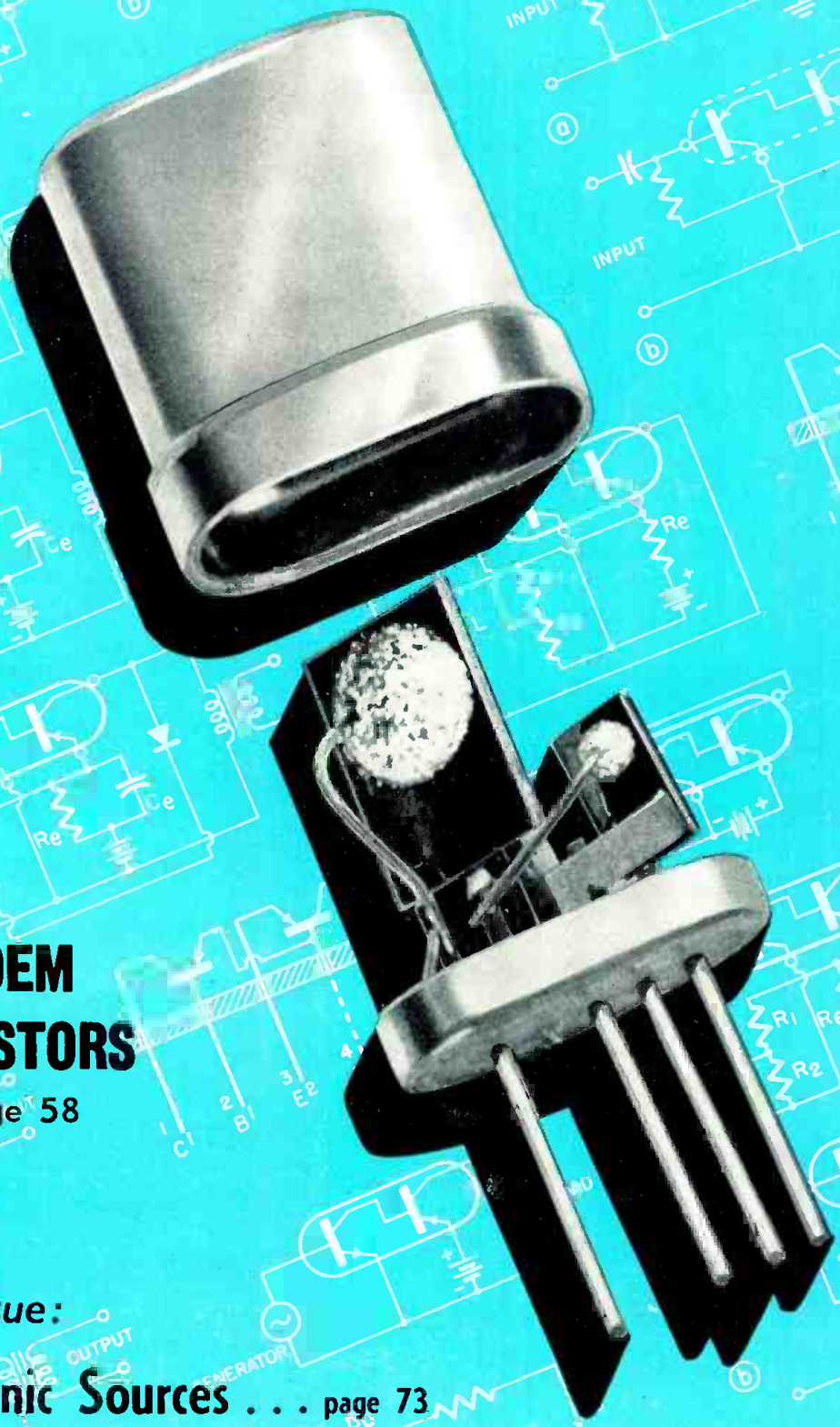
TELE-TECH
& Electronic Industries



TANDEM TRANSISTORS

See Page 58

In this Issue:

February • 1956

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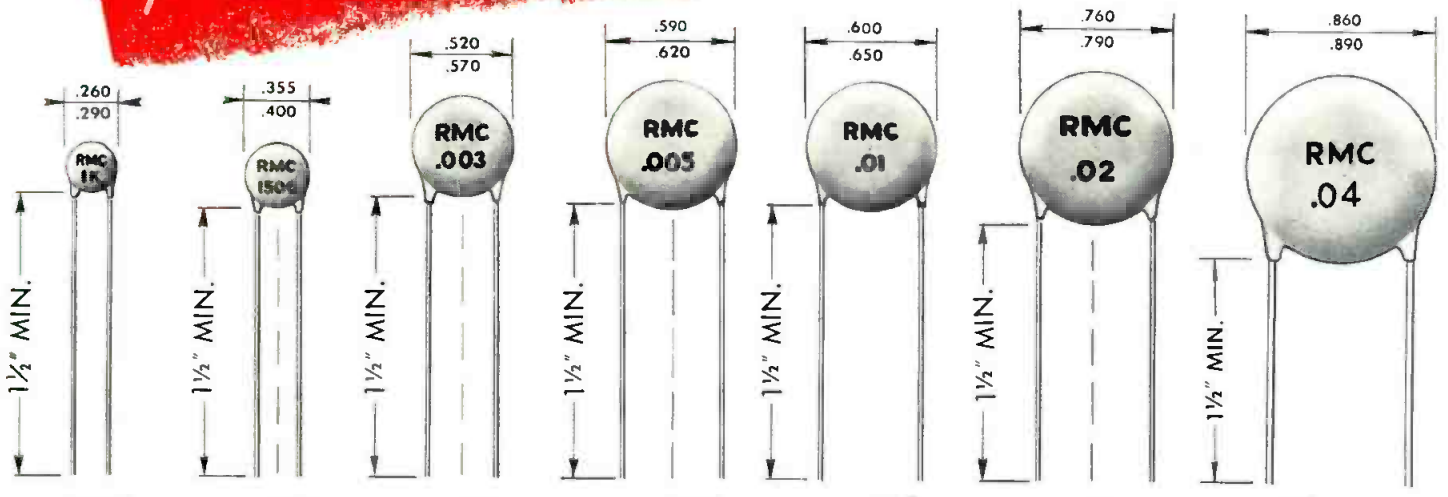
Efficiency Economy Guaranteed in RMC type B DISCAPS



.00015
.00047
.00068
.0008
.001

.0015
.002
2x.001

.003
.004*
.005*
2x.0015
2x.002*

.0047
.005
2x.002
.01* ±20%
.02* +80%−20%

.01*
.02*

.01
.02
2x.004

.02*
+80%−20%
.04*
+80%−20%

*Rated 600 V.D.C.W. Flash test 1200 V.D.C

SPECIFICATIONS

Guaranteed Minimum Value

POWER FACTOR: 1.5% Max. @ 1KC (initial)

POWER FACTOR: 2.5% Max. @ 1 KC (after humidity)

WORKING VOLTAGE: 1000 V.D.C.

TEST VOLTAGE (FLASH): 2000 V.D.C.

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

INSULATION: Durez phenolic—vacuum waxed

INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms

AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms

RMC Type B DISCAPS are designed for all by-pass or filtering applications and meet or exceed the RTMA REC-107-A specifications for Z5U ceramic capacitors. The efficiency of Type B DISCAPS in all types of electrical and electronic equipment has been proven over the years. New lower prices guarantee initial economy while additional economies are effected in faster production line handling.

Type B DISCAPS are rated at 1000 V.D.C.W. and are available in capacities between 150 MMF and 40,000 MMF.

It will pay you to investigate the advantages offered by RMC DISCAPS. Write today for expert engineering help on your capacitor problems.

