internal 400- and 1000-cycle modulation — excellent shielding for bridge work.
	1211-A Unit Oscillator, $295	0.5-5 Mc; 5-50 Mc	2 w; 200 mw	50Ω		Compact, inexpensive, well shielded — frequency increments of 0.2% per division.
VHF and UHF	**1215-B Unit Oscillator, $190**	50-250 Mc	80 mw	50Ω		Semi-butterfly tuned circuit with no moving contacts.
	1208-B Unit Oscillator, $190	65-500 Mc	100 mw	50Ω	Converted to Sweep Oscillators with unique 1750-A Sweep Drive — output regulated with 1263-A Amplitude-Regulating Power Supply (described below).	Very wide range, thorough shielding.
	1209-B Unit Oscillator, $235	250-920 Mc	200 mw	50Ω		Butterfly circuit avoids uhf tuning difficulties — excellent stability.
	1218-A Unit Oscillator, $465	900-2000 Mc	200 mw	50Ω		Audio, pulse, square-wave or frequency modulation from external source.
Special Purpose	**1217-A Unit Pulser, $225**	30 c — 100 kc (12 fixed frequencies)	20v	200Ω positive pulses, 1500Ω negative pulses		Rise time, 0.05µsec — external drive possible over range — square waves at any frequency.
	1213-AB Crystal Oscillator, $130	1-Mc Crystal provides harmonics of 10 kc, 100kc, 1Mc, up to 1000 Mc.	6v at 10 kc, 100 kc; 1v at 1 Mc	varies with frequency		Stability, 1 ppm per day — fine frequency adjustment provided.
	1390-A Random Noise Generator, $240	30 cycles — 20 kc; 30 cycles — 500 kc; 30 cycles — 5 Mc	1v	800Ω grounded	Noise Spectrum	Invaluable audio-test tool — high, uniform spectrum-level over range.

1210-B, 1211-A, 1215-B, 1208-B, 1209-B, 1218-A, 1217-A, 1213-AB Require type 1203-A Unit Power Supply . . . . $40.

SIGNAL GENERATORS

	Frequency Range	Output	Characteristics
1001-A $695	5kc — 50 Mc 8 direct-reading ranges	0.1µv-200 mv; 10Ω jack becomes 50Ω with series unit supplied. 25Ω at end of output cable — 2v at 300Ω from 2nd jack	Incremental dial indicates 0.1% of frequency per division — modulation adjustable 0-80%, indicated on meter; 400c internal or 20-15,000c external am — ±1% calibration, high stability, low drift and negligible leakage and incidental fm.
805-C $1495	16 kc — 50 Mc 7 direct-reading ranges	Less than 0.1µv to 2 v — 75Ω at panel; 75Ω cable has termination impedance of 37.5, 7.1 and 0.75Ω	Internal and external modulation variable 0 to 100%, indicated on meter — drift less than ±0.1% during 5 hrs. continuous operation — ±1% calibration; frequency increments as small as 0.01% — less than 0.05% incidental fm for full 100% modulation — no leakage or excessive harmonic distortion, no cable errors.
1021-AV $595	40-250 Mc in one band	0.5µv — 1v at 50Ω	Butterfly-tuning circuit has no sliding contacts, no noise, good stability and very low drift — internal 1 kc and external amplitude modulation adjustable from 0 to 50% — incidental fm under 100 ppm over most of range.
1021-AU $615	250-920 Mc one band		
1021-AW $845	900-2000 Mc one band	0.5µv — 1v at 50Ω	UHF pencil tube with tuned plate and cathode, remarkably free of noise modulation — ±1% calibration; incremental frequency control for small adjustments — drift under 0.1% per day — 100-10,000 cycles square-wave modulation from external source — stray fields cannot be detected with receiver having 2µv sensitivity.

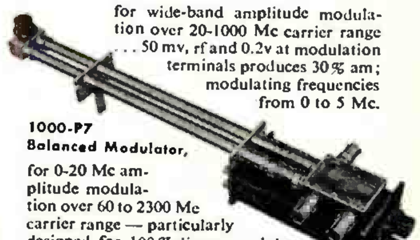
40-2000 Mc with three oscillator sections and one power supply



For Modulating Oscillators and Signal Generators Over Wide Ranges with Negligible fm . . .

1000-P6 Crystal-Diode Modulator . . . $40

for wide-band amplitude modulation over 20-1000 Mc carrier range . . . 50 mv, rf and 0.2v at modulation terminals produces 30% am; modulating frequencies from 0 to 5 Mc.

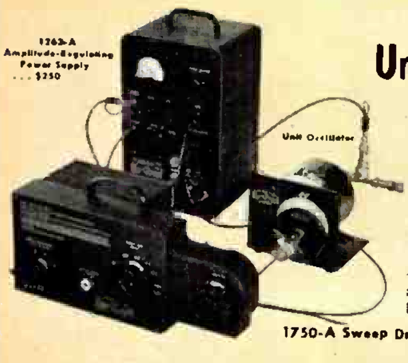


1000-P7 Balanced Modulator,

for 0-20 Mc amplitude modulation over 60 to 2300 Mc carrier range — particularly designed for 100% linear modulation and pulsing with fast rise time and short duration. **$225**

Unique Sweep Drive

Adapts Manually-Operated Equipment To Automatic Sweep



1750-A Sweep Drive . . . $400

The 1750-A Sweep Drive attaches to knobs, dials or shafts for automatic sweeping of oscillators and other equipment. Sweep Arc, Speed, and Center Frequency are all continuously variable, even while the Sweep is in motion, and large percentage variations in frequency are possible. Speed is adjustable from 0.5 to 5 cps — a CRO sweep voltage proportional to shaft-angular-position is supplied, permitting calibration of CRO horizontal axis — Limit Switch, Universal Coupling System and many other features.

In combination with G-R Unit Oscillators covering the range from 0.5 to 2000 Mc, a versatile and inexpensive system of Sweeping Signal Sources is available. The 1263-A Regulating Power Supply has been developed especially for automatic sweep applications and will hold oscillator output-voltage constant to within 2%, independent of frequency.

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period June 1955 through January 1956 that are of special interest to electronic engineers

June 26-July 1—58th Annual Meeting of the American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N.J.

June 27-July 1—AIEE Summer Meeting, New Ocean House, Swampscott, Mass.

June 28-July 9—International Electrotechnical Commission, London, England.

July 12-14—2nd Western Plant Maintenance Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 15-19—AIEE Pacific General Meeting, Butte, Montana.

Aug. 22-23—Symposium on Electronics in Automatic Production, sponsored by Stanford Research Institute and the National Industrial Conference Board, Sheraton Palace, San Francisco, Calif.

Aug. 23-Sept. 3—British National Radio Show, Earls Court, London, England.

Aug. 24-26—Western Electronic Show & Convention, San Francisco Civic Auditorium, San Francisco, Calif.

August 26-28—Sixteenth Annual Summer Seminar, sponsored by the Emporium Section of the IRE, Emporium, Pa.

Aug. 26-Sept. 4—German Radio, Television, Gramophone and Radiogram Exhibition, Dusseldorf, Germany.

Sept. 6-17—Production Engineering Show and Machine Tool Show, Navy Pier and International Amphitheatre, Chicago, Ill.

Sept. 12-16—10th Annual Conference and Exhibit, sponsored by ISA, Shrine Exposition Hall and Auditorium, Los Angeles, Calif.

Sept. 14-16—ACM General Meeting, Moore School of Electrical Eng., Univ. of Pa., Philadelphia, Pa.

Sept. 14-16—The Second National Annual Meeting of the IRE Professional Group on Nuclear Science (PGNS), Oak Ridge, Tenn.

Sept. 17—Symposium on Automation, sponsored by the Cedar Rapids section of the IRE, Cedar Rapids, Iowa.

Sept. 20-22—10th Anniversary Industrial Packaging and Materials Handling Show, Kingsbridge Armory, New York, N. Y.

Discussing plans for symposium of some of the world's foremost authorities on radio, radar and sound wave propagation July 5-7 at the San Diego Navy Electronics Laboratory are, left to right, James W. Browder, Ryan Aeronautical Co. electronics engineer; Capt. H. E. Bernstein, commanding officer, N.E.L.; Dr. J. B. Smyth, of N.E.L. staff, who will be symposium secretary; and Curtis L. Bates, ass't director of engineering, Ryan.

Sept. 26-27—RETMA Symposium on Automation, University of Pa., Philadelphia, Pa.

Sept. 26-30—The First Trade Fair of the Atomic Industry, Sheraton-Park Hotel, Washington, D. C.

Sept. 27-Oct. 1—Int'l. Analog Computation Meeting, Brussels, Belgium.

Sept. 28-29—Industrial Electronics Conference, sponsored by the AIEE and IRE, Detroit Rackam Memorial Auditorium, Detroit, Michigan.

Sept. 30-Oct 2—High Fidelity Show, Palmer House, Chicago, Ill.

Sept. 30-Oct. 2—International Sight and Sound Exposition, Inc., Palmer House, Chicago.

Oct 3-5—National Electronics Conference, Hotel Sherman, Chicago, Illinois.

Oct. 3-7—AIEE Fall General Meeting, Morrison Hotel, Chicago, Illinois.

Oct. 3-7—78th Semi-annual Convention of the SMPTE, Lake Placid, New York, N.Y.

Oct. 11-13—AIEE Aircraft Electronic Equipment Conference, Los Angeles, California.

Oct. 12-15—Convention of the Audio Engineering Society, Hotel New Yorker, N. Y.

Oct. 17-19—RETMA Radio Fall Meeting, Hotel Syracuse, Syracuse, N. Y.

Oct. 21-23—New England Hi-Fi Show, Hotel Touraine, Boston, Mass.

Oct. 24-25—Annual Technical Meeting sponsored by the IRE Professional Group on Electron Devices, Washington, D. C.

October 24-26—Sixth National Conference on Standards, sponsored by the American Standards Association and the National Bureau of Standards, Sheraton Park Hotel, Washington, D. C.

Oct. 31-November 1—East Coast Conference on Aeronautical and Navigational Electronics, Baltimore, Md.

Nov. 2-5—World Symposium on Applied Solar Energy, conducted under leadership of Stanford Research Institute, Phoenix, Arizona.

Nov. 3-4—The Eighth Annual Electronics Conference, sponsored by the Kansas City section of the IRE, the Town House, Kansas City, Kansas.

Nov. 7-9—Eastern Joint Computer Conference and Exhibition, sponsored by the AIEE, the IRE, and the Association for Computing Machinery, Hotel Statler, Boston, Mass.

Nov. 9-10-11—19th Annual National Time and Motion Society and Management Clinic, Hotel Sherman, Chicago, Ill.

Nov. 14-17—Second International Automation Exposition, Chicago Navy Pier, Chicago, Illinois.

Dec. 12-17—Nuclear Congress and Atomic Exposition, sponsored by the Engineers Joint Council, Cleveland, Ohio.

Jan. 9-10, 1956—Second National Symposium on Reliability and Quality Control in Electronics, sponsored by the Professional Group on Reliability and Quality Control of the IRE, co-sponsored by the American Society for Quality Control and the RETMA.

Jan. 30-Feb. 3, 1956—AIEE Winter General Meeting, Statler Hotel, New York, N.Y.

April 15-19, 1956—The 34th annual convention of the National Association of Radio and Television Broadcasters, Conrad Hilton Hotel, Chicago, Ill.

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TELE-TIPS

(*Continued from page 28*)

11.5 grams. Ferrite cores and multiple winding construction makes the difference.

CLEAN SOLUTION to a dirty problem became a prize-winning entry in Minneapolis-Honeywell's "Idea Derby" when a salvage minded factory designer devised a method of eliminating precious germanium waste. The waste of coolant water from a cutting and grinding operation was carrying off expensive bits of germanium dust. The remedy: forcing the water through a filter, then rerouting it back through the filter a second time to compensate for slow action which allowed an initial two-minute discharge to pass unfiltered.

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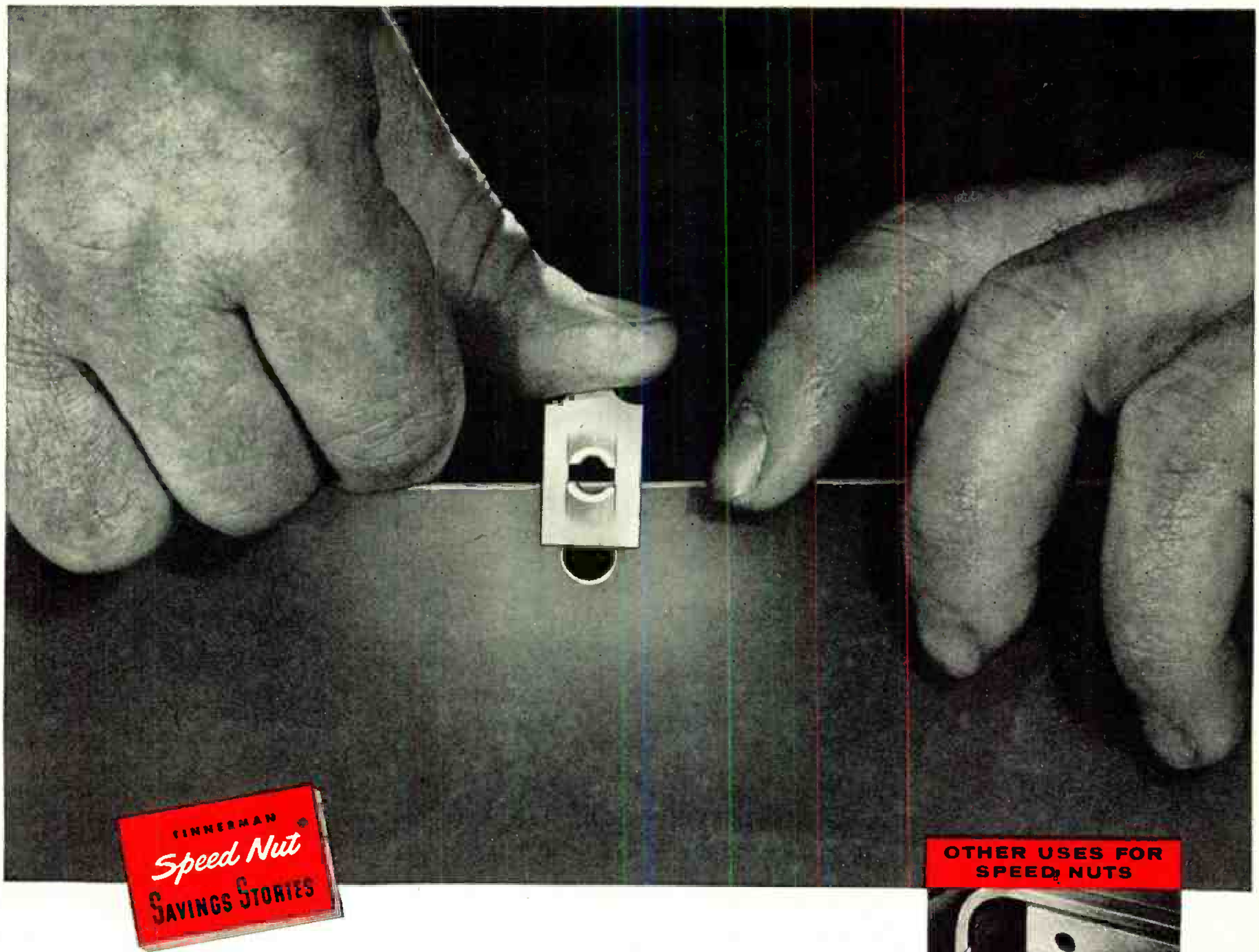
5. Signals time to start lunch for home-from-school troopers.
6. Speeds along homework chores with variety entertainment fare.
7. If necessary, keeps convalescents in touch with the world and aids in turning on electrical units like lamps.
8. Helps in making sure dinner is on the table on time—and not burned.
9. Makes sure favorite program—radio or TV—isn't missed by the thoughtful use of the buzzer signal or unfailing time piece.
10. Allows for bedtime music yet is "turned off" automatically.

KIEM-TV staff members scored a real newsbeat during recent earthquake in Eureka, Calif. by grabbing their Leica and getting pictures of the damaged area. Power was out for several hours. But the 50 shots

(*Continued on page 34*)



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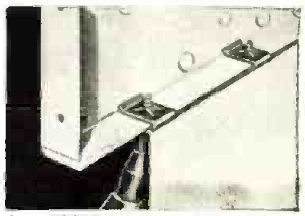

Assembly costs cut 50% on farm equipment with "J" type SPEED NUTS.

"J" type SPEED NUTS help plastic sign maker save 48% in assembly costs.

TELE-TIPS

(Continued from page 32)

they had obtained were developed, and glass mounted. The negatives went on the air via the stations stand-by generator. Images were reversed electronically so that viewers received positive images.

QUICK RETORT: Cambridge University Press received an inquiry from a sugar refining firm saying, "We would like to purchase some of your books for use in our library. Would it be possible to do so at wholesale prices?" The answer: "We would like to purchase some sugar for our coffee break. Would it be possible to do so at wholesale prices?"

DIRECTORY ERRATA

SCOTTIE ELECTRONICS, INC., manufacturers of ceramic components and supplies including capacitors, discs, plates and tubulars; also eyelets, feed-thrus, standoffs and high voltage insulators.
Correct address is 204 Bridge Street, Peckville, Pa., instead of former address on Pleasant Avenue.

AMPEX CORPORATION, manufacturers of portable tape recorders and portable amplifier-speakers, 934 Charter Street, Redwood City, Calif.

Chairman, A. M. Poniatoff; President, George I. Long; Manager Instrumentation Division, Robert Sackman; Manager Audio Division, Phillip L. Gundy.

Branch offices as follows: Atlanta, 710 Peachtree Street, N. E. Phone Atwood 8402; Chicago, 156 E. Ontario Street, Phone MIchigan 2-2386; Dayton, 1024 Third National Bank Building, Phone HEmlock 2722; New York, 405 Lexington Avenue, Phone MUrray Hill 4-4437; San Francisco, 100 Bush, Phone YUkon 6-3782; Washington, D. C., 7338 Baltimore Avenue, College Park, Md., Phone UNion 4-4727.

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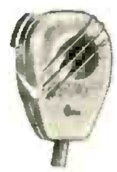

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Letters . . .

Editors, Tele-Tech

In the article of May 1955 on Modulation Sideband Splatter of VHF and UHF Transmitters by Dr. Wm. Firestone, Angus MacDonald and Henry Magnuski, the authors stated that in order that an A.M. system be significantly better than an F.M. in respect of sideband splatter, the modulation must be carefully controlled.

We have carried out a similar investigation in Cambridge and have come to the conclusion that the modifications to the A.M. transmitters necessary to satisfy this condition are very simple. We find that provided a simple filter is fitted to the output of the modulator, consisting of one air-cored choke and one condensor, and provided that modulation is limited to approximately 80%, sideband interference is no longer an important or controlling factor in channel spacings of the order of 20 kc/s.

We intend to publish, in due course, an account of the development of close channel spacing systems using A.M. in the near future.

J. R. Brinkley
J. R. Humphreys

Pye Telecommunications

Editors, Tele-Tech

We were quite gratified with the appearance of our article "Stabilizing Transistors against Temperature Variations" in the March 1955 issue of TELE-TECH. However, we should like to point out several errors in the article. The first equation on p. 75 should read

$$R_L = \frac{G\,[r_e + r_b\,(1-\alpha)]}{\alpha}.$$

Similarly the equations appearing in the second column of p. 75 should read

$$I_c = I_{co}\rho + \frac{E\,(\rho - 1)}{\alpha R_2}$$

$$\text{and } R_2 = \frac{E(\rho - 1)}{\alpha\,(I_c - I_{co}\rho)}$$

respectively. In addition, Figs. 5 and 7 are reversed.

Several inquiries by readers have indicated that the article is a little difficult to follow as printed. We believe this difficulty should be minimized if the section labelled "Emitter Current" on p. 76 is read after Eq. 4 on p. 145 instead of in its present location. This arrangement would then place the section labelled "Circuit Analysis" on p. 76, immediately after the conclusion of the "Typical Application" section. This sequence seems more coherent and should help readers to a better comprehension of the article.

S. SHERR
and T. KWAP

General Precision Laboratory Inc.
Pleasantville, New York

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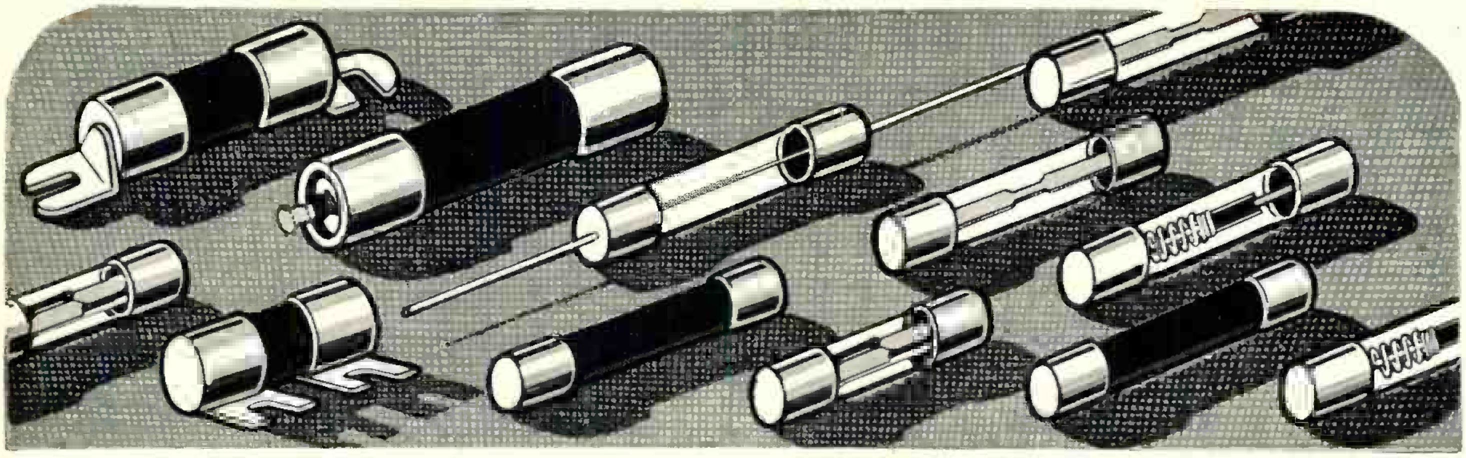

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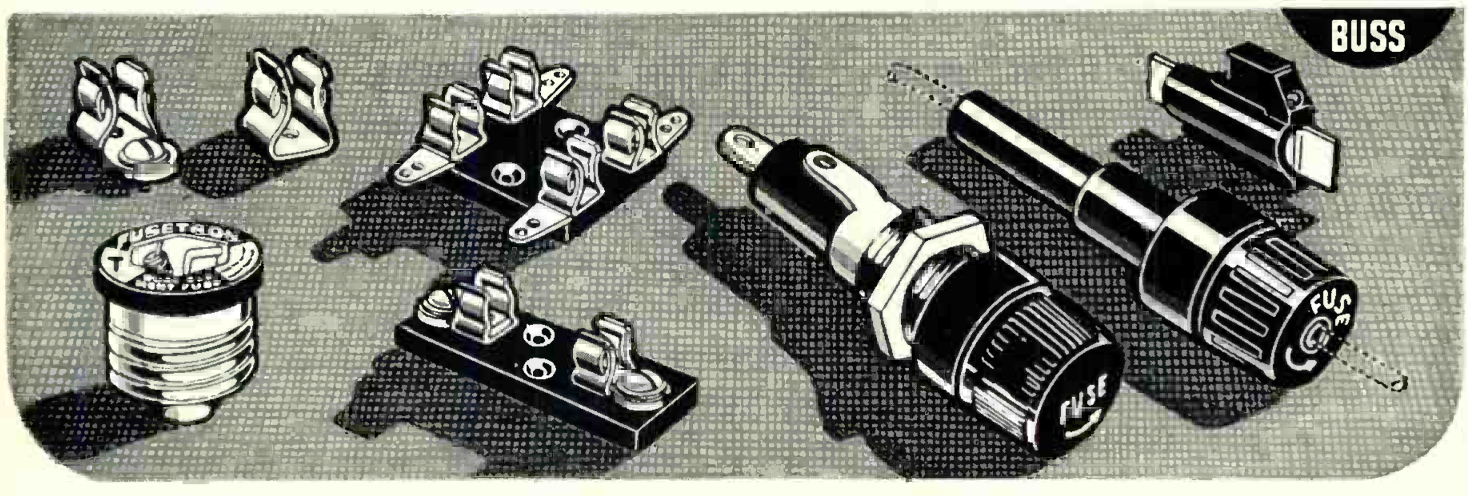

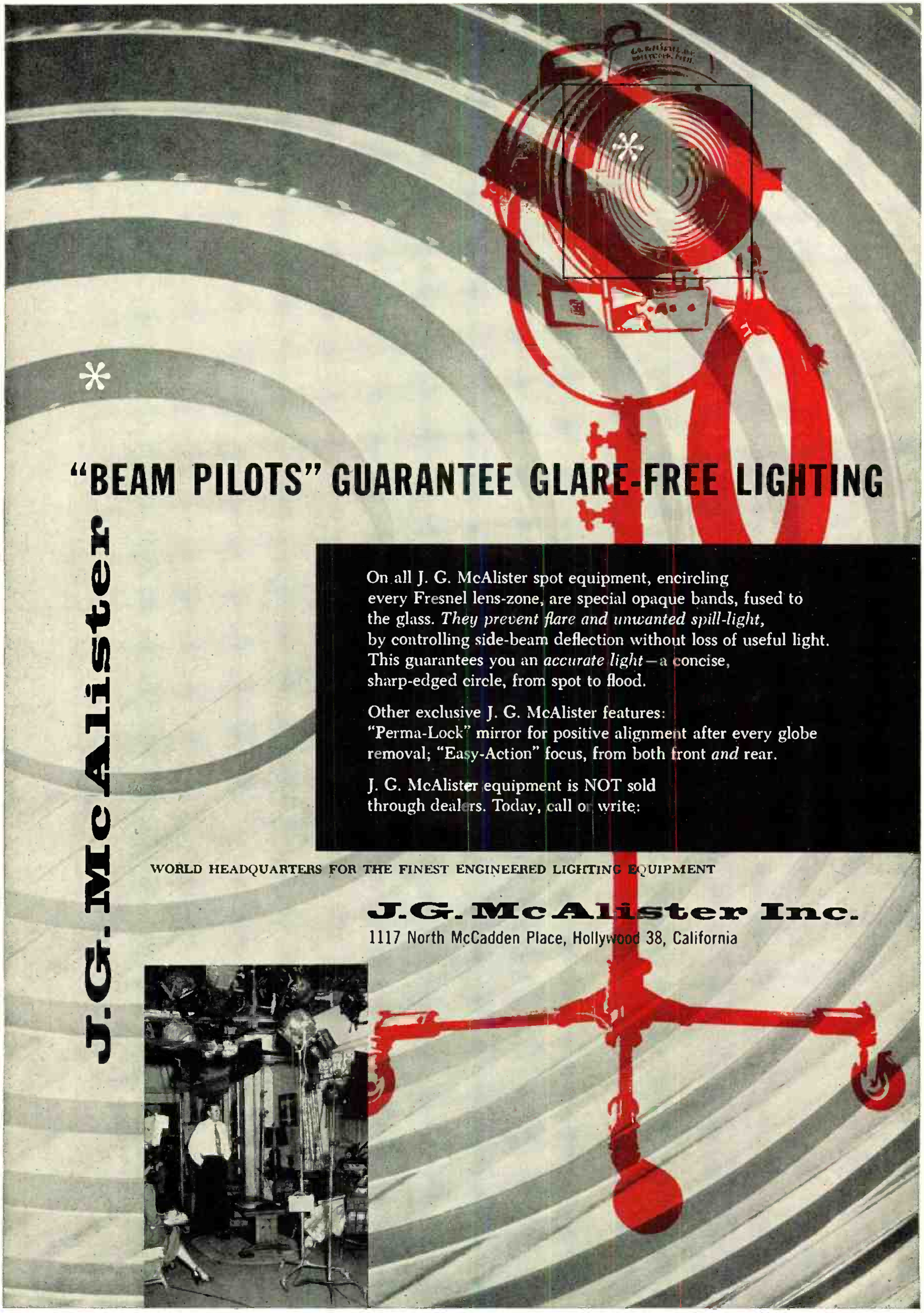

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BOOKS

Development of The Guided Missile

By Kenneth W. Gatland. Published 1954 (2nd ed.) by Philosophical Library, Inc., 15 E. 40 St., New York 16, N.Y. 292 pages. Price $4.75.

The growing importance of guided missiles in our defense structure—and the basic dependence on electronic devices for the operation of these missiles—is attracting an increasing amount of attention from electronic industries engineering and management personnel. A fuller understanding of the aeromechanical aspects of missiles should be of considerable value to those electronic engineers engaged in the development of control, telemetering, radar and similar systems utilized in missile operation.

An excellent means for gaining insight into the state of the missile art is the volume written by a British aircraft design engineer and founder of the British Interplanetary Society. It has been revised from the first edition to include material on propulsion, rocket techniques, guided bombs, and Russian potentialities for long-range rocket development. Of necessity, security requirements have dictated the omission of some of the most important facets of missile technology. Nevertheless, this book, written on an intermediate technical level, provides a noteworthy collection of specific missile developments in the U.S., Britain, France, Germany and other countries.

Most of the book is devoted to propulsion, development techniques, missile armament history, air-to-air missiles, bomb guidance, long-range missiles and high-altitude rockets. Two interesting chapters are devoted to space satellite rockets and interplanetary flight. One appendix covers telemetering systems. The book is well written, nicely illustrated, and should have considerable appeal to many electronic engineers. AJF

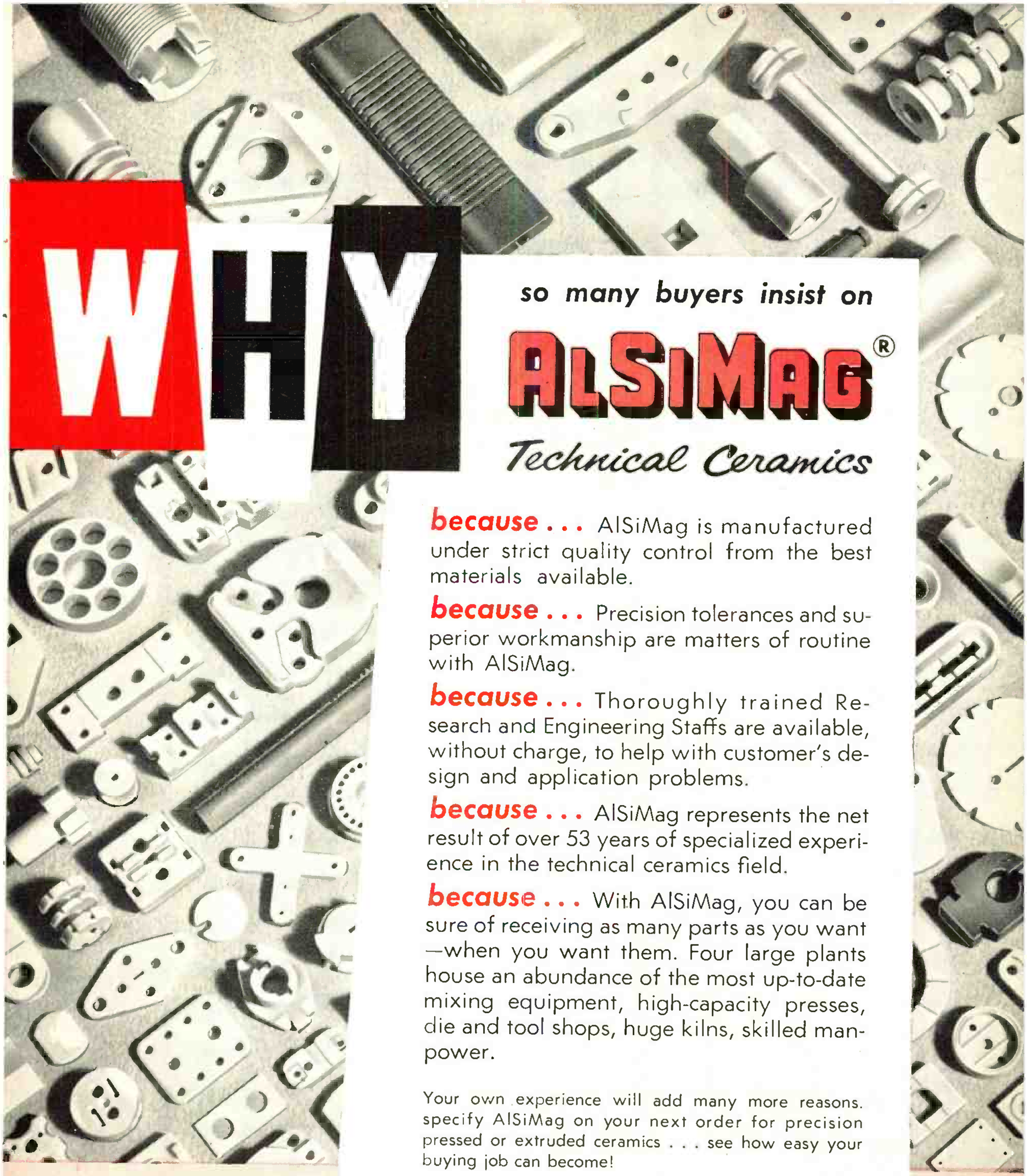
Computer Development (SEAC & DYSEAC) at the Natl. Bureau of Standards

Published by the National Bureau of Standards, Office of Scientific Publications, Washington 25, D.C. TRA -309. 146 pages. Price $2.00.

The more important aspects of the Bureau's electronic computer program, based largely on experience relating to SEAC (National Bureau of Standards Eastern Automatic Computer) and DYSEAC (second SEAC) are presented in this publication.

Topics covered include dynamic circuitry techniques, systems design, high speed memory development, input-output devices, engineering development,

(*Continued on page* 46)



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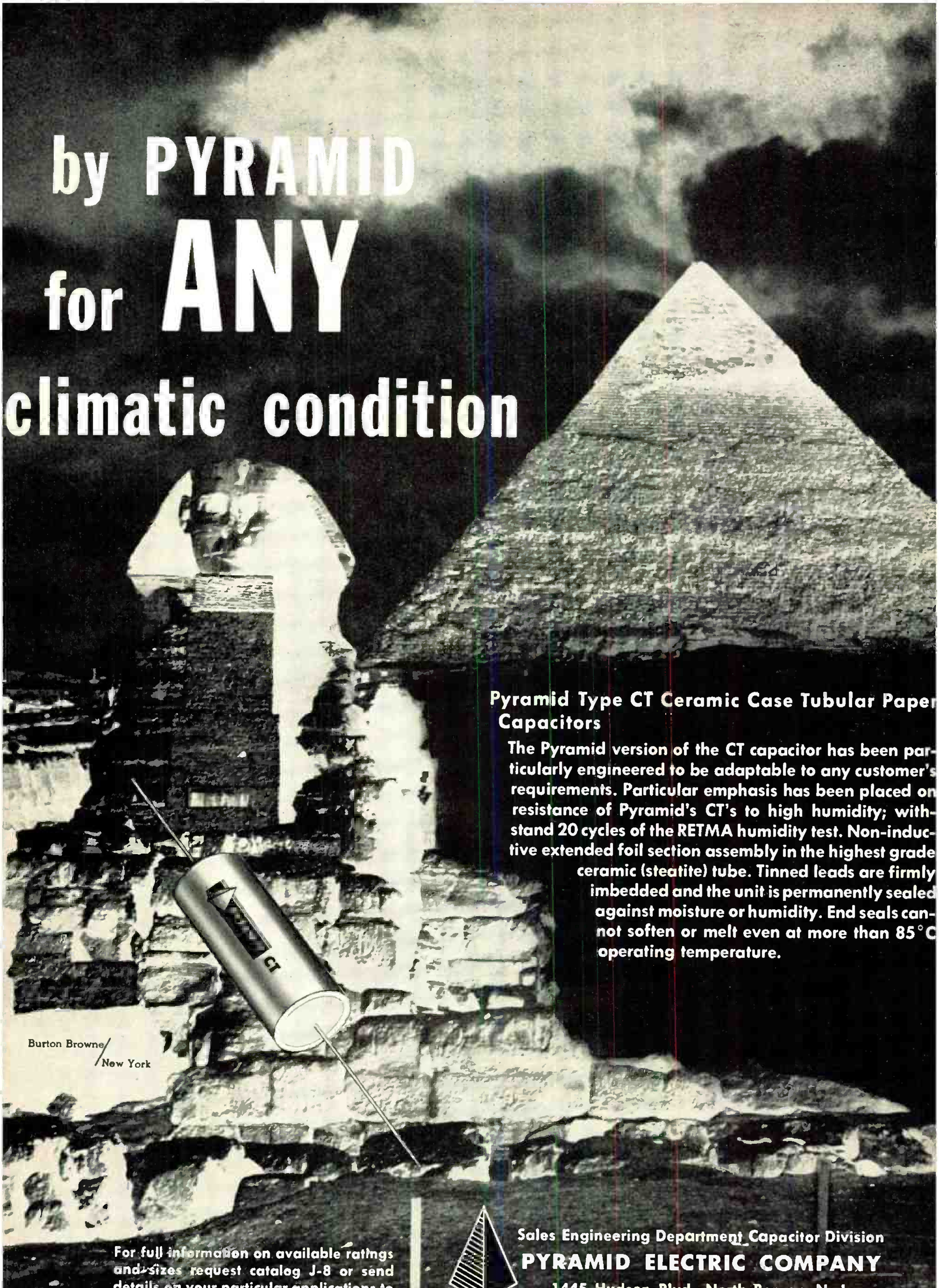
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BOOKS

(Continued from page 42)

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Basic Synchro And Servomechanisms

Prepared by Van Valkenburgh, Nooger & Neville, Inc. Published by John F. Rider Publisher, Inc., 480 Canal St., N.Y. 13, N.Y. 240 pages with more than 300 illustrations.