DISCAP CERAMIC CAPACITORS

RMC

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

TELE-TECH
& Electronic Industries

FEBRUARY, 1956

FRONT COVER: TANDEM TRANSISTORS. This artistic rendition focuses attention on a new type of transistor configuration which may have important application advantages. Continued research and experimentation is now underway at the National Aircraft Corp. in Burbank, Calif. A summary of the operating characteristics of presently constructed units is contained in the article beginning on page 58.

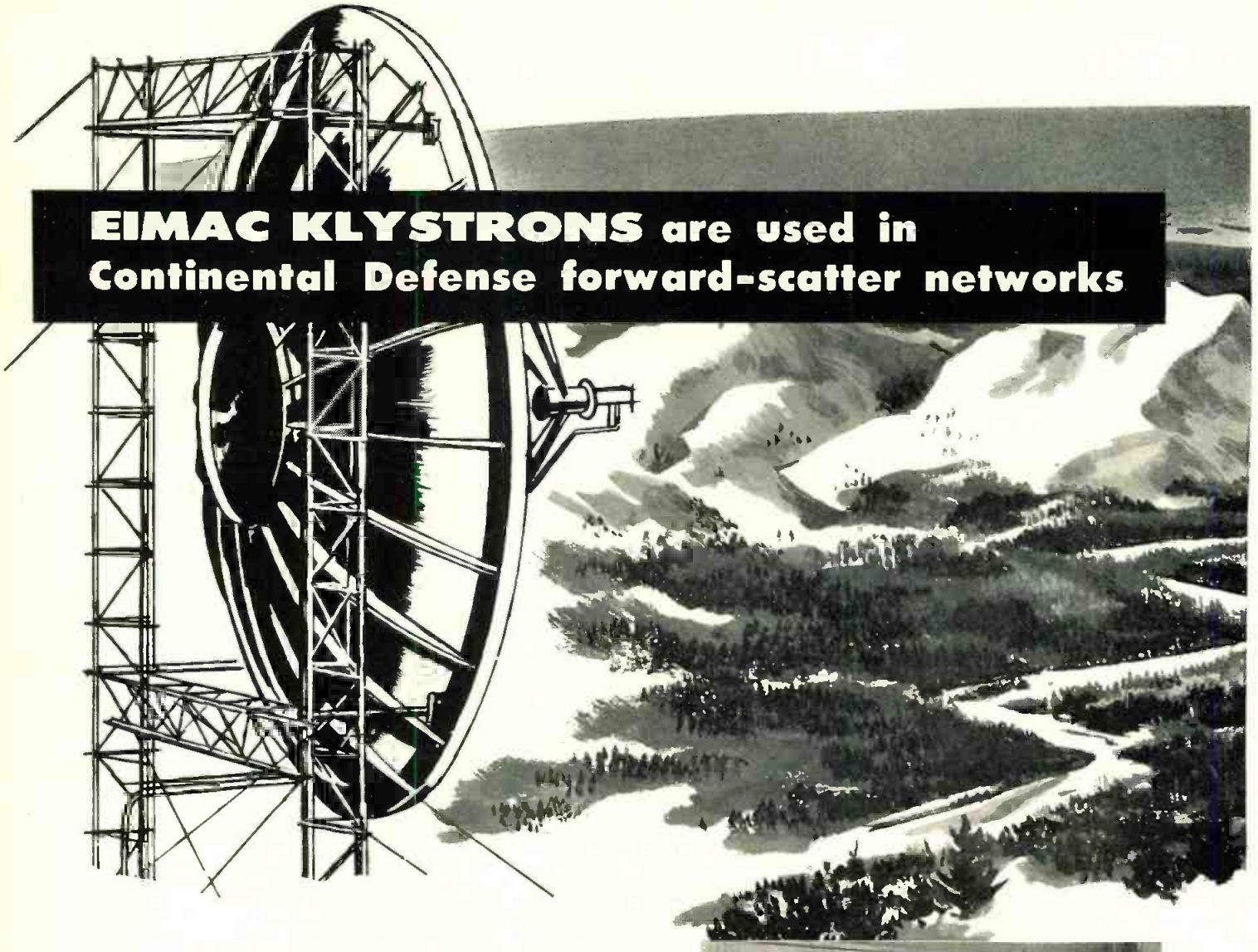
MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

TELE-TECH's *International* ELECTRONIC SOURCES 73

TELE-TECH & ELECTRONIC INDUSTRIES, February 1956, Vol. 15, No. 2. Published monthly by Caldwell-Clements, Inc. Publishers also of MART and TECHNICIAN. Publication Office of TELE-TECH & ELECTRONIC INDUSTRIES, 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. Accepted as controlled circulation publication at Bristol, Conn. 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. Printed in U.S.A. by Hildreth Press, Inc., Bristol, Conn.



EIMAC KLYSTRONS are used in Continental Defense forward-scatter networks

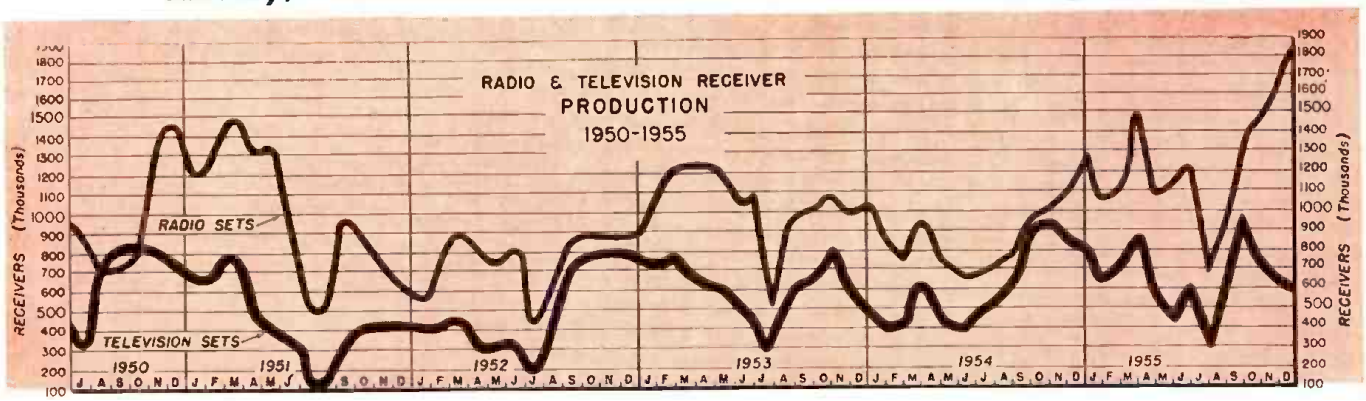
Collins Radio Company's pioneering of circuits and equipment has contributed greatly to the success of the revolutionary new art of forward-scatter communications. From the beginning of this program, Eimac tubes have provided the high power necessary to make scatter propagation practical. In Collins newest high power microwave transmitters for beyond-the-horizon communications in Continental Defense networks, only Eimac klystrons are used as final amplifier tubes.

Third in a series of advertisements emphasizing the extensive application of Eimac amplifier klystrons and circuit components, negative grid tubes and rectifiers by leading manufacturers of forward-scatter UHF/microwave transmitters.

Collins two and ten kilowatt forward-scatter transmitters utilize Eimac amplifier klystrons, negative grid tubes and rectifiers.

Eimac
THE POWER FOR FORWARD-SCATTER

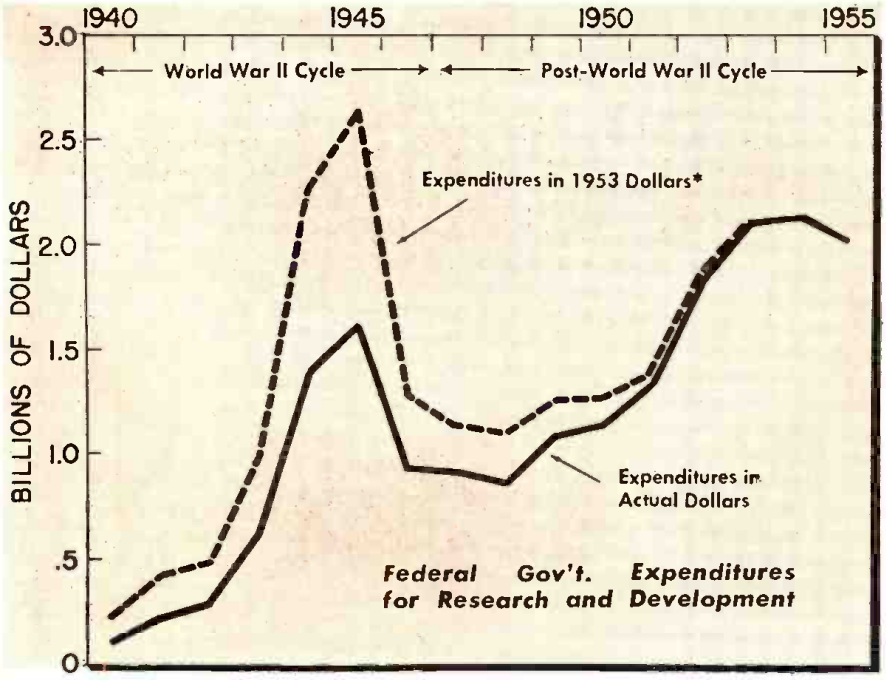
EITEL-McCULLOUGH, INC.
SAN BRUNO • CALIFORNIA
The World's Largest Manufacturer of Transmitting Tubes



Estimates & Projections of Bachelor Degrees in Electrical Engineering 1940 - 1965

year	All Eng'g Degrees	Electrical Degrees	year	All Eng'g Degrees	Electrical Degrees
1940	15,100	2,880	1956	28,000	6,600
1945	8,500	1,540	1957	30,000	7,600
1948	31,000	6,716	1958	37,000	8,300
1949	47,000	11,042	1959	37,000	8,300
1950	52,000	13,270	1960	38,000	8,500
1951	42,000	9,488	1961	39,000	8,750
1952	30,000	6,453	1962	39,000	8,750
1953	24,000	4,899	1963	40,000	9,000
1954	22,000	4,485	1964	43,000	9,700
1955	23,000	4,900	1965	43,000	9,700

Basic data obtained from U. S. Office of Education



Government Contract Awards

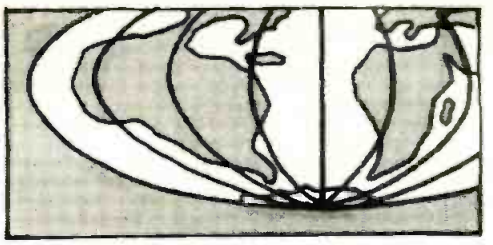
This list classifies and gives the value of electronic equipment purchased by gov't. procurement agencies in Dec. 1955.

Actuators	25,445
Amplifiers	52,263
Antennas	222,835
Automatic Pilots	2,817,205
Batteries	244,650
Boards, Terminal	25,800
Breakers, Circuit	432,952
Computers	296,257
Connectors	34,240
Converters	159,248
Converters, Digital Data	150,000
Development—Transmitting Tubes	232,519
Discriminators	51,674
Dummy Loads	54,196
Dynamotors	225,172
Generators	887,451
Generators, Signal	214,851
Handsets	384,953
Headsets	422,298
Indicators	391,672
Insulators	95,316
Lamps	182,421
Meters, Frequency	32,486
Meters, Noise	84,314
Meters, Power	80,646
Microphones	543,291
Motors	355,951
Multiplexers	170,770
Oscilloscopes	168,898
Radar Equipment	6,551,004
Radio Equipment	3,771,922
Receivers, Radio	123,148
Receiver—Transmitters	930,328
Recorder—Reproducers	48,619
Rectifiers	262,303
Relays	691,627
Repeaters, Telegraph	26,113
Research—Guided Missile Fuses	200,000
Research—Microwave	48,245
Research—Semiconductors	90,190
Research—Strip Transmission Lines	45,000
Research—TV	73,563
Resistors, Variable	199,528
Servos	65,305
Simulators, Flight	12,177,543
Switchboards	85,490
Switches	589,768
Tape, Magnetic	50,420
Thermostats	26,985
Transmitters	409,020
Tubes, Electron	3,485,915
Tuning Units, R-F	29,950
Wire and Cable	567,704

INDUSTRIAL TUBE SALES

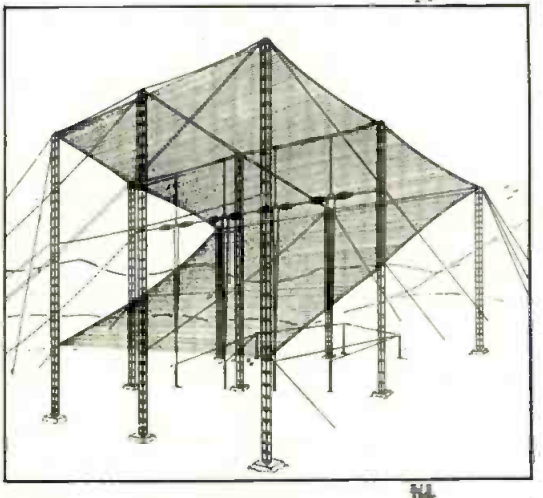
	Equipment Manufacturers				Government		Miscellaneous		Totals	
	Units	$ Value	% of $ Sales Radio*	% of $ Sales Mil. Use	Units	$ Value	Units	$ Value	Units	$ Value
year 1955 (est.)	4,252	57,541	77.1	70.3	1,472	38,437	1,227	13,671	6,951	109,648
3rd/4 1955	1,014	13,197	79.1	73.9	434	8,497	309	3,572	1,757	25,266
2nd/4 1955	1,112	15,216	78.3	74.6	411	9,838	305	3,331	1,828	28,385
1st/4 1955	1,063	14,743	75.3	63.9	259	10,493	306	3,350	1,628	28,586
year 1954	4,687	68,222	82.7	74.8	1,075	40,870	1,115	12,919	6,877	122,011

Figures in thousands — From National Electrical Manufacturers Association — ** Broadcast, Radar, Sonar, Communication and Navigation*



Columbus Could'a Stood in Bed...

Tower's HORIZON STRETCHER makes the earth FLAT



POOR CHRIS went to a heap of trouble to prove that the Earth was not flat, then TOWER came along and "flattened" it out again. Mr. C's "round" earth caused too many problems with FM signals. They just couldn't be "read" beyond the horizon. That is, until TOWER engineered, fabricated, and erected the first successful High Gain Corner Reflector Antenna installation (insert) to receive FM radio and TV signals far beyond yesterday's horizons.

A pioneer in "Scatter Propagation," TOWER has proven again that knowledge, gained through experience, sets the pace for TOMORROW . . . today!

Write for free illustrated booklet

TOWER

tower fabricators and erectors the world over

CONSTRUCTION COMPANY

Sioux City, Iowa

an Ampex can keep your accountant happy too!