A basic training course which teaches the fundamentals of synchro and servomechanisms without recourse to mathematics is presented in this 2-volume picture-book series. Written to be understood even by those without college training, these books furnish a clear background in the functioning of these systems.

Using the technique of having one or more illustrations of the most exciting and informative type on every page, they deal with the subject on a step-by-step basis, each page covering an individual phase of the subject.

The volumes were derived from the courses that proved successful in the Common Core Training Program of the U.S. Navy. They have been tried and tested.

Practical Electroacoustics

By Michael Rettinger. Published 1955 by Chemical Publishing Co., Inc., 212 Fifth Ave., New York, N. Y. 272 pages. Price $10.00.

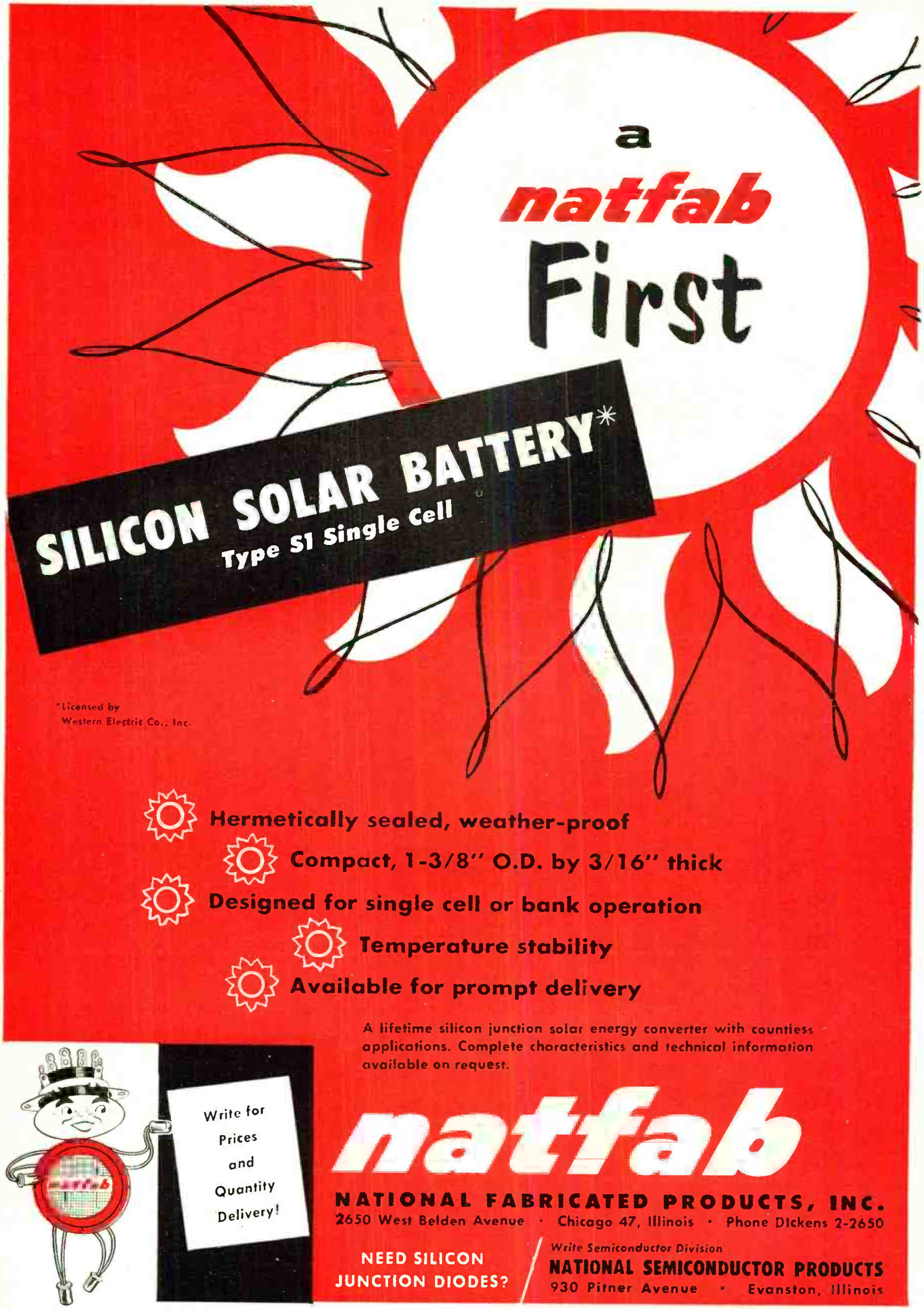
Engineers will find the essentials of audio communication equipment described and analyzed in this book. The author has presented an over-all view of those laws, facts, and applications which are essential for a study of the subject.

In the light of present developments engineering information is covered in both its practical and basic applications.

Profusely illustrated with tables, charts and curves it reduces calculations to a minimum and allows for checking and illustrating relationships.

With special attention given to the relatively new field of magnetic recording it also includes engineering information on construction of loudspeaker cabinets, mixing channels, amplifier building output resistors and magnetic record, reproduce, and erase heads.

(Continued on page 50)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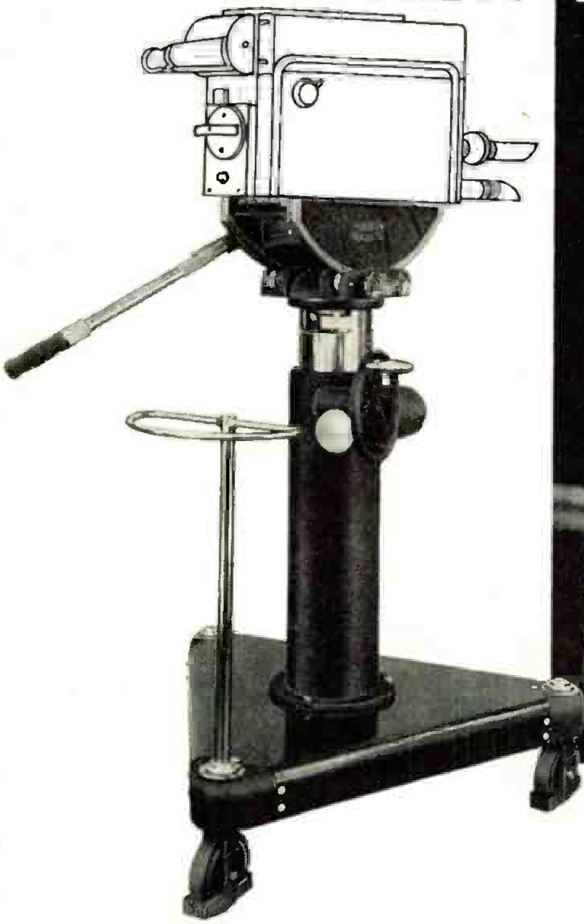

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BOOKS

(Continued from page 46)

Books Received

Cheyenne Mountain Tropospheric Propagation Experiments

Published by U.S. Dept. of Commerce, National Bureau of Standards 39 pages. Price 30 cents. A. P. Barsis, J. W. Herbstreit, K. O. Hornberg. Description and sample results of vhf and uhf testing facilities for studies of tropospheric radio-wave propagation.

Metallic Rectifier Manual

Published by Bradley Laboratories, 168 Columbus Ave., New Haven 11, Conn. 128 pages. Price $2.00. Deals with rectifier types, designs, circuitry, characteristics and applications. Future revisions and additions are included in the purchase price to keep the manual up to date.

Handbook of Spectrum Analyzer Techniques

Published by Polarad Electronics Corp., 43-20 34th St., Long Island City, N.Y. Price 50 cents. 45 pages. This concise booklet is a gathering and articulate presentation of knowledge on the theory of operation, design considerations and applications of spectrum analyzers.

ASTM Standards on Electrical Insulating Materials (with Related Information)

Priced at $5.50 this 660 page, soft cover, book was published February, 1955, by the American Society for Testing Materials, 1919 Race St., Philadelphia, Pa. It is a compilation of data including the latest methods of testing and specifications for electrical insulating materials. Embodying 60 methods of test, 17 specifications, 3 recommended practices and a list of definitions it was edited expressly for manufacturers, suppliers and consumers of electrical insulating materials.

A Review of the Air Force Materials Research and Development Program

A survey published by OTS, U. S. Dept. of Commerce, Washington 25, D.C. 143 pages. Price $3.75. This volume reviews work in the field of materials and processes containing abstracts of Wright Air Development Center technical reports in areas of textiles, metallurgy, petroleum products, structural materials, rubbers, plastics, packaging, protective treatments, and analysis and measurements.

The Defense Materials System in Our American Industry

A 41 page booklet published by Business & Defense Services Administration of the U. S. Dept. of Commerce, Washington 25, D.C. Price 25 cents. It may be obtained from Superintendent of Documents, Government Printing Office and the Dept. of Commerce Field Offices. It tells why a materials and production control system is needed and describes the fundamental characteristics of the Defense Materials System.

What Every Engineer Should Know About Rubber

By W. J. S. Naunton, published by the British Rubber Development Board, Maket Buildings, Mark Lane, London, E. C. 3., 1954, 128 pages. Information is printed here to enable the engineer to make effective use of rubber.

"7:00 P.M. On the air..."

"Delayed broadcast going out from playback head in Position 1. Show being erased on head at Position 2. Recording incoming network signal on head in Position 3. Monitoring incoming signal on playback head in Position 4."

This is an actual case history. Operating engineer in this test was Bert Berlant, designer-manufacturer of the equipment used.

The Berlant Broadcast Recorder, BR-1, actually has provision for 5 heads, (3 heads are standard) and with a simple switching arrangement allows both single and dual track operation.

Research and development on this professional tape recorder took three years. 382 engineers wrote the specs from a detailed questionnaire sent them before work was started. *Every important feature* they requested is incorporated. The one described in the test is an example.

Other exclusive features are: UNISYNC DRIVE: a completely new hysteresis synchronous direct drive with 99.8% timing accuracy and total temperature rise of 30 degrees. UNIFIED CONTROL: one simple convenient error-proof lever system. A-B TEST FADER: fades from incoming signal to playback without transients or clicks.

And these additional requested features: Fast forward and reverse at any speed. Instantaneous *Reeloks*. Automatic cut-off. Tape tension arms. Adjustable bias... and three motors.

All of the above is what *you*, the engineer, wanted. The man in the "figure" department wanted dependability and low maintenance cost... at the right price! We listened to him, too.

$545 IS THE PROFESSIONAL USERS NET FAIR TRADED PRICE.

You'll want to test it yourself, we know. For a distributor close to you, for more complete technical brochure, write: Berlant Concertone
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Dept. N13 Los Angeles 16, California

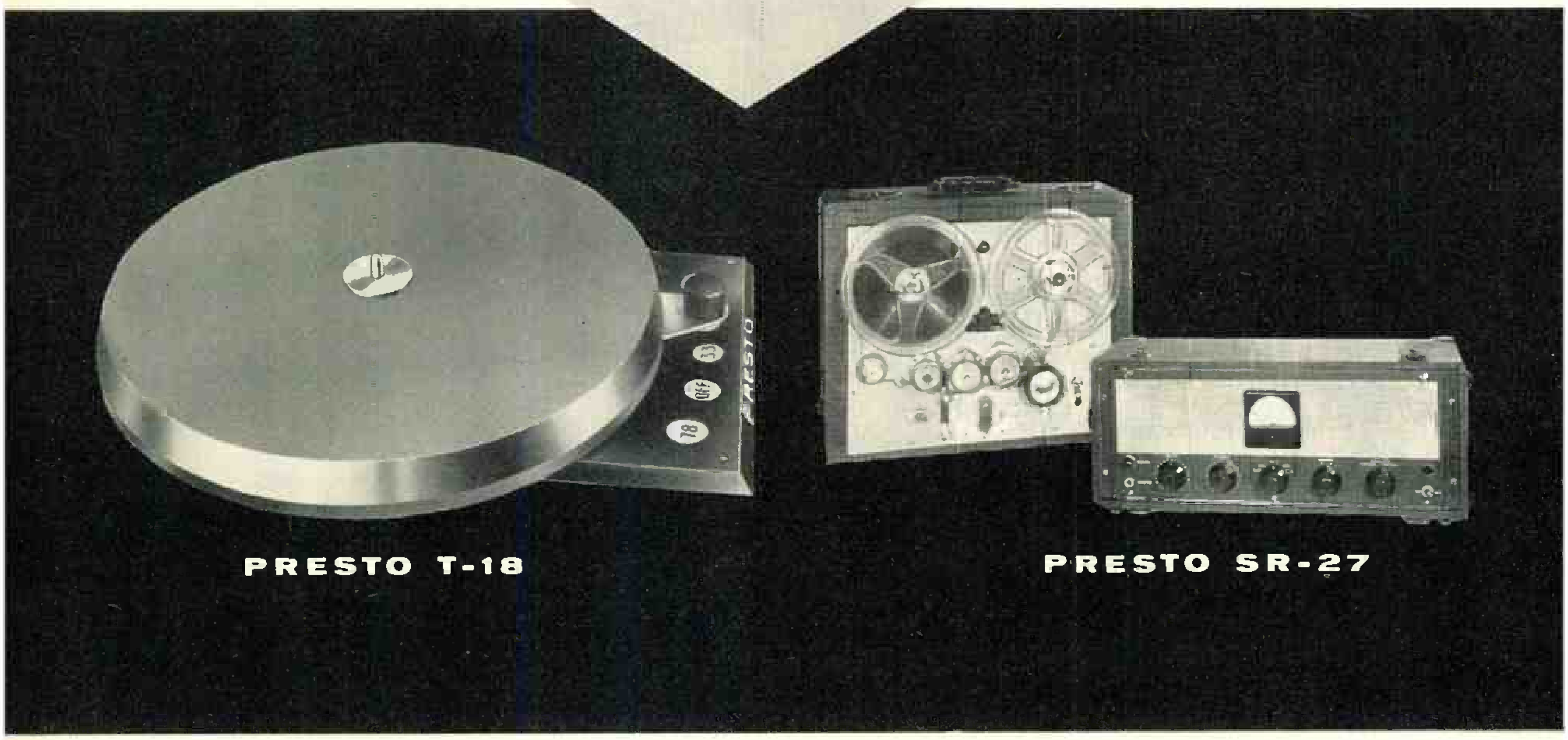
THIS IS REPORT NO. 1 IN A SERIES OF FIELD TESTS.

Manufacturers of Concertone... world's foremost high fidelity recorders and accessories.

TWO NEW PRESTO UNITS

PRECISION THREE-SPEED TURNTABLE T-18

LOW-COST PROFESSIONAL TAPE RECORDER SR-27



PRESTO T-18 TURNTABLE

introducing new flick shift!
one sideway motion
selects 3 speeds—33⅓, 45, 78 rpm.

The new streamlined T-18 sets the highest standards in turntable design and performance today. Most revolutionary is the exclusive 3-speed shift—with 3 idlers mounted on a single movable plate. A sideway flick of the single control lever automatically engages the proper idler. Trouble-making arms and shift cams are eliminated. Other advantages! Extra heavy weight, wide-bevel table, precision deep-well bearing, built-in adapter for 45 rpm discs, smart telephone black and brushed chrome finish. Only $53.50. Also available with hysteresis motor, $108.

PRESTO SR-27 TAPE RECORDER

featuring top-performance features
of finest PRESTO units—
economy priced for the first time!

Top value as well as top performance are yours in this 2-unit combination—SR-27 tape recorder and A-920 amplifier. The recording unit features 3-motor drive; separate record, erase and playback heads; fast forward and rewind. No take-up reel clutch, no idler pulley. A truly professional performer! Companion amplifier has 10 watt output at 16 ohms, self-contained power supply, separate preamps and VU meter, 2 playback speakers. Playback head can be monitored during recording. This combination is your best buy in hi-fi at only $485.

PRESTO RECORDING CORPORATION

PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Instantaneous Recording Service, 42 Lombard Street, Toronto

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISC

TELE-TECH
& Electronic Industries

O. H. CALDWELL, Editorial Consultant ★ M. CLEMENTS, Publisher ★ 480 Lexington Ave., New York 17, N. Y.

Weapons' Concept Clarified

WEAPON SYSTEM CONTRACTOR: "Under this concept we place the responsibility for design of a complete weapon system with a prime contractor. This includes necessary planning and scheduling under the supervision and final authority of the Air Force. The prime contractor must not only design the basic weapon, but must also lay down the performance specifications for the sub-systems in the air weapon and the ground support items which are needed."

ASSOCIATE CONTRACTOR: "Associate contractors are, in fact, prime contractors to the Air Force. Their job is to develop and produce sub-systems and equipments for the air weapon. While the system contractor establishes the performance specifications, the associate contractor establishes the detailed design specifications. He then develops and produces these selected sub-systems and equipments in support of the air weapon." ....

Lt. Gen. C. S. Irvine, USAF, Deputy Chief of Staff Material, June 15, 1955.

Lt. General C. S. Irvine's recent speech before RETMA's Annual Conference in Chicago clarifies some of the many questions which have arisen with regard to the Air Force's "weapons systems concept" of electronic procurement. In declaring this concept to stem from the basis of good management, General Irvine touched on some points that have been the subject of our editorials in months past. (See A New Look at Plant Sites, p. 63 May 1954; Bargain Days for Uncle Sam, p. 57 Feb. 1955; Government Purchasing and the Electronic Industries, p. 65 May 1955.) The Weapons System Concept, you may recall, was the topic of an IRE forum at the recent 1955 National Conference on Aeronautical Electronics.

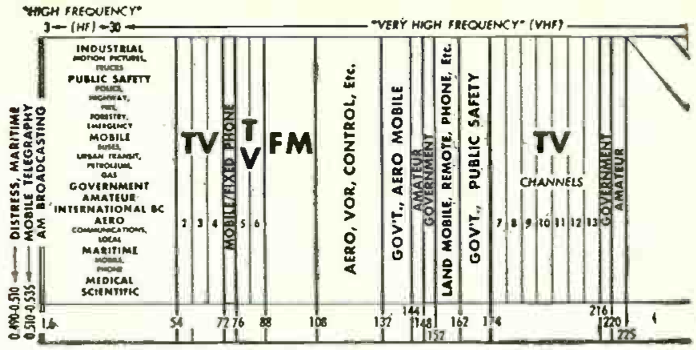
Important Points: In reviewing the roles that prime and associate contractors play in this program, General Irvine assured (1) that the Air Force does not wish to encourage the air frame industry to take over the work being performed by established equipment industries. As a control, the prime contractor's proposals with regard to the subcontract structure will be carefully reviewed by the Air Force to assure a substantial spread of subcontract planning. After a contract has been let, the prime contractor may not deviate from the subcontract structure agreed upon without prior written approval of the Air Force. (2) As a policy, the Air Force program for financing facilities will not make it possible for air frame companies to move into the equipment industries. (3) Also in reviewing the subcontract structure the Air Force will weigh and consider the degree to which the proposal reflects geographic dispersal. (This latter item is one which presently is of utmost concern to West Coast electronic industries and is a topic on which we shall report fully in our West Coast issue next month.)

Standardization and Reliability: With regard to the adverse effects that such a procurement program may have on standardization, the Air Force replies that it relies heavily on the associate or subcontractor because of his extensive knowledge of the field, and recognizes that it is neither prudent or desirable to insist on standardization which will limit the weapon capability. Further improvements in electronic equipment reliability are of prime concern however and will be sought after.

As we have pointed out in previous editorials, we favor the weapons systems concept of purchasing as well as the doctrine of plant dispersal, but we recognize too that there will be some extremely difficult problems involved and the complexion of the industry as we know it today may be somewhat altered. It will be the actual implementation of this program by the Air Force that will really be the determining success factor in the end. For with this program the Air Force is in the unique position of controlling a considerable amount of employment in the electronic industries all over the United States. As such we can expect that it will quickly be subject to the efforts of regional pressure groups seeking to secure contracts for their favorite areas. Smaller sub-contractors will now find the going even harder. Dispersal tends to limit sales in their immediate area, and to seek additional volume in other areas runs up the costs. Dispersal may also bring with it a goodly number of industrial relocations and these in turn will have both good and bad effects, on labor turnover, engineering manpower, housing, etc. Generally, however, we regard General Irvine's announcements as being reassuring to established electronic equipment manufacturers, but we recommend close attention to the implementation of the announced policies and program.

RADARSCOPE

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



NEW RETMA STANDARDS PROPOSALS now being circulated include: Addition to REC-109B on intermediate frequencies wherein 262.5 KC will be standard as an i-f in vehicular receivers. Packing Tests for Radio-Phono- High Fidelity Equipment and Recorders. Good Engineering Practice on the Limits of Radiation from TV Broadcast Receivers between frequencies of 15 KC and 50 MC. Proposed Standard for Fixed Composition Resistors Test Standard for Ceramic Based Printed Circuits. Revision of REC-115A RETMA Standard Molded Mica Capacitors. Revision of TR-132, RETMA Standard on Fixed Wire Wound Power Resistors. Units standards for Ceramic Based Printed Circuits. Solid Dielectric Transmission Lines.

NEW COMMITTEE on ELECTRONIC MATERIALS authorized by Directors of the American Society for Testing Materials will be concerned with materials for electron tubes such as grid wire, cathodes, mica stampings, glass-to-metal seals and luminescent materials. It has been designated as the F-1 committee.

AUTOMATIC CONTROL DEVICES AND SYSTEMS for expanded automation in the machine tool field is the subject for the major and long range engineering program being embarked upon by Minneapolis-Honeywell Regulator Co.

SUPER-POWER X-RAY

World's most powerful crystallographic X-ray machine, shown here with its designer, Westinghouse research scientist Dr. Abraham Taylor, reduces the taking of X-ray photographs from hours to minutes. X-rays are produced when high-speed electrons strike a belt-driven, water-cooled, rotating metal anode (c) at the end of the tube and are beamed through metal "windows" in the sides of the tube.

WATCH FOR top radio circuit licensor to offer transistorized radio set to mass producing licensees . . . any day now.

FUTURE of newspapers may depend on how interested the electronic industries become in the broadcast facsimile field. For example, if aggressive manufacturers put promotional effort behind "newsfax" home receiver, extraordinary appeal of having electronic newspaper delivered in the home, reporting within minutes after an event occurs, could cut into conventional newspaper medium very heavily. Additional factor is that facsimile transmitter could be installed for a small fraction of the cost of a metropolitan newspaper plant.

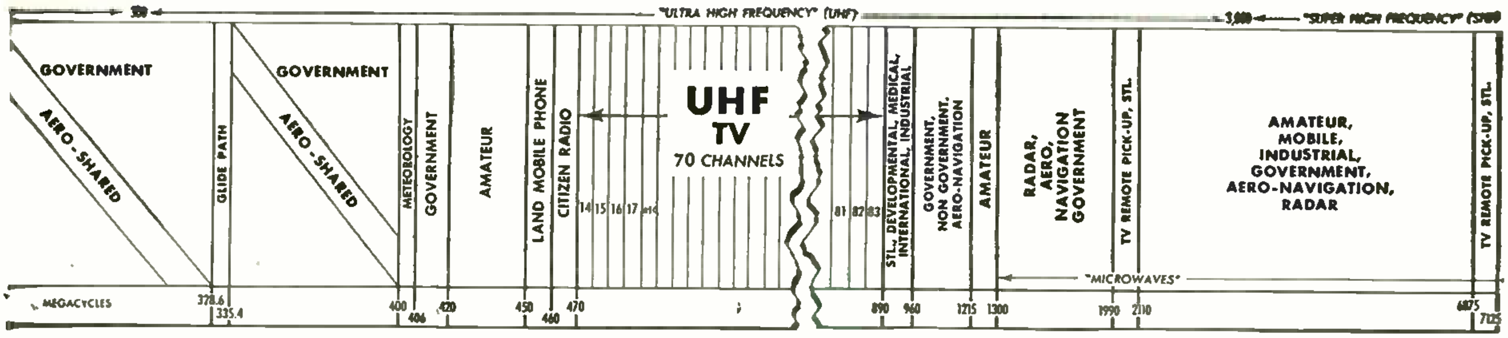
"AUTOMATION—Friend or Foe?" That's the title of a concise and well-written exposition published in a recent General Electric Employee Relations News Letter. Step by step, the article explains automation's function, impact, evolution and relation with the worker in non-technical terms.

TUBES

"BRAIN-IN-A-BOTTLE" or "frozen television" is the way storage tubes are being described to the public. While such a description leans heavily on dramatic license, it serves the purpose of acquainting the public with the increasing number of commercial applications which are anticipated. At the recent Dayton IRE show, Raytheon demonstrated its QK464 storage tube, which is capable of storing 125,000 bits of information or one frame of a TV picture for a week, or playing it back up to 30,000 times. Some of the applications for this type of tube are classified, but in commercial usage it is expected to be employed in fluoroscope and X-ray diagnostic work, replacing the photographic plate. The storage tube would require a much shorter X-ray exposure time, and be available immediately. Other possible applications include newsphoto transmission, incorporation in police teletype circuits, and library microfilm viewing.

AIRCRAFT

BATTLE over military's TACAN air navigation system appears to be heading for a showdown, as indicated by report prepared by the House Military Operations Subcommittee and approved by the Committee on Government Operations. The report is based on hearings held earlier this year, and information provided by the Department of Defense. It recommends that Congress investigate the relative merits of TACAN and VOR/DME for use in a common system which meets both civil and military requirements, and that



the Secretary of the Department of Defense not permit further production deliveries in excess of such amounts needed for technical development. The subcommittee recommends that TACAN be declassified, and that the General Accounting Office perform a thorough audit of costs incurred and outstanding contracts. Furthermore, it is recommended that the President review the functions of ANDB, ACC, CAA and military departments concerned with the common system for air navigation, and if the study justifies it, to submit a reorganization plan.

TELEVISION

FOREIGN TV GROWTH is indicated in recent issues of the DuMont Dispatch. The following country-by-country developments are reported:

Argentina: 50,000 TV receivers in Buenos Aires; no license fee; programs financed through advertising; plans for four 50-kw new commercial transmitters and two 200-kw state-controlled transmitters, in addition to one 40-kw unit in operation now.

Australia: Licenses granted to first four TV broadcasting companies.

Austria: New four-station network scheduled to open July, 1955.

Belguim: Two new stations opened, plus intermediate station to link with Western Germany Network.

Canada: 15% excise tax on sets and parts to remain in effect another year.

Colombia: Government has purchased 15,000 17-inch sets for resale to boost audience for its own facilities. New TV center and 11 relay stations to be built.

Denmark: New 10-kw transmitter being installed in Copenhagen, two others to be erected elsewhere in year. License fee is $7.25.

England: Independent Television Authority expects to get 10% of $644 million spent annually by advertisers. Of 1,300,000 sets to be covered by temporary London commercial station at Croyden, due on this September, 100,000 have tuner, 800,00 easily converted, 400,000 not convertible. 4,307,772 sets in Britain.

France: More relay stations to be built. Possibility of accepting advertising to be debated.

Germany (Western): 75 types of TV sets being manufactured. Expect 350,000 production in 1955. Microwave relays link 22 transmitters, covering 60% of population.

India: Bombay chosen as site of first TV station.

Iraq: Experimental station purchased by government, to transmit first telecasts in Middle East.

Italy: TV transmitter to operate at Naples by end of year, in Sicily by end of 1956. Joint U.S.-Italian firm to produce tubes by September. 1954 TV set production, 100,000.

NEW HIGH-FREQUENCY TRANSISTORS

"Meltback" principle of manufacturing transistors, developed at GE by Dr. Robert N. Hall (l), cuts cooling time of crystals to less than 1 sec., permits thinner separating layers—and much higher frequencies of operation. Previous methods had called for 20 min. cooling period, during which impurities migrated from their proper layers to adjoining layers. At right is GE scientist, R. I. Scace.

Japan: Two commercial TV stations now on air.

Panama: Government has cancelled three provisional permits pending new legislation.

Spain: 500 receivers in use. 500-watt booster added to experimental station.

Sweden: Plan to establish two networks with 50 transmitters. $15.45 license fee proposed.

Switzerland: Second transmitter to be in operation soon.

U.S.S.R.: Programs from Moscow being relayed to country's first booster. Total of six stations now in operation.

Venezuela: Three stations now operating.

Yugoslavia: Experimental transmission from Belgrade began this year. Regular operation scheduled for 1957.

Subminiaturization, unit construction and improved fault finding techniques combine to produce reliable aircraft radio systems

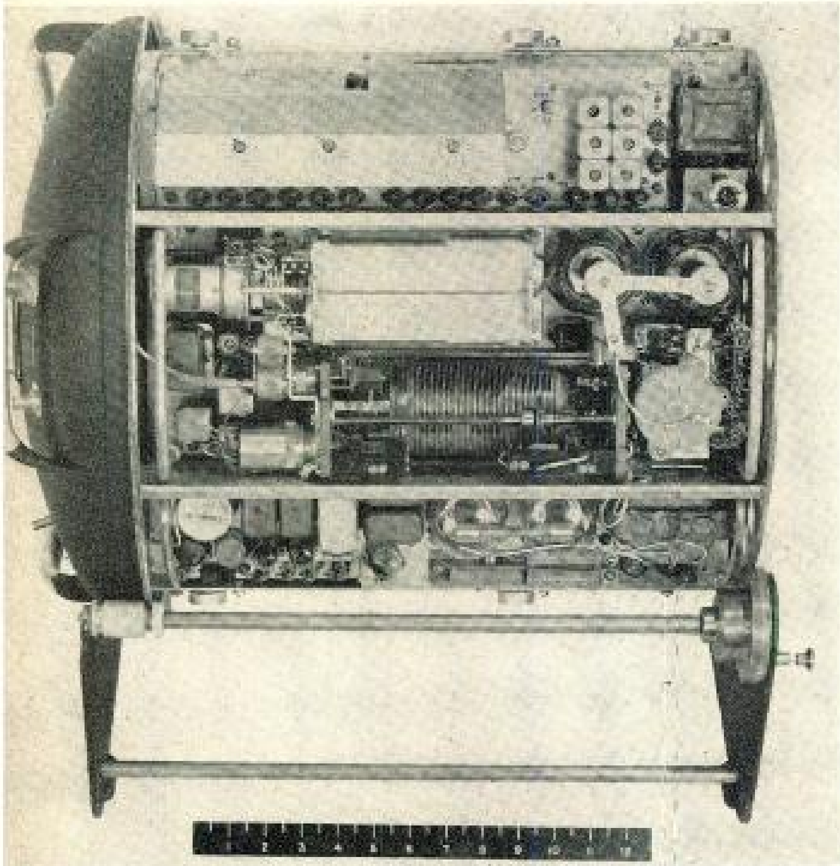


Fig. 1: Subminiaturized receiver-transmitter with pressurized case removed

By GEORGE H. SCHEER

Reliability in

MILITARY aircraft of today are very complicated machines. Advances in technology over the past few years have made it possible to relieve the pilot and other crew members, if any, of much remembering and thinking, by transferring these functions to mechanisms. This demand for greater automaticity naturally resulted in more complexity as circuitry was added to accomplish the added tasks. Yet airplanes are becoming smaller and faster, and they fly higher, so we are faced with the incompatibilities of more complexity, more performance, more installed equipments, in smaller spaces.

We knew in advance that we could not have frequency synthesizers, automatic antenna tuning and loading, and complete remote operation without an increase in complexity. We knew that we could not make the pilot's job easier and, at the same time, materially increase the burden of the maintenance man who must keep the equipment in working order. By utilizing unit construction with interchangeable subassemblies and providing quick fault finding through simple "go, no-go" testing techniques, we offset the disadvantages of maintaining complex equipments. In fact, at the lower echelons of maintenance, the job is actually easier than it was with earlier, less complex equipments. No actual repair is necessary except at depot level.

GEORGE H. SCHEER, Chief Communications Branch, Wright Air Development Center, Wright-Patterson Air Force Base, Dayton, O.

The basic circuitry required to provide high automaticity was carefully scrutinized and evaluated. We have found little if anything wrong in this department. But still we had an unacceptably low in-service rate. Through several controlled test programs, we gathered data which will be of value not only for increasing the reliability of airborne electronic equipment, but in any relatively complex electronic equipment. The greatest source of unreliability was found to be failure of individual component parts.

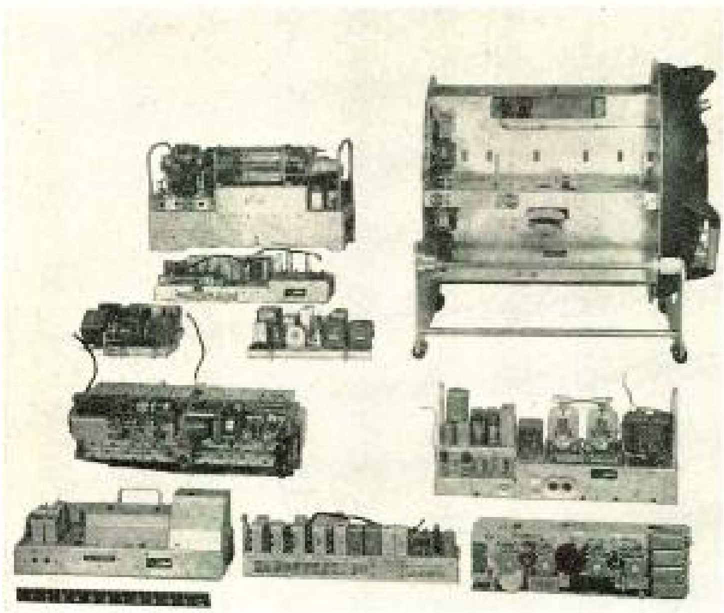
Worst Offenders

Subminiaturization was a "must" in order to meet the demands for more equipment in a smaller space. The state of the art in subminiature components had not kept pace with the equipment designers' demands. Most of these parts had not had the benefit of years of mass production during which the quality and reliability of the part increased as a natural consequence of continual improvement. A case in point was the subminiature vacuum tube, designed specifically for our new military equipments. Of all components, these tubes were the worst offenders. There is nothing new in this situation. Miniature tubes were much the same when first introduced, but they have since improved in reliability through years of production "knowhow."

In the case of the subminiature vacuum tubes and other components, we could not wait years for a product of satisfactory reliability. We were faced with obtaining satisfactory reliability in a matter of months; our airplanes were waiting for the equipments. Before we discuss matters further, I want to point out that we are not pointing any fingers at anyone. Industry and the Air Force combined forces to analyze the problem areas and to remedy the faults. Our purpose now is to give you our findings so that everyone may benefit and avoid any repetition of the known causes for unreliability. The job is far from finished, but we have made very substantial advances. It is everybody's job from now on.

The first thing we discovered was that parts made to JAN specifications were inadequate. These specifications were intended to permit easy mass production by many sources and their requirements are minimum.

By applying the Rand formula, we can see at a glance how our troubles



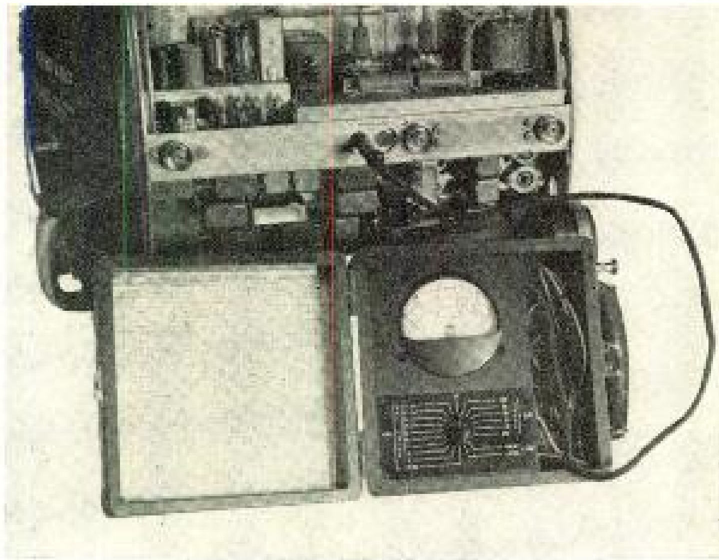


Fig. 2: (l) Trans-ceiver subassemblies. Fig. 3: (r) Meter plugs into test socket.

Complex Airborne Equipment

Following is a listing of typical component failures in controlled field testing of a complex airborne radio communications system. Results are a compilation of both airborne and ground failures. It is noted that components are shown only by class, with no detailed breakdown by type. It is also noted that all components with the exception of subminiature vacuum tubes had undergone improvement before the test period. Subminiatures have been improved and are available from vacuum tube manufacturers as listed below. However, tube failures listed below are with older subminiatures due to their nonavailability during the test period. Relative numbers of components in the equipment are not indicated, except that each equipment used a total of 67 subminiature tubes, all types, as listed below.

Relays	
Sealed	11 failures
Unsealed	1
Capacitors	
Tantalum Type	5
Paper	1
Vacuum	1
Switches	
Stepping	2
Wafer	1
Input	1
Aneroid	1
Resistors	
Variable WW	1
Filters	
Chokes	2
Miscellaneous	
Plugs	3
Solenoids	1
Clutches	1
Gears	1
Dials	1

Component Failure Summary

Vacuum Tubes (all)	56.96%
Relays	15.19
Capacitors	8.86
Switches	6.33
Plugs	3.80
Filters	2.53
Solenoids	1.27
Resistors	1.27
Gears	1.27
Dials	1.27
Clutches	1.27

Revised Subminiature Vacuum Tube Specifications:

5636	MIL-E-1/168B
5639	MIL-E-1/169B
5643	Pending
5718	MIL-E-1/172A
5719	MIL-E-1/173B
5840	MIL-E-1/140A
5896	MIL-E-1/174B
5899	MIL-E-1/97B
5902	MIL-E-1/187B
6021	MIL-E-1/188B

originated. Admittedly, this formula is arbitrary and probably pessimistic, but it does give about the right order of magnitude. Our example is a hypothetical case of an equipment with 2000 active components, the failure of any one of which will make the equipment inoperative in some function. This formula also requires that we specify how many equipments we are willing to take, knowing there will be an early life failure. Again, for demonstration purposes only, we shall say that we would accept one equipment out of each 100 with early life failure to be expected. Then (1—0.99)/2000= .000005. Interpreted, this says that every individual component must have a failure rate of less than five per million units. This is the reason we got into trouble; manufactured components were not that good.