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

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

For further information, write Dept. U-2290

SIGNATURE OF PERFECTION IN SOUND

AMPEX CORPORATION

934 Charter Street, Redwood City, California

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TELE-TECH'S MARKET of the Electronic Industries **AT A GLANCE**

	VP-Mfg. Engrg.	Chief Engrs.	Design Engrs.	Project Engrs.	Devel. Engrs.	Research Dirs.	Technical Dirs.	Pres.-Gen. Mgrs.	Production Mgrs.	Common. Engrs.	Supervisors	Plant Engrs.	Military Cont.
MANUFACTURING													
Automation Equip.	•	•	•	•	•	•	•	•	•		•	•	•
Audio & Video	•	•	•	•	•	•	•	•	•		•	•	•
Avionics	•	•	•	•	•	•	•	•	•	•	•	•	•
Color Television	•	•	•	•	•	•	•	•	•	•	•	•	•
Components	•	•	•	•	•	•	•	•		•	•	•	•
Computers	•	•	•	•	•	•	•	•	•		•	•	•
Control Consoles	•	•	•	•	•	•	•	•	•	•	•		
Government	•	•	•	•	•	•	•	•	•		•	•	•
Guided Missiles	•	•	•	•	•	•	•	•	•	•	•	•	•
Industrial Elec's	•	•	•	•	•	•	•	•			•		
Military Elec's	•	•	•	•	•	•	•	•	•		•	•	•
Mobile	•	•	•	•	•	•	•	•	•	•	•	•	•
Printed Circuits	•	•	•	•	•	•	•	•	•	•	•	•	•
Res. & Dev. Labs	•	•	•	•	•	•	•	•		•		•	•
Studio Equipment	•	•	•	•	•	•	•	•	•	•	•	•	
Telemetering	•	•	•	•	•	•	•	•	•	•	•	•	•
Test Equipment	•	•	•	•	•	•	•	•	•	•	•	•	•
Transistors	•	•	•	•	•	•	•	•	•	•	■	•	•
TV-Radio-Radar	•	•	•	•	•	•	•	•	•	•	•	•	•
Vacuum Tubes	•	•	•	•	•	•	•	•	•	•	•	•	•
Xmission Lines	•	■	•	•	•	•	•	•	•	•	•	•	•
OPERATION													
Broadcasting	•	•				•	•	•		•	•		
Communications	•	•				•	•	•		•	•		
Consulting Engrs.				•	•			•			•		
Microwave	•	•				•	•	•		•	•		
Recording	•	•					•	•		•			

Chart shows how TELE-TECH's 27,000 circulation is concentrated among top-level engineers in the electronic industry's principal buying power groups.

THE ELECTRONIC INDUSTRIES DIRECTORY

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

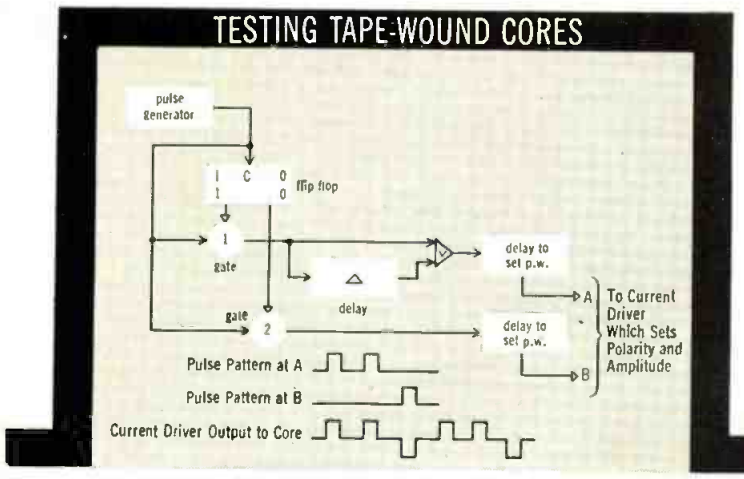
testing components with Burroughs pulse control systems

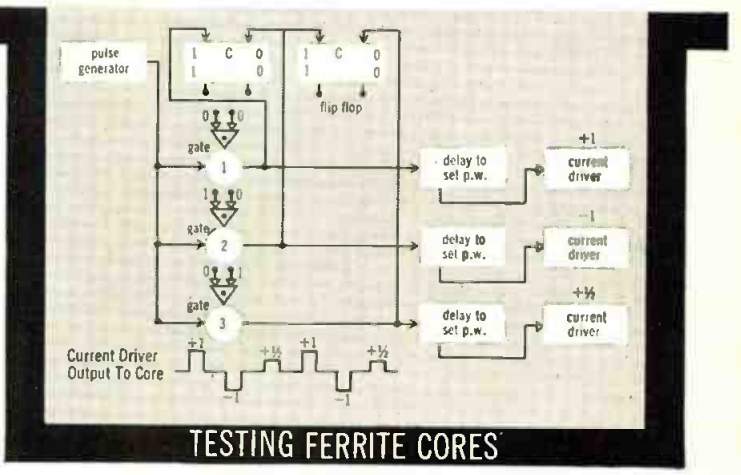
ern methods for testing cores

The future of magnetic cores in information handling systems is already well assured. Their high reliability, fast action, small size, and low power consumption stimulate the imagination of more and more engineers working in data processing, weapons systems, and control. And every day finds these new components included in more new designs.

One problem still facing those who want to exploit these exciting properties is the lack of precise uniformity in cores made on a production basis. For as Burroughs has found through 5 years of working with the pioneers in core applications, uncertainties still exist. And before cores become standardized, many changes will probably be made. Those who want to take advantage of the great potential in this new component now must use reliable test procedures which precisely check the tolerances of each core, and are versatile enough to check for the new core specifications of tomorrow.

Burroughs Pulse Control Systems answer this need for leading manufacturers and users of cores by simulating the actual conditions under which each core produced will eventually operate. When conditions require a change in core operating characteristics, the testing system is changed at will, in a matter of minutes, to meet the new requirements.



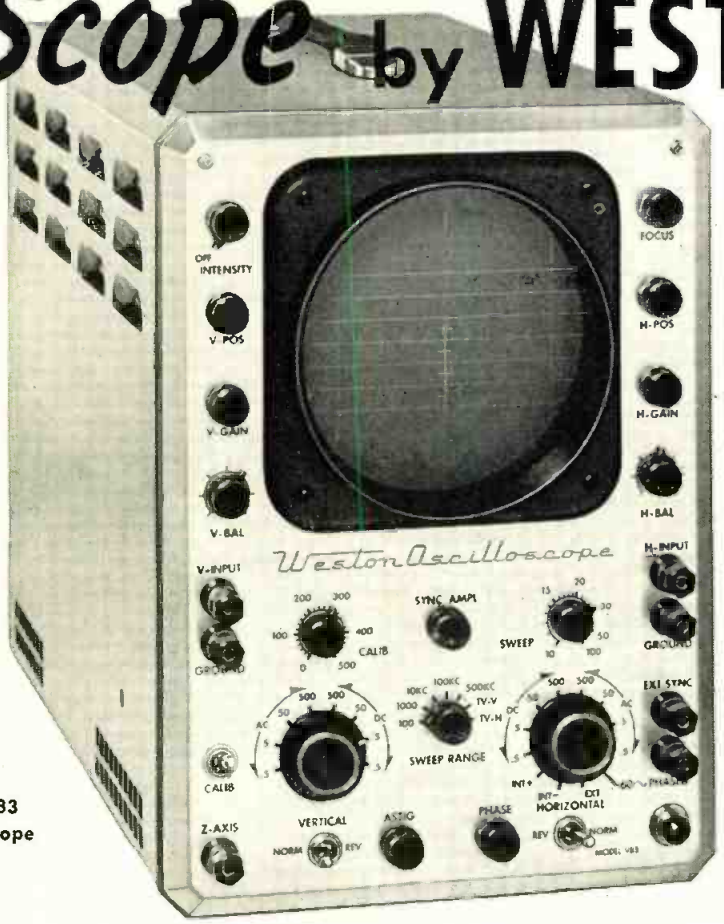


Shown here are typical examples of how these core manufacturers, including Burroughs own core production department, use Burroughs Pulse Control Systems to check tape wound and ferrite cores. An interesting booklet describing core testing in greater detail is yours for the asking. But if you want to test another component by digital techniques, just send us your problem. We'll be glad to work it out, at no cost, and show you how Burroughs Pulse Control Systems can save you hours of engineering time and production headaches.

BURROUGHS

Electronic Instruments Division • 1209 Vine Street • Philadelphia 7, Pa.

NOW...the All-purpose 'Scope by WESTON



Weston
Model 983
Oscilloscope

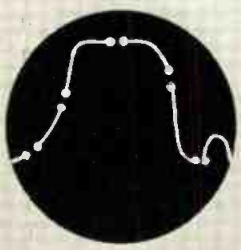
Model 983 is a high gain, wideband Oscilloscope designed to accurately reproduce waveforms comprising a wide band of frequencies. High sensitivity of 15 millivolts per inch RMS makes this "scope ideal for — SETTING RESONANT TRAPS... SIGNAL TRACING IN LOW LEVEL STAGES... AS A GENERAL NULL INDICATOR... for PHASE CHARACTERISTIC MEASUREMENT IN INDUSTRIAL APPLICATIONS...and for SWEEP FREQUENCY VISUAL ANALYSIS.

The 'scope contains identical vertical and horizontal push-pull amplifiers with a choice of AC or DC coupling without affecting either sensitivity or band width. Both amplifiers have compensated step attenuators and cathode follower input. *It has excellent square wave reproduction with overshoot of only 2 to 5%, with a rise time of 0.1 microsecond. The 'scope response is essentially flat throughout the specified range of 4.5 mc and is usable to 6 mc.*

The unit has provisions for internal calibration, internal phased sine wave, and Z-axis intensity modulation. Reversal of polarity of both horizontal and vertical signals is easily accomplished by means of toggle switching. *Tube replacements are non critical, and etched circuitry facilitates quick and rapid maintenance.*

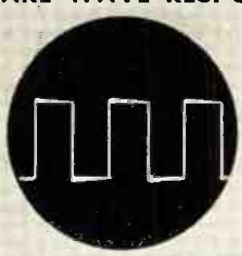
The Model 983 Oscilloscope is now available through local distributors. For complete literature write WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.

WAVEFORM ANALYSIS



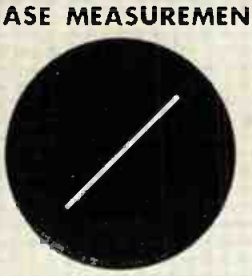
Response curves accurately displayed. Ideal for use with Weston intensity marker display. A fast, retrace sweep circuit with cathode follower output prevents pattern distortion.

SQUARE WAVE RESPONSE



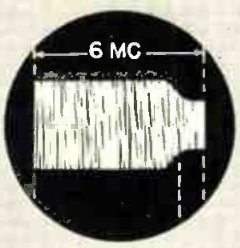
Overshoot is only 2 to 5%. Rise Time is 0.1 Microsecond. Square wave depicted 250 kc.

PHASE MEASUREMENTS



Phase shift between horizontal-vertical amplifiers, 0-500 kc-0°, to 1 mc within 2°; by internal adjustment with gain controls at max 0° phase shift possible on any specific frequency to 6 mc.

RESPONSE CHARACTERISTIC



Note flatness throughout specified range; to 3.6 mc down 1.5 db, at 4.5 mc down 3 db, at 6 mc down 6 db.

WESTON *Instruments*

The *Citation* **Model No. F35-B**

● for school, business, home, the educator, and industry. Ideal for churches, offices, stores and institutions.

The *Hi-Fi Pro* **Model No. S36-B**

● for musicians, sound engineers, lecturers, and industrial applications.

The *Finest* precision built Tape Recorders of the century

by Magnecord, *The Choice of Professional*

The *Editor* **Model No. P60-A**

● for broadcasting studios, recording studios, electronic measurements, educational and sales management applications.

The *Professional* **Model No. M90**

● for radio and TV studios, orchestral, industrial and electronic applications, and a great boon to the moving picture industry.

y model carries the greatest line of operating features ever to be incorporated in any portable or console Tape Record

A new booklet just published by Magnecord briefly outlines 207 valuable uses for a tape recorder in today's modern living, at home or away, at work or play. It segregates the 207 uses into classifications such as professional, educational, church, business, recreation, etc. Write, phone, or stop in for your copy.

Magnecord, Inc.

A COMPLETE LINE OF DEPENDABLE ENCAPSULATED RESISTORS

PERMASEAL®

PRECISION WIREWOUND RESISTORS FOR 85C AND 125C AMBIENTS

When you have applications requiring accurate resistance values at 85C and 125C operating temperatures, in units of truly small physical size—you'll find the resistor you want is one of the 46 standard Permaseal designs in tab and axial lead styles.

They meet or exceed requirements for all types of military and industrial electronic apparatus and instruments. They are "extra-protected" by a special Sprague-developed plastic embedding material that performs beyond the severe humidity resistance specifications of MIL-R-93A and Proposed MIL-R-9444 (USAF).

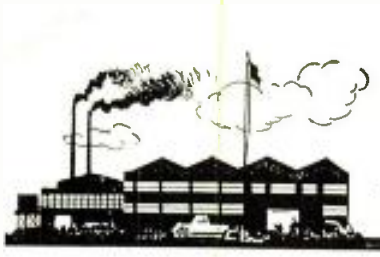
Permaseal winding forms, resistance wire and embedding material are matched and integrated to assure long term stability at rated wattage over the operating temperature range.

These high-accuracy units are available in close resistance tolerances down to ±0.1%. They are carefully and properly aged for high stability by a special Sprague process.

SPRAGUE

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

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



As We Go To Press...

100 KW Color Transmitter For Portland, Ore.

Purchase of a complete RCA 100-kw VHF television installation by a new color TV station in Portland, Ore. has been announced by Gordon Orput, President, and J. L. Middlebrooks, General Manager of North Pacific TV, Inc., which holds the construction permit for the Channel 8 station, and by A. R. Hopkins, Manager, Broadcast and TV equipment Dept., RCA.

The purchase involves approximately $1 million, Mr. Hopkins said, and will represent the largest single installation of RCA equipment for an independently owned color television broadcast station.

The new Portland station, which will be completely equipped for origination of color television programs, hopes to complete installation before July, 1956. Subject to approval by the FCC, the station will utilize a new RCA 100-kw transmitter and an RCA-developed 100-kw superturnstile antenna to achieve 316,000 watts ERP.

A unique feature of the Portland installation will be the 100-kw RCA antenna and a remote switching network which will enable the station to achieve maximum power with only a portion of its transmitter equipment, should the need arise. The switching system will enable the station to segregate individual transmitting components for emergency operation or routine maintenance.

Alertness of Human Beings Electronically Measured

Amplifying certain bio-electric potentials which have been found, at Tufts University, to be affected by alertness, a transistorized portable instrument has been designed by Berkshire Labs, Greenville, N.H., for use in the determination of the state of alertness of human beings.

The signal voltages are picked up by electrodes suitably placed on the forehead of the person whose alertness is to be determined. Signal may appear on an indicating meter on the front of the panel, or may be viewed on a CRO.

Gun control "talker" (l.) maintains contact with gun crew while operator tracks target

All-Weather Fire Control Tracks Jets For Navy

The Navy's new Mark 63 gunfire control is capable of tracking jet aircraft with 3 in. and 5 in. naval guns in any weather. This remarkable accuracy has been achieved by combining newer gunfire controls and radars with the gyro-optical tracking principles of WW II gunsights.

Total of more than $4 million of the fire control equipment has been placed with the designers, Sperry Gyroscope Co., Div. of Sperry Rand Corp., Great Neck, N.Y.

New Nuclear Microscope Is World's Largest

Nuclear physicists of Stanford University's High Energy Physics Lab. are now able to examine even the tiniest particles of matter, through the world's largest nuclear microscope.

This huge instrument consists of a 220 ft. electron linear accelerator coupled to a 55-ton, 16 ft. high magnetic spectrometer. Developed under sponsorship of the Office of Naval Research, the AEC and the Office of Scientific Research of the Air Research and Development Command, it is capable of measuring the nucleons of an atom core with an accuracy of four thousandths of a trillionth of an inch.