Even this would not be so bad if there were some positive means of determining, during manufacture and test, just which of these components would fail in early life. Unfortunately, this is usually impossible. We do know that components such as vacuum tubes can be made more reliable by a longer burn-in time and a process of elimination. Unreliable tubes can be culled out and the remainder of the lot should therefore be more reliable.

Tantalum capacitor failures have
(*Continued on page* 86)

Improved chromaticity signal-to-noise performance over conventional "nonlinear" system is achieved within FCC specifications

Linear Color TV Receiver

By C. HOWARD JONES

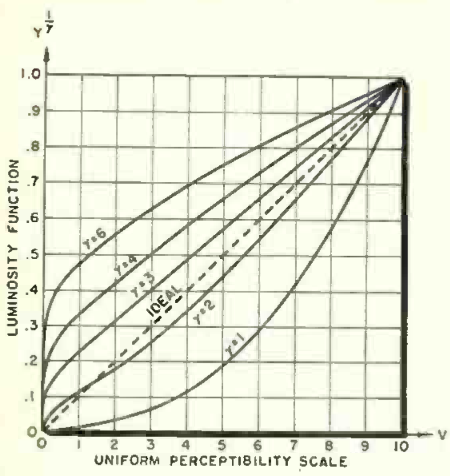


Fig. 1: Gamma values for luminosity function

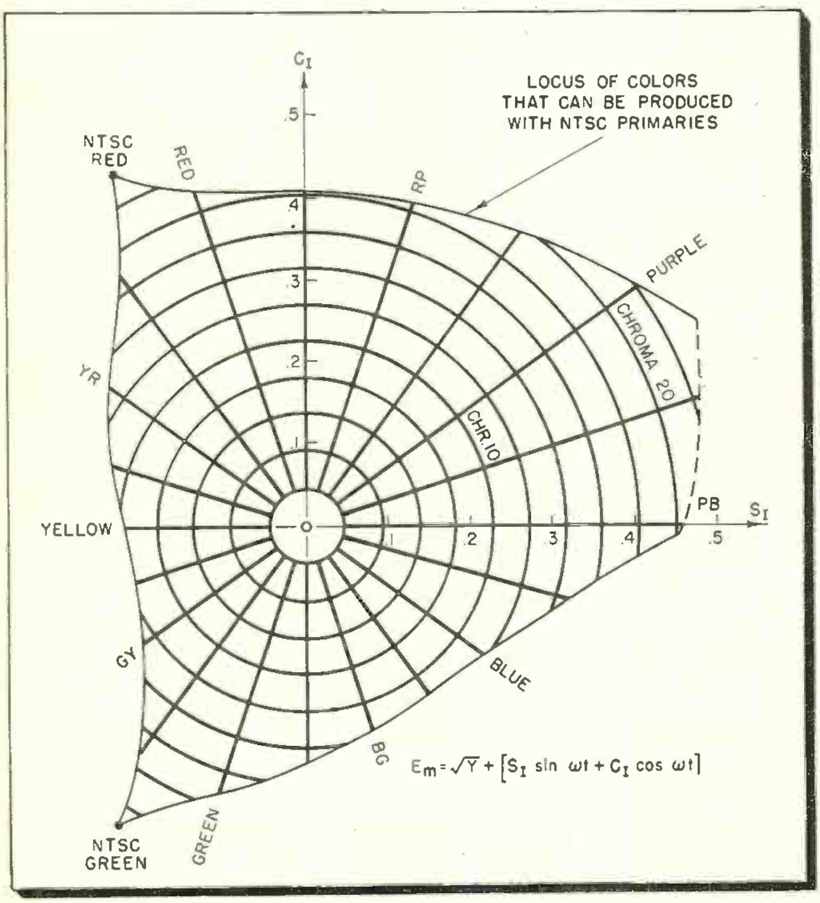
C. H. Jones

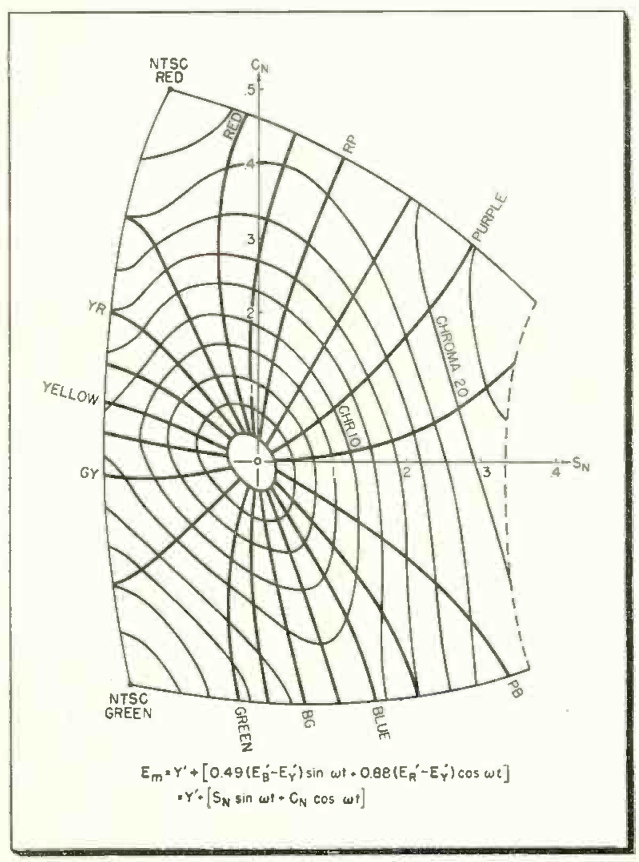
A linear signal can be defined as one in which the 3.58 MC color subcarrier vector is linearly related to chromaticity. With a linear signal, changes in saturation change the amplitude of the 3.58 MC color signal but do not change its phase. The NTSC signal can be called a "nonlinear" signal. Changes in saturation generally cause the phase of the color signal to change as well as its amplitude. This article compares a "linear signal" with the more conventional "nonlinear signal." Receivers for both types of signals are shown. The linear system gives a 2 or 3 db improvement in chromaticity signal-to-noise ratio.

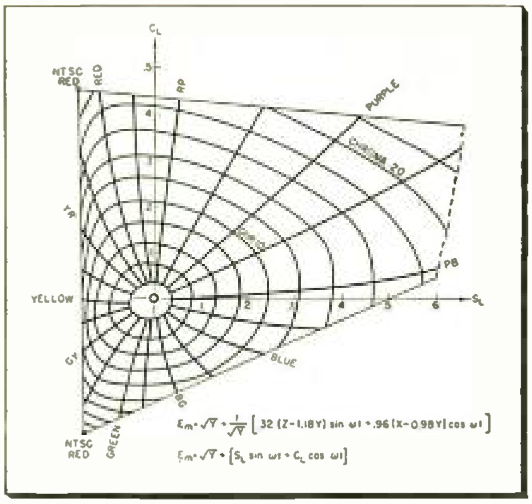
■ The NTSC Color TV signal specifications adopted by the FCC are worded in a way which permits a certain amount of progress in the art. It was believed that the specifications should be specific enough to allow signals to be broadcast and receivers to be built today. However, it was recognized that the specifications should be broad and flexible enough so as to allow room for improvements in the future.

The author has described a variety of possible types of color TV signals.[6] The Munsell Colors were used in studying and comparing the various signals. The three scales used in the Munsell Color specifications are Value, Hue, and Chroma. These three scales are used to measure brightness, dominant wavelength (or hue), and saturation respectively. The Munsell units have been chosen to agree as closely as possible with a normal person's perception of these three parameters. A linear type of signal was recommended as being desirable from a noise standpoint. This paper compares the conventional non-linear signal and a linear signal with an ideal signal in a quantitative way. Receiver circuits for nonlinear and linear signals are compared. In mak-

Fig. 2: (l) Ideal signal. Phase and amplitude of a color subcarrier at Y 0.2. Signal has uniform spacing of color on a perceptibility basis. Fig. 3: (r) Non-linear signal. CTI transformation is warped due to way gamma is applied to chromaticity components







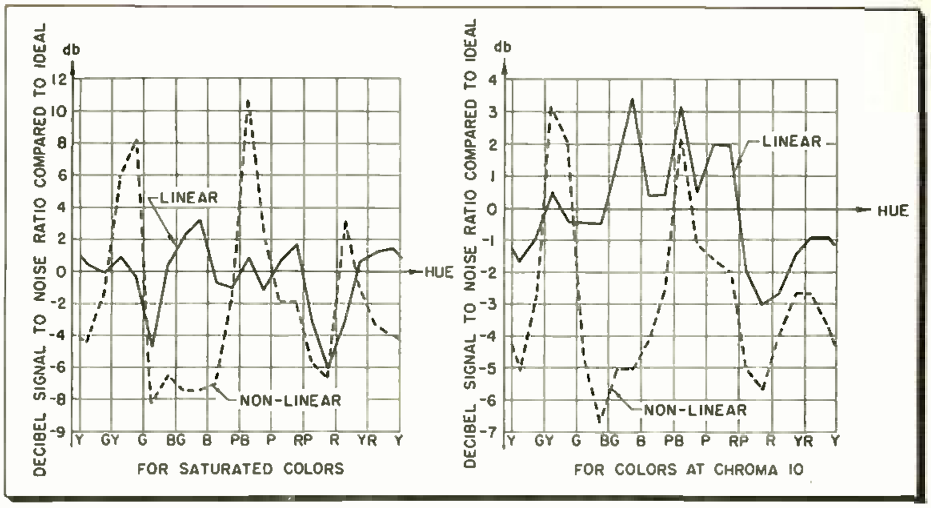


Fig. 4: (l) Linear signal. Phase and amplitude of color subcarrier at Y 0.2. This is a linear transformation of the CTI diagram. Fig. 5: (r) Noise susceptibility for "linear" and "nonlinear" signals

ing these comparisons a gamma[2] of 2.0 was chosen for convenience. However the comparison would be about the same if a gamma of 2.2 had been assumed. Fig. 1 shows that gamma (γ) values of either 2.0 or 2.2 give a brightness function $Y^{1/\gamma}$ which is roughly proportional to Munsell Value (V).

$$10\, Y^{1/\gamma} \approx V \text{ when } \gamma = 2 \text{ or } 2.2$$

where Y is the relative luminosity. For highlight brightness Y = 1 and for black Y = 0.

Effect of Gamma

It has been realized for some time that the application of gamma correction to the individual red, green and blue components of the chromaticity signal, results in a nonlinear transformation of the chromaticity diagram as the information is transmitted. [1,3,6] See Fig. 3. The Hue contours[6] tend to be close together in regions of the primary colors blue, green and red and spread apart in the region of the complimentary colors cyan, yellow and magenta. This results in a reduction in hue signal-to-noise ratio for primary colors of high saturation. For colors of low saturation, the Hue spacing is more uniform but the gamma distortion reduces the diameter of the Chroma (saturation) contours. This results in a reduction of signal-to-noise ratio for colors of low saturation.

Fig. 2, 3, and 4 give the phase and amplitude of color subcarrier for an ideal signal, a nonlinear signal, and a linear signal. The average length of the color vector for saturated colors was made the same for all three. Hence, all three signals are equally compatible with black-and-white TV. Radial contours are for 20 equally perceptible changes in hue, and circular contours are for equally perceptible variations in saturation.[4] With the "ideal signal" of Fig. 2, Chroma circles are all round and equally spaced and Hue lines are all straight and separated by equal angles. Hence, noise would be equally noticeable for all colors transmitted. Such a signal is unsuited for TV, because it would be very difficult to decode and use at receivers. An "ideal signal" is useful, because, by comparing practical linear and nonlinear type signals with it, we can see how close they come to this ideal. Figs. 3 and 4 show the vector phase and amplitude of the chromaticity signal using a nonlinear and a linear signal. These three types of chromaticity signals are all compared at a middle gray $\sqrt{Y} = 0.445$ brightness level. Comparison of the three signals at other brightness levels yields similar results. Angular separations between the colors at saturation and at chroma 10 were measured for 20 hues and the results are shown in Fig. 5. Both the linear and nonlinear signals deviate appreciably from the ideal but the linear signal is substantially better than the nonlinear.

Accurate reproduction of skin tones and other low saturation colors is of more concern than reproduction of highly saturated colors. Hence, the comparison of signal-to-noise ratio at chroma 10 is of particular interest. The nonlinear signal drops to 6 db below the ideal while the linear signal at its worst point is only 3 db below the ideal. It will be noted that for all hues except near green-yellow (GY), the linear signal is superior to the nonlinear signal and in that region it is only 0.5 db below the ideal.

Others[5] have shown that the transmission of a $\sqrt{Y}$ brightness signal is preferable to a E_Y' signal because the former is unaffected by Chromaticity noise.

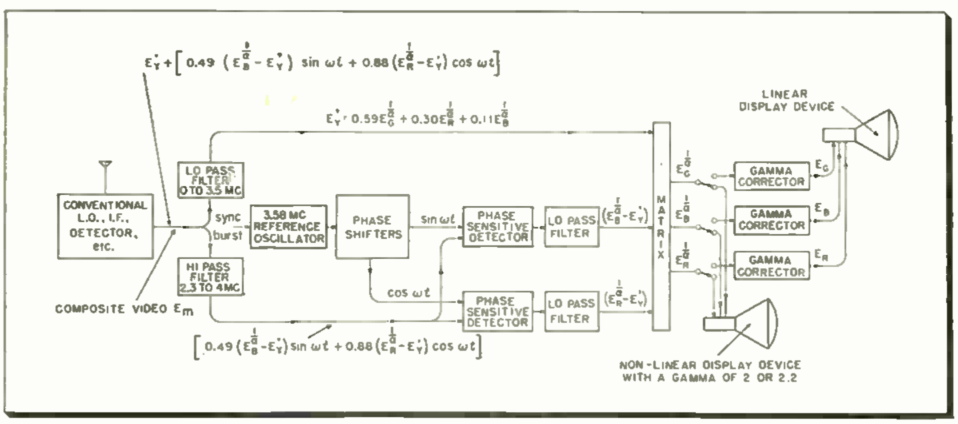
Now let us consider the nature of the two types of signals and see just what sort of circuitry is required for each.

The two signals to be compared are:

the nonlinear signal

$$E_m = E_Y' + [k_G' E_G^{1/\gamma} \sin(\omega t + \Theta_G') + k_R' E_R^{1/\gamma} \sin(\omega t + \Theta_R') + k_B' E_B^{1/\gamma} \sin(\omega t + \Theta_B')] \quad (1)$$

Fig. 6: Nonlinear color television receiver block diagram



C. HOWARD JONES, Westinghouse Electric Research Labs, East Pittsburgh, Pa.

Linear Color (Continued)

where $E_Y' = .59\ E_G^{1/\gamma} + .30\ E_R^{1/\gamma} + .11\ E_B^{1/\gamma}$

and the linear signal

$$E_m = \sqrt{Y} + \frac{1}{\sqrt{Y}}\left[k_R\ E_G \sin(\omega t + \Theta_G) + k_R\ E_R \sin(\omega t + \Theta_R) + k_B\ E_B \sin(\omega t + \Theta_B)\right] \quad (2)$$

where Y is the brightness

$Y = .59\ E_G + .30\ E_R + .11\ E_B$.

The circuits to be described for both types of signals will be of exactly the same sort regardless of the constants

$$\gamma, k_R', \Theta_R', k_B', \Theta_B', k_G', \Theta_G', k_R, \Theta_R, k_B, \Theta_B, k_G, \Theta_G$$

that are chosen. However, to obtain the quantitive comparison of the sort given by Figs. 3, 4 and 5, constants had to be assumed.

For the nonlinear signal, a gamma of two was assumed and the other constants were those which have been adopted by the FCC.

$$E_m = E_Y' + [.593\sqrt{E_G} \sin(\omega t - 119.4°) + .632\sqrt{E_R} \sin(\omega t + 103.6°) + .449\sqrt{E_B} \sin(\omega t - 12.4°)] \quad (3)$$

The constants chosen for the linear signal are those suggested by the author in an earlier paper.[6]

$$E_m = \sqrt{Y} + \frac{1}{\sqrt{Y}}[.434\ E_G \sin(\omega t - 117.4°) + .322\ E_R \sin(\omega t + 110.6°) + .325\ E_B \sin(\omega t + 15.2°)] \quad (4)$$

A more familiar form of the nonlinear signal of Eq. (3) is

$$E_m = E_Y' + [.49(\sqrt{E_B} - E_Y') \sin \omega t + .88(\sqrt{E_R} - E_Y') \cos \omega t] \quad (5)$$

and a corresponding form of the linear signal of equation (4) is

$$E_m = \sqrt{Y} + \frac{1}{\sqrt{Y}}[.32\ (Z - 1.18Y) \sin \omega t + .96\ (X - 0.98Y) \cos \omega t] \quad (6)$$

Fig. 7: Block diagram of proposed color TV receiver for linear signal

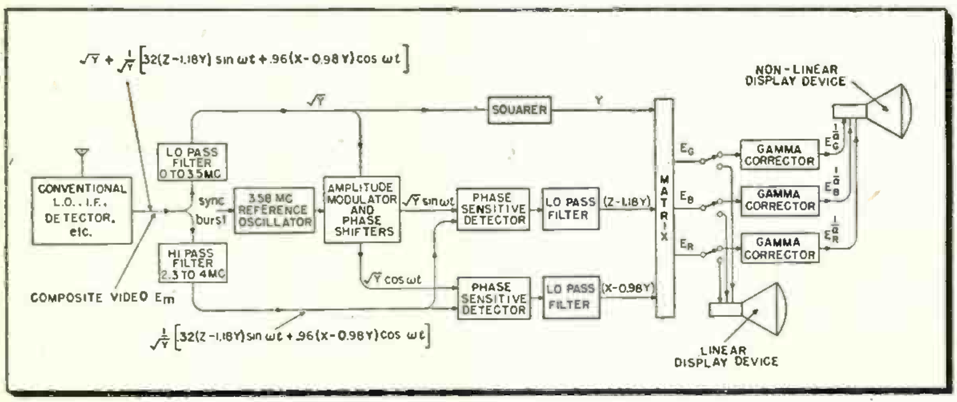


Table I.

Comparison of the Quality of Color Pictures for "Nonlinear" and "Linear" Systems.

		Nonlinear Signal and Receiver	Linear Signal and Receiver
Color rendition in the absence of noise*		Correct	Correct
Brightness rendition in the absence of noise*		Correct	Correct
Chromaticity rendition with a given noise level	At high saturation	8 db below ideal	6 db below ideal
	At low saturation	6 db below ideal	3 db below ideal
Brightness rendition with noise in the Chromaticity band	At high saturation	Appreciable degradation	No degradation
	At medium saturation	A little degradation	No degradation
	At zero saturation	No degradation	No degradation

* A large signal to noise ratio approximates this condition.

Receiver Circuits for Both Signals

Figs. 6 and 7 illustrate in block diagram form the receiver circuitry required for each type of signal. In both types of receivers, the low pass and high pass filters are used to separate the brightness and chromaticity portions of the signal. In both types of receivers, the 8 cycle burst of 3.58 MC received during the horizontal retrace time is used to maintain a reference oscillator at constant phase and amplitude. In both receivers, two signals 90° apart in phase are obtained from the reference oscillator and applied to the "phase sensitive detector" circuits. In the conventional receivers, these two signals are of fixed amplitude while in the linear type receivers the amplitude of the reference signals is made proportional to the signal $\sqrt{Y}$.

In both types of receivers, the job of the phase sensitive detector or chromaticity demodulator is simply to obtain a product. If A and B are two input voltages to such a circuit, the output is A x B. Now in color TV the two input voltages have a frequency of about 3.58 MC and have a phase difference that depends on the color being transmitted at that instant. For example, consider the reference signal A sin ωt and the color signal (S sin ωt + C cos ωt) being fed to a phase comparator (product circuit). Output would be

$$A \sin \omega t\ (S \sin \omega t + C \cos \omega t) = AS \sin^2 \omega t + AC \sin \omega t \cos \omega t = (AS/2)(1 - \cos 2\omega t) + (AC/2) \sin 2\omega t$$

A low pass filter removes the 2ωt terms to leave only (AS/2). Similarly, if the reference input signal had been B cos ωt, the output from the filter would be (BC/2). Hence, by means of a product circuit and a low pass filter, it is possible to obtain a signal that is proportional to the product of the amplitudes of the two input signals and the cosine of the phase angle between the two.

Electrically, an instantaneous product can be achieved a number of ways.[7] Pentodes or pentagrid mix-

(*Continued on page* 90)

NBS research points to 90% savings in the cost of digital computer memories through the application of gas diodes

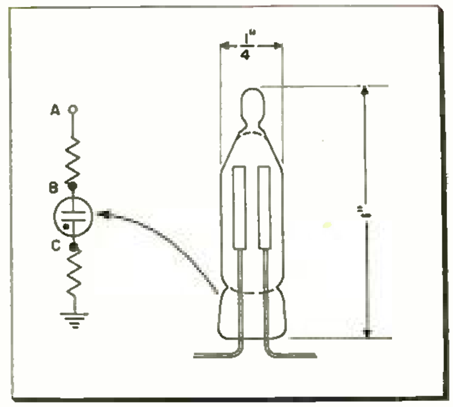


Fig. 1: Basic memory circuit, using gas diode.

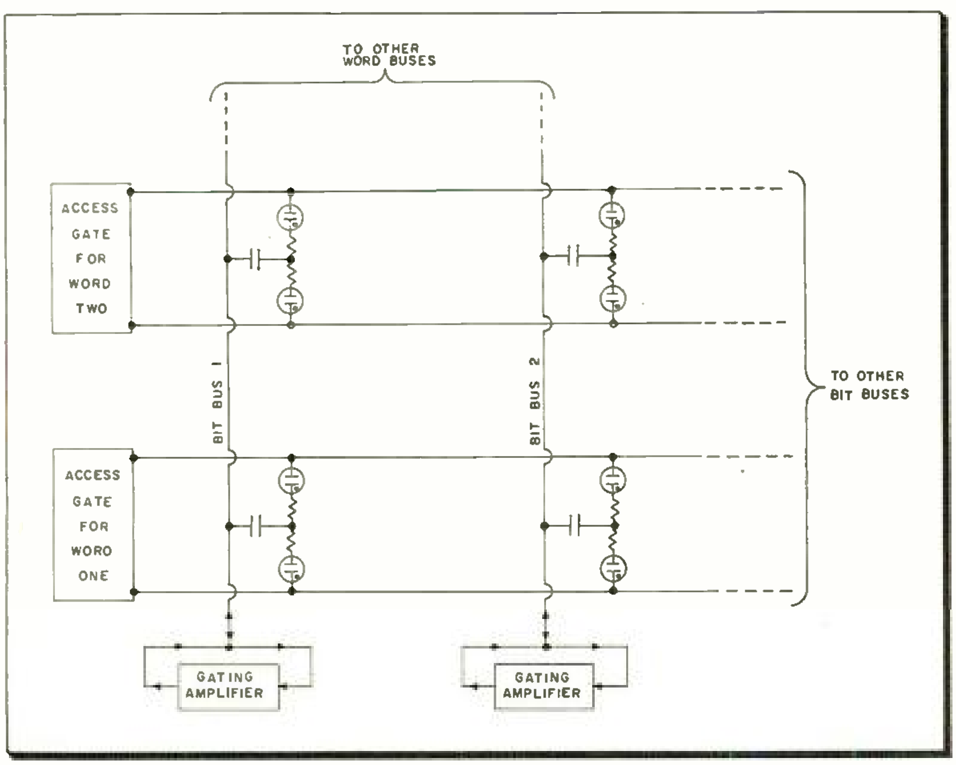
GAS DIODE CIRCUITS For Electronic Computers

WITH the increasing use of electronic digital computers, complex problems have been presented which require for their solutions high-speed memories so large that present-day costs make them economically impractical. The cold-cathode gas diode—such as the simple neon glow lamp—offers possibilities for low-cost high-speed memories, once the inherent disadvantages of the tubes are overcome. A. W. Holt and D. C. Friedman of the National Bureau of Standards data processing systems laboratories have undertaken a study of these visual-indicating tubes for memory and indicator circuits. The result has been a number of circuits that provide an approach to reducing the cost of digital computer memories from the present dollar per bit (binary digit) to about 10 cents.

In addition to the storage properties of these gas-diode memories, indication is also possible since in most of the circuits considered the lamp will flash in only one of the two stored states. The work was sponsored by the Wright Air Development Center and the Air Force Cambridge Research Center.

The cold-cathode gas diode as a computer element has a number of advantages: smallness of size, ruggedness, cheapness, cool operation low power requirements, high possible pulse power, visual indication and several types of possible binary states of electrical operation. However, they also have a number of disadvantages which tend to limit their use. Among these are: a wide range of characteristic potentials; variability of these potentials with use, ambient light, and temperature; long deionization time; and difficulty in obtaining access to a single bit when used in a matrix. Recent efforts at the Bureau have been directed toward developing circuits to overcome the latter two difficulties in order to obtain indicator memories.

Fig. 2: Organization of the gas diode-capacitor memory circuit.



The basic memory circuit consists simply of a gas diode connected in series between two resistors. See Fig. 1. Power is applied to one resistor at a point which may be called A for convenience. This resistor is connected to the diode at point B. The other terminal of the diode is tied, at point C, to the second resistor which is returned to ground. This circuit may be a pilot lamp. an oscillator, a flip-flop, an or-gate, an and-gate, a memory bit, or even a photo-flash. How it is used depends upon the voltages applied to points A, B, and C, the values of the resistors, and whether the output is electrical, photoelectrical, or optical.

When used as a dc indicator memory bit, the total resistance exclusive of the diode is of the order of 0.1 megohm. A potential somewhere between the firing voltage and the holding voltage is applied at point

(*Continued on page* 92)

Viewpoints on D-Amplifier

Cut-off Predictions Via Bandwidth Indexes, Improved Ladder Networks, and Suitable Wide-Band Couplers, Aid Amplifier Design

PART ONE OF THREE PARTS

By Dr. HARRY STOCKMAN

THE increased activities in the field of Distributed Amplification are evident not only from the appearance in the market of new types of small-signal distributed amplifiers, or D-amplifiers, but also from the fact that at least one distributed power amplifier, or DP-amplifier, reaching 100 watts output signal power, is now commercially available. Nevertheless, it is important to realize that the progress in network theory, and availability of suitable components, not only has expedited the development of the D-amplifier, but has also helped along its competitor, the single-tube cascaded amplifier (synchronously or stagger tuned). In fact, even at upper cutoff frequencies in excess of 200 MC, there may now be a question whether one should use cascaded D-amplifier stages, or cascaded single-tube cascaded stages. This situation can only be explained by the availability of better coupling circuits, closer to the theoretical limit[9], and better tubes. Excepting Transmission Line Tubes from this particular discussion, the progress towards suitable D-amplifier tubes, small or large signal, has been extremely slow; if any at all. The new and better tubes in the market with high g_m/C-ratio all seem to favor electrode system design, and electrode connections, which fit single tube cascading, but give the D-amplifier designer a hard time. (As this is written, however, the GL6442 tube is just entering the market, having both sides of the filament free from the cathode, thus providing an r-f, high-g_m tube, which at least fulfills the basic requirements of the Paraphase circuit). There has developed a "wait-and-see" policy in the industrial field of D-amplification; typical for such a policy is one commercial design in which the manufacturer restricts the D-amplification to the output stage only, using one-tube-cascading in previous stages.

There exists a promising crossbreed between the two design principles outlined: that of the "Distributed Pair"[10]—several distributed pairs in cascade representing a powerful design principle. This brings up the vital question of Network Synthesis, implying poles-and-zeros techniques. It has been said about certain amplifiers, designed in the laboratory via analysis plus cut-and-try methods, that their gain-bandwidth product can be doubled if the design is scrutinized via modern network synthesis methods. This statement should be seen against the background that any specified amplifier has applied to it a particular mixture of requirements on such performance criterions as suitable transmission, phase, and differential time-delay characteristics, and suitable time response delay, rise and decay times, overshoots, etc.[11,12].

Production & Profits

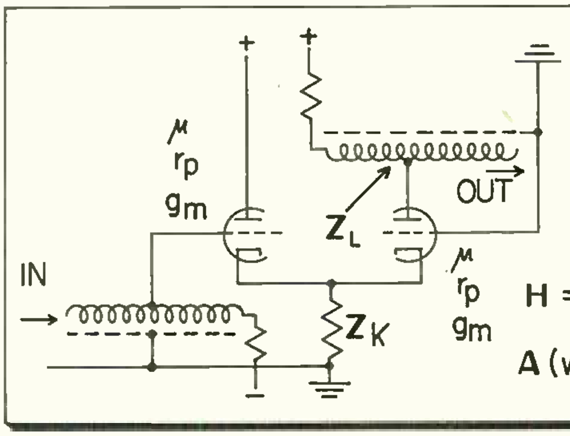
The question of suitability for mass production is decisive on the choice of proper design principle. In a laboratory-built five-storage-element interstage, single-tube-cascaded amplifier, the number of precise adjustments may not be a serious objection, but in the same amplifier, readied for mass production, the precise adjustments of the complicated interstage may ruin the manufacturer's chance for a profit. (A six-storage-element interstage is out of the question even in most laboratories, since the true circuit scarcely is the proposed one, due to the existence of excessive leakage admittances, and due to the fact that the tolerances of the always frequency-dependent components tend to become exceedingly narrow). A bulkier, heavier, multitube D-amplifier of about the same performance as the five-storage-element interstage, referred to above, requiring practically no fine adjustments, may be turned out for much less money, and do faithful service for many years to come without the need for much servicing.

Possible Solution

Actually, we should not draw any hard and fast rules, comparing single-tube-cascading with D-amplification, unless we first specify whether we are dealing with a multichannel r-f amplifier, or with a millimicrosecond pulse amplifier. A single-tube cascaded amplifier may be the perfect solution for the former, while a D-amplifier may be the natural solution for the latter. The criterions on steady-state and pulse amplifiers may differ greatly, and some additional viewpoints on this important subject matter will be given in the following.

In the frequency range above

Fig. 1: The paraphase amplifier with formulas for equivalent triode.



$$\mu' = -\mu \frac{H}{1+H}$$

$$r_p' = r_p \frac{1+2H}{1+H}$$

$$g_m' = -g_m \frac{H}{1+2H}$$

$$H = g_m Z_K (1 + \tfrac{1}{\mu}) \doteq g_m Z_K$$

$$A(w) \doteq \frac{g_m^2 Z_L}{2g_m + 1/Z_K}$$

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Design

200 Mc, or so, and particularly when in low-pass design the upper cutoff frequency reaches 500 or even 1000 Mc, the D-amplification (paraphase) scheme is practically the only solution[12]. Competition is provided by the divided-band amplifier, and the conventional traveling-wave amplifier in frequency conversion schemes.

Before entering into the discussion of some technical topics, pertaining to D-amplifier design, we may list as yet unapproached "milestones just around the corner", (1) a specially designed tube with all electrode outlets in just the right places, selling for a few dollars, and making possible d-c to 1000 Mc inexpensive miniaturized D- and DP-amplifiers, and (2), a common-vacuum transmission-line tube, selling for $50 or so, which upon the attachment of a modern, tubeless power supply provides a 2000 Mc inexpensive, ultra-miniaturized D- or DP-amplifier; all complete. Lesser required bandwidth than the one indicated would be turned into extra gain. If enough years pass on before these two building stones are provided, the chance is that they will not be provided at all. This is because of the rapid advances in the semiconductor field.

In the following text the term "gain" has been used indiscriminately for amplification and power gain, except in places where this usage may lead to misunderstandings.

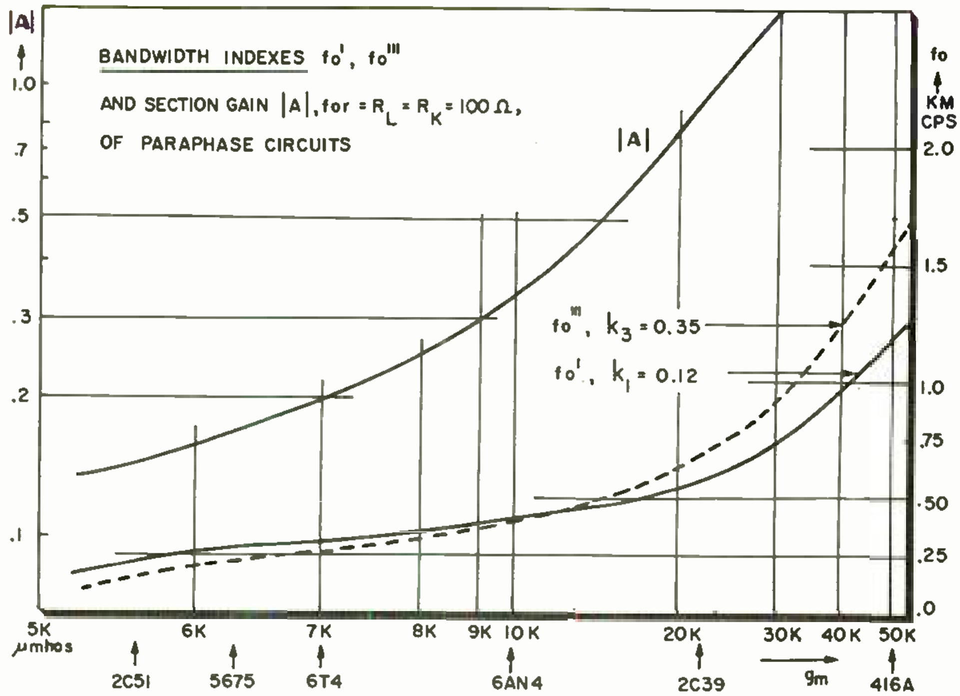

Fig. 2: Plots of bandwidth indexes as functions of g_m with indicated tube types

Paraphase Circuit

In the design of extremely-wide-band amplifiers, extending from dc to perhaps 1000 Mc, the distributed amplifier solution appears particularly attractive. Conventional amplifiers of this type employ pentodes up to 400, or possibly 500 Mc, and, when the frequency exceeds this value, a triode-cathode-follower-grounded-grid-triode, or Paraphase type of circuit, may be used. Fig. 1 shows the basic principle of a paraphase circuit, which may utilize separate triodes, or twin triodes.[1,2] It is of interest also to investigate the possibility of replacing the tubes by transistors or transistor combinations.

The generally adopted terminology is to refer to the repeated group of identical or nearly identical active elements as a section, and the additive combination of sections into a larger group of active elements as a stage. Several stages may be cascaded into a final, complete amplifier.

The prototype for the conventional cascaded amplifier has one active element per stage, and a total gain for n identical stages of $A(\omega)_{tot} = A(\omega)^n \exp jn\phi(w)$, where $A(\omega)$ is the absolute gain per stage and $\phi(\omega)$ the phase shift per stage, which alternatively may be expressed as the time delay $t_d = \phi(\omega)/\omega$ or $d\phi(\omega)/d\omega$, depending upon definition. If the zero frequency response is A(o), the requirements of a good amplifier may be formulated in terms of the ideal responses $A(\omega) = A(o)$ and $\phi(\omega) = \omega t_d$, or t_d = const. Adding to this the requirements that the amplifier should be free from non-linear distortion, and have the $A(\omega)$, $\phi(\omega)$ response outside the upper cut-off frequency fulfill the minimum requirements for a satisfactory response in the time domain, a sound basis for comparing amplifiers has been established. It should be noted that the steady-state characteristics $A(\omega)$, $\phi(\omega)$ determine the transient behavior of the amplifier. This does not imply, however, that we can determine the transient behavior merely by examining the $A(\omega)$, $\phi(\omega)$ characteristics.

With reference to the conventional one tube per stage, cascaded amplifier, the use of a "figure of merit" makes possible the estimation of obtainable gain, when the upper cut-off frequency is given, or estimation of the obtainable upper cut-off frequency, when the gain is given. One of the most useful figures of merit is Wheeler's Bandwidth Index $f_o = g_m/\pi\sqrt{C_1 C_2}$ of dimension frequency.[3] Here the values of C_1 and C_2 depend upon how C_1 and C_2 are defined and measured; as in-between-electrode capacitances (catalog values), as total "loaded" input and output capacitances, as specifically obtained capacitance due to a grounded grid, etc. Two particular kinds of f_o values are therefore of interest: one obtained when C_1 and C_2 are read off from a tube handbook, and the other when C_1 and C_2 are the calculated or measured "loaded" values actually existing when the tube is placed in the circuit (C_1 and C_2 generally increased because of tube socket capacitance, stray capicitance due to wiring, cathode to heater capacitance, etc.).