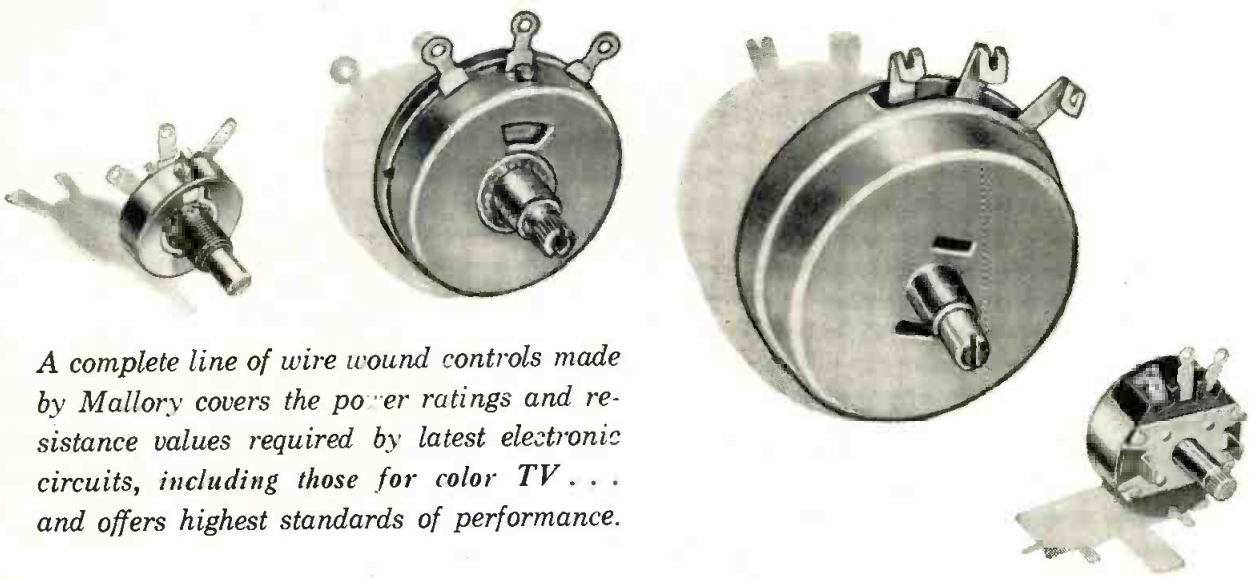
Where an electron microscope shoots electrons through its target with energies of 50,000 to 100,000 electron volts, the nuclear microscope steps them up as high as 550,000,000 electron volts. This makes nuclear particles look about 100,000 times bigger.

MORE NEWS on page 15

ARMY'S NEW FIELD RADIO

Reportedly four times more powerful than the WW II-Korean models, the new versatile AN/GRC-19 functions both as a 100 wpm radio teleprinter and as a radiotelephone. It is designed for mounting in parachute-dropped vehicles and tanks. The unit was developed jointly by the Signal Corps Engrg. Labs and Collins Radio Co.

MALLORY



A complete line of wire wound controls made by Mallory covers the power ratings and resistance values required by latest electronic circuits, including those for color TV . . . and offers highest standards of performance.

Wire wound controls with the ratings, resistances and reliability you want

Mallory
Wire Wound Resistors
for heavy duty service

A comprehensive line of vitreous enamel power resistors made by Mallory meets the requirements of many electrical and electronic circuits where high power dissipation is needed . . . in voltage dividers, bleeders, load or shunt resistors.

Mallory resistors are space-wound on high quality steatite cores, using large gage wire with matched temperature coefficients of all parts. They are designed for maximum heat dissipating area, to assure cool operation. A special non-porous, non-alkaline vitreous enamel coating gives effective protection of the winding.

Fixed and adjustable types are available in ratings from 5 to 200 watts. Write for data.

When your new circuit designs call for controls with higher power dissipation, plan to use the dependable, trouble-free performance that you can get with Mallory wire wound controls. These are true precision products, made to exacting standards to guarantee complete uniformity and adherence to specifications on every control you receive.

The Mallory line of wire wound controls includes a broad range of designs, wattage ratings and resistance values. All ratings are conservative . . . no need to over-design to allow for extra safety. You can choose from models with insulated or grounded rotors . . . all fitted with standard ⅜" mounting bushing and short screwdriver-slotted shaft. The following types are available:

Model	Watts	Resistance range—ohms	Rotor connection
R	2	1- 20,000	insulated
C	2	½- 15,000	grounded
M	4	½-100,000	insulated
E	7	3-150,000	grounded

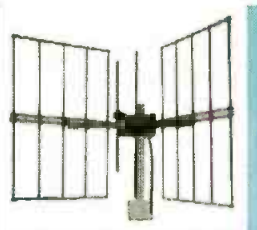
For complete information, write to Mallory today for Technical Bulletin. A Mallory control specialist will be glad to lend personal assistance on your commercial or military applications.

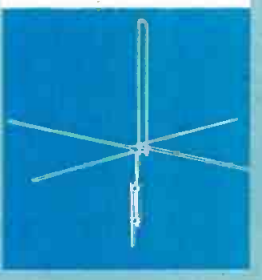
Expect more . . . get more from

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

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

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





BARGAINS in POWER

No single piece of radio equipment can equal the antenna for economically increasing effective power.

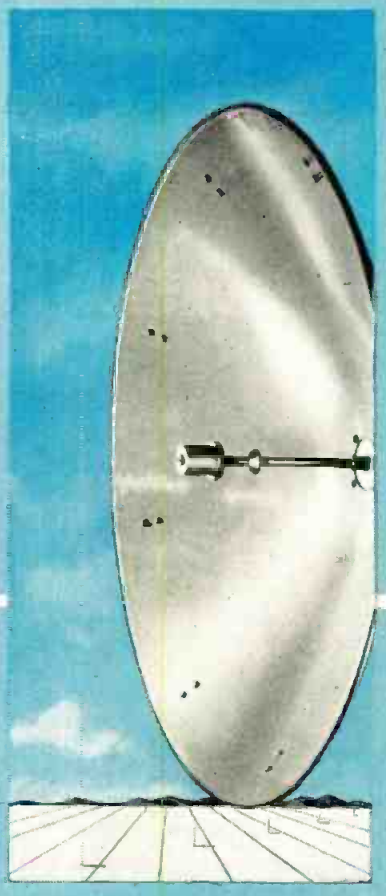
One of the less expensive components in a radio communications installation is the antenna. Yet the antenna, which usually represents less than ten per cent of the total equipment cost, can multiply the effective power of every transmitter in the system *several hundred per cent.* Equally true, a poorly designed or inappropriate antenna can waste the power produced by the costly equipment behind it.

Manufacturers of the UNIPOLE, High Gain, Corner Reflector, Parabolic and Yagi Antennas

In planning a new system, selection of the proper antenna often will allow a lower power transmitter to achieve desired signal range. For existing systems, the use of a higher gain antenna will reduce "dead spots."