In most conventional distributed amplifier designs, the total number of tubes in the product mn (n tubes per stage, m stages in cascade) must be kept to a minimum. As has been shown in the literature, this means a fixed voltage gain per stage of e = 2.72, or rather, if the associated change in bandwidth is considere—d[6], $\sqrt{e}$, or as a general thumb rule, a gain of approximately 2 times. For equal input and output impedance, this means a gain per stage of 6 db. The fixed-gain concept points toward the possibility of formulating a gain-bandwidth figure, or a figure of merit, which directly indicates the obtainable upper cut-off frequency. This procedure at first appears somewhat artificial, for we do not

(*Continued on page* 100)

Simple Method of Video Delay-Line

By DANIEL A. GILLEN

Breaking line into sections, eliminating coupling, and introducing opposing mutual is basis of new method for compensating distributed constant video delay lines

COLOR TV and other recent electronic developments have brought many engineers face to face with delay line problems. Receiver manufacturers, in particular, are concerned with the problem of adapting design principles of the past to receivers where size, cost, simplicity, and reliability are important considerations. Transmitter engineers, although not influenced to the same extent by size and cost, are interested in the fidelity and the reliability of the lines.

A great deal of data has been published on delay lines that take the form of low pass or all pass filters and utilize lumped constants. These lines do not meet the requirements of cost and simplicity when high delays at video frequencies are required, and therefore will not be discussed here.

Distributed constant lines appear to be a much better choice for most video applications. H. E. Kallmann has explained thoroughly the basic design and operating principles of such lines. He shows us that delay lines may be constructed by winding a long solenoid over a grounded strip of conducting material so that the capacity to ground is essentially distributed along the coil. He also shows that the characteristic impedance of the line is equal to $\sqrt{L/C}$ at low frequencies and the time delay is given by $\sqrt{LC}$, where L is the inductance and C is the capacity to ground.

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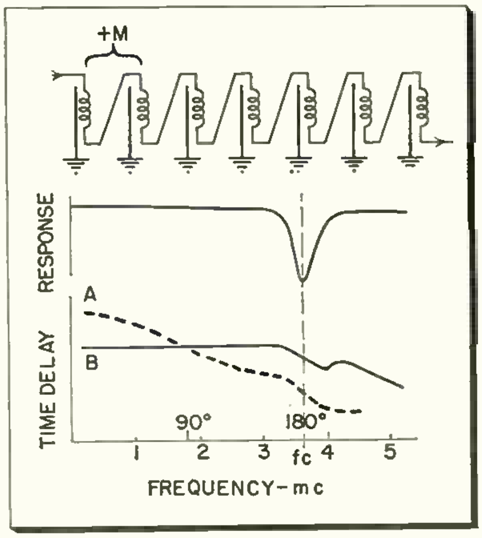
At the higher frequencies, the time delay of a simple distributed constant line is less than at the lower frequencies. Fig. 1 illustrates this graphically. As the frequency is raised, the currents in coupled turns become less and less in phase with each other. This is equivalent to a reduction in the effective aiding (or negative) mutual inductance and therefore reduces the total effective inductance of the coil. By the formula $T = \sqrt{LC}$ a reduction in L will cause a reduction in time delay. Therefore, a curve of T vs. f will have a downward slope.

When we attempt to design delay lines having the same electrical properties but shorter physically, the phase difference in coupled turns becomes even greater at the higher frequencies. Therefore, the slope of the time delay characteristic becomes greater as illustrated. The curves shown are typical for lines having one microsecond time delay. The line corresponding to the lower curve is one fourth the length of the line corresponding to the upper curve. It becomes obvious that the reduction of length is limited by the phase distortion that may be tolerated.



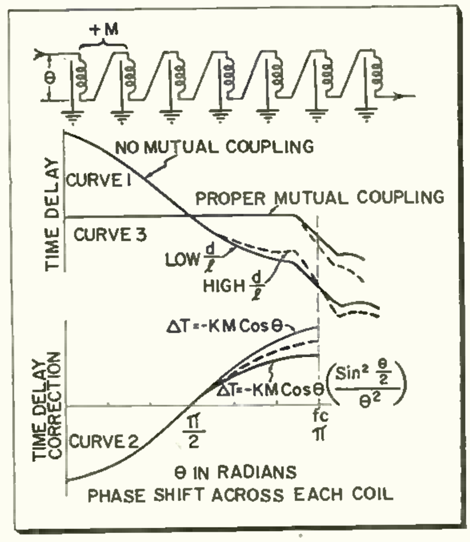
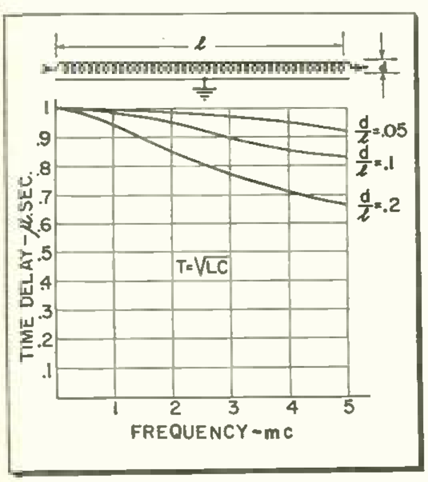
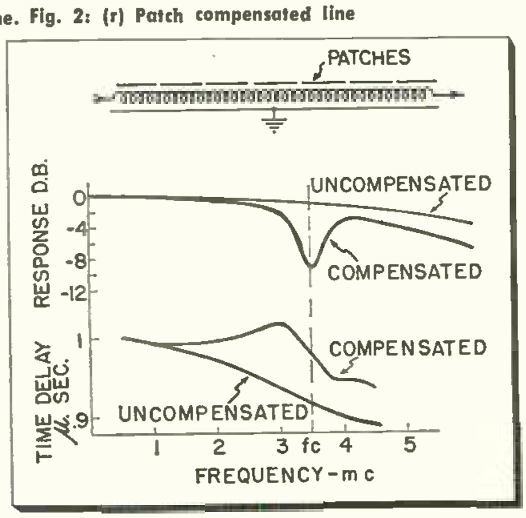


Fig. 3: (l) Compensation by mutual inductance. Fig. 4: (r) Mutual inductance vs. time delay

Fig. 1: (l) Uncompensated line. Fig. 2: (r) Patch compensated line





A familiar method of compensation for the poor time delay characteristic described on the previous illustration involves the use of floating "patches" which are small conducting strips placed close to the winding as shown in Fig. 2. These patches increase the coupling at the higher frequencies to compensate for the reduction of mutual inductance between turns.

Kallmann has adequately described this method of compensation. The patches give excellent compensation on lines that are conservatively designed, but on severe

Phase Compensation

designs (that is short delay lines that require a large amount of compensation) the patches tend to overcompensate the line just below the cutoff frequency. At this frequency the patch becomes equal to one-half wavelength. Two or more sets of patches staggered in position is one method that is now used to avoid this difficulty.

Patch compensation increases the losses in the line at the higher frequencies since dielectric losses in the patch capacity are difficult to avoid. This loss is indicated by the difference in high frequency response for the uncompensated and compensated conditions.

Compensation is also achieved by using a universal progressive type of winding and, by proper choice of the winding configuration the bridging capacity can be supplied by the capacity between turns. Here again, the dielectric losses tend to increase at the high frequencies. Both of the above forms of lines are now used commercially.

Compensation By Mutual Inductance

Fig. 3 illustrates a new method of phase compensation.

By breaking up a distributed constant delay line into sections and spreading it out so that no coupling exists between sections the time delay would look like curve A. Now if we add the proper amount of opposing mutual phase, compensation is achieved as shown by Curve B. The opposing mutual between sections reduces the inductance at low frequencies. As the frequency increases to the point where the phase shift across each coil is 90° the effect of the mutual inductance cancels out. As the frequency increases still further the mutual effectively aids the inductance. Thus the time delay is reduced at the low frequencies and increased at the high frequencies, which is in the correct direction to provide phase compensation.

When the phase shift across the coil becomes 180° a dip occurs in the response curve. This frequency is designated as f_c. The time delay of each section must be determined so that this dip occurs beyond the desired frequency range. Note that the time delay characteristic is extremely flat to within a few per cent of f_c.

The curve shown is from a line designed specifically for the brightness channel of a color receiver. Advantage is taken of the dip in the response characteristic by placing it at 3.58 MC in order to eliminate the need for a subcarrier trap.

Fig. 4 is a help in visualizing the effect of the mutual inductance on the time delay characteristic of the line. Curve 1 shows a typical time delay characteristic obtained with a line of the type previously described where there is no mutual between windings. In this case the curve is plotted with θ, which is the phase shift across each coil, as the abscissa. The form of the time delay characteristic is very similar to a cosine

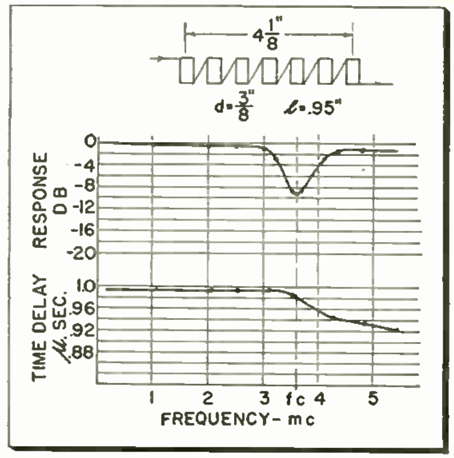


Fig. 7: Y channel delay line, 1000 ohm

TABLE I

TOTAL INDUCTANCE $L=TZ$

TOTAL CAPACITY $C=T/Z$

NUMBER OF SECTIONS $n=2Tf_c$

CHARACTERISTIC IMPEDANCE $Z=\sqrt{L/C}$

TOTAL TIME DELAY $T=\sqrt{LC}$

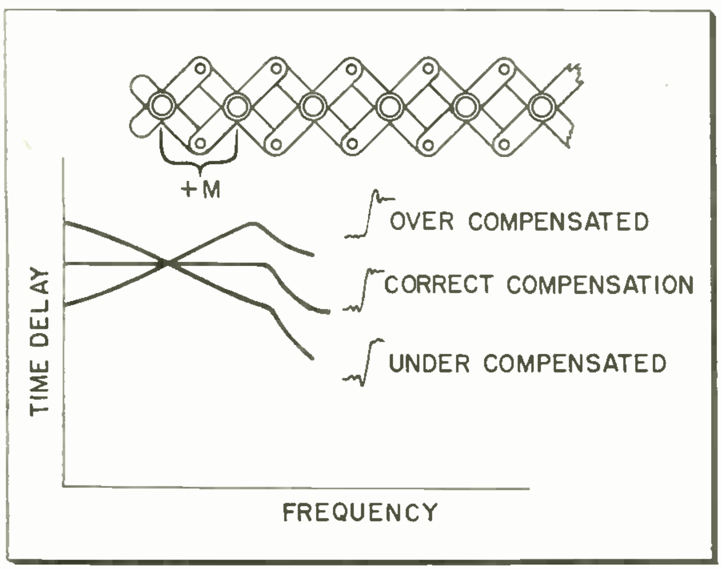
TIME DELAY PER SECTION $T_s=1/2f_c$

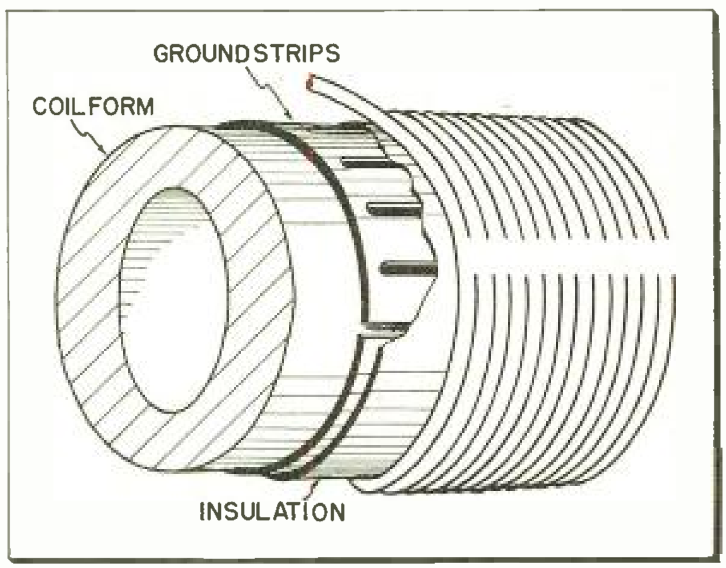
curve up to within a few per cent of π radians.

The curvature near f_c of the time delay characteristic will depend upon the form factor of the individual coils and a coil with a high ratio of diameter to length will have a curve as indicated by the dotted line. The curves are shown on an arbitrary time delay scale in order to better compare the relative shape.

It is difficult to obtain a general formula for the effect of mutual inductance on time delay for any coil form factor. We can, however, calculate two boundary conditions. If we assume long slim coils in the line spaced relatively close together then the major portion of the mutual coupling will be between turns having a phase difference of θ. Cal-

Fig. 5: (l) Results when adjusting the line by square wave response. Fig. 6: (r) Cutaway view of individual coil shows construction details





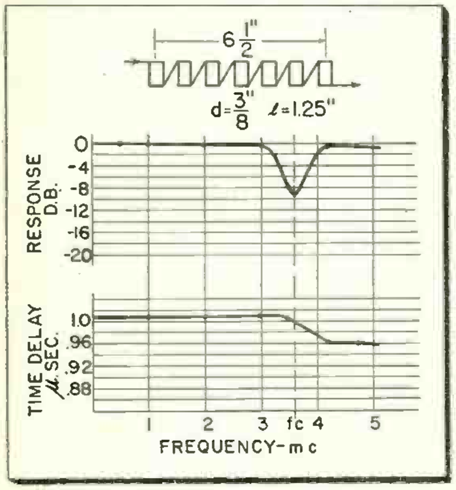


Fig. 8: Y channel, delay line, 2500 ohm

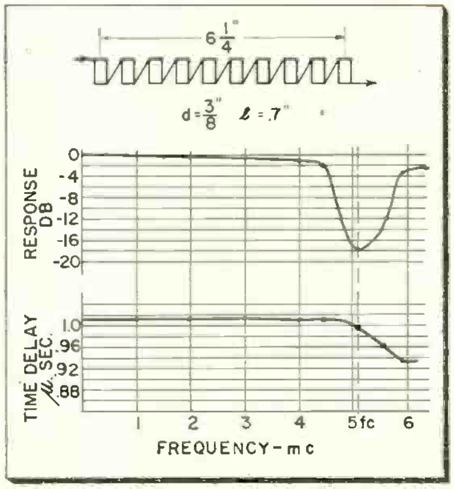


Fig. 9: Y channel, delay line, 2500 ohm

culating the correction obtained under the above condition we obtain an expression for the time delay correction $\Delta T = -KM \cos\theta$ where K is a constant and M is the mutual between one coil and the adjacent coils. This expression is plotted as one of the boundary conditions. The other boundary condition assumes very short coils, so that the mutual is equal between any turn of the reference coil and all of the turns of the adjacent coil. The expression for the time delay correction in this case is

$$-KM \cos\theta \, \frac{\sin^2(\theta/2)}{\theta^2}$$

and it takes the form shown. The correction obtained by any practical coil will lie between the two boundary conditions and is indicated by the dotted curve. Note that the amount of the correction can be adjusted as required by changing M, since M determines the magnitude of the correction curve.

Fortunately, the correction curve obtained for the long slim coil corresponds in shape to the inverse of the uncompensated curve for the similar coil and likewise the short coil is also properly compensated. Thus the choice of form factor of the coils can be based on considerations other than the desire to obtain proper compensation.

Design Procedure

Most of the design formulas shown in Table I are quite basic and require little explanation. The usual procedure used in calculating a line is to compute the inductance and the capacity needed from the known quantities of impedance and time delay. A cutoff frequency above the desired frequency range of the line is then chosen so the number of sections will be a whole number. The inductance and capacity per section can then be obtained. The time delay and characteristic impedance of a line designed in this manner will normally lie well within ten per cent of the desired values.

(Continued on page 105)

High Efficiency Yoke for Small Neck Tube

By CHARLES E. TORSCH

RECENT revival of interest in TV picture tubes of smaller neck diameter than the present 1 7/16 in. size has centered on a 1 1/8 in. nominal neck size.

Several set and picture tube makers have agreed on this as a compromise between midget-necked radar tubes and the prewar standard 1 3/8 in. neck. This decrease in neck diameter is sought to cut receiver costs for associated yokes, transformers, sweep driver tubes, and B supply.

It is now realized that the 1 1/8 in. tube, with a new 90° yoke, will give substantial benefits to set makers. This 1 1/8 in. tube yoke produces full 90° sweep with less than half the vertical power normally consumed in 1 7/16 in. tube yokes, and approximately 80% of the normal horizontal sweep intake.

With these efficiencies attained, 125 volt B supplies will be adequate without resort to the bulky iron described in 1953.[1] Operation of the new vertical sweep is practical direct from the 125 volt B supply without resort to boosted B supply from the horizontal sweep.

As has been noted,[2] horizontal sweep efficiency in the yoke *can* get too high. This is possible when picture tube anode supply voltage is derived from the horizontal sweep as is now universally done. Lowering of the energy stored in the yoke required to produce full sweep shrinks the volume of the energy reservoir from which the retrace-time rectification is fed. While the initial elevation or "no-load" level of the reservoir may be the same in either high or low efficiency systems, a given flow demand will obviously drop the reservoir level or static pressure more drastically on the tiny pool (high efficiency sweep) relative to the same flow rate from a large pool (low efficiency sweep).

Poor high voltage regulation from excessively efficient horizontal sweep systems has led to use of separate, expensive, and energy consuming r-f or pulse rectifying anode supplies. Set designers have been accustomed to 10 — 15% anode supply voltage regulation, at 100 μa load and will probably continue to require this supply stiffness when tinted safety-glass is used to enhance picture contrast.


Fig. 1: 90° yoke for 1 1/8 in. dia. tube neck

Curiously enough, more interest has been shown in vertical sweep efficiency with 1 7/16 in. tube necks and conventional yokes. Many sets ran the vertical from boosted B supply generated by horizontal sweep[3] which entailed high dc bias on the flyback transformer core and high plate surge on the vertical output.

(Continued on page 109)

CHARLES E. TORSCH is chief engineer, The Rola Co., Div. of Muter Co., 2530 Superior Ave., Cleveland, O.

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Concertone Recorder Modification

HAROLD SCHAAF, Chief Engineer, WRFD Worthington, Ohio

THE Model A-1401 Concertone is a portable recorder with the loudspeaker in one case and the tape transport and amplifiers in another. It has both a high level and low level high impedance input. The output is also high impedance. We modified one of these recorders so that it is very useful for recording and playback from our control room.

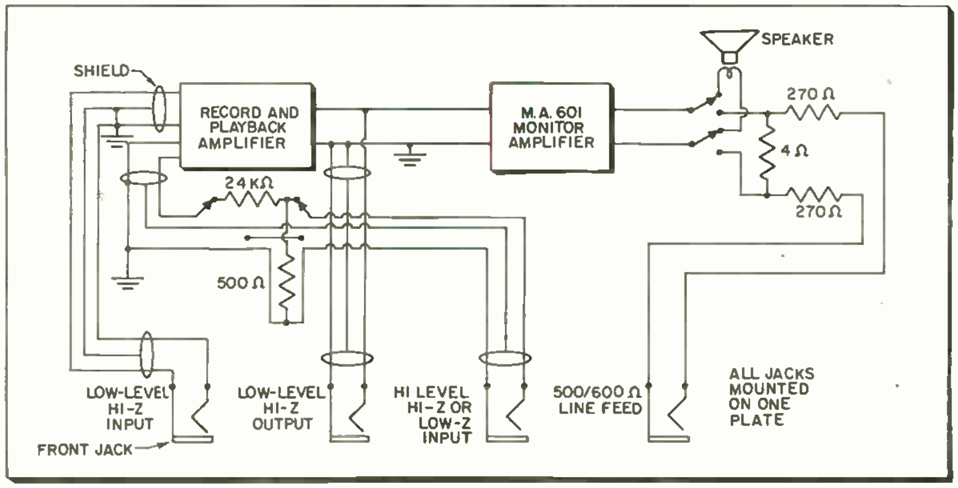
A cabinet, with casters on it was constructed so that the speaker, the transport and the amplifiers are all in one housing. With the casters installed on it, the cabinet could be easily moved between the input and output racks.

Four phone jacks were mounted on a plate at the side of the cabinet, and two switches were mounted on the front panel.

The low level, high impedance, input to the recorder was wired directly to the first jack. One of the front panel switches and a resistance network was installed in series with the high level input and the second jack. The switch allows us to select either high or low impedance for this input. We use this input to record directly from one of our audio channels. The high impedance output jack following the playback amplifier was changed so that it did not cut off the monitor amplifier when a plug was inserted. This is the third jack on the strip. The output of the monitor amplifier was wired to the other front panel switch and through a resistor network to the fourth jack. The switch allows us to use the loudspeaker for cueing tapes and then to feed the output of the monitor amplifier to the console line inputs for playback.

One cable using a phone plug on one end and a Western Electric telephone patch plug on the other was made up and is used for either playback or recording.

Before the modifications were made, the recorder was used an average of ½ hour per week. Since modification, its use has been stepped up to an average of 1 hour per day.



Modification of A-1401 concertone recorder

Attenuation Box

WM. J. SNYDER, Chief Engineer, WNOP, Newport, Ky.

Like many smaller stations we did not have an attenuator box to run satisfactory tests on our equipment or proof of performance tests. After pricing many we decided to try to build an accurate one ourselves.

Shielding of the unit was a problem. A square wooden box 12 in. on a side and 8 in. high was built. A piece of soft copper (.021-inch thickness) was shaped to fit inside the wooden box. Enough was left at the top so it could be bent over the outer edges of the box. A piece of aluminum 12 in. square (.25-inch thickness)was placed over the bent edges of copper.

Next came the selection of good low capacity switches. For this Switchcraft Telever switch 4-PST type were chosen. With all levers in the center position all pads would be disconnected from the circuit. Then as the levers were pulled in the downward position the pad would be in the circuit. This facilitates the use of any one pad or combination.

The values of pads selected were: 40DB, 30DB, 20DB, 10DB, 5DB, 4DB, 2DB, 1DB, 0.5DB, 0.4DB, 0.2DB, 0.1DB. This is a total of 113.2DB being continuous from 0DB to 113.2DB in steps of 0.1DB. The aluminum top was laid off and twelve switches mounted.

Each pad would have to be as accurate as possible. A chart was made for the various values of resistors needed for the balanced H pads at 600 OHMS. Ordinary 10% resistors were selected and in many cases it took more than one resistor to obtain the values. Precision resistors were not used because of their high cost and odd values. For very low values of resistance 20 OHMS or less, resistance wire was used. The wire was wound on 2.2 Megohm 2 watt surplus resistors and held in place with Q dope. The shunting was small. To mount all resistors, a board 10½ in. square was suspended from the aluminum top by two pieces of copper 4 in. wide. Terminal strips were mounted on each side of the switches so the resistors could be soldered between the terminal strips.

After wiring everything, all measurements were made against a Hewlett Packard instrument. Each pad was checked individually and all were exact except 10, 20, and 30DB were 0.3DB low. 40DB measured high by 1.3DB. The frequency response was within 0.2DB from 40 to 15,000 cycles. Then combinations were checked for accuracy. Many checks were made like this and all within ones were correct. Everything checked close enough so that reliable measurements could be made on any broadcast equipment.

Attenuator Box Circuit

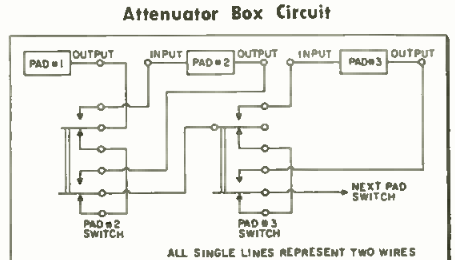


Fig. 1: New Secondary Frequency Standard which covers all broadcast bands.

Review of the present methods of frequency measurement and the advantages offered by newly developed equipment.

By H. S. KNAACK

Secondary Frequency Standard

THE operation of measuring an unknown frequency is presently performed in one of three ways:

(1) by the use of one of the modern counters,

(2) by means of a single channel comparison device, exemplified in broadcast station monitors, which is direct reading in deviation in cycles per second from a presumably known frequency, or

(3) by comparison with a known frequency such as is generated by a primary or secondary standard.

The third method, which is by far the most accurate, is the one to be discussed in this article, especially with reference to secondary standards, since this type is more flexible, does not require as much equipment as the primary and is considerably cheaper.

Neither the primary nor secondary standards are afflicted with the chief cause of inaccuracy of the counter or the deviation monitor, that is, the drift of the calibrating crystal. Since the counter counts only in relation to the length of a gate, and since this gate length depends on the absolute accuracy of the calibrating crystal, it may be seen that unless the crystals are checked periodically, the instrument may easily be in error by many counts per million over a period of as short as a couple months. The monitor is afflicted with this same trouble, and broadcast stations spend many dollars each year keeping this crystal on the frequency shown on the nameplate.

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Although the counter and monitor are far more convenient, the primaries and secondaries pay off in extreme accuracy, usually of the order of 1 part in 10 million or better, and even often approaching the value of 1 part in 50 million. To achieve this tremendous accuracy, we make use of such auxiliary equipment as synchrometers, interpolation oscillators and frequency transfer units as well as standard, and not-so-standard, receivers.

Receivers used are of both the fixed frequency and communication type receivers, with the fixed frequency receivers usually having more than one channel, and crystal controlled on the frequencies inhabited by WWV. These receivers are widely used in frequency measuring services where frequent reference to WWV is necessary. However, for the run-of-mine measurement, any communication receiver will suffice since it can be used not only to hear the unknown signal, but may be used to hear WWV also.

Synchrometers are nothing more than very fancy clocks, usually with the motor running on 1000 cycles, since this frequency is easily available from most standards. These units also have means to compare the clock against standard time clicks from WWV or over wires from the Naval Observatory to an accuracy of 0.001 seconds. Over the course of 24 hours, it is possible to determine the average frequency of the oscillator to 1 part in 85 million. The addition of a synchrometer to an excellent crystal oscillator composes a primary standard.

Frequency transfer units are used only with equipment which will not generate extremely high order harmonics. For instance, nearly all of the standards now on the market are very nearly useless as frequency comparators beyond a frequency of 50 MC. The transfer unit is generally a self-excited, tunable oscillator which will cover a narrow range, say 10 to 20 MC, but is capable of generating harmonics of considerable amplitude up to as far as the 100th. With this device, it is possible to compare a harmonic of the transfer unit to the unknown signal, and then measure the fundamental of the transfer unit. The principal difficulty of this method is that while the measurement of the fundamental is being made, the self-excited oscillator may drift very appreciably compared to the 1 part in 10 million accuracy usually aimed at.

Interpolation Oscillators

Audio oscillators used in frequency measurement are quite often restricted to a range of about 10 to 5000 cycles, although any commercial audio oscillator may be used. Oscillators manufactured specifically for frequency measurement are calibrated over the range of about 1 to 5000 cycles, are accurate to within a couple of cycles, and are known as interpolation oscillators. They are used when the beat between the standard and the unknown signal is in the audio range. The interpolation oscillator is zero beat against the heterodyne between the signals to give us the deviation in cycles per second. Ranges greater than this are normally not required since 5000 cycles is the highest beat we ever need measure against channels separated by only 10 KC.

One of the methods of extending the range of the usual standard is to provide selective tunable amplifiers which will amplify the desired harmonic to a usable value. The difficulty in this approach however is that there is now another control to adjust, thus complicating the method to the point of diminishing returns. The unit pictured in Fig. 1 is a unit that eliminates both the frequency transfer unit and the selective amplifiers over all of the commercial ranges used for broadcasting. Since it is a Secondary Standard, the synchrometer is eliminated also.

This unit has integral circuits (see Fig. 2) synchronized with the 100 KC oscillator which will give outputs with fundamentals of 1, 10, 50, 100 and 250 KC. The harmonics of these fundamentals are useful for measuring in conjunction with good communication type receivers as follows:

1 KC to 30 MC
10 KC to beyond 160 MC
50 KC to beyond 200 MC
100 KC to beyond 200 MC
250 KC to beyond 900 MC

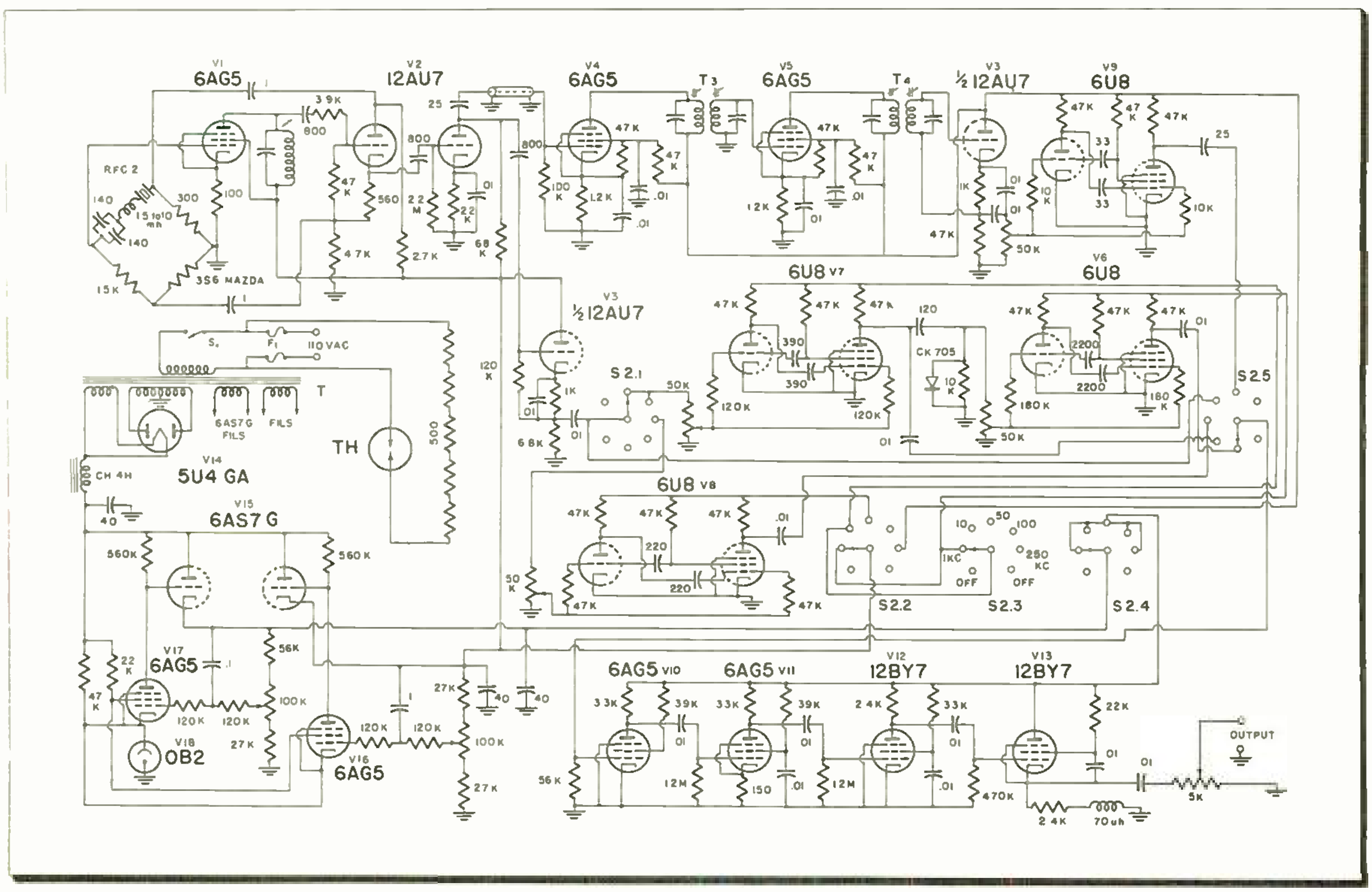
These harmonics are all available for the selection since they all coexist for any given fundamental. Thus, there is available for comparison, a standard frequency on all of the commercial channels used for broadcasting, communication or TV. In conjunction with the audio oscillator as an auxiliary piece of equipment, any frequency in the spectrum may be measured with an error which is the sum of that of the frequency standard (maximum of 0.1 part per million) and the calibration error of the audio oscillator, which is usually of the order of 1% for moderately expensive instruments. At frequencies of 100 MC, this would amount to about 60 cycles maximum for deviations of 5000 cycles, or correspondingly less for smaller deviations.

There is an additional feature of this instrument that is not present in any instrument known to the author. This is the variable frequency feature that makes it known as a "sliding" secondary standard. A condenser is included in series with the crystal arm of the Meacham bridge oscillator that will allow adjustment of the fundamental frequency of the crystal over the range of approximately plus or minus 40 parts per million. In addition, the dial is calibrated in such manner that one dial division equals 1 part per million deviation, with the dial divisions being of equal length. Thus, for changes in frequency resulting from aging of the crystal, it makes no difference where the zero is on the dial for comparison measurements. In normal operation, the dial is set so the instrument is zero beat against WWV and its reading is recorded. Then the dial is set so the standard is zero beat with the unknown signal, if this point is within reach of the dial, and the dial reading recorded again. The deviation of the unknown signal is then the difference in dial readings multiplied by the frequency in megacycles. In addition, and at the same time, the direction of the deviation is indicated, in that a higher dial reading for the unknown indicates high deviation, and a lower dial reading indicates a low deviation.

This method of measurement also

(*Continued on page* 95)

Fig. 2: Schematic diagram. Both frequency transfer unit and selective amplifiers are eliminated. Variable frequency feature makes it "sliding" standard.



Tests for glow discharge tubes point up characteristics considered in designing regulated supplies

GAS TUBE Stabilized Power Supplies

By SHERWIN RUBIN and DOUGLAS SCOTT

ABSTRACT

A test arrangement used for measurement of the impedance characteristics of type OA-2, OB-2 and 5651 Glow Discharge Tubes is described. Individual curves of impedance magnitude and angle vs frequency over the range of 10 to 70 KC are presented. The 5651 is found to have an impedance magnitude in the order of ten times that of the OA-2 and OB-2.

A COMMON form of regulated power supply uses a glow discharge tube as a reference source in the cathode of the first dc amplifier stage. A typical regulator of this type is shown in Fig. 1. It is evident that the characteristics of the gas tube are of importance in the design of this form of regulator. In view of this, the Engineering Electronics Section of the National Bureau of Standards undertook a qualitative study of the characteristics of the glow discharge tubes OA-2, OB-2, and 5651 and some of the results obtained are given in the following.

Andrew[1] has called attention to the possibility of the regulator amplifier oscillating due to the character of impedance presented by the gas tube. Iannone and Baller[2] have published measured impedance characteristics of the OA-3/VR75, OB-3/VR90, OC-3/VR105 and OD-3/VR150 tubes, but nothing of a similar nature appears to be available on the later types OA-2, OB-2, and 5651.

Test Procedure

Three tubes of each type were measured. All tests were made within the current and voltage limits given by manufacturer's specifications. The tubes used were taken at random from Electronic Storeroom stock of the National Bureau of Standards. Iannone and Baller's results for octal counterparts of the OA-2 and OB-2 served as an order of magnitude check on these tubes. A spot check on three additional 5651's removed from purchased test equipment was made to insure that the tubes chosen displayed representative characteristics. Confirmation within ±15% was found.

Fig. 2 illustrates the test arrangement. An alternating voltage varying in frequency from 10 CPS to 70 KC was impressed across the gas tube by means of an audio signal generator in series with a non-inductive resistor, R_1. R_1 was chosen approximately ten times as large as the maximum impedance of the gas tube in the range of frequencies used. Because of this resistor and the variable impedance of the gas tube, the alternating voltage across the tube varied from 1.0 volt to 0.01 volt during the course of the test. Spot checks in which the voltage across the gas tube was varied in magnitude at a given frequency failed to show any appreciable variation in magnitude or angle of impedance for such voltage variation.

Electronic ac voltmeters were used to measure the alternating voltage across the generator and across the glow discharge tube. A regulated power supply furnished a constant current through the tube and a resistor R_2 large enough to avoid shunting the tube.

The decade amplifier shown in Fig. 2 was necessitated by the attenuation in voltage across the gas tube at low impedance levels due to the high value of R_1.

The phase angle of the gas tube impedance was determined from Lissajous patterns and corrected for residual phase shift by subtracting the phase shift measured across a composition resistor inserted in place of the gas tube and having a magnitude equal to the mean value of the tube ac impedance. Both repeated measurements and spot checks with a phase meter confirmed the original measurements within 5%.

Results

In the case of the OA-2 and OB-2, at currents of 10 ma in one tube, and at 12.5, 17.5 and 23 ma for another tube, extremely unstable dis-

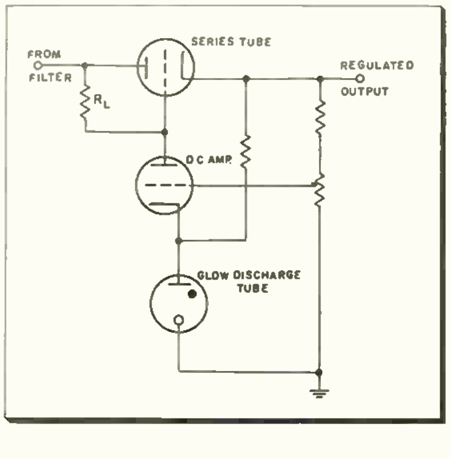
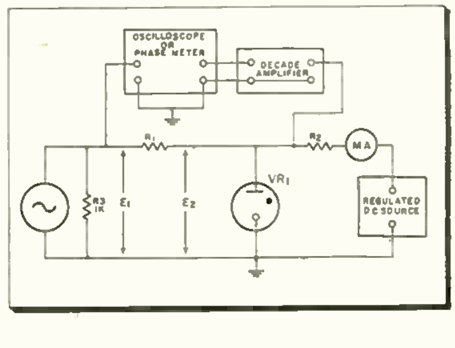


Fig. 1: Simplified voltage regulator circuit

Fig. 2: Gas tube impedance measuring circuit



SHERWIN RUBIN and DOUGLAS SCOTT are connected with the Engineering Electronics Section of the National Bureau of Standards, Washington 25, D. C.

continuities in phase occurred. These occurred spontaneously, or could be induced by placing a small capacitor in shunt with the glow tube, or by turning the constant potential off and on. No attempt was made to pursue this aspect further during the course of the investigation, and the operating anode currents were chosen to avoid this effect.

The alternating voltage across R_1 was measured and the magnitude of the impedance of the tube was determined from the alternating voltage across the tube and the alternating current through it. The direct current through the tube was found from the total direct current and the computed direct current through R_1 and R_3.

The results of the tests are shown graphically, in Figs. 3, 4 and 5.

When the magnitude of the impedance of the gas tube in the cathode stabilized voltage regulator becomes appreciable in comparison with its series feed resistor, the voltage at the cathode of the dc amplifier begins to fluctuate with the same order of magnitude as at the grid. This reduces the effectiveness of the amplifier. In view of this, the item of most interest is the higher impedance of the 5651 over the entire frequency range as compared to that of the OA-2 and OB-2. Ripple suppression is consequently less effective when the 5651 is used.

In order to illustrate the effect of shunting the gas tube with the largest capacity recommended by the manufacturer for the particular tube, the impedance characteristic was measured with a 0.1 μfd. capacitor across the tube. It will be noted that the capacitor had no significant effect on the magnitude of the impedance of any of the tubes below 1 KC in frequency. This frequency range includes the normal power supply ripple frequencies. The figure shows, however, a significant change in impedance angle for the 5651 at about 400 CPS.

All tubes showed an inductive impedance angle when not shunted with the capacitor. In the case of the OA-2 and OB-2, there is a noticeable rise in the impedance level in the vicinity of 3 KC when the tube is shunted with the capacitor, indicating parallel resonance. Thus the tubes appear to act as rather lossy inductors.

1. A. M. Andrews, "Design of Series-Parallel Voltage Stabilizers," Letters to Ed., *Electronic Eng.*, Aug. 1952.
2. F. Iannone and H. Baller, "Gas Tube Coupling for D. C. Amplifiers," *Electronics*, Oct. 1946.

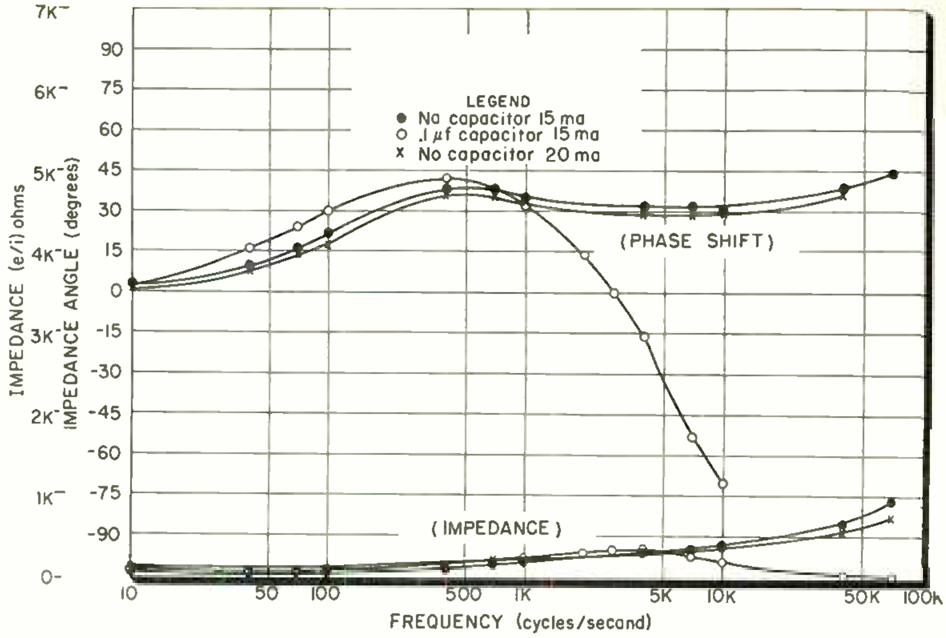


Fig. 3: Phase shift and impedance characteristics of OB2 voltage regulator tube

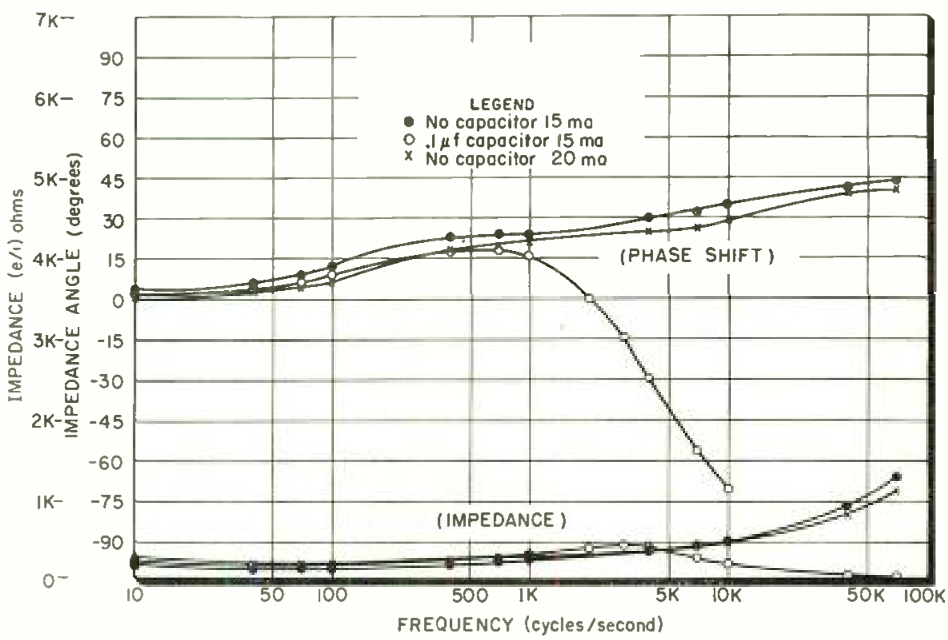
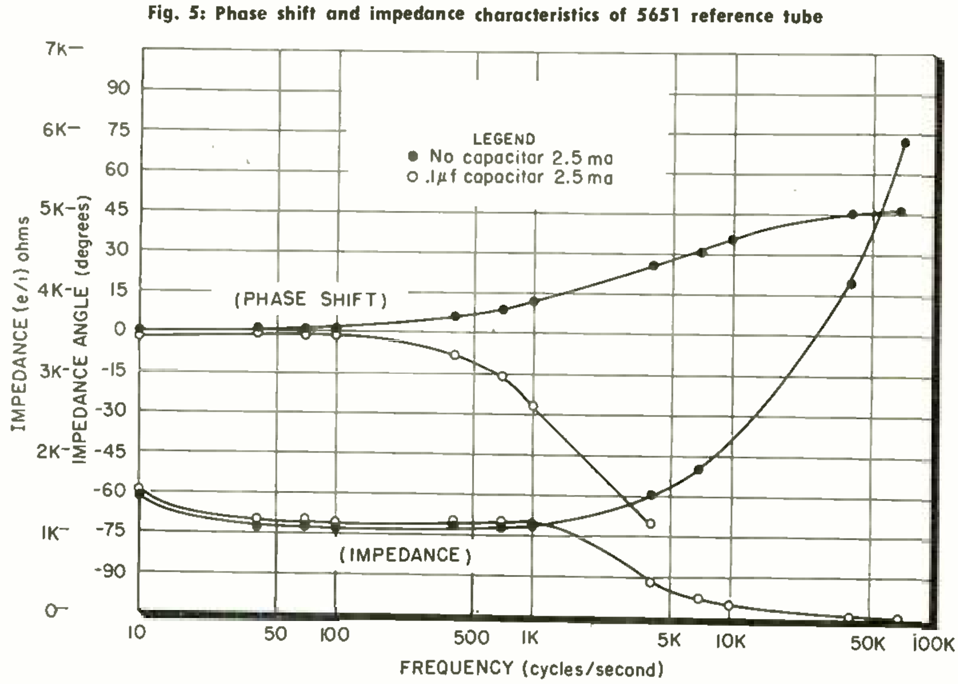


Fig. 4: Phase shift and impedance characteristics of OA2 voltage regulator tube

Fig. 5: Phase shift and impedance characteristics of 5651 reference tube



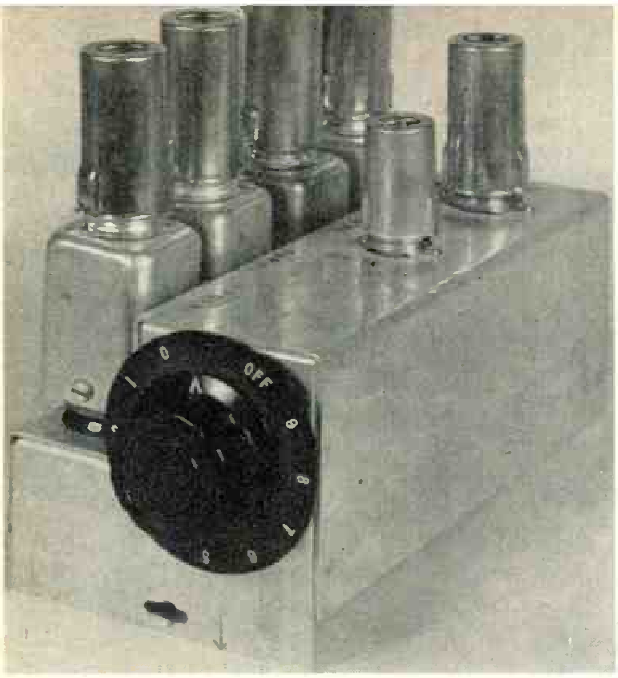


Fig. 1: Decade preset counter used in analog-digital time measuring system

Binary system for laboratory and industrial applications may be utilized as time-delay generator, frequency divider or recording chronograph

Time and Frequency Measurements with a NEW PRESET COUNTER

By PAUL BEY

P. Bey

■ Precision time measuring systems incorporated in modern electronic equipment require accurate radio transmission of time signals. During a program to increase the accuracy of the Naval time transmissions, the Naval Research Laboratory developed an analog-digital time measuring system. The basic unit of this instrument is a new type of preset counter (Fig. 1).

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Preset Counter

The preset counters constructed at the Laboratory consist of cascaded vacuum tube binary stages (Fig. 2). The preset principle of these counters, however, can be applied to beam switching tubes or magnetic flip-flops equally as well. Without feedback, the counter produces one output for every sixteen input counts. During the counting cycle, the fourth stage triggers the second and third stages. Since two input counts are required to flip the second stage and four input counts are required to flip the third stage, the feedback is equivalent to adding six input counts. In other words, a scale of 10 is obtained from a scale of 16.

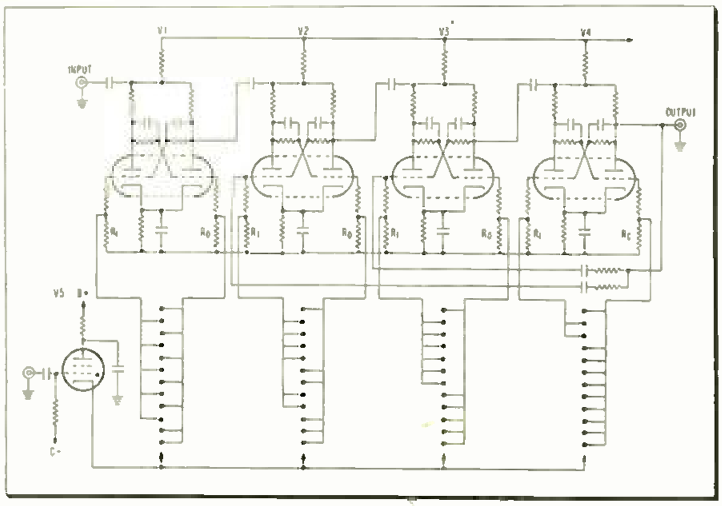
Table 1 depicts the possible stable states of the binary stages during a counting cycle of 10. The convention used here is that conduction in the right-hand section of a stage corresponds to storage 0 and conduction in the left-hand section corresponds to storage 1. The cathode of V_5, a thyratron pulse generator (to decrease the reset time, a blocking-oscillator type pulse generator should be used in place of the thyratron) is connected to each selector arm of the 4-ganged single-pole 12-position wafers. A non-conducting state of V_5 is maintained by the negative bias on its grid. When V_5 is fired by a positive signal applied to the grid, a voltage pulse is developed across resistor R_1 or R_0 of each stage of the discharge current. Resistors R_1 and R_0 must be small in comparison to the flip-flop components in order that interaction between stages does not affect the trigger action. This voltage pulse generated by V_5 results in storage 0 or 1 in each stage depending on whether R_0 or R_1, respectively, is selected by the switch. If a preselected count of n (n = 10) is desired, the switch is set to generate the complement storage, 10—n.

Preset counters ordinarily use vacuum tube or diode coincidence gates to select the desired count. The method described here results in a decided simplification of selection circuitry since no vacuum tube or diode matrix is required. Also the counting rate may be increased because there is less capacitance across

TABLE 1

Stable States of the Binary Stages

Input Count	Stable State Stages 1234
0	0000
1	1000
2	0100
3	1100
4	0010
5	1010
6	0110
7	1110
8	0001 feedback
9	1111



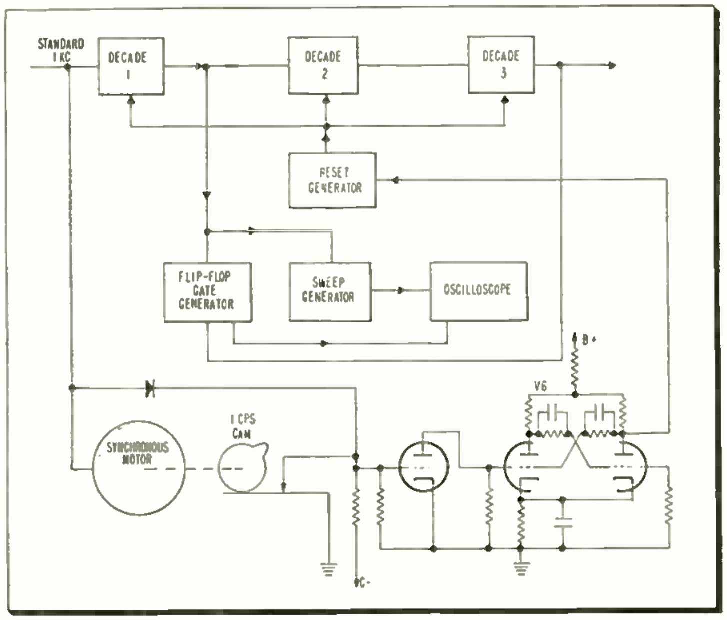


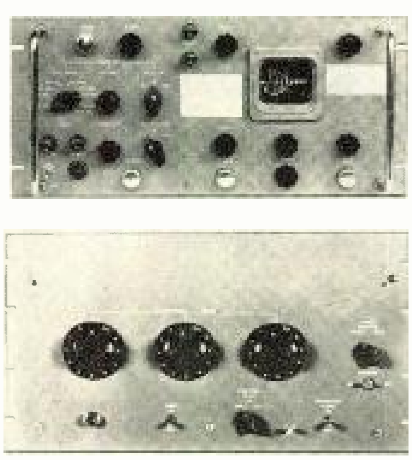
Fig. 2: (above) Schematic diagram of preset counter
Fig. 3: (right) Schematic diagram of time delay generator

the flip-flops than in a conventional preset counter.

Preset counters find many applications for industrial and laboratory timing and counting control. Other applications employing unique features of the new reset principle are described below.

A method of generating precise one-second signals from a clock and accurately delaying these signals in a decade manner is illustrated in Fig. 3. The flip-flop, V_4, is held in the storage 0 state during the time the clock contact is closed. The first 1 KC pulse after the contact opens triggers the flip-flop to the storage 1 state, thus generating one-second signals of the same accuracy as the 1 KC signal driving the clock. Coincident with this occurrence, the 1000:1 counter driven by 1 KC pulses derived from the clock driving signal, is reset to the storage selected by the reset switches. If the storage selected is 1000 − m, the output pulse from the counter occurs m milliseconds following the clock signal.

Fig. 4: Time delay generator



An oscilloscope sweep is locked either to pulses generated by the 100 or 10 cycle decade of the counter as selected by a switch. The one-second signal delayed by the counter fires a thyratron through the reset resistor of a flip-flop, while the decade-sweep-pulses are applied to the opposite grid. The normal state of the flip-flop is conduction in the tube to which the sweep pulses are applied. The thyratron pulse is of sufficient amplitude to trigger the flip-flop. Hence, a step voltage is generated at the plates of the flip-flop tubes. The time corresponding to its leading edge relative to the clock signal is the delay introduced by the preset counter—its duration is one period of the sweep. This one-second step voltage along with marker pulses derived either from the 100 cycle decade (for the 10 cycle sweep) or from the delay counter 1 KC input (for the 100 cycle sweep), are applied to a mixer, the output of which drives the intensifying grid of the oscilloscope cathode ray tube. The step voltage intensifies one cycle of the 10 or 100 cycle sweep and the marker pulses produce ten equally spaced time intervals. A one-sec. radio time signal applied to the y-input of the oscilloscope is observed only if it occurs during the gate time. Hence, its delay relative to the clock signal is known by the decade switch setting along with its location relative to the markers. The NRL unit designed to measure the time delay of standard Radio time signals is pictured in Fig. 4.

When precise delays in the order of microseconds are required, as in the case of radar calibrations, the reset time becomes comparable to the counting rate. In this case, the preset counter is connected as illustrated in Fig. 5. The time signals (A) open the gate to the counter signal (B) of, say, frequency f b. The output from the counter applied to the reset generator and gate, closes the gate and resets the counter to the N-m storage as selected by the dec-

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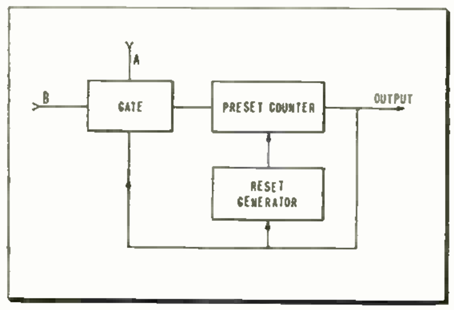

Fig. 5: Time-delay generator block diagram

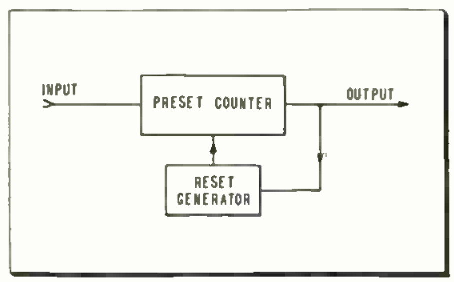

Fig. 6: (a) Counter-frequency divider diagram

Fig. 7: (b) Counter chronograph block diagram

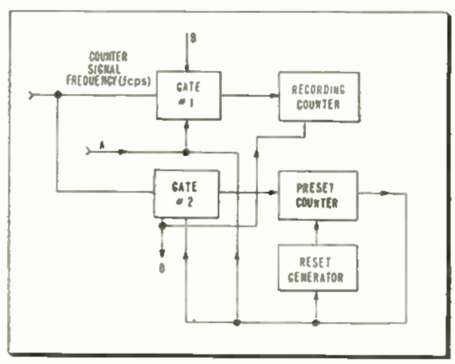

Fig. 1: Mikes are 4 to 10 ft. from speaker

The use of high-gain audio amplifiers makes it imperative that studio noise and reverberation time be minimized. Here are methods adopted by one major TV station

THE AUDIO PROBLEM in TV Broadcasting

By RODNEY D. CHIPP

THE construction problems in a TV studio are twofold, and involve both sound isolation and minimum reverberation time. To a degree they are more difficult in TV than in AM, for the reason that, in most cases, microphones should not appear in the picture. Usually, microphones should not appear in the picture. Usually, microphones are at from 4 to 10 ft. from the performers, and the gain of the associated amplifiers is correspondingly high (Fig. 1). These factors cause a high ratio of reflected sound to direct sound plus better than average pickup of unwanted sounds. To offset these effects, two things are important: (a) reverberation time should be as low as possible, and (b) every step should be taken to reduce ambient noise.

Before discussing equipment and control room arrangement, I'll discuss some of the construction features of our new Telecentre studios, and how they relate to control of these items.

Generally, rock wool or glass wool blanket, or equivalent products marketed under various names, are used for acoustic treatment. This material is fastened directly to studding and is protected by wire mesh or expanded metal. Ordinarily, the ceiling is completely covered and the wall area is covered from 50% to 100%.

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In order to deaden our Telecentre studios, the following treatment was applied: (a) from 3 ft. above the floor to approximately ¾ of studio height, 1 in. Banacoustic batts protected by mesh on all wall surfaces. (b) Above the batts and on all ceiling surfaces a coating of "asbestos-spray." If a specific program appears to need "liveness," this is introduced by means of a tape reverberation unit. Sets can also be placed to introduce live spots in specific locations.

To isolate studios from external noises, the construction of floors and walls is of extreme importance. At the Telecentre we used the following scheme on all studio floors. The floor surface is 3/16 in. sheet rubber. The floor slab consists of high density concrete, covered first with a 5 in. thick fill of light-weight cinder concrete, over which, in turn, is a 1½ in. layer of cement finish. This type of floor construction has several advantages: The light-weight fill serves as a medium in which to place conduit for wiring, and it also helps minimize sound transmission between studios located one above the other.

When two studios adjoin, a double partition wall between them should be employed except where a back to back control arrangement is used. Fig. 2 shows Studios 2 and 3 at the Telecentre—with the two control areas between the studios.

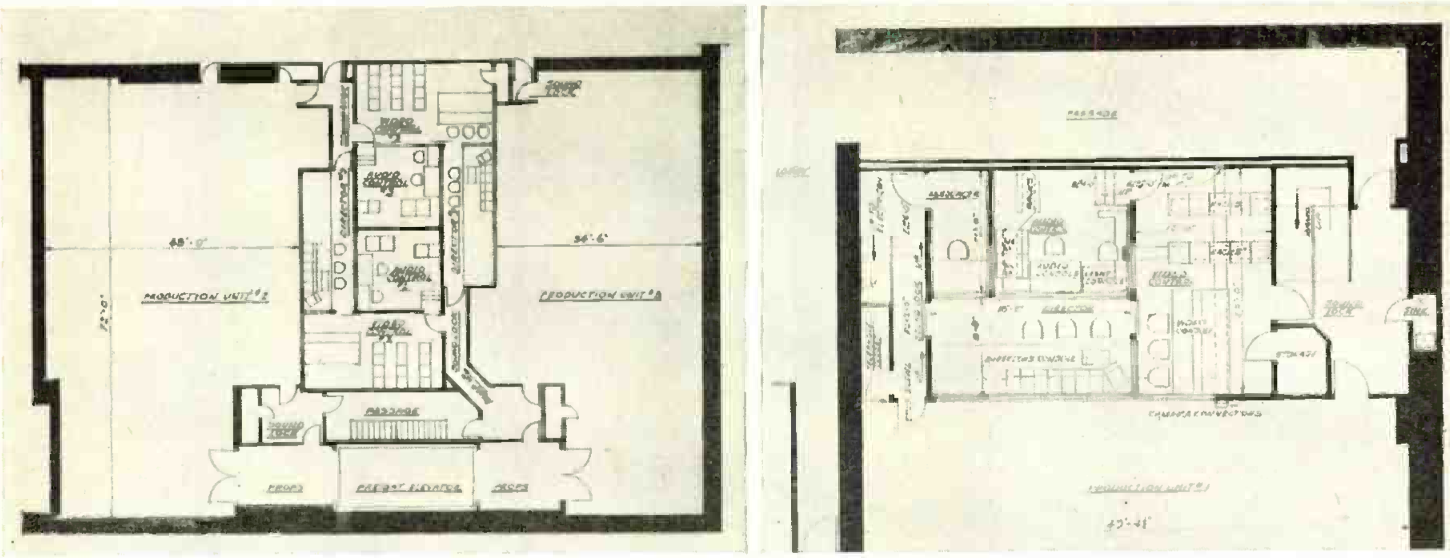
Masonry work, whether on an enclosing wall or a partition wall, should be constructed with care. In particular, holes or voids must be filled before acoustic treatment is applied. This matter is more important than it may seem, for the location of sound leaks after acoustic material has been fastened down is a long and expensive process.

A popular type of partition wall, where sound isolation is required, consists of two walls of 4-in. cinder blocks, with an air space between. The use of double walls provides greater isolation for a total given materials weight than a single, thicker wall.

Sound Locks

Wherever possible, sound locks should be utilized. These consist of two individual sound-treated doors separated by a short, acoustically-treated passage. The door itself is of solid wood 2½ in. thick, and in the closed position fits snugly against a sponge-rubber gasket all around its perimeter. Some types of sound proof doors have a plunger which operates on closure of the door to project a piece of felt from the door down into a recessed opening. Doors of this type provide the high degree of sound isolation necessary.

Windows should be double-glassed, with different glass thick-



Figs. 2 & 3: DuMont Telecentre studios in N.Y. have been designed to provide maximum sound isolation

nesses, and the panes should not be parallel. The glass on the studio side of the window should be pitched, and not closer than 5 in. to the other pane at the closest point. Felt or rubber lining should be used for the set-in window frame. If glass partitions are required, they should be constructed in the same manner.

Where a duct passes through a studio wall, it should be enclosed before entering the studio in order to prevent sound transmission from outside. Installing the duct above a hung ceiling is very effective, further, the duct should be lined with acoustic material or provided with sound traps. In extreme cases, both treatments may be necessary. Neither supply nor return ducts should be run through another studio if it is possible to avoid doing so. They should be routed through service space all the way to the fan room. Flexible connections, usually in the form of canvas collars, should be employed, and the air-conditioning fans and compressors should be installed on vibration-isolation units.

Electrical conduits present a similar problem, but to a lesser degree. Where possible they should be run outside the studio. Good practice indicates the use of flexible connections wherever conduit enters the studio, and for joints to panel boxes, outlet boxes, and switches.

Operation

There are, ordinarily, quite a few people in motion in a TV production who are not connected with the scene being televised, and they all contribute without intention to the extraneous noise level. Prop men and stage hands may be moving objects in preparation for the following scene. Cable movement or whispered instructions may be picked up by a microphone. Personnel must take great care to keep all such noise at the lowest level possible. Further, maintenance of equipment must include measures to eliminate squeaks.

There are also audio problems within the control booth. One solution is the split booth (Figs. 3 & 4.) Note that the control booth is divided into separate areas. A detailed view shows that we have separated the functions of audio, video, and video switching. The section in the front contains the program director and the switcher only. In front of them are camera monitors, preview monitors, and line monitors. Directly in back of the switcher is a separate booth containing the audio operator. To the right of the audio operator is the announce booth, and to his left is the video control section. These spaces are connected by doors which are normally kept closed. Glass windows permit the audio operator to see the announce booth on his right, the video control room on his left, and the monitors in the director's room in front of him. He also has an excellent view of the acting area. The announcer, likewise, can see the audio operator on his left, the camera monitors, and the acting area. The director has a full view of the acting area and all monitors.

The arrangement devised by Du Mont Engineering (Fig. 5) has proven to be extremely satisfactory. The production staff, as well as the technicians have found that this segregation has permitted smooth, trouble free operation. Some advantages are: (a) In the event of camera trouble, the director does not hear instructions passed from video control to camera. (b) The director does not hear technical conversations between studio control and master control regarding levels, line difficulties, etc. (c) The audio man can set his speaker volume as high as necessary for proper monitoring without disturbing other members of the team. (d) The director and switcher work in a relatively undisturbed atmosphere, with monitors adjusted to suit them.

The microphones used will depend upon the pickup characteristic desired. For most applications directivity is helpful in minimizing the

Fig. 4: Split booth isolates audio operation from video, cuts down important ambient noise

Fig. 5: Separate audio control minimizes confusion resulting from intrastudio conversation

pickup of ambient noise. On panel and interview type shows there is usually no reason for the mike to be out of view, and in such cases a small unobstrusive unit is used. For fixed shots we frequently suspend the mike from the overhead battens or pipe grid in the studio; but for the usual type of program the mike is suspended from the end of a boom such as seen in Fig. 1. The boom operator can tilt and rotate the mike, and the boom itself has freedom of movement unless blocked by sets, lights, or cables. Part of the art of producing a TV show is the avoidance of getting cameras or mike booms "locked in" so that they cannot follow the action as intended. This should be considered in the pre-planning of the program.

The custom audio equipment designed for use in our N. Y. Telecentre is the heart of the system. It is a compact and versatile console. Some of the basic concepts of this console were partially on paper as far back as 1948. Upon further study and better knowledge of operational requirements a prototype was built and installed in Du Mont's Adelphi Theatre in New York in 1951. After usage of this prototype it was felt we were on the right track as far as a compact audio console was concerned, and we decided to fully equip the Telecentre with this type of unit.

Design procedure was somewhat different than usual: (1) The audio operational requirements were translated into numbers of controls, amplifiers, and their relative functional importance. (2) A panel layout which represented reasonable system design with a compact mechanical arrangement was drawn up, and (3) engineering was then required to fill in the circuitry behind the knobs and levers.

The major operational requirements were:

(1) Twelve studio microphone positions.
(2) An announce circuit, primarily for use in an announce booth separated from the studio, but also available from the studio floor.
(3) Built in sound effect equipments, including variable peaked telephone filter, a band pass filter, and a tape reverberation and echo effects unit.
(4) Four remote audio sources under separate attenuator controls.
(5) Applause control, which in large studios or theatres becomes a real problem. In this unit applause level control is placed in a relatively important functional position in the mechanical layout.
(6) Coordinated control of video with audio, i.e., controls which permit the technical director to switch through his video switching buttons, sound sources which may be patched to the studio.
(7) Public address system control. This is a must in a large studio or theatre, and, like the applause, its volume control is in a relatively important physical position on these consoles. Further, the public address system should be provided with a selector or multiple selectors which permit an operator to bridge only one microphone at a time.
(8) A playback system, separate from the public address system. This provides audio cue to the studio while film or remotes are occupying program time. This is not to be confused with the normal intercom circuit between booth and studio.
(9) Turntables equipped with a mercury type starting switch, lever action fader control, cueing amplifier and speaker, and triple pick-up heads. This makes the turntables an independent unit so that any type record can be "cued-up" and "snubbed" ready for operation. When releasing the record one hand can hold the record, turn on the driving motor, and fade in the recording all in one coordinated motion.

In Fig. 6 is shown the panel layout which, by the use of lever action faders, permits a compact and efficient functional design to provide the audio controls outlined in the preceding summary.

The twelve microphone faders are divided in two sections with transfer switches to Bus A or Bus B immediately below the levers.

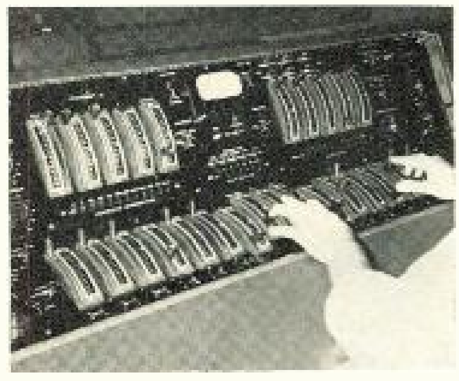
The perspective-reverberation insertion switches are located in the left half of the upper panel, while the sound effects for the individual microphone circuits are located at the right. The utility selector and a key for transferring the VU meter to this utility circuit are located in the center portion of the panel.

The conventional round knobs are associated with the volume controls not normally varied continuously. They include the two playback and PA mixers, the control booth monitoring speaker and the playback speaker in the studio, a utility attenuator, and some sound effects controls.

No amplifying equipment is housed in the console or its desk. Two standard racks of amplifiers, power supplies, jack fields and tape reverberation unit are associated with each.

Regardless of the impending changes in video in the near future, audio component design is well advanced and will probably remain in the present form for some time to come. It is urged in studio work that adequate number of inputs, including microphones, film inputs, turntables, remotes, etc. be provided for in any original plan, and that instead of one or two monitoring circuits four to six be provided at the outset. An audio system with adequate facilities from the start will pay for itself in operating conveniences.