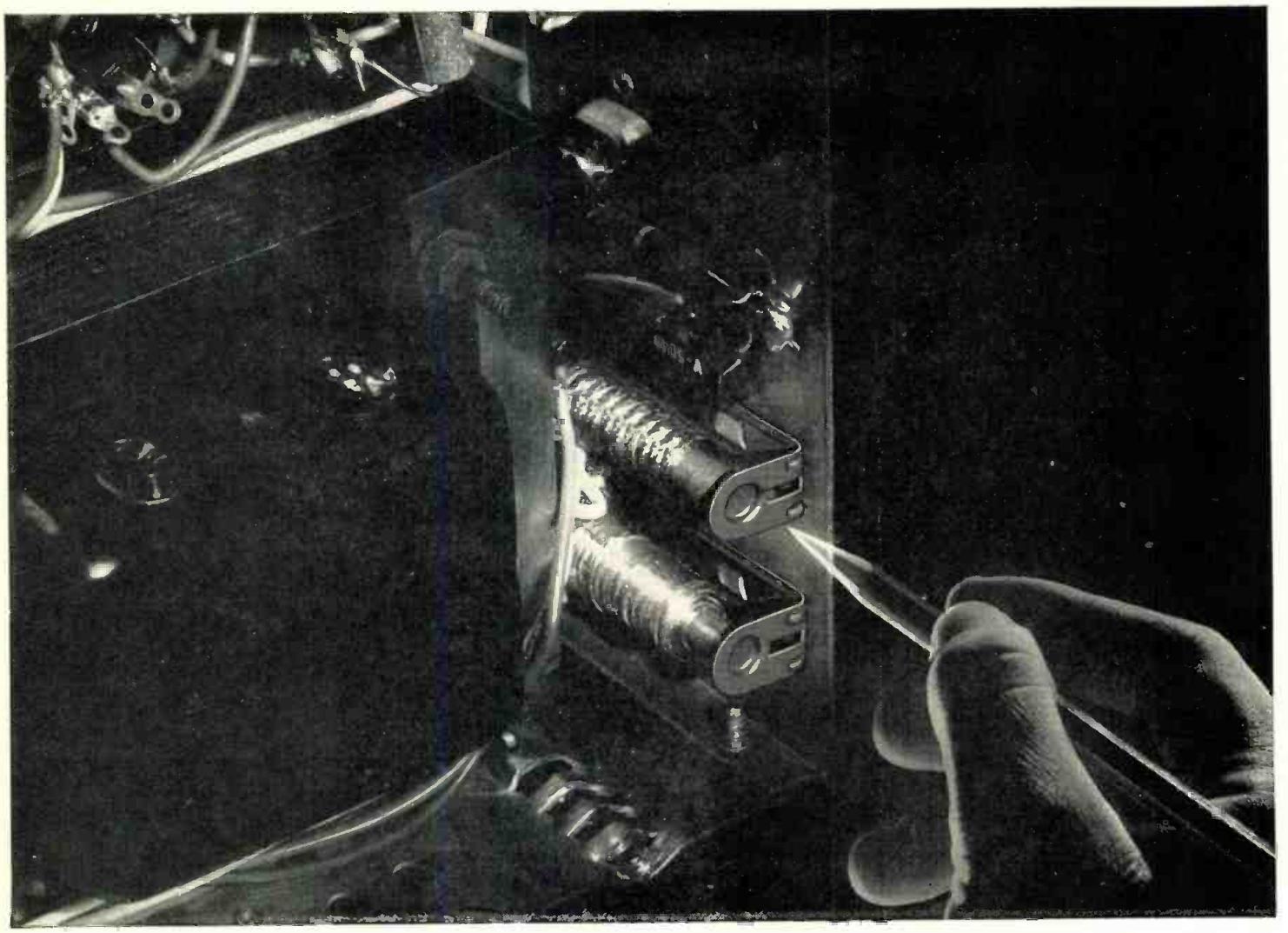
Andrew is a pioneer in designing and developing antennas. We make over 30 standard types for microwave, broadcast and mobile communications. Special models or adaptions of standard models are readily made to order.

Write or phone Andrew for a dollars-and-cents evaluation of the type of antenna that can give your installation the greatest bargain in power.



Andrew CORPORATION
363 EAST 75th STREET · CHICAGO 19

OFFICES: NEW YORK • BOSTON • LOS ANGELES • TORONTO



Engineered by Tinnerman...

SPEED CLIP® simplifies assembly, adjustment and servicing...and saves money!

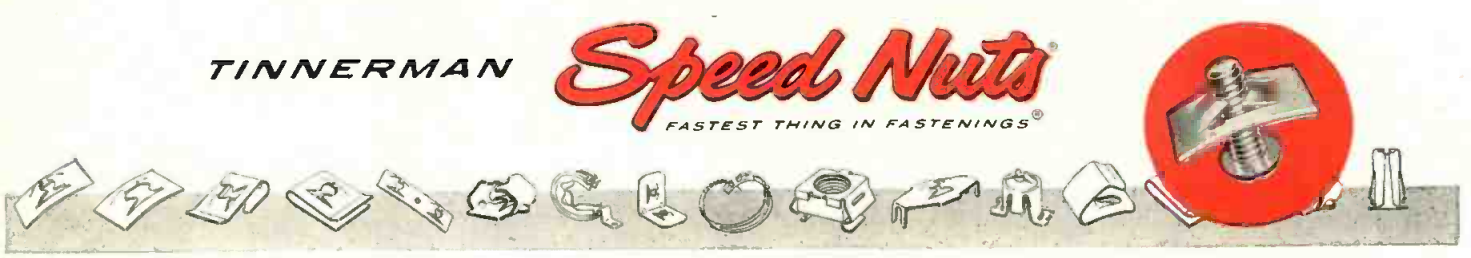
The Westinghouse Television-Radio Division, Metuchen, New Jersey, needed a fastener to fill a complex fastening requirement. Tinnerman was consulted, and developed a *special* SPEED CLIP that fit the job perfectly!

This one-piece, spring steel SPEED CLIP is assembled quickly and easily to the television tuning coil. The SPEED CLIP, with tuning coil attached, is then simply snapped by hand into twin mounting holes in the chassis to lock the unit securely in place. This SPEED CLIP cuts costs on the assembly line. And it permits fast and simple adjustment of the television tuning coils, eliminating the problem of blindly searching with a screw driver for the slot of a special hex nut.

Find out how SPEED NUT Brand Fasteners can help you improve your own fastening methods. Ask your Tinnerman representative for details of our Fastening Analysis Service or write for Bulletin No. 336.

TINNERMAN PRODUCTS, INC., Box 6688, Dept. 12, Cleveland 1, Ohio
Canada: Dominion Fasteners, Ltd., Hamilton, Ontario. *Great Britain:* Simmonds Aerocessories, Ltd., Treforest, Wales. *France:* Aerocessoires Simmonds, S. A., 7 rue Henri Barbusse, Levallois, (Seine). *Germany:* Hans Sickinger GmbH "MECANO", Lemgo-i-Lippe.

TINNERMAN Speed Nuts®
FASTEST THING IN FASTENINGS®



As We Go To Press . . . (Continued)

$6 Million Ford Grant For Educational TV

Three grants from the Ford Foundation totaling $6,493,840 in support of educational TV were announced jointly by Ralph Lowell, chairman of the Board of the Educational TV and Radio Center and by Albert N. Jorgensen, chairman of the newly created Joint Council on Educational TV.

Lowell and Jorgensen termed the action a significant step toward strengthening and expanding the national educational TV movement. Two of the grants, one of $6,263,340 and the other for $90,500, go to the Center, and the third grant of $140,000 goes to the Joint Council.

"These grants will aid materially in efforts directed at the coordination and expansion of educational TV and will mean the wider and more effective utilization of the channels reserved for educational stations," the two officials declared.

Electronic Info Center

Advisory Group on Electronic Parts, Permanent Secretariat, 200 South 33rd St., Philadelphia 4, Pa., has been established as the information center for research and development on electronic parts by the Dept. of Defense. Brig. Gen. Edwin R. Petzing, USA (Ret.) is Director and Allan M. Hadley, Deputy Director.

Tube Information Service Established By NBS

The National Bureau of Standards has set up a special section in their Washington, D. C. electron tube laboratory to accumulate and disseminate technical data on both domestic and foreign radio tubes.