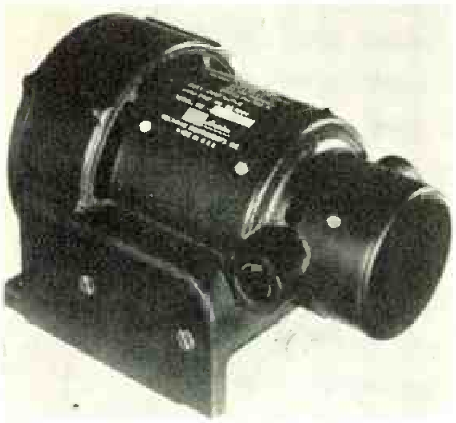
Fig. 6: Lever-action faders in compact panel layout provide full control of audio operation



New Avionic Products

P. M. INVERTER

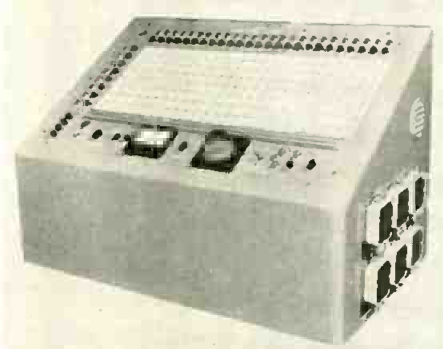
The "Arga" miniature precision permanent magnet motor generator converts 28 v. directly to 400 cycle ac. Governors maintain constant speed. The units operate over an input range of



18 to 30 v. dc. and an output of 90 to 150 v. ac. Output voltage is independent of battery condition. Available in 25 va., 100 va. and 250 va. ratings, with standard winding put out 115 v. Voltages, however can be varied to meet customer's requirements. At a 0.9 power factor, the ac. voltage regulation is within ±5% and the frequency within ±1.0%. **Beckman Instruments, Inc., Arga Div., 220 Pasadena Ave., S. Pasadena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-50)

FUNCTIONAL TESTER

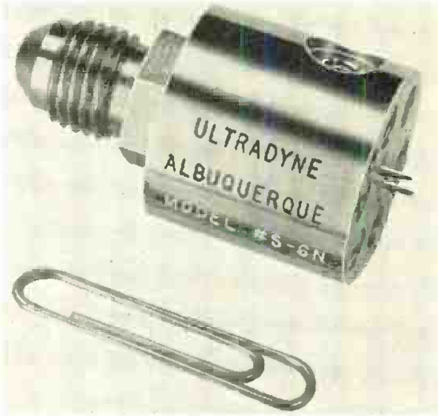
The Model 250F functional tester, designed for testing multiple complex relay systems, has a capacity of 200 test positions with provisions for the operation of a series of external relays in any of the 200 test positions. Every type of inter-connected relay system can be tested for errors in continuity-discontinuity shorts. Incorporated in the tester is a programming board which enables



choice of circuit testing sequences for various combinations of normally open or normally closed relay circuits. **DIT-MCO, Inc., Electronic Div., 505 W. 9th St., Kansas City 6, Mo.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-47)

PRESSURE TRANSDUCER

The Model S-6 miniature pressure transducer, a single coil, diaphragm type, variable inductance unit, is for use either as the variable inductor of inductance-controlled FM/FM sub-car-



rier oscillators or for voltage-controlled oscillators and bridge circuits. For voltage output applications, the gage is supplied with a matched dummy to provide two arms of an electrical bridge circuit. The unit is ⅞ in. in diam. and ⅞ in. long. Acceleration sensitivity is 0.01%/g or less, and rise time to a step pressure pulse is of the order of 50 μsecs. **Ultradyne Engineering Labs, Inc., P. O. Box, 8007, Albuquerque, N. M.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-48)

RECORDING SYSTEM

The "Datatape" portable, magnetic tape recording system is for the airborne collection of test data. It is reported that the recorder unit will store 28 tracks of information on 1¼ in. tape, providing 24 data channels and 4 auxiliary channels, including a microphone input. Has tape capacity for 43 minutes of recording at 10 in./sec. on tape of conventional thickness. System will operate unattended aboard airplanes and

guided missiles at distances beyond the effective range of telemetering equipment. **Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena 15, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-49)

PM MOTOR

The Type AM-215 is typical of a line of smaller, more efficient 1¼ in. diameter permanent magnet motors especially designed for minimum radio noise and to meet MIL-M-8609 speci-

fication. Weighs only 5 oz. and measures 1.25 in. O.D. x 2.14 in. long. Temperature range is from —55° C. to +71° C. Motor speeds range from 6,000 to 20,000 rpm; controllable to ±1.0% over a voltage range of 24 v. to 29 v. by using a governor. Available with gear train, governor, brake or any such combination. Used with a gear train, gear ratios range from 6:1 to 4,000:1. **John Oster Manufacturing Co., Avionic Div., 1 Main St., Racine, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 7-46)

PRESSURE INDICATOR

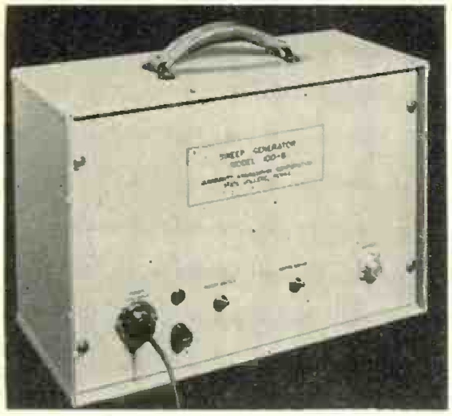
A new absolute pressure indicator has a range of 0.1 mm.Hg. to 20 mm.Hg. and an expanded scale in the 0.5 to 5.0 mm.range. The instrument operates on 115 v. ac. and incorporates the Hastings heated thermopile principle. Noble-metal thermocouples are housed in nickel-plated gauge tubes, assuring freedom from outgassing, system contamination, and corrosion. Dimensions of the gauge tube, 1½" long by

⅜ in. O.D. with a ⅛ in. IPS male thread coupling. Internal volume of the tube is less than 0.05 cu. in. Can be used with a one-knob switching unit. **Hastings Instrument Co., Inc., Hampton, Va.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-45)

New Electronic Test &

SWEEP GENERATOR

The frequency ranges of three models of wide band sweep generators for installation, service, maintenance, and other uses in TV antenna and cable systems, etc. are as follows: Model



100-S, 52-92 MC; Model 100-SS, 10-92 MC; Model 200-S, 160-220 MC. Output is 0.3 v. into 72 ohms with response plus or minus one db. over the frequency range. Sweep rate is approximately 58 CPS when the power line source is 60 CPS. Hum in equipment under test thus appears as 2-cycle modulation of the response curve and not as a fixed error in the curve. **Community Engineering Corp., State College, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-7)

WOW AND FLUTTER METER

The Model 28 wow and flutter meter meets IRE-SMPTE-ASA standards methods for flutter content determination, and can measure the displacement and frequency errors in telemetering and data recording systems. Accuracy, flutter readings, ±5%. Input impedance, 500,000 ohms. Test signal frequency, 3,000 CPS ±5%. Min. average input signal level, 0.1 v. rms. Dynamic

limiter range, approx. 40 db. Sensitivity, linear full scale 3.0%, 1.0%, 0.3%. Response rates, 0.5 to 10 CPS (wow), 10 to 300 CPS (flutter). **Donner Scientific Co., 2829 Seventh St., Berkeley 10, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-16)

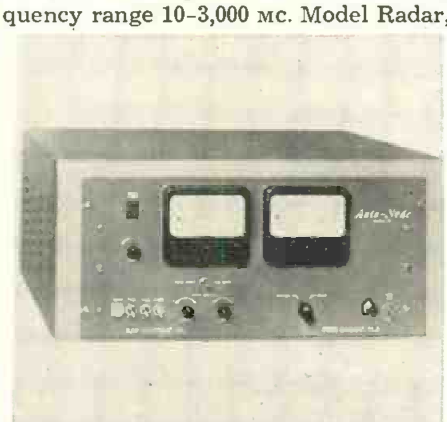
TRANSISTOR TESTER

The Model TT-11A transistor tester checks NPN, PNP, junction and point contact transistors, diodes, and other semi-conductor devices. Measurements of the various transistor or diode param-

eters are performed, or the instrument set to read them. Static and dynamic tests are performed by a bridge comparison circuit. Results are independent of voltage and temperature variations. The unit includes an internal power supply for transistor biases of 0-10 ma. for emitter current, and 0-10/100 v. for collector voltage. **Electronic Research Associates, Inc., 67 E. Centre St., Nutley, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-14)

NOISE FIGURE INSTRUMENT

The "Auto-Node" automatically measures noise figure from 5 to 26,500 MC over the VHF, UHF, and microwave frequencies. Two models are available. Model TV, frequency range 5-220 MC; i-f strip, 20 or 40 MC, extra i-f strips available 300 ohm output balanced. Twelve-channel selector switch. Noise figure range, 0-24 db. Can work with "Mega-Node Sr" with frequency range 10-3,000 MC. Model Radar,



2 i-f strips, 30 and 60 MC; other i-f's available. Noise figure, 0-7 db. With the "Mega-Node Sr," will cover 10-3,000 MC range. **Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-8)

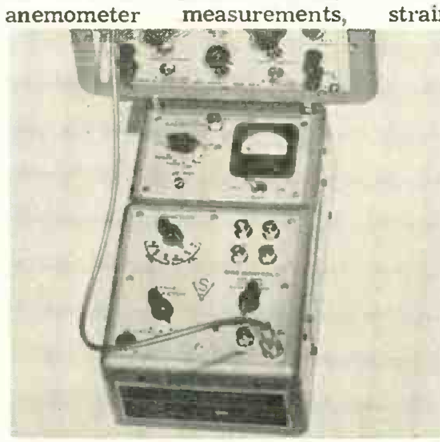
DELAY LINE

The Model 605 precision variable delay line consists of 60 sections of LC m-derived networks and one 60-position switch. The LC m-derived networks are especially designed for fast

rise time and negligible over-shoot. The rotary switch changes the amount of time delay between the input and output by connecting the output terminal to any of the 60 sections of LC networks. The m-derived networks and the rotary switch can be removed and incorporated into equipment in need of variable time delay. Five types available. **Advance Electronics Co., 451 Highland Ave., Passaic, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-15)

PRE-AMPLIFIER

The Type VS-61 A ultra-low-noise scope pre-amplifier has less than 0.5 µv RMS over its entire frequency range, 2 CPS to 60 kc. Based on the discovery that transistor noise can be reduced substantially below the noise level of vacuum tubes if suitable low noise operating parameters are selected. The new amplifier is expected to find application in biological research, hot-wire anemometer measurements, strain

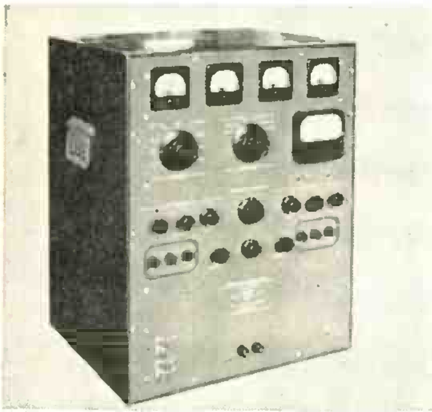


gauge measurements, etc. Input impedance 1,000 ohms, gain 1,000. Differential or adding input. Entirely battery operated, with 4 transistors, 6 vacuum tubes. **Volkers & Schaffer Mfg. Corp., P.O. Box 995, Schenectady, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-58)

Measuring Equipment

PHASEMETER

The precision phasemeter, Model P-1060, is designed for the precise measurement of phase difference between two sinusoidal voltages. It provides absolute accuracy of 0.1° with



incremental accuracy of 0.01° operating throughout the frequency from 30 to 20,000 cycles/sec. Any phase angle from 0° to 360° can be measured without ambiguity. Insensitive to even harmonics, the unit can tolerate approximately 1% third harmonic content within the rated accuracy of measurement. Dimensions 19½ x 16¼ x 25 in. **W. L. Maxson Corp., 460 West 34th St., New York 1, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-10)

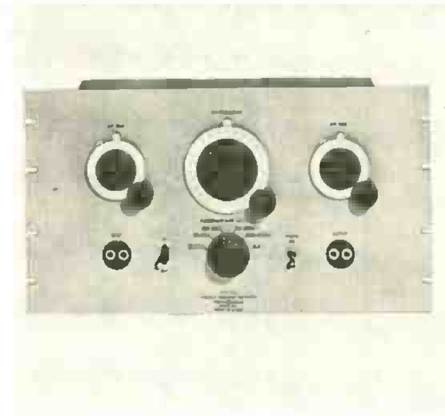
VERTICAL SPEED TRANSDUCER

A new unit designed to provide an electrical signal proportional to rate of ascent and descent of aircraft. Has a time constant of 2 seconds at 50,000 feet, which decreases to less than 0.2 seconds at sea level. Its high speed response makes it effective for obtaining an "anti-porpoising" signal. Output voltage between 0-5 V. peak to peak and may be telemetered on standard

FM-FM systems. Normal operation from 400 cycle, 115 V. supply, but can be powered by any frequency from 350 c.p.s. to 10K c.p.s. **Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-51)

FILTER

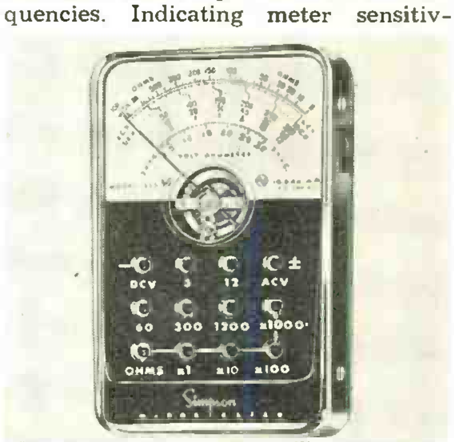
Type 7052 is a variable high and low frequency filter to eliminate unwanted noises, act noises, rumble, whistles, etc. Can be used in the laboratory to measure harmonic distortion. The unit



incorporates a 4-stage amplifier with an R-C interstage coupling network. Features include: "in and out" switch, triple mu-metal transformer shielding, tube shock mounting, and shielding to enable operation in low level circuits. Frequency range, 20 to 15,000 cps response, plus or minus 1 db. Power requirements 250 v. dc. at 5 ma., 6.3 v. at 1.2 amps. **Cinema Engineering Co., Div. Aerovox Corp., 1100 Chestnut St., Burbank, Calif.** (Ask for 7-12)

POCKET SIZE VOLT OHMMETER

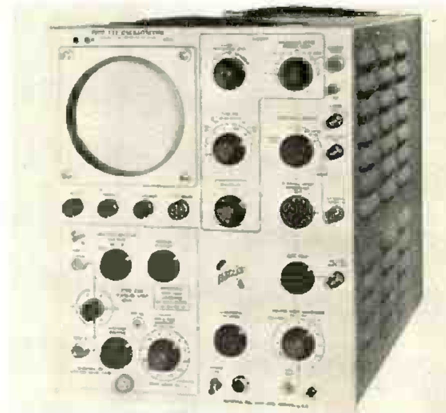
The Model 355 self-shielding volt-ohmmeter—the "Midgetester"—measures 2¾ x 4½ x 1 in., overall. The plastic cover of each test lead termination safeguards the operator from touching probe voltage. The lead wire insulation rating is 5,000 v. The rectifier for ac. voltage measurements is the full wave bridge type and provides vibration-free meter operation at all frequencies. Indicating meter sensitiv-



ity is 78 μamps; this, shunted for all measurements, provides a basic sensitivity of 100 μamps. Sensitivity for ac. voltage measurements is 10,000 ohms/v. **Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.** (Ask for 7-11)

OSCILLOSCOPE

The Type 532 oscilloscope is designed for users who have no need for the high-speed sweeps, high writing rate, and wide passband of the Tektronix Type 531. The Type 532 has all the ad-



vantages of all Type 53 and Type 53/54 plug-in units, only the wide-band units are limited to a passband of dc. to 5 MC and risetime of 0.07 usec, by the characteristics of its main amplifier. Sweep range, 1 usec/cm. to 12 sec/cm. continuously variable, with 21 calibrated steps from 1 usec/cm. to 5 sec/cm., accurate within 3%. 5X magnifier extends calibrated range to 0.2 usec/cm. **Tektronix, Inc., P.O. Box 831, Portland, Ore.** (Ask for 7-13)

PANEL METER

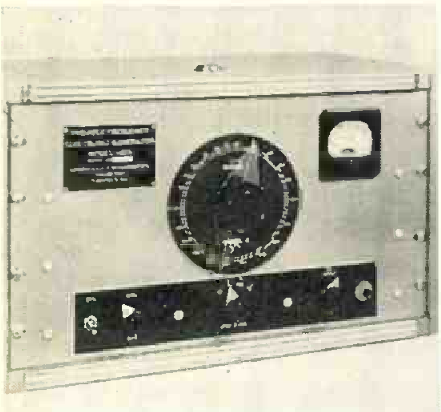
The "Custom" 4½ in. panel meter is available in 4 types housed in magnetically shielded metal cases with easily read scales and front zero adjustments. Readable from 8 to 10 feet. Assures 2% accuracy. The "Custom Chrome" has a rectangular black die-cast bezel with a polished chrome trim. The "Custom Chrome Illuminated" is the same with 5,000 hr. self-contained lamps for illuminated scales. The "4½ Custom" has an all black bezel, though

specific colors are available for industrial users. The "4½ Custom Illuminated" is equipped with 5,000 hr. lamps, also. **Phaostron Co., 151 Pasadena Ave., S. Pasadena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-18)

New Pulse & Signal Generators

FREQUENCY GENERATOR

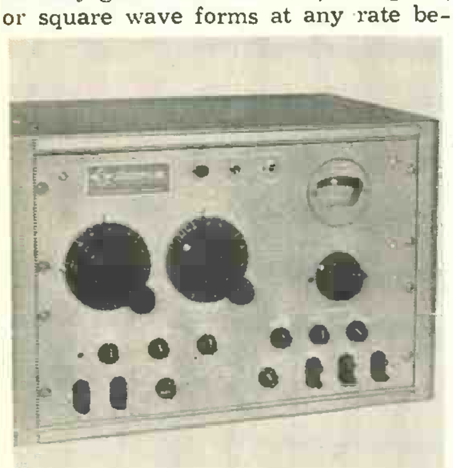
The Model 1455 variable frequency generator—50 va. output, 20-18,000 CPS range—can also be supplied tailored to a particular portion of the 20 CPS to 18 kc range with even lower dynamic



output impedance. Voltage output, nominal 115 variable, 110-120 v. at full output and from 60-135 v. at reduced output. Regulation, full load to no load less than 2% output voltage increase. Full load to no load recovery time less than 1 sec. Power input 115 v., 60 CPS. **Communication Measurements Laboratory, Inc., 350 Leland Ave., Plainfield, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-52)

FREQUENCY GENERATOR

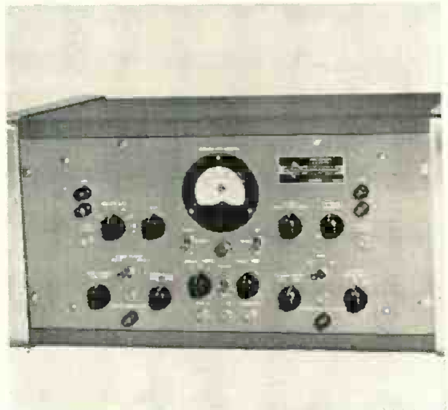
The Model 200K for use with an "Electromec" large-screen oscilloscope produces a constant amplitude output voltage, continuously variable in frequency from 20 CPS to 200 kc. Continuous frequency variations are produced by the modulation of a voltage controlled oscillator with internally generated sawtooth, triangular, or square wave forms at any rate be-



tween 0.5 CPS and 50 CPS. Provision is made for external modulation. Requiries 12¼ in. panel space. Weight 50 lbs. **Engineering Dept., Electromec, Inc., 3200 N. San Fernando Blvd., Burbank, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-55)

GENERATOR-CALIBRATOR

The Model PC-100A pulse generator and calibrator produces two rectangular pulses with independently controlled amplitudes and polarities. Polarities are positive or negative. Amplitudes are



0-75 v., open circuit from 220 ohm source. Repetition frequencies are adjustable at 50-5,000 pps, and paired-pulse interval is adjustable at 5-5,000 μsec. Time durations are 1 μsec for sliding-pulse output, and 1 μsec for fixed-pulse output synchronized from external source, and 1.5 μsec when operated self-synchronously. **Teletronics Laboratory, Inc., 54 Kinkel St., Westbury, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-53)

MAGNETRON

The RCA-6521, a pulsed oscillator with a fixed frequency of 5,400± 20 MC/sec. for weather radio equipment, has a maximum peak anode voltage rating of 16 kv and a peak anode current rating of 10 to 16 amperes. Peak power outputs are obtainable from 60 kw to approximately 100 kw. Operates with high efficiency at pulse durations up to 2.2 μsecs. Full ratings can be used at altitudes up to 16,000 feet without pressurization. Die-cast aluminum jacket encloses a cathode and integral "Alnico" magnet. **Radio Corp. of America, Tube Div., Harrison, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-56)

MORE TECHNICAL INFORMATION

describing the new products presented here may be obtained by writing on company letterhead to New Products Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.

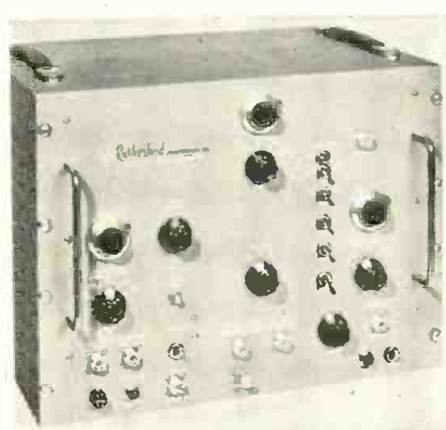
WAVE GENERATOR

The Model 1073-A sine-squared, square wave generator is a portable test unit that provides maintenance personnel and technicians with a simple-to-operate, precise unit. The

"go no-go" nature of the instrument produces new types of wave forms for testing any TV or other pulse unit or system for amplitude and phase characteristics. Three $\sin^2$ pulse widths are provided: 0.25, 0.125, and 0.062 μsec corresponding to bandwidths of 2 MC, 4 MC, and 8 MC, respectively. Size, 8 x 8 x 15½ in. **Telechrome, Inc., 632 Merrick Rd., Amityville, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-54)

PULSE GENERATOR

The Model B-2A pulse generator, improved by an input trigger circuit, relocation of the cooling fan, and changed output circuit, is a general purpose instrument that gives repetition rates from 10 CPS to 100 kc. Widths are from 0.1 μsec. Delays range from 0 to 10,000 μsecs with output pulse of 40 v. into 93 ohms. Five synchronizing pulses

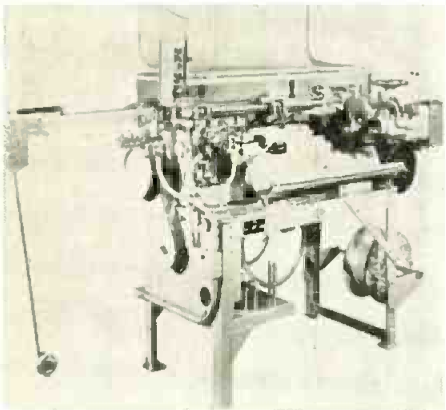


at various time intervals during single repetition period. Can be triggered externally and for single pulse operation. **Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-57)

New Plant & Lab Equipment

WIRE STRIPPING MACHINE

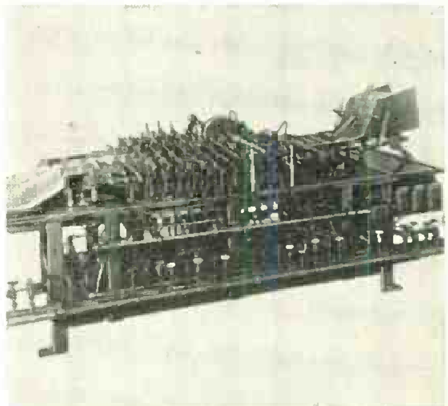
The TA-20-S wire machine measures, cuts and strips one or both ends of insulated wire and combines automatic terminal attaching to one end of the wire lead. Also, an attachment is avail-



able for marking finished wire with identification code numbers and letters. All these operations are accomplished automatically at up to 3,000 finished pieces per hour. Will handle solid or stranded wire from 3 in. up to 250 in. long. Has automatic prefeeder to assure even lengths of wire leads and a wire reel-holder as part of the machine. **Artos Engineering Co., 2757 S. 28th St., Milwaukee 46, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 7-38)

GLASS WORKING MACHINE

The fully automatic glass working machine, No. 160-ABO-CG-4, performs various operations on glass tubing. A fabricated table supports the main bearings, hopper feed, glass forming



mechanism, and glass cutter. All driving parts are mounted under the table. The glass blank is automatically carried from the hopper feed to several heating positions. In the constricting position, the taper is drawn by driving rollers. The glass is then cooled or reheated depending on whether it is to be mechanically or flame cut. Ends are formed as required. **Eisler Engineering Co., Inc., 750 13th St., Newark 3, N. J.** —TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-40)

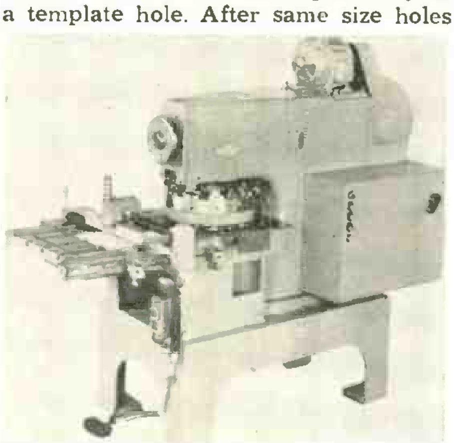
CONTOUR PROJECTOR

Model 8 "Kodak" contour projector is adaptable for either horizontal or vertical projection gaging. Designed for checking small parts staged in simple holding fixtures for horizontal projec-

tion; or, on an easily-mounted glass stage, for vertical projection with the machine turned on end. "Ektar" lenses used in the machine are rigidly mounted and housed. Their "Lumenized" coating, with the "Ektalite" field lens back of the screen, yield a bright image that enables the projector to be used anywhere in a plant. Distributed by **Optical Gaging Products Co., 26 Forbes St., Rochester, N. Y. Eastman Kodak Co., Rochester 4, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 7-41)

TURRET PUNCH PRESS

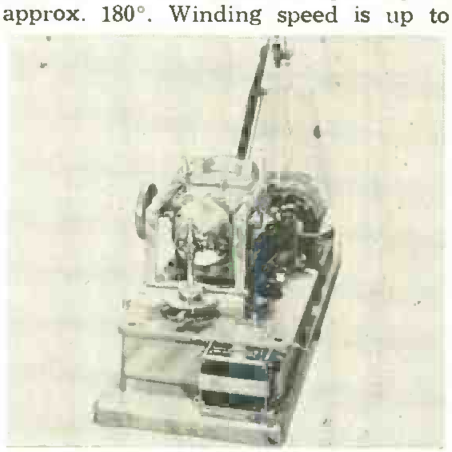
The RA-4P turret punch press pierces printed wiring boards at high speed in low to medium quantities (10 to 10,000 per kind). Holes to 1½ in. diam. are punched to ± 0.005 in. tolerance at 80 to 120 holes/min. in printed wiring boards, terminal strips, or small metal components. Trips automatically when the operator depresses the hole locator to engage positively in a template hole. After same size holes



are punched, a foot switch automatically swings the next color-coded tool in position in 1.5 seconds. **Wiedemann Machine Co., 4272 Wissahickon Ave., Dept. 82, Philadelphia 32, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 7-42)

STATOR WINDER

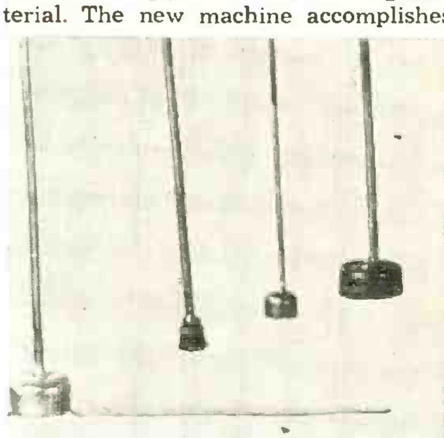
The Model 36-MCO external slot stator winder winds the smallest and largest possible pitches. Winds straight or skewed external slot stators and rotors from either rotation direction. Handles stack lengths from ¼ in. to 1¼ in. and from 7/16 in. O.D. to 1½ in. O.D. Winds wire sizes from 30 to 40 gauge. Winds down to a slot span of 1 to 3, and any specified span up to approx. 180°. Winding speed is up to



180 rpm, and a complete job changeover requires only 15 to 20 minutes. A magnetic brake stops the machine at the right number of turns. **Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-39)

CAP AND LEAD MACHINE

The "Tweezer-Weld" machine, a new automatic device for butt-welding cap and lead assemblies on resistors, capacitors, and other electronic components, eliminates the necessity to pierce the cap, insert the lead, and solder it inside. Further, by butt-welding leads to caps, noise in resistors is eliminated and sub-assemblies are made heat resistant to the melting point of the welding material. The new machine accomplishes

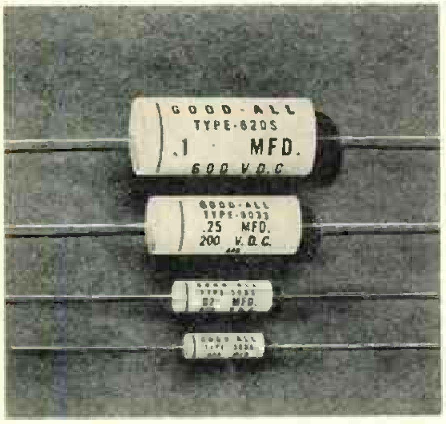


a copper-to-brass weld with many times the strength of a mechanical solder connection. Exceeds all military specifications. **Federal Tool Engineering Co., 1384 Pompton Ave., Cedar Grove, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-43)

New Capacitor Products

"SERAMELITE" CAPACITOR

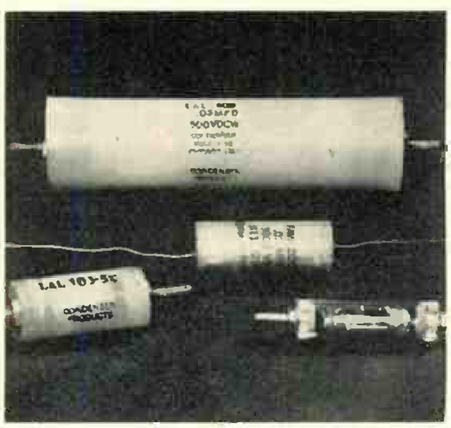
The "Seramelite" capacitor will operate continuously over a temperature range of —50°C. to +100°C. and is available with either paper or "Mylar" dielectric. Encased in ceramic tubes, they



are sealed with a new thermosetting plastic. The unit will not drip at temperatures even higher than 100°C., and leads are easily soldered. After 28 days at 60°C. and 95% relative humidity and 100% applied voltage, it still had an insulation resistance of 1,000 Meg-μf with a maximum of 10,000 megohms. Capacitance range, 0.001 μf to 2.0 μf. Voltage range, 100 to 1,600 WVDC in sizes small as 0.215 x 27/32 in. **Good-All Electric Mfg. Co., 112 W. First St., Ogallala, Nebr.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-32)

POLYSTYRENE CAPACITOR

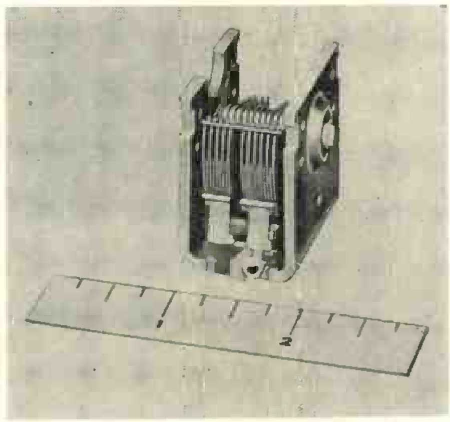
Recently announced was a polystyrene capacitor designed as a charge storage unit and as a capacitance divider. Except for its studs and aluminum foil winding, the unit is completely plastic, and the surrounding case has a much higher insulation resistance than glass or metal. At room temperature, insulation resistance is 30,000,000



MEG x μf at 400 v. dc. At 75°C., insulation resistance is 1,000,000 MEG x μf at 400 v. dc. **Condenser Products Co., Div., New Haven Clock and Watch Co., 140 Hamilton St., New Haven, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-33)

TWO-GANG CAPACITOR

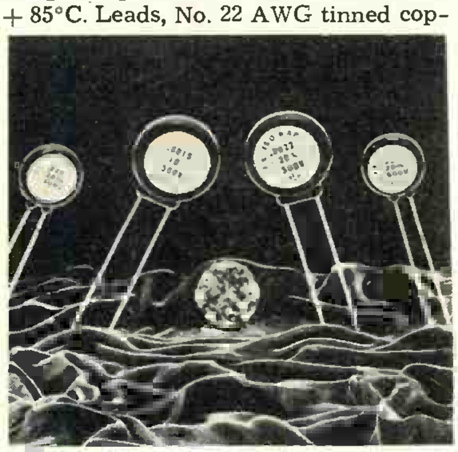
The new miniature two-gang variable capacitor, Model 2851, is designed for miniaturized portable and "pocket" radios using transistors and printed circuits. Only 15/16 in. high, the com-



ponent weighs barely an ounce because an aluminum "cradle" is used instead of steel. Product of an intensive miniaturization research program, the unit is so designed as to fit into printed circuit panels, if desired. Said to be smaller and lighter than any previous commercial model. The unit is available now for set manufacturers. **General Instrument Corp., 829 Newark Ave., Elizabeth 3, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-34)

CERAMIC CAPACITOR

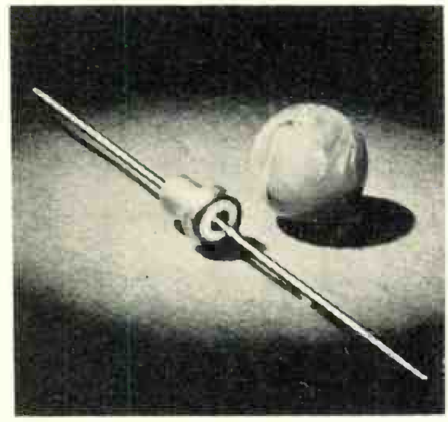
The "Iso-Kap" molded disc ceramic capacitor has the following design features and characteristics: Power factor, through 220 μμf., 0.6% maximum at 1.0 MC.; above 220 μμf., 1.5% maximum at 1.0 kc. Voltage, 500 v. dc. working, 1,500 v. dc. test. Insulation resistance, 10,000 megohms, minimum. Case, 3,000 v. dc. minimum breakdown to ground. Operating temperature range, — 55°C. to + 85°C. Leads, No. 22 AWG tinned cop-



per wire, 1½ in. long, minimum. Military Specifications: Will pass MIL-C-11015A, JCNAAF-C-26, and RETMA REC-107A. **Centralab, Div. of Globe-Union, Inc., 900 E. Keefe Ave., Dept. D-38, Milwaukee 1, Wis.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-35)

ELECTROLYTIC CAPACITOR

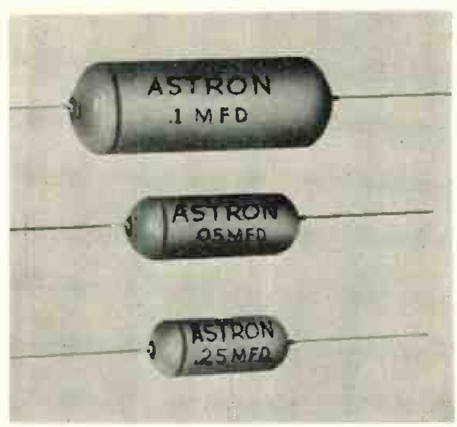
The Type 104D, miniature "cup" electrolytic capacitor, is designed for low voltage applications. Provides values of capacitance to 30 μf in units less than 1/10 cu. in. volume. Use of



tantalum, the most stable of anodic film-forming materials, provides unusual performance stability. The unit exhibits no shelf-aging under long-period test. Normal operating temperature range is — 55 to + 85°C. at rated v. dc. Can be obtained on special order to operate with a 15% voltage derating. Complete information as to size, rating, and performance is available at **Sprague Electric Co., 233 Marshall St., North Adams, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-37)

METALLIZED CAPACITORS

The "Comet," said to be the first metallized paper, molded plastic, miniature tubular capacitor, provides extra protection against over-loads and momentary surges. The metallized paper construction provides small size, light weight, and low r-f impedance. A new solid thermosetting impregnant provides high dielectric strength and im-



proved insulation resistance. The bonded shell and protected seal are immersion-proof and impervious to extremes of heat, cold, and moisture. Leads can not pull or melt out. Operates dependably up to 125°C. **Astron Corp., 255 Grant Ave., East Newark, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-36)

WASHINGTON
News Letter

Latest Radio and Communications News Developments Summarized by TELE-TECH's Washington Bureau

NEW LOOK AT SPECTRUM—Long-range planning and study of the spectrum between 50 and 890 megacycles for the reallocation of television in one single portion of the frequency space—47 channels from 60 to 342 MC—has been proposed by FCC Commissioner Robert E. Lee as a method to establish a more equitable and more logical pattern of frequency assignments. Commissioner Lee who emphasized his plan was made on a personal basis to "provoke study" feels his proposal to reallocate TV would obviate the present problems of solving situations like de-intermixture, satellite and booster operations and other UHF TV issues. Commissioner Lee recommended that all non-broadcast radio services like amateurs, aeronautical, fixed communications, industrial, and mobile should be placed below 60 MC or above 362 MC. He opposes piecemeal plans of reallocation for the benefit of special users and feels that equipment in these bands, especially in the non-broadcast services, rapidly deteriorates so that reallocation on a long-range basis can be effectuated without serious loss.

NEW FCC COMMISSIONER—Replacing on July 1 Miss Frieda Hennock, "stormy petrel" on the FCC who has been the continual "dissenter" on that body and chief advocate of educational television was Richard A. Mack, who had served with distinction for the past eight years on the Florida Railroad and Public Utilities Commission. Capable and efficient, Mr. Mack has added to the stature of the FCC and the misgivings in some broadcasting circles about his background in common carrier regulation are deemed by competent observers to be without any foundation whatsoever. Two of his fellow Commissioners, named by President Eisenhower —Chairman George C. McConnaughey and Commissioner John C. Doerfer, former chairmen of the Ohio and Wisconsin commissions respectively—have demonstrated their viewpoints that broadcasting and television regulation should encourage growth of these important media of mass communication.

REVIEW GOVERNMENT NEEDS—The FCC and the Office of Defense Mobilization, the key governmental agency in mobilization planning, have been negotiating on a plan to turn over a portion of the 162-174 MC band, now available for general communications by non-military government agencies to non-government land mobile radio services in principal metropolitan areas. This is a move which has been advocated in recent years by TELE-TECH. The ODM also is understood to be studying a collaboration with the White House requirements by the armed services for spectrum space.

MOBILE PLANNING BODY—The FCC has been urged to establish a Radio Technical Commission for Land Mobile Services, comparable to similar bodies in aviation and marine radio services, by a leading authority in the mobile communications radio field, Motorola Vice President Daniel E. Noble. He presented the proposal in views on the Commission's plans for splitting mobile radio channels in the 25-50 and 152-162 MC bands. The Motorola executive recommended to the FCC that his proposed group could make constructive progress in the formulation of an "intelligent, long-range plan" for the guidance of mobile radio operations rather than the present method of "patching and fitting to meet immediate pressures" for spectrum space for these services. He stressed a geographical-sharing frequency program in the land mobile radio services is ultimately "inevitable" and such a government-industry advisory group would effectively develop the means for administering such a plan.

UHF TELEVISION PLANS—The FCC is formulating a plan to raise the maximum power for UHF television stations from one million to five million watts as one of the important steps to enable UHF stations to operate on a par with VHF outlets. This was the announcement of Commission Chairman George C. McConnaughey at the 33rd annual convention of the National Association of Radio and Television Broadcasters, attended by 2,000 broadcasters and manufacturers' officials, and featured by the address of President Eisenhower, the first nation's chief executive to speak before the NARTB. Another move to implement the growth of UHF, the FCC Chairman disclosed, will be to seek the assistance of manufacturers and research engineers in the improvement of the sensitivity of UHF receivers and the tuning mechanism of UHF sets.

COMMUNITY ANTENNA TV CASE—The first comparative hearing in the field of privately-owned radio relay systems, operating as common carriers, to serve community antenna television systems was scheduled before the FCC in an examiner proceeding to commence July 5. Two applicants—Blackhills Video and Bartlett & Reed Management—who seek to serve Rapid City, S. Dak., by relaying programs picked up off-the-air from Denver television stations are to be considered by the FCC with the selection of one system a good possibility. The Rapid City customer is a community TV distribution system.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

"Circuit-designed and circuit-tested" to meet today's TV requirements

Add two more to Sylvania's long list of original tube developments. Typical of all Sylvania "Originals" these tubes fill timely and important applications for the equipment designer.

One meets the TV designer's need for a horizontal amplifier suitable for low B+ chassis applications. The other provides a dual-purpose tube combining a higher-rated vertical deflection amplifier and oscillator for normal B+ chassis. Each type is "circuit-designed and circuit-tested" for optimum performance in its application to the modern television receiver.

For complete information on the New Sylvania types 25DN6 and 6CS7, check the appropriate space. Or if you have interests in other equipment fields let us send you a complete listing of Sylvania "circuit-designed and circuit-tested" tubes.

Type 25DN6

"Circuit-designed" for horizontal amplifier use in *off-the-line* low B+ series-string TV applications; and to eliminate "snivet" problems.

"Circuit-tested"—to exhibit a low plate knee characteristic and deliver high peak currents which are necessary for proper deflection.

Type 6CS7

"Circuit-designed" to provide an oscillator combined with a vertical deflection amplifier with higher plate dissipation (6.5 watts).

"Circuit-tested" — to deliver optimum performance at higher ratings under the more stringent operating conditions of modern circuitry.

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

☐ Please send complete data on the new 25DN6 and 6CS7

Please send information on other "circuit-designed and circuit-tested" types as indicated below.

☐ Other entertainment types ☐ Control equipment types
☐ Military equipment types ☐ Test equipment types
☐ Special-purpose types ☐ ______________types

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For product information, use inquiry card on last page.

 (Continued from page 57)

been due principally to leaking at the acid seal which deteriorated purely as a function of time. Generally, there is no way to test quality and reliability into a component; it must be built in to start with. Likewise, quality and reliability cannot be tested into a finished equipment. It will be only as good as its individual component parts.

Poor Workmanship

While unreliability has been due principally to component part failures, quality of workmanship is also important. You may have the finest equipment as far as components are concerned, but it may still be unreliable because of poor mechanical connections, unsoldered or cold solder joints, and the like. The problem is aggravated by turnover in production workers and a tendency in some to become careless with long familiarity. The answer is not easy, but every effort must be made to eliminate poor workmanship. Automation may be a help in this area, but again, only if superlative quality components are used.

We have found that an adequate factory testing program affords considerable protection to the customer. This is particularly true until such time as we can be certain that every individual component is always highly reliable. The following curve gives an approximation of what happens during the life of an equipment.

From Fig. 4 it is quite obvious that the customer should not receive an equipment prior to point "a" on the curve, since the highest failure rate exists prior to that point. However, between points "a" and "b" we have

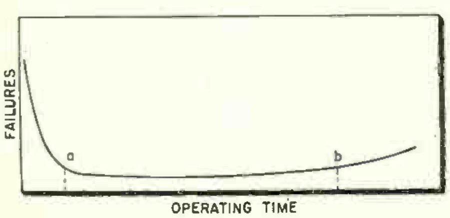


Fig. 4. Lowest failures between a & b

a plateau representing the lowest failure rate, thus requiring minimum maintenance. When point "b" is reached, variable in time for different equipments, normal wear begins to show its effects, and more maintenance is required. At some point beyond "b", the equipment becomes uneconomical to maintain. Depending on the equipment, it should be overhauled to replace all worn parts, or removed from service permanently. The time between points "a" and "b" is generally measured in years; some of our equipments are still doing well 15 years after they were produced. On this basis, the argument that 200 hours of factory testing reduces the life of the equipment by that amount, has no real meaning. Furthermore, the cutoff point in useful life is never based on accumulated operational hours as such.

As the equipment reliability is improved through better components, workmanship, and production "knowhow," point "a" moves to the left, indicating that less factory test time is required because fewer failures occur in test.

We have found that it is possible to obtain excellent correlation between factory failures and field failures in operational use. We have one case, however, where there was no correlation. In a situation such as this, when field failures are more numerous than factory tests indicate, it is mandatory that a careful examination be made to determine the factors in service use which cause the unexpected failure rate. Once determined, factory testing must be altered to simulate the same conditions, and close correlation can be established.

Of particular interest is a 48-hour "shakedown" test which is accomplished on each equipment, early in production, and before final adjustments are made. It is a brute-force test, not very scientific, but it has proven to be the most valuable test performed as far as weeding out early-life failures is concerned. The assembled equipment is mounted on a crude shaketable, without shockmounts. It is operated 48 hours with vibration introduced for ten minutes of each hour. Simple transmitter power output tests and receiver listening tests easily indicate complete failures and intermittents. It is significant that poor mechanical connections, unsoldered or cold solder joints, etc., show up quickly. In fact, of all failures occurring during the 200 hours of factory testing, 49.2% occurred in the 48-hour "shakedown" tests in a representative group of radio sets, attesting to its usefulness.

Final checks, during which all alignments and adjustments are made add about 18 hours of operation. 11.1% of the factory failures occur here. The three-hour systems test showed 15.9% of the failures. The half hour of quality control testing added another 6.4% of the failures in the factory. The one-hour cold test added 7.9% of the factory failures. The last test was a straightforward life test of 125 hours. In spite of the fact that the time involved in the life test is more than 50% of the total factory test time, only 9.5% of the factory failures occurred here. It is quite obvious then that a long factory test time *does* cull out many failures which otherwise would have occurred in early life in the field.

Test Periods

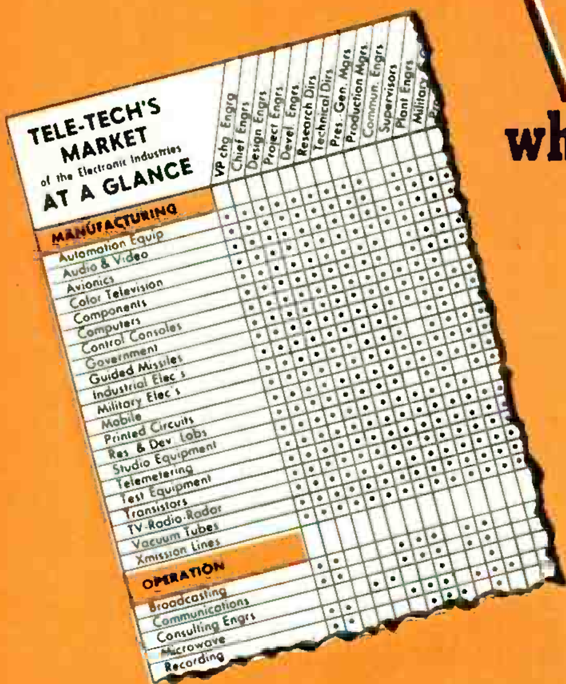
Obviously, long test periods applied 100% to each and every equipment are deterrents to mass production. Test time can be reduced as quality improves, providing the failures occurring in such tests are decreased to a negligible amount. Failure analyses, which must be on a continuous basis always, will point the way to necessary corrections. In the examples just given, assuming the failures shown by the 125-hour test became so low in number as to be unimportant in culling out defects, it would first be reduced in length, and perhaps finally eliminated. However, it must be maintained as a type test on a few equipments continuously in order to provide a control.

The same procedure would be employed in the cold test. Obviously, quality control tests, systems tests and final tests must always be done on a 100% basis. At such time as the 48-hour "shakedown" failed to contribute significantly to factory failures, it could be reduced in time, and finally eliminated. When this is feasible, we shall have an unquestionably superlative piece of equipment, which is, of course, our goal.

In discussing the areas which needed revision and correction, we found that some were dependent on others, and we shall talk about them singly and collectively. If there are doubts in your mind as to whether or not the effort is worthwhile, let me say that we improved the operational reliability of a complex piece of airborne equipment more than thirty fold in a period of three months.

We mentioned earlier that superlative components are a "must." We hope that these components can be made available for all industry to use, perhaps as a special grade under JAN specifications. Much work remains to be done on subminiature components, but we must take advantage of all that has been learned to date and keep current. From now

After all is said and done the Electronic Chief decides which one



After all the facts have been presented, it's the "electronic chiefs"—the chief engineers and other top engineering personnel—who decide what to specify and buy in the way of electronic products. They have the authority, and with TELE-TECH & ELEC TRONIC INDUSTRIES you have a direct means presenting your sales messages to them. Th read TELE-TECH regularly because it is ed for, and circulated to them exclusively.

Charted above are the top engineering and executive personnel engaged in the manufacturing and operating divisions of the growing $8 billion electronic market. 78% of TELE-TECH's 27,072* total circulation is in these main buying power divisions which account for 90% of the total dollar volume. TELE-TECH & ELECTRONIC INDUSTRIES gives you the most effective and concentrated circulation in the electronic market.

* Effective January 1955.
Cannot appear in BPA statement until June audit.

TELE-TECH & ELECTRONIC INDUSTRIES

PREFERRED MAGAZINE OF THE "ELECTRONIC CHIEFS"

480 Lexington Avenue, New York 17, N. Y. Plaza 9-7880

Airborne Reliability

(Continued from page 86)

on we feel that it is everybody's job to carry on the reliability program until our goal has been met and reliability is no longer a problem.

One of the most important factors, applicable to components as well as finished equipment, is increased emphasis on quality control. We found out from the very start that sampling procedures at vendors' plants and at the equipment manufacturer's plant had to be discarded and 100% inspection invoked. This means 100% reinspection at the equipment manufacturer's plant. On some components, additional vendor testing was required. On other components, redesign was required or, in extreme cases, a different source of the item was necessary. In all areas, more and better inspection was required at every phase of manufacture. Sampling procedures cannot be employed until such time as the quality of the product has been proven to be consistently superlative beyond the shadow of a doubt.

At this point we shall examine a few of the components to show some of the variety of problems encountered. Subminiature vacuum tubes turned out to be an enigma. The original development samples were phenomenally reliable, but, contrary to previous experience, the production tubes were unreliable instead of better. Special measures were taken to correct mechanical deficiencies, and specification limits were tightened on many parameters as well as on testing procedures. Improved tubes are now being installed in produced equipments, and we expect a marked increase in their reliability. The same treatment is being applied to pencil triodes. Almost 60% of our component failures in operational use have been vacuum tubes, indicating how important this one item is.

Improving Relays

Relays are still bad offenders in spite of improvements. In this area, we can cite examples typical of many of the unreliable components. It indicates that quite often the fault is of such nature that the design was unsatisfactory from the start, and quite obviously so. One sealed relay employed a volatile hydrocarbon as an impregnant. Arcing at the relay contacts naturally caused free carbon to be precipitated, since the hydrocarbon vapors had no means of escape. In a short time the deposits on the relay contacts caused erratic operation. In another case, a hydrocarbon was used to fill the PA tuning capacitor, permitting a much smaller physical size than if the dielectric were air. However, this hydrocarbon had such a low flash point that any leakage within the pressurized case would have caused an explosive mixture. A product was substituted which had an adequate flash point and satisfactory dielectric constant.

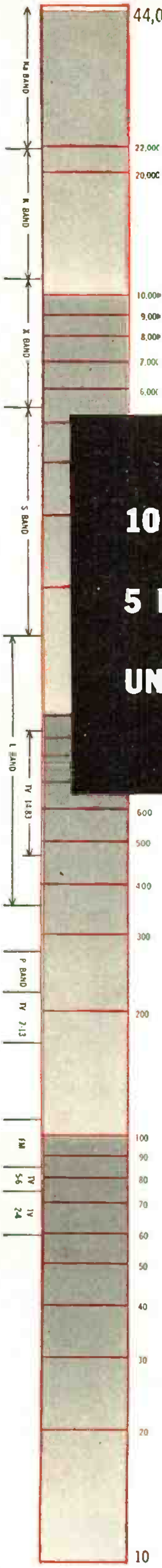
Next in order of magnitude were capacitor failures, the large majority being of the tantalum type. Switches of all types need further improvement, as do connector plugs.

Summarizing our findings, the prime requisite for high reliability is highly reliable components. Quality control is extremely important, and inspection must be increased; on components, inspection must be 100% until the quality is so high that sampling may be employed without danger. Quality cannot be tested into anything; it must be inherent. Testing time must be adequate to cull out failures which would otherwise occur in early life. Testing time can be reduced in many areas when these tests do not show a significant number of failures occurring.

One very important area borders on the intangible. The attitude of everyone concerned, from component part to finished equipment, must be one of alertness and suspicion. The smallest sign of possible trouble or irregularity must be thoroughly investigated immediately. No detail is too small to cause a serious problem in reliability in the field.

What do we buy with reliability except reduced maintenance? If we are considering military applications, consider how important it is to you, personally, in the next war, that a bomber deliver its nuclear cargo on an enemy target. One single component failure might cause an abort, and your very existence might be jeopardized by that one component failure. Likewise, one interceptor might be the only barrier between you and an enemy bomber carrying an atomic weapon. One component failure and the bomber would get through.

For the future, as we increase our equipment reliability on a continuous basis through industry's effort, we shall approach our goal of 2000 hours operation without any interruption for maintenance. When this point is reached, it will be cheap indeed to discard the equipment at the end of this operating period, regardless of its initial cost.



PORTABLE DIRECT READING SPECTRUM ANALYZER

10 TO 44,000 mcs

5 RF HEADS

UNI-DIAL TUNING

MODEL TSA

Now, a new Polarad spectrum analyzer only 21 inches high that covers the entire frequency range 10 to 44,000 mcs with 5 interchangeable RF tuning heads. The model TSA operates simply—single dial frequency control—with utmost frequency stability. It provides highest accuracy, and reliability for observation and true evaluation of performance over the entire RF spectrum—saving engineering manhours.

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Model STU-4	RF Tuning Unit 21,000-33,000 mc.
Model STU-5	RF Tuning Unit 33,000-44,000 mc.

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Resolution: 25 kc.

Frequency Dispersion: Electronically controlled, continually adjustable from 400 kc to 25 mc per one screen diameter (horizontal expansion to 20 kc per inch)

Input Impedance: 50 ohms—nominal

*Sensitivity:
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- STU-2A 910-2,200 mcs −87 dbm; 1,980-4,560 mcs −77 dbm
- STU-3A 4,370-10,920 mcs −75 dbm; 8,900-22,000 mcs −50 dbm
- STU-4 21,000-33,000 mcs −55 dbm
- STU-5 33,000-44,000 mcs −45 dbm

Overall Gain: 120 db

Attenuation:
**RF Internal 100 db continuously variable, IF 60 db continuously variable

Input Power: 400 Watts

*Minimum Discernible Signal
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- Five interchangeable RF tuning units for the entire frequency range 10 to 44,000 mcs.
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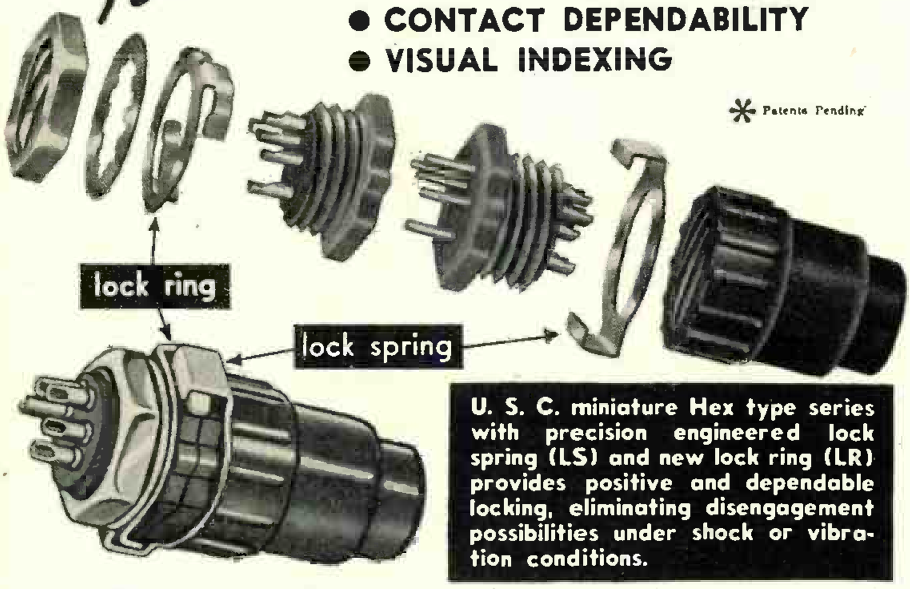

Linear TV

(*Continued from page 60*)

er tubes can be used. Also a simple circuit employing two square law elements such as germanium rectifiers can be used. This is illustrated in Fig. 8. If we assume that v_1 is always positive and larger than 0.5 v_2, then both diodes will always be conducting. The resistors R_1 and R_2 are equal and are small compared to the forward resistance of the square law germanium diodes. Hence the curent i_1 is proportional to the square of the voltage across it.

$$i_1 = k\left(v_1 + \frac{v_2}{2}\right)^2$$

where k is a constant and similarly

$$i_2 = k\left(v_1 + \frac{v_2}{2}\right)^2$$

The output voltage is then

$$v_o = (i_1 R_1 - i_2 R_2)$$

$$= k R_1\left[\left(v_1 + \frac{v_2}{2}\right)^2 - \left(v_1 - \frac{v_2}{2}\right)^2\right]$$

$$= (2k R_1)\, v_1 v_2$$

Hence, the output voltage is proportional to the product of the two input voltages.

For the nonlinear receiver of Fig. 6, it will be noted that the two product signals from the low pass filters

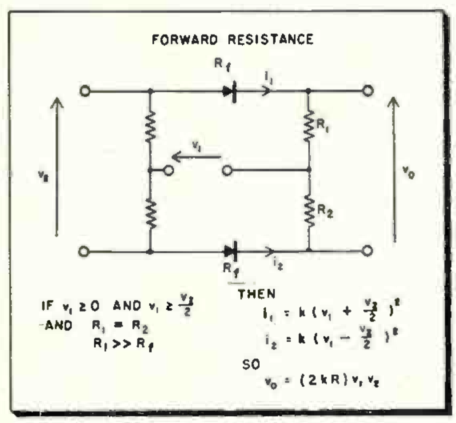

Fig. 8: Germanium rectifier "product" circuit

associated with the two phase sensitive detectors are proportional to the coefficients of the sine and cosine terms of chromaticity signal. Similarly, for the linear receiver, the two product signals from the low pass filters associated with the two phase sensitive detectors are proportional to the coefficients of the sine and cosine terms of the chromaticity signal. In both types of receivers, these signals are fed into a matrix.

In the nonlinear receiver, the other signal fed into the matrix is E_Y' which comes directly from the low pass filter. However, in the linear receiver, the $\sqrt{Y}$ signal from the low pass filter is squared to obtain a voltage proportional to brightness Y which is fed to the matrix. The squarer circuit may simply consist of a square law rectifier and resistor as shown in Fig. 9. An amplifier with a square law response can also be used.

The matrix[8] unit in both types of receivers is similar. Each of the out-

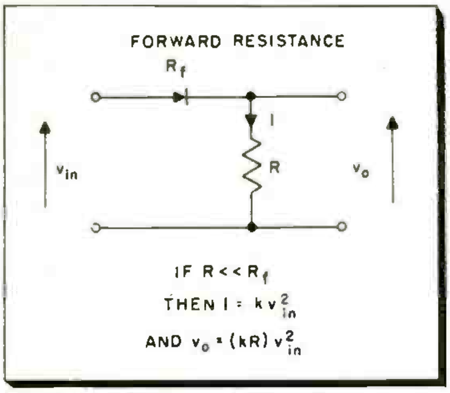

Fig. 9: Simple rectifier "squarer" circuit

puts of the matrix is simply a weighted sum of the three inputs. Since the addition may require negative quantities of some of the inputs, it is necessary to have both polarities of these inputs available. In both types of receivers, the matrix units can be made up of 10 or 12 resistors.

In the nonlinear receiver, the three output signals from the matrix are $E_R^{1/\gamma}$, $E_G^{1/\gamma}$ and $E_B^{1/\gamma}$. Assuming a gamma of two, these are $\sqrt{E_R}$, $\sqrt{E_G}$ and $\sqrt{E_B}$. Now, if the color picture is to be displayed on a cathode-ray tube in which the beam current varies approximately with the square of the grid voltage then these three voltages are suitable. Present color tubes have a gamma of approximately two, and so the three signals from the matrix unit can be used. If a linear display device or one having a gamma substantially different from two is used, then all three of the signals have to be gamma corrected.

With the linear receiver, it is evident that a simple matrix could be used to obtain X, Y, and Z. These three signals could then be matrixed in turn to obtain E_R, E_G and E_B. However, it is simpler to obtain the three color signals directly with one matrix unit. If a linear color display device is used, the signals can be used directly. If the display device is nonlinear, then gamma corection is requied. With a single gun color display, only one gamma correction circuit is needed.

With the linear type receiver, voltages suitable for any set of three both is required. Since this condition primary colors can be obtained from the matrix. With a nonlinear receiver, only NTSC primaries can be obtained directly from the matrix. After linearizing the signals, it is possible to transform to other primaries.

With the linear type of signal, all visible colors can be transmitted. with the nonlinear signal, transmission is limited to colors within the NTSC triangle. However, most of the colors,[5] normally encountered lie within this triangle.

The idea of having a different bandwidth associated with two quadrature components (I and Q) of the chromaticity is equally applicable to both types of signals.

Conclusion

The linear signal has a S/N ratio about 3 db better than the nonlinear signal for the same compatibility and for the same amount of cross talk between chromaticity and brightness. Both systems theoretically give exact reproduction of brightness, hue, and saturation at frequencies up to 400 KC in the absence of noise. The linear signal requires more circuitry at the receiver than the nonlinear signal. It requires a squarer circuit and amplitude modulation of the 3.58 mc reference signal before it is applied to the phase sensitive detectors.

This paper was presented at the National Electronics Conference, Oct. 1954, held in Chicago.

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Gas Diode Circuits

(Continued from page 61)

A. If the tube is unfired, this potential is not enough to cause conduction, and the bulb will be dark. This may be taken as the binary zero. B is at the supply voltage; C is at ground. If now a positive potential is applied momentarily at A or B, or a negative potential is applied at C, the tube may be caused to conduct. This makes it glow. Point B drops in potential while point C rises. The new levels will be maintained as long as the potential at A is above the minimum holding potential for the tube. This may be considered as the binary one.

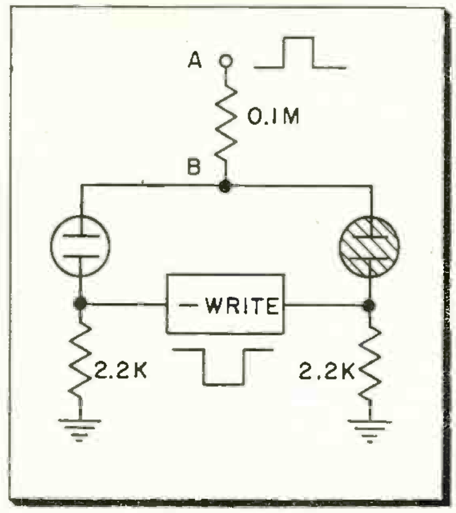


Fig. 3: Circuit with gas diodes, resistors and a negative write source

To return to the binary zero state, it is necessary to interrupt the holding potential until the tube deionizes fully. This is one disadvantage of the circuit; another is that a continuous path is necessary to maintain the tube in the binary-one state, making it difficult to obtain access to one bit without disturbing others.

Memory Access Circuits

The first innovation was an attempt to overcome the access difficulties. It consisted of turning from the static bit just described to a dynamic type of storage. In this system, a binary one is stored if a tube has "recently" been fired. "Recently," in this sense, means within the last 100 microseconds. A binary zero is stored if the tube has not been fired in this time. Since a continuous path need not be maintained for storage, any scheme of matrix access circuitry may be employed. In the experiments with gas diodes the diode-transformer and-gate developed for the NBS diode-capacitor memory was used.

In using such an access matrix, the dc holding potential at A is replaced by a 5-microsecond 100-volt pulse occurring every 100 microseconds (called a "Hold" pulse) on all word buses simultaneously. This will not fire a tube storing a zero, but will reionize a tube storing a one. In order to write a binary one, a positive pulse is applied to the proper word bus, and a negative pulse is applied to the proper bit bus. Neither pulse alone is sufficient to fire the tube; the simultaneous presence of

(*Continued on page 94*)

occurs only at the intersection of the selected buses, only the desired bits are written as ones.

In order to examine the stored words, a positive READ pulse is applied to the proper word bus. If the tube has been ionized recently, this pulse is suffcient to cause conduction, and a signal will be sensed at the *read repeater*. During the holding pulse, the logical sum of the memory appears at the*read repeaters* if this information is desired.

This is a one-way memory: that is, information that has been read into the memory must be completely erased before new information can be read in. In order to write a zero, it is necessary to inhibit the *hold* pulse until the tube will no longer reionize when it is applied, and no provision has been made to make this occur on a single bit. However, because it is a high-speed one-way member, it has several possible applications. For example, it may be used as a buffer between the internal memory of a computer and a high-speed printer. In it would be stored all the information for a long printout. While the printing operation is going on, the computer may be calculating the next set of data. An erasing time of about one millisecond may be economically allowed at the end of a printing cycle in this application. The memory may also be used as a visual tally board for a high-speed computer. In this case, erasure will be controlled by the operator at suitable intervals.

Double-Diode Memory Circuits

The second innovation was made to provide high writing speed in both directions, using a double-diode bit. See Fig. 3. In this circuit, two gas diodes, three resistors, and a negative *write* source are employed. Both tubes are fed from the power source through a common resistor. The power source is at the A end of the common resistor, and the anodes of both diodes are tied to the B end of the resistor. The cathodes of the diodes are returned to ground through separate resistors. The cathodes are also connected to the outputs of the negative *write* source.

In the operation of this circuit, a dc potential above the firing potential is applied to A. One of the bulbs will thus always be on. To write in the opposite digit, the cathode of the "off" tube is pulled down with a negative *write* pulse, which causes it to fire. This causes the common point B to drop to near ground potential, so that the "on" bulb now has less than holding voltage across

Gas Diode Circuits

(Continued from page 93)

it. It goes out and starts to deionize. At the end of the *write* pulse the point B rises again to holding potential, but all the current goes through the newly "on" bulb while the other continues toward its fully deionized state. Since the system is symmetrical, fast writing is possible in either direction.

Laboratory studies show that changing from a one to a zero, or vice versa, may be accomplished in 5 microseconds or less. However, it takes some time to reach steady-state conditions; so that as the repetition rate of changing from a one to a zero and back again increases, it becomes more difficult to determine whether switching has taken place. At the limiting rate, the "off" and "on" tubes have the same state of conduction.

This type of memory may be used generally as a high-speed memory, provided the rapidity of change of any one datum is limited to the speed of changing from one binary state to the other. It is an indicating type of memory which may be read out visually by hiding one bulb of each pair or read out photoelectrically, with either push-pull or on-off input to the photocells.

Gas Diode-Capacitor Memory

Another memory which operates more slowly in one direction than the other has been the subject of limited study. See Fig. 2. Here, a gas diode is connected in series with a capacitor. Bipolar pulses are applied to the other side of the diode, and *read-write* pulses are applied to the other end of the capacitor. Suppose that the capacitor has been charged to −15 volts. When the first half of a bipolar pulse is applied to the top terminal of the diode, there is sufficient voltage across the diode to fire it. Conduction takes place and the capacitor tries to charge toward +15 volts. Whether it reaches this potential is immaterial, since during the second portion of the bipolar pulse the tube conducts in the opposite direction and charging is toward −15 volts. At the end of charging, the capacitor is left with the original charge. Thus a binary one (since the tube flashed) has been read and restored. If, however, the capacitor had been uncharged, the bipolar pulse would not have fired the bulb, the tube would have remained dark, and the capacitor charge would have remained unchanged. Since in this case all leakage would be toward ground, there is no chance of losing a zero. However, a binary one would tend to leak toward zero and therefore must be regenerated by the process of reading.

In order to write a binary one, it is necessary only to fire the tube during the bipolar pulse. This may be done by a negative bottom *write* pulse applied during the first half of the biplar operating pulse. The regular regeneration cycle then holds this new information. To write a binary zero, the tube is fired during the first portion of the bipolar pulse; then, when the pulse starts down to charge the capacitor in the opposite direction, a bottom pulse is applied which holds the lower plate of the capacitor at −15 volts. This does not prevent the normal cycle of charging the upper plate to −15 volts, since this potential is set by the operating pulse amplitude and the drop across the diode. The bottom pulse is maintained until the upper pulse is over. At this time the upper plate of the capacitor is disconnected so that when the bottom is returned to ground, the top also rises to ground potential. Deionization must have progressed sufficiently before the next operating pulse to prevent refiring of the bulb.

Frequency Standard

(Continued from page 69)

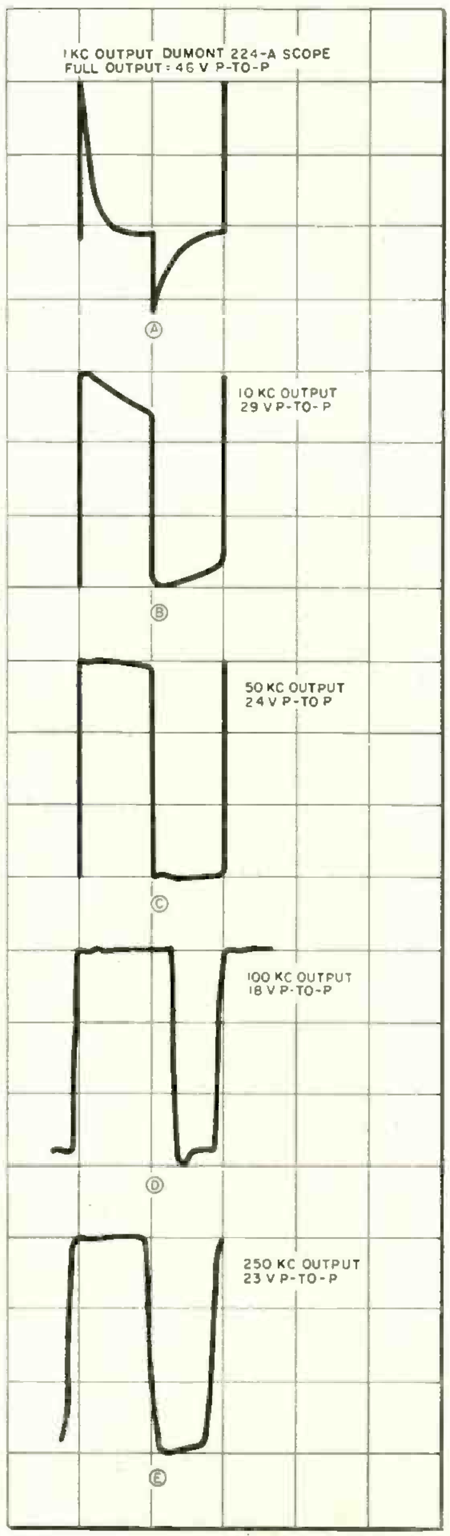
precludes the necessity of having extreme stability of operation for long periods of time, although the stability here is of the order of 1 part in 10 million for periods of days, since it is convenient to re-zero the standard against WWV at frequent intervals over a long series of measurements. The stability of this instrument for periods of as long as a half hour approaches that of WWV itself, and in locations where only the sky wave of WWV is receivable, the stability of the instrument is far better than that of the received signal, which may vary as much as plus or minus 3 parts in 10 million. In the final analysis, the stability of the "sliding secondary standard" is considerably better than that of the received signal at any location where reception is influenced by the sky wave. It is suggested here, that for accuracies greater than that of the received signal of WWV, it is possible to construct a primary standard by attaching a synchrometer to one unit, check it against astronomical time, and use this instrument as a standard with which to compare other units which, in their turn, may be used as "sliding" standards. In addition to the uses to which

Frequency Standard

(*Continued from page 95*)

this instrument may be put for frequency measuring purposes, it is an excellent time base generator, since its output is a square wave at fundamental output frequencies above 10 KC. Fig. 3 shows the output wave shape for the various output frequencies. The height of the square wave is approximately 20 volts into a load of 2000 ohms. The differentiation shown for the 1 and 10 KC

Fig. 3. Output wave for various frequencies



waves is deliberate, to reduce the lower harmonics, thus alleviating the trouble of having them feed into the IF systems of receivers used in measurements at higher frequencies.

In addition to being a time base generator and a frequency standard, this unit may be used as a trigger generator with either positive or negative pulses by the addition of a condenser, a resistor and a diode. Fig. 4 shows the wave shapes of the output for a differentiation network using a 100 μf condenser and a 2200 ohm resistor. With this combination, peak to peak pulse height is essentially that of the square wave output. (Actually about 5% less.) Since the rise time of the square wave is quite small compared to the time constant of the differentiation network (0.22 μsec), there is very little effect on the height of the pulses. In fact, for a network having a time constant of 0.11 μsec, the decay in amplitude of the pulses is only about 15%.

Two other uses that are obvious is to use the differentiated pulses as

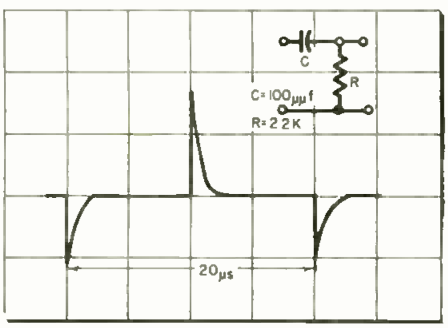


Fig. 4 Wave shapes of output

timing combs for calibrating oscilloscope sweep speeds or linearity, and in conjunction with swept oscillators and panoramic devices, to display frequency markers on the scope for measurements of bandwidth or selectivity, or for measurements of stability of oscillators, or for calibration of transmitters.

Other uses for the instrument will be evolved by the user after complete familiarization.

Fig. 2 shows the complete schematic of the circuit of the unit pictured in Fig. 1. V1 and the first half of V2 are the amplifier and phase splitter, respectively, of the Meacham bridge oscillator. Output amplitude of this circuit is approximately 2.5 volts, and is an almost perfect sine wave with distortion of only about 2%. Since the purpose of this instrument is to generate harmonics, and the oscillator is further used to synchronize multivibrators, this amplitude is not great enough, and since the 10th harmonic of the oscillator is used to synchronize the 250 KC multi, it is required that we

For product information, use inquiry card on last page.

Secondary Frequency (Continued from page 97)

increase the amplitude and the distortion of the output of the oscillator. This is done by the second half of V2 acting as a voltage amplifier somewhat heavily driven so that the output waveshape is quite distorted, its 10th harmonic being of the order of 0.2 volts.

Synchronizing a 250 KC multivibrator, or generating a 250 KC harmonic from a 100 KC oscillator are both impossible on the face of it. However, using V4, V5 and one half of V3 as a two-stage amplifier and cathode follower output, it is quite easy, using the tenth harmonic of the crystal output, to synchronize the multivibrator. This amplifier has a gain of only about 450, but it has a selectivity which is quite high. Response at plus or minus 40 KC is about —80 db, which is more than enough to completely reject the unwanted ninth and eleventh harmonics. Thus, all of the output frequencies available at the terminal at the rear of the chassis are directly tied to the frequency deviation dial on the front panel.

The output of the second half of V2 is used directly through a cathode follower (one half of V3) to synchronize the 50 and 10 KC multivibrators, with the output of the 10 KC unit used to synchronize the 1 KC multi.

Pentode Unit

The multivibrators are somewhat unconventional, since they use a triode-pentode tube. The screen, grid and cathode of the pentode unit is used as a triode, and in conjunction with the triode unit in the envelope composes the multivibrator. The output is taken from the plate circuit of the pentode unit, thus eliminating all loading on the multi, and besides, generating a considerably better square wave output than is possible from a loaded multivibrator. The outputs of the multivibrators, or the output of the second half of V2, are fed individually to the input of the harmonic generator, or square wave amplifier, composed of V10, V11, V12 and V13.

The gain of the square wave amplifier is sufficient to completely square off even the output of the oscillator, and the response of this amplifier is sufficient to give a square wave output with a rise time of the order of 0.03 μsec. This is sufficient to give appreciable outputs at frequencies well up into the UHF TV band, at least appreciable in comparison with the sensitivities of receivers and the size of received signals in this vicinity.

The multivibrators and the oscillator are powered by a 175 volt regulated supply with a regulation of less than one volt for line voltage changes of 80 to 130 volts. Operation is not recommended, however, below a line voltage of 100 volts, since the filaments will operate at too low a temperature, and will endanger the synchronization of the multis. Variations in plate voltage for the different loads imposed when switching from one output to the other is so small that it is invisible on any meter that will indicate 0-175 volts on one scale. Hum on this supply is of the order of 10 millivolts.

The harmonic, or square wave, amplifier is the only section powered by the 250 volt supply. This supply, also, has regulation of less than one volt over line voltage changes of from 100 to 130 volts. The principal reason for regulating this supply is not to secure a steady voltage, but to have a supply with low enough regulation so that the output square wave is not distorted by the drain required by the two

12BY7's. These tubes have a plate current variation of approximately 120 ma combined, which is a rather heavy current to apply in a period of 0.03 μsec. Even so, there is some affect which shows in distortion of the top of the square waves in Figs. 3c, 3d and 3e.

Positive locking of the multivibrators is assured by the differentiation that takes place in the coupling circuits to the grids. At the lower frequencies, this differentiation is greater where it is more necessary to have sharp spikes for synchronizing. With this equipment in operation at a recognized frequency measuring service for a period of more than seven years, it can be shown that multivibrators do not become unstuck for periods of from 10,000 to 42,000 hours. In fact, the 50 KC multivibrator has been in continuous operation for a period of over 60,000 hours with the original tube. Comparable multivibrators, using sine wave synchronizing voltages regularly take off at periods as short as 2000 hours. With sync voltage applied to both grids, for even division, we also have symmetrical square wave output.

The prime features of the instrument are the use of the square wave amplifier to generate a complete spectrum of harmonics of the fundamental frequency, and the bringing out of the control that sets the oscillator frequency. In addition to being accessible to the operator, the control is calibrated in terms of parts per million deviation about the center frequency of the oscillator. With an excursion of plus or minus 40 parts per million, this makes the instrument far more valuable to the user than one that is not adjustable, or has a more restricted range.

For correct operation, with the maximum accuracy, it is recommended that the unit be operated on a 24 hour per day basis, if this is possible. Since the unit is aged for a period of over 700 hours at the factory, drift is reduced, and satisfactory accuracy may be obtained with a warm-up period of 3 or 4 hours.

WCEMA's Annual Meeting

The combined San Francisco and Los Angeles Councils of the West Coast Electronic Manufacturers Association will gather August 25th at 12:00 noon in the Terrace Room of the Fairmont Hotel, San Francisco, for their Annual Corporate meeting. Presiding over the meeting will be H. Myrl Stearns, president of the association.

D-Amplifier

(*Continued from page 63*)

expect to be able to calculate the cutoff frequency from facts, ignoring the amplifier network data, and with a variable number of tubes per stage. Nevertheless, if it is assumed that the amplifier is always built in agreement with best engineering —practice, and if the bandwidth index is provided with an empirically determined weighing coefficient, it is possible to devise bandwidth-index formulas on a practical basis, which prescribe the cutoff frequency within ± 10 or 20%. The value of such a bandwidth index is most apparent in trying out on paper different tubes for a particular "amplifier-to-be." If the cut-off frequency comes out too high, a cheaper tube, or cheaper tube combination, may be be." If the cutoff frequency comes out too low, a more expensive type of active element must be used. The two newly developed bandwidth indexes described below have proven very useful for general guidance in practical amplifier design work.

Figure-of-Merit

While the following bandwidth indexes are, in principle, applicable also to transistor active elements, they are particularly developed for tubes. The first one, eq. (1), applies to both pentodes and paraphase triodes; with one specific value of the constant for pentodes, and another for triodes.

A review of factors limiting the upper cut-off frequency must by necessity include the grid loading of the input line, which is due to C_1, L_c, T and other factors, where L_c is the cathode inductance and T the transit time. (All these data are tube data.) While L_c and T should be taken individually into account, they are not generally given in tube handbooks, and their influence, via C_1, on the resulting grid conductance is not always of a simple nature. As a first approximation, the resistive and capacitive grid loading is interpreted in terms of C_1, and we therefore like to stress C_1 as a reduction factor in formulating a new figure-of-merit.

High transconductance g_m is such a general final requirement of an active element, that it may be considered desirable to boost the figure of merit by increasing the power to which g_m is raised. Starting out with the basic gain x bandwidth ratio $g_m/\sqrt{C_1 C_2}$, in accordance with Wheeler's bandwidth index, we therefore obtain, as a first approach

$$\frac{g_m}{\sqrt{C_1 C_2}} \cdot \frac{g_m}{C_1} = \frac{g_m^2}{\sqrt{C_1^3 C_2}},$$

$$\text{or } f_o' = \frac{k_1 g_m}{\sqrt[4]{C_1^3 C_2}} \text{ cps.} \quad (1)$$

The mid-expression above appears in dimension second^{-2} and is drastically brought to the dimension second^{-1} by square root application. Eq. (1) makes very strong the influence of C_1 compared to C_2 on the ability of a certain tube, or certain tube-pair, to yield a high f_2 value. This is very much in accordance with practical experience, for sometimes a small value of C_2 is not particularly important, since C_2 is generally smaller than C_1 anyhow, both for triodes and pentodes, and since a small C_2 may have to be purposely increased by an external capacitance to prevent a high value of plate-line characteristic impedance.

Since "loaded" values of C_1 and C_2 (and possibly also g_m) may be expressed to some extent by modification of the coefficient k_1 in eq. (1), "unloaded" catalog values may be used. For practical reasons introducing the triode grid-to-cathode capacitance plus 1 μμf as C_1, and the plate-to-cathode capacitance plus 1 μμf as C_2, f_o' has been calculated for a large number of tubes in the paraphase circuit, and plotted against g_m in the diagram, Fig. 2. The added capacitances of 1 μμf take care of tube socket capacitances, etc., to a first approximation. Typical tubes have been indicated at proper g_m value, and the cut-off frequency that can be reached with each type of tube is shown on the scale to the right. The absolute gain $|A|$ as a function of transconductance has been plotted for comparison. $|A|$ is derived for low- and mid-frequency considerations, and does not take into account high-frequency effects. The average value of the constant is $k_1 = 0.12$. Amplifiers built with some of the indicated tubes have reached the indicated 3 db cutoff frequency within ±20%. When several distributed amplifiers are being breadboarded, all following the same general pattern, ψ may be empirically determined to a more precise value, so that the cutoff frequency can be determined within a narrower tolerance.

Paraphase Equivalent Formula

The notation f_o'' is reserved for a bandwidth index not of interest for this presentation. The cathode impedance Z_K of the paraphase circuit, Fig. 1, Z_K for simplicity treated as resistive and of

D-Amplifier

(Continued from page 101)

value R_K, may be included in a bandwidth index f_o''', which may still be considered expressed by "tube data" only, i.e. by the data of a triode, equivalent to the two triodes in the paraphase circuit.[1,2] Using the $g_m/\sqrt[4]{C_1^3 C_2}$ ratio, utilizing the g_m of the equivalent triode given in Fig. 1, the new bandwidth index becomes

$$f_o''' = \frac{k_3 g_m^1}{\sqrt[4]{C_1^3 C_2}} = \frac{k_3 g_m^2 R_k}{\sqrt[4]{C_1^3 C_2}\,(1 + 2 g_m R_k)} \text{ cps,} \quad (2)$$

where k_3 is an empirical constant, which may be given the average value 0.35. This formula is of particular interest for extremely-wide-band distributed amplifiers, extending above 500 Mc or so, for here R_K is quite small and of the same order of magnitude as $1/g_m$. Thus "1" in the parenthesis cannot be neglected, as is the case at the dc end of the spectrum, where the formula degenerates into a Wheeler-type bandwidth index. For the former case, normalizing R_K to 100 ohms, this empirical formula becomes very useful, although the value of the coefficient k_3 is as yet only vaguely determined, due to rare access to amplifiers working above 500 Mc. The normalized bandwidth index is

$$f_o''' = \frac{100\, k_3 g_m^2}{\sqrt[4]{C_1^3 C_2}\,(1 + 200\, g_m)} \text{ cps.} \quad (3)$$

This bandwidth index has also been plotted in Fig. 2. It is seen that for transconductances of the order of 10,000 μmhos, f_o' and f_o''' give about the same result, indicating a possible cutoff frequency of about 400 Mc. For less transconductance, f_o' predicts higher cutoff; for more transconductance f_o''' predicts higher cutoff. Repeated use of the two indexes will indicate which one is most practical.

The distributed-amplifier designer may not depend much upon precise values of the constants k_1—and k_3, since the greatest value of above formulas is to provide a basis for relative comparison of different tube types. Thus if one amplifier design is known, the constants may be calculated from it, assuming the cutoff frequency to be known. When the formula is tried on other tubes in the same general amplifier layout, each tube type will become represented by a different cutoff frequency. Very often the preferred tube is the one that gives most megacycles per dollar spent!

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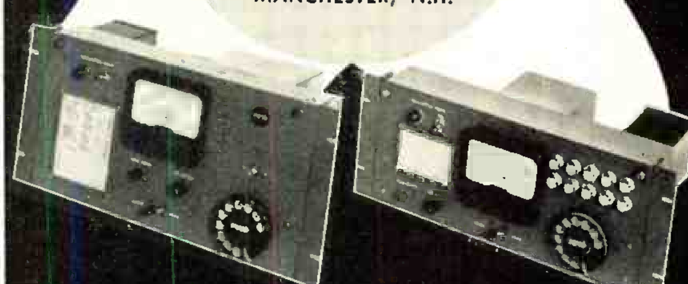

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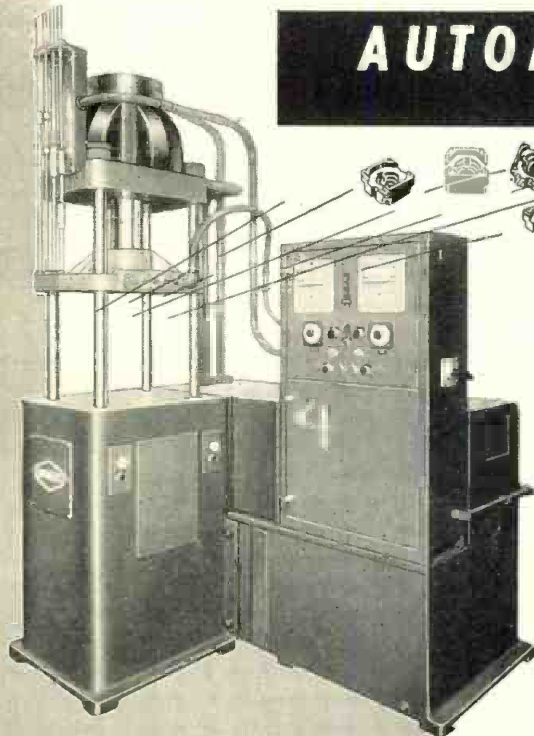

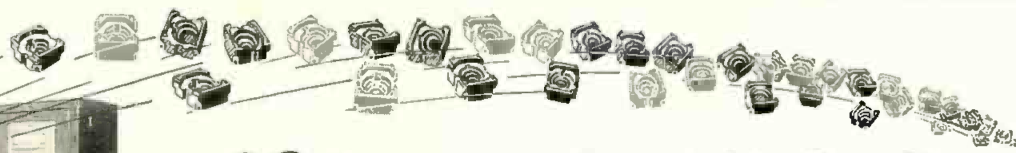

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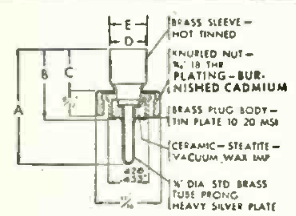

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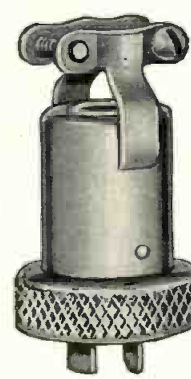

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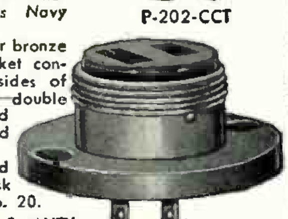

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Video Delay

(Continued from page 66)

As the mutual is increased to provide correct compensation the transients before and after the transition become symmetrical. A further increase in mutual produces a spike after the transition.

It is desirable in making this test to limit the high frequency components in the square wave signal to approximately f_c. This eliminates additional transients caused by phase or amplitude distortion occurring above f_c and results in a pattern on the scope that is less difficult to interpret.

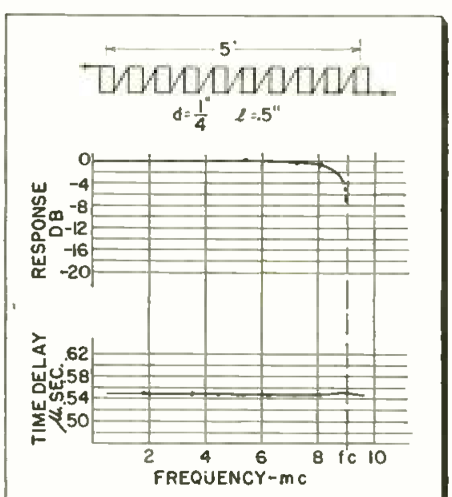
The coils were mounted in a jig similar to a pair of lazy tongs, which made it possible to vary the mutual and maintain uniform spacing while observing the transient response.

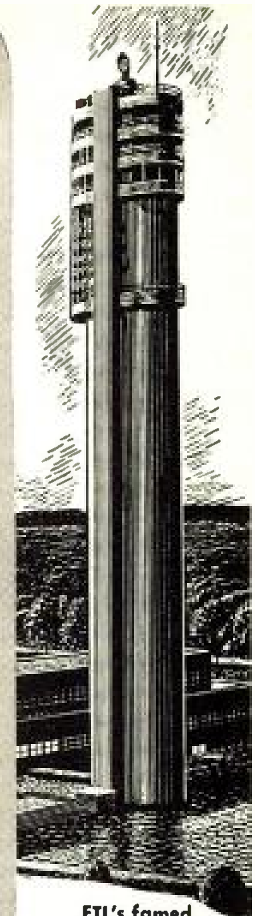
Fig. 6 is a cutaway view of an individual coil showing the details of the construction. The ground strip has been cut into splines to reduce eddy current losses which have an appreciable effect on the response of the line. The resistance of the material used for the ground strip need not be extremely low and silver paint having a resistance of 2 ohms per electrical square has been found entirely satisfactory. For best response the insulation used must have low dielectric losses at high frequencies. Polyethylene tape is excellent for this purpose.

The form material used has proved to be reasonably non-critical in designs where it is possible to extend the ground strip completely around the circumference of the form as is illustrated. In this case very little of the current to the ground strip passes through the form material and therefore it does not appreciably affect the losses.

Impregnation of delay line coils is

Fig. 10: High frequency delay, 1000 ohm





Video Delay

(Continued from page 105)

difficult and is best avoided when possible. Non-uniform penetration of the impregnating material will result in non-uniform capacity to ground. This will give excessive variations in performance and poor transient response.

Fig. 7 shows measurements of response and time delay on a 1000 ohm line designed for the brightness channel of a color receiver. Note that there is appreciable attenuation of the signal before the phase characteristic becomes non-linear. The response is flat to within 1 db to 3 MC and the cutoff frequency is placed at the subcarrier frequency.

When a line must be designed to very close specifications the basic formulas must then be considered a first approximation. The introduction of mutual into the line will change L by an amount that depends upon the magnitude of the time delay correction that must be provided by the mutual. A number of variables affect this magnitude. The form factor of the coil has a major effect, as was shown previously, and thus a coil having a high ratio of d to l could be expected to require higher mutual than a long slim coil. Notice that this does not necessarily mean closer spacing between coils, since the form factor also affects the spacing required to obtain a given coefficient of coupling. Another important variable is the self capacity of the winding chosen. This capacity reduces the need for phase compensation in a manner similar to the effect of the patch compensation.

The method of determining the correct amount of mutual for a new design is best found by empirical methods. Fig. 5 illustrates the results obtained when adjusting the line by means of the square wave response. Corresponding time delay characteristics are indicated. The under compensated line produces a spike preceding the transition as shown. on a ⅜ in. diameter form, and insulated from the ground strip by 1½ mil polyethylene tape.

A line having the performance measurements of Fig. 7 is a 205 turn solenoid of number 40 teflon, wound cores or universal progressive windings have also been used successfully in order to obtain smaller lines without using smaller wire sizes.

Fig. 8 is a delay line designed to have a characteristic impedance of 2500 ohms. Other performance characteristics are similar to the line of Fig. 7.

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BY D. C. DUNCAN

General Manager, Helipot Corporation

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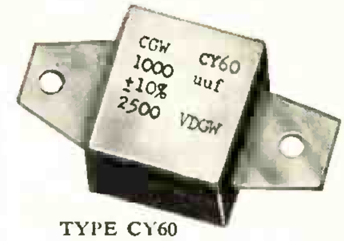

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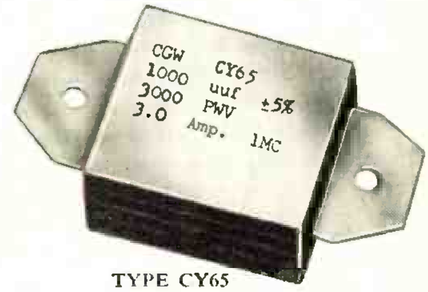

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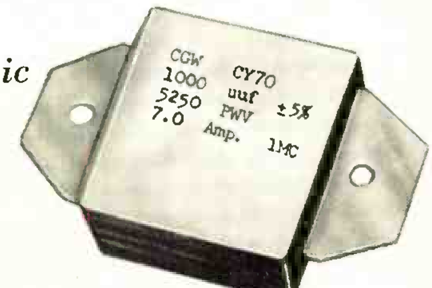

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Video Delay

(*Continued from page* 106)

Fig. 9 is also a 1 microsecond line designed to give good frequency response to 4 MC. Notice that because of the higher cutoff frequency, this line requires ten coils instead of seven.

Fig. 10 is a line designed to have excellent response and phase linearity to 8 MC. Although the previous discussion has been confined almost entirely to video delay lines for color receivers, the design is flexible and the basic principle used can be applied to many other delay line problems where phase linearity is important.

Preset Counters

(*Continued from page* 73)

ade switches, where $m = 1, 2, \ldots N$ and N is the counter capacity. The repetition rate of the signal generated by the counter is equal to that of the input time signals but it is delayed by m/f seconds.

Frequency Division

Division by integers of the counter input signal frequency is produced by the circuit of Fig. 6. With no reset applied, the counter output frequency is f/N where f is the input signal frequency and N is the capacity of the counter. When the reset switch is set to select storage N-m ($m = 0, 1, \ldots N$) the counter output resets to this state. Therefore, the counter pulses occur N-m counts apart with a period $(N-m)/f$ or frequency $f/(N-m)$. This arrangement provides signals of frequency $f/1$, $f/2, \ldots f/N$.

The circuit of Fig. 7 demonstrates a method of recording the time of occurrence of a series of events relative to a fixed time. An instrument similar to this was constructed for astronomical time measurements at the Naval Observatory.

Gate 1 is opened at the reference time by a clock signal (A). A time signal (B) occurring at time t closes gate 1, opens gate 2 and actuates the recorder. After a precise delay generated by the preset counter, gate 2 is closed, gate 1 is opened and the preset counter reset to the pre-selected delay.

Knowing the amount of delay introduced by the preset counter, the time of occurrence of subsequent signals relative to the clock signal can be determined from the recorded counts.

Efficiency Yoke

(Continued from page 66)

Studies over the past three years led to the decision that a 1⅛ in. neck (maximum O.D. 1.168 in.) would permit most tube makers to mount improved small electron guns in adequate clearance for future mass production. Glass bulb makers are still governed by the neck flare shape being cast by centrifugal molds for lowest ultimate costs.

With a glass contour closely established, coil shape and position were determined. As the vertical coils were desired to gain most in performance, these were placed on the *inside* of the assembly next to the tube neck. This also allowed these coils to be of greater length than conventionally possible.

Vertical performance is copper-limited. The same weight of copper used in usual, large-necked 90° yokes will perform more than twice as effectively in the inner position on the small-neck yoke.

The vertical coils are series connected, start-to-start in accordance with our findings on color yokes. Total winding resistance can be wound from 20 to about 150 ohms; 43 ohms is often desired.

The horizontal coils are wound in opposite directions and connected in parallel to assure balanced transient response and avoid need for a balancing capacitor required for series coils. Total inductances between 12 and 30 mh can be wound; the higher value is best suited to direct coupling to the damper tap, with 250 volt B supply. The lower range of inductance values may be used to advantage with 125 volt supply.

Extensive discussions with and among three major ferrite core manufacturers led to adoption of a compromise design, in keeping with the MPA standards of dimensional increments and tolerances. This shape was tooled by all three core makers and not restricted by Rola in the interests in achieving quick standardization of the shape. An internal diameter of the core was set at 1.6 in. and an axial length of 1⅝ in. Core-to-horizontal-coil insulation is employed. See Fig. 1.

REFERENCES

1. C. E. Torsch, "High Efficiency 90° Cathode-Ray Sweep System," *Tele-Tech & Electronic Industries*, June 1953.
2. C. E. Torsch, "High Efficiency, Low Copper Sweep Yokes with Balanced Transient Response," *Trans. IRE PG on Bdcst. & TV Rcvrs.*, April 1954.
3. U.S. Patent 2,477,557

PERSONAL

Rodney D. Chipp has been appointed director of engineering for all manufacturing divisions of Allen B. Du Mont Laboratories, Inc., it was announced by **William H. Kelly,** vice president and general manager.

R. CHIPP

J. McALLISTER

John F. McAllister, Jr. has been named Manager of Engineering for the G.E. radio and television department. He will be responsible for the design and development of all G.E. radio and television receivers.

Dr. James B. Fisk has been elected executive vice president in charge of research for Bell Telephone Laboratories.

David L. McPherson, formerly of the Sperry Gyroscope Co., has joined the Linear Equipment Laboratories, Inc., 380 Oak St., Copiague, N. Y. as Chief Engineer.

Dean Barton has been appointed manager of the Helipot Corp., South Pasadena, Calif., manufacturer of precision potentiometers. Prior to his promotion, Mr. Barton was supervisor of project engineering for the past two years.

James C. Kyle, formerly physicist and research specialist with the Ames Aeronautical Laboratory at Moffett Field, Sunnyvale, Calif; has been named technical director of the Transducer Division, Consolidated Engineering Corp, Mr. Kyle will be responsible for administering the transducer product development program.

Stuart L. Bailey, President of Jansky and Bailey, Wash. D. C., recently announced the election by the Board of Directors of Delmer C. Ports, Chief Engineer, to the position of Vice- President.

Daniel R. Von Recklinghausen has been appointed Chief Research Engineer of Hermon Hosmer Scott Inc. of Cambridge, Mass.

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Manufacturer of precision built foot switches is seeking representation in the following areas: California, Texas, North and South Carolina, Kentucky, New York, New England, Pennsylvania, and New Jersey. (Ask for R-7-1)

John J. Goode Associates are interested in representing manufacturers of electronic components, electro-mechanical devices, instruments and controls in the New England area. Mr. Goode was formerly associated with a New England electronic manufacturer.

ORRadio Industries, 120 Marvyn Rd., Opelika, Ala., appointed three new manufacturers' representatives to handle its line of Irish Magnetic Recording Tape. **R. H. (Rusty) Hays** of Dallas will take over the Texas and Oklahoma territory. **The Jack Hedquist Company** of Minneapolis will cover Minnesota, North Dakota, South Dakota, North Iowa, and Western Wisconsin. **R. D. Butchart** of Detroit will represent the firm in Michigan.

American Microphone Company, an Elgin National Watch Co. affiliate, has announced the appointments of two reps to handle their lines in specific areas. **The Heimann Company,** 1711 Hawthorne Ave., Minneapolis, 5, Minn., will handle the line in Minn., No. Dakota, So. Dakota, and Northern Wisc., and the **Gordon Sales Company,** 14647 Seymour Ave., Detroit, 5, Mich., will represent them in the state of Mich.

Rodney M. Foley has joined **RMC Associates** to represent the firm in Northern New Jersey. RMC represents seven prominent manufacturers of electronic equipment.

Perfection Mica Company has announced the appointment of two new representives: **Precision Sales,** Inc., 331 Columbia, Utica, N. Y. which will handle Precision's coated shielding in upper New York state, and **White & Co.,** 781 Mayview, Palo Alto, Calif., which will cover Northern California, and portions of Oregon and Washington.

Thomas B. Aldrich has opened a manufacturers' representative office in Palisades, N. J. He is situated to handle the middle Atlantic territory including metropolitan New York, Southern New York, Long Island, Connecticut and Northern New Jersey. Mr. Aldrich has been in the trade for nineteen years during which time he served as a sales manager for a leading manufacturer and acted as a representative for outstanding firms.

TELE-TECH ADVERTISERS — JULY, 1955

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.

INDUSTRY NEWS

G. E. Lewis has been appointed as manager of radar and precipitation sales for the General Electric Company's Holyoke plant.

A. Crawford Cooley, Robert Dressler, and **Howard R. Patterson** have been elected vice-presidents of Chromatic Television Laboratories, Inc.

Milo L. Voight has been appointed Controller of Norden-Ketay Corporation.

William R. Bush has been appointed to the new post of assistant general sales manager of Hoffman Laboratories, Inc.

Edgar G. Dunn has been appointed manager of the new data processing Center for Sylvania Electric Products it was announced by Sylvania Controller, Leon C. Guest, Jr.

Fred Pollak has been promoted to sales manager of National Fabricated Products.

James D. McLean has been appointed vice president of Philco Corporation's Government & Industrial Division. Other recent appoints were: Joseph H. Giles, vice president in charge of manufacturing; Marshall A. Williams, general sales manager; and D. B. McKay, regional manager.

F. P. Rice has been appointed director of operations, Consumer Products, for the Allen B. DuMont Laboratories. His appointment is intended to strengthen the DuMont manufacturing and sales operation.

At the last meeting of the Sales Managers Club, Eastern Group, the following officers were elected to serve for the next year: Chairman, **Charles Golenpaul** of Aerovox, Inc., Vice Chairman, **Geroge E. Martin** of Weston Electrical Instrument Corp., and **Walter Jablon** of Radio City Products Co., Inc.

Allen E. Byers has been appointed as General Manager of Waveforms, Inc., of New York City. Mr. Byers was formerly with the Graybar Electric Co. as Manager of Communications Sales at Detroit, Mich.

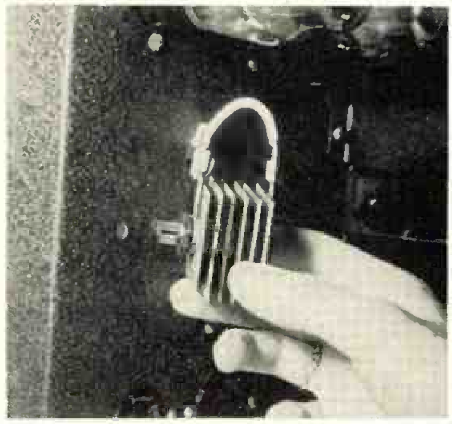
Ralph E. Foster has been promoted to the position of Assistant Manager in charge of the Radio Condenser automobile tuner plant in Hoopeston, Ill.

John J. Dempsey has been appointed to the position of Division Manager of the Components Division of Servomechanisms, Inc., located at 625 Main Street, Westbury, New York.

NEW PRODUCT

CLIP-TYPE RECTIFIER

The "Qui-klip" snap-in type rectifier features a clip arrangement that requires no tools for assembly; therefore, speeds assembly time and completely eliminates broken studs. Developed in



conjunction with Tinnerman Products Corp., Cleveland, O., the new rectifier does not require special sockets for mounting—needs only two round holes to snap into place. Solderless connectors are available for making electrical contact to the rectifier. **Radio Receptor Inc., 240 Wythe Ave., Brooklyn, N. Y.** —TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 7-19)

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845 Jones Div., H. B., Cinch Mfg. Corp.—Shielded plugs & sockets
846 Kahle Engineering Co.—Tube & transistor production equipment
847 Kester Solder Co.—Flux core solder
848 Mallory & Co., Inc., P. R.—Vibrator power supply
848A Marconi Instrument Co.—10-500 mc signal generator
849 McAlister, Inc., J. G.—Lighting equipment
850 Melpar, Inc.—Engineering personnel
851 Microdot Div., Felts Corp.—Low noise cable
852 Minnesota Mining & Mfg. Co.—Extra play magnetic tape
853 National Fabricated Products Inc.—Silicon solar battery
854 Phaostron Co.—Metal-cased multimeter
855 Plastic Capacitors, Inc.—Plastic film dielectric capacitors
856 Polarad Electronics Corp.—Direct reading spectrum analyzer
857 Polarad Electronics Corp.—Microwave spectrum selector
858 Potter Co.—Capacitors, filters
859 Precision Paper Tube Co.—Paper tubing
860 Presto Recording Corp.—Three-speed turntable, tape recorder
861 Pyramid Electric Co.—Ceramic case tubular paper capacitors
862 Radio Corporation of America—Color TV broadcast equipment
863 Radio Corporation of America—Receiving tubes
864 Radio Materials Corp.—Ceramic disc capacitors
865 Raytheon Mfg. Co.—Microwave tubes
866 Remington Rand Inc.—Engineering personnel
867 Resinite Corp.—Embossed coil forms
868 Resistance Products Co.—High voltage resistors
869 Rust Industrial Co.—Transmitter remote controls
870 Sanders Associates—Tri-plate variable attenuator
870A Sound Apparatus Co.—Polar recorder
871 Sprague Electric Co.—Miniature pulse transformers, metallized paper capacitors
872 Sprague Electric Co.—Miniaturized wirewound resistors
873 Stackpole Carbon Co.—Phenolic & Iron molded coil forms
874 Stephens Mfg. Co.—Microphones
875 Sylvania Electric Products Inc.—High frequency transistors
876 Sylvania Electric Products Inc.—Receiving and special purpose tubes
877 Sylvania Electric Products Inc.—Engineering personnel
878 Syntronic Instruments, Inc.—Yokes & focus coils
879 Teletronics Lab., Inc.—Milli-microsecond pulse generator
880 Texas Instruments, Inc.—Silicon & germanium transistors
881 Thermador Electrical Mfg. Co., Div. Norris Thermador Corp.—Transformers
882 Tinnerman Products Inc.—Fasteners
883 Transradio Ltd.—Low attenuation cable
884 Triad Transformer Corp.—Subminiature audio transformers
885 Tung Sol Electric Inc.—Picture tube
886 U. S. Components Inc.—Miniature hex connectors
887 U. S. Engineering Co., Inc.—Electronic hardware
888 University Loudspeakers Inc.—Loudspeakers
889 Welwyn international Inc.—High stability resistors
890 White Dental Mfg. Co., S. S.—Molded resistors
891 Wickes Engineering & Construction Co.—Phase & vector display equipment

Only one simple form to fill out

Listings continued on next page

Write in boxes the code numbers of products for which you want information. See list above and on next page.

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Company address ....

....

Your name ....

Your title ....

TELE-TECH—JULY 1955

CALDWELL-CLEMENTS, INC., 480 Lexington Avenue, New York 17

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CALDWELL-CLEMENTS, INC., 480 Lexington Avenue, New York 17

PRODUCT INFORMATION?

Use the cards below to get it quickly through . . . **TELE-TECH** & Electronic Industries

Listings continued from preceding page

NEW PRODUCTS DESCRIBED IN THIS ISSUE

Inquiry Card No.	Manufacturer — Item
7-7	Community Engineering Corp.—Sweep Generators
7-8	Kay Electric Co.—Noise Figure Instrument
7-10	W. L. Maxson Corp.—Phasemeter
7-11	Simpson Electric Co.—Pocket Size Volt-Ohmmeter
7-12	Cinema Engineering Co.—Filter
7-13	Tektronix, Inc.—Oscilloscope
7-14	Electronic Research Associates, Inc.—Transistor Tester
7-15	Advance Electronics Co.—Delay Line
7-16	Donner Scientific Co.—Wow and Flutter Meter
7-18	Phaostron Co.—Panel Meter
7-19	Radio Receptor Co.—Clip-type Rectifier
7-32	Good-All Electric Mfg. Co.—Scramelite Capacitor
7-33	Condenser Products Co.—Polystyrene Capacitor
7-34	General Instrument Corp.—Two-Gang Capacitor
7-35	Centralab, Div. of Globe Union, Inc.—Ceramic Capacitor
7-36	Astron Corp.—Metallized Capacitors
7-37	Sprague Electric Co.—Electrolytic Capacitor
7-38	Artos Engineering Co.—Wire Stripping Machine
7-39	George Stevens Mfg. Co., Inc.—Stator Winder
7-40	Eisler Engineering Co., Inc.—Glass Working Machine
7-41	Optical Gaging Products Co.—Contour Projector
7-42	Wildemann Machine Co.—Turret Punch Press
7-43	Federal Tool Engineering Co.—Cap and Lead Machine
7-45	Hastings Instrument Co., Inc.—Pressure Indicator
7-46	John Oster Manufacturing Co.—Permanent Magnet Motor
7-47	DIT-MCO, Inc., Electronic Div.—Functional Tester
7-48	Ultradyne Engineering Labs., Inc.—Pressure Transducer
7-49	Consolidated Engineering Corp.—Recording System
7-50	Beckman Instruments, Inc.—Permanent Magnet Inverter
7-51	Trans-Sonics, Inc.—Vertical Speed Transducer
7-52	Communication Measurements Lab., Inc.—Frequency Generator
7-53	Teletronics Laboratory, Inc.—Generator-Calibrator
7-54	Telechrome, Inc.—Wave Generator
7-55	Engineering Dept., Electromec, Inc.—Frequency Generator
7-56	RCA Tube Div.—Magnetron
7-57	Rutherford Electronics Co.—Pulse Generator

TECHNICAL BULLETINS AND LITERATURE

Inquiry Card No.	Manufacturer — Item
B-7-1	International Instruments, Inc.—Panel Meters
B-7-2	Moran Electronics Components, Inc.—Coils
B-7-3	Allen B. Dumont Labs, Inc.—Mixing Panel
B-7-4	Advanced Vacuum Products, Inc.—Hermetic Seals
B-7-5	Rapid Electric Co., Inc.—Germanium Rectifiers
B-7-6	Acheson Colloids Co., Div. of Acheson Ind.—Colloidal Graphite
B-7-7	R. W. Cramer Company—Time Delay Relays
B-7-8	General Electric Tube Dept.—Cathode Ray Tubes
B-7-9	National Vulcanized Fibre Co.—Fibre and Plastic
B-7-10	Centralab Div., Globe Union, Inc.—Electronic Components
B-7-11	Electrical Ind. Div., Amperex Electronic Corp.—Threaded End Seals
B-7-12	Technology Instrument Corp.—Oscillographic Recorder
B-7-13	Erie Resistor Corp.—Electronic Components
B-7-14	General Transformer Corp.—Transformers
B-7-15	Howard B. Jones Div., Cinch Mfg. Corp.—Plugs and Sockets
B-7-16	Electronic Research Associates, Inc.—Transistor Test Equipment
B-7-17	Frank L. Capps and Co.—Condenser Microphones
B-7-18	Allen B. DuMont Labs., Inc.—Color Studio Scanner
B-7-19	Varo Mfg. Co., Inc.—Precision Electronic Equipment
B-7-20	Remington Rand, Inc.—Electronic Data Processing
B-7-21	Texas Instruments, Inc.—Transistors and Diodes
B-7-22	AC Spark Plug Div., General Motors Corp.—Data Repeaters
B-7-23	Ameridan Phenolic Corp.—Electronic Components
B-7-24	Westinghouse Electric Corp—Railroad Radio Equipment
B-7-25	The Dayton Rogers Mfg. Co.—Chart
B-7-26	Lavoie Laboratories, Inc.—Storage Seal
B-7-27	New Jersey Electronics Corp.—Power Supplies
B-7-28	Pents Laboratories, Inc.—Transmitting Triode

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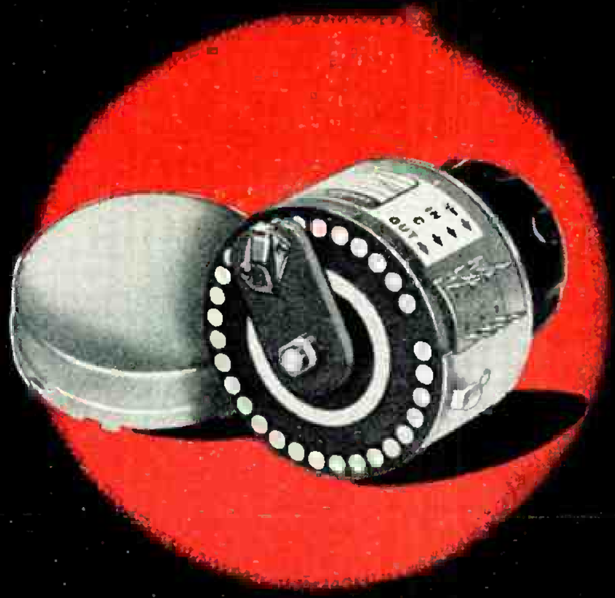

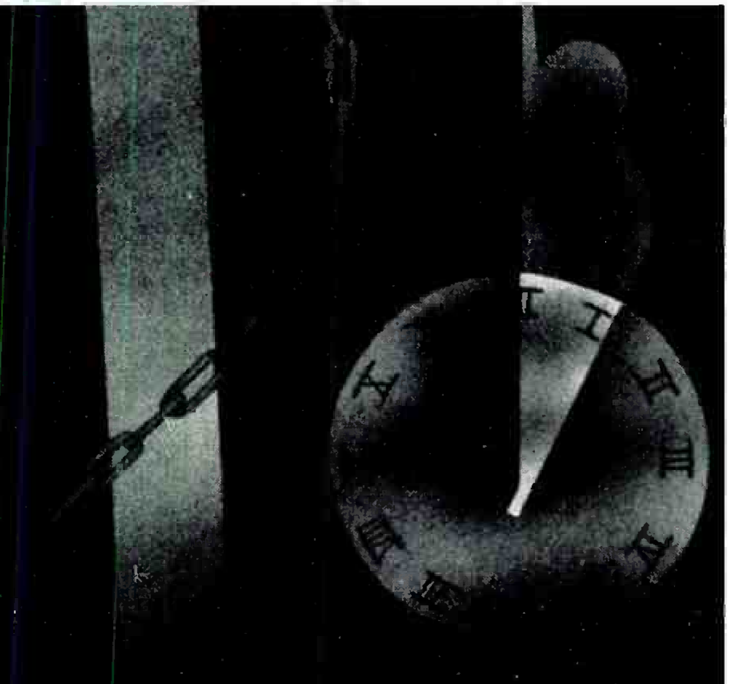

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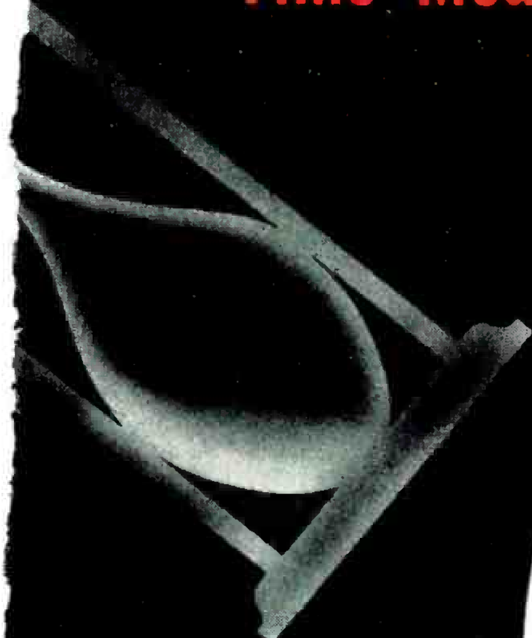

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This kind of durability in electronic equipment isn't an accidental by-product at **Daven.** Skilled engineering at every step of design and production assures that **Daven** attenuators consistently outperform original equipment specifications. Check these exclusive **Daven** features that add up to leadership in the attenuator field:

"Knee-Action" Rotor
- Tamper proof
- Uniform contact pressure and low contact resistance over the life of every unit.
- Each rotor blade individually supported to give positive contact in operation under all types of conditions.

Low-Loss Molded Terminal Board
- For high resistance to leakage.

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- With air insulation.

Brass Case of 2-Piece Construction
- Greatly reduces clearance space required for removal of cover in rear of unit.

"Lock-Tite" Dust Cover
- Held by positive, bayonet-type lock which prevents cover from becoming detached under stress of vibration.

Enclosed Roller-Type Detent Mechanism
- For extra long life and positive indexing.
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7 *of the top 10* are RCA-developed

The top 10 on this totem pole are the tube industry's "highest-volume" entertainment receiving-type tubes designated for initial equipment sockets in the first quarter 1955*. RCA originally developed and sponsored 7 of these 10 (plus the basic type 6SN7-GT). And subsequently, RCA improved them all. This is tube leadership—the criterion of progress in *tube quality.*

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Backed by its superior system of "progressive" quality-control, RCA is "mass-producing" high-quality receiving tubes having remarkably high uniformity of characteristics and dependability. Why not take advantage of RCA's extensive manufacturing facilities—and discuss your present and future tube requirements with your RCA Field Representative.

*RETMA Report for first three months of 1955.

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