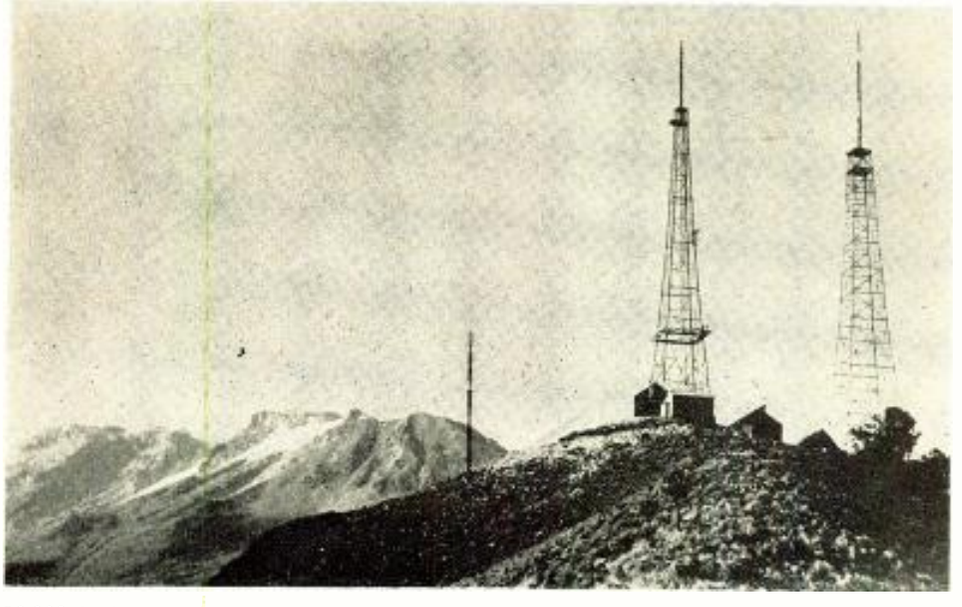
The program, which started seven years ago as a service to NBS personnel, is now being extended to all scientists and engineers in Government and industry. The Bureau recently began punched-card coding for automatic selection in order to process requests more rapidly.

With this service, it is possible to find (1) information about any particular tube, (2) all tube types whose electrical characteristics, bulb sizes, or base configurations fall within a particular range, and (3) domestic tubes that can be substituted for unavailable foreign tubes. Junction transistors and diodes are also included in the program.

At the present time nearly 10,000 cards, filed by tube type number, are appropriately referenced to manufacturers' source material.

Inquiries for tube information should be directed to C. P. Marsden, Chief, Electron Tubes Section, National Bureau of Standards, Washington 25, D. C. Manufacturers are urged to supply the Bureau with technical information on new types just as soon as they are placed on the market.

Highest TV Transmitter



18,800 ft. Mt. Popocatepetl, once active Mexican volcano, is now the site of the highest TV transmitter in the Western Hemisphere. Located some 3,000 ft. below the volcano's summit at Paso de Cortez, about 50 miles from Mexico City, the 45 kw station is the most powerful in Mexico. Equipment development was by Federal Telecommunication Labs, Nutley, N.J., research division of IT&T.

NEW ARMY COMPUTER

J. Wesley Leas, chief engineer of the "Bizmac" project — the $4-million electronic data processing system bought by the U. S. Army from RCA — examines magnetic tape. More than 2,500,000 digits can be stored on single tape. "Bizmac" will handle inventory control at the Ordnance Tank-Automotive Command in Detroit.

Philco Expands Tube Sales

Lansdale Tube Co., Div. of Philco Corp., has entered into the field as a direct supplier of vacuum tubes and semi-conductor products to industry and the Government.

Single Sideband Proposal Gets Industry Endorsement

Only a handful of comments, all favorable, were received by the FCC in response to their proposal to require single sideband transmission in the fixed radiotelephone service below 25,000 kc.

Those filing comments were Collins Radio, RCA and the General Electric Co.

Collins pointed out that with the present state of the art it is not unreasonable to require that all new transmitters installed after Jan. 1, 1958 for the below-25,000 kc fixed services should be capable of SSB operation.

RCA Communications Inc. said that it generally favors the proposal for the benefits to the public in terms of spectrum savings.

G-E, while favoring the proposal, said that other systems, too, offer economy of spectrum space, and that the adoption of SSB operation should not preclude the possibility of obtaining experience with any future systems which might be proposed.

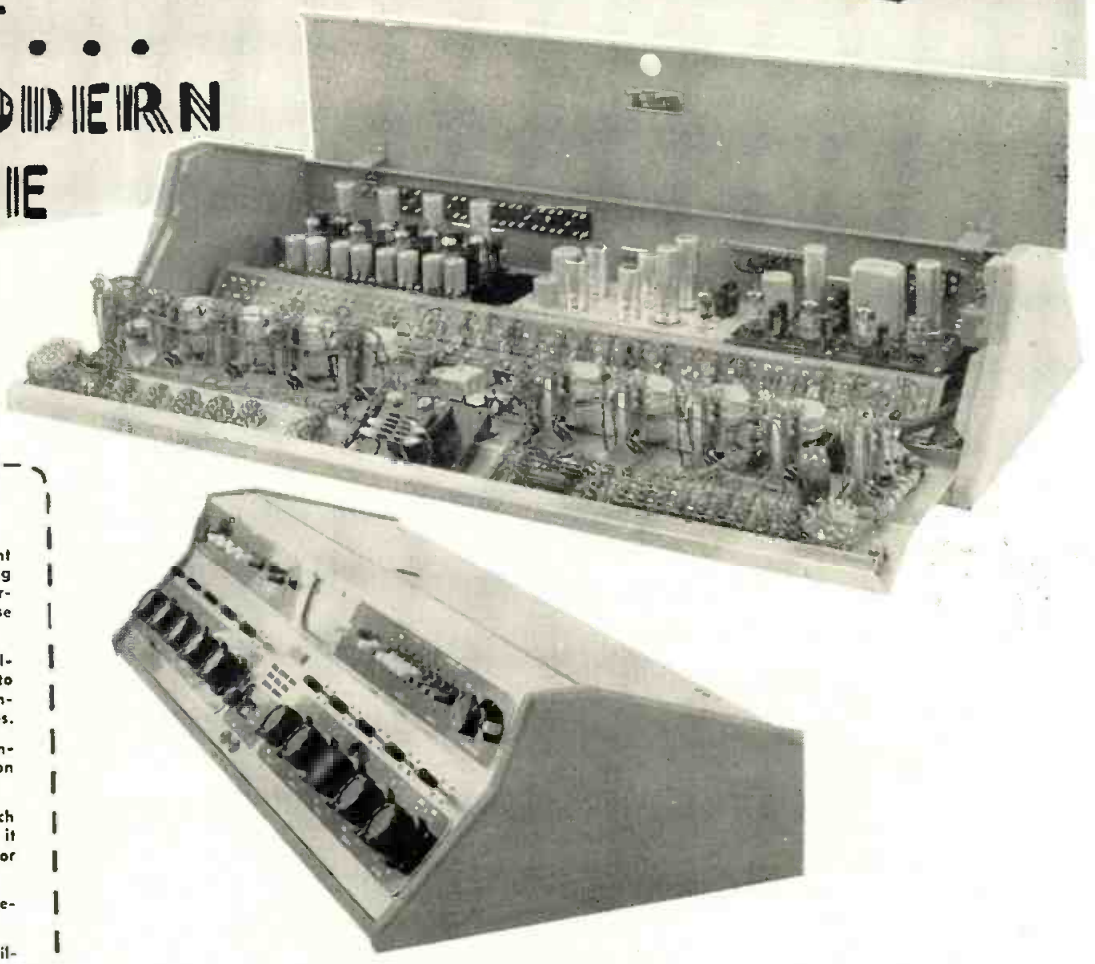
The deadline for filing comments was Dec. 30, 1955.

MORE NEWS ON PAGE 20

The "GATESWAY"

IS BROADCASTING'S NEWEST... MOST MODERN CONSOLE

GATES Hi-WATTER SERIES
MORE WATTS PER DOLLAR INVESTMENT



This is new:

- Inbuilt cue/intercom with front panel speaker for both talking and listening on all major circuits without disrupting house monitoring system.
- Inbuilt variable Hi-pass equalizer with front panel control to instantly correct or improve unlooked for program deficiencies.
- 4 tape/projector/turntable channels with individual cue position on each attenuator.
- New era in serviceability. Reach every part in as much time as it takes to move a hinged panel or chassis.
- Printed wiring for greater reliability — lower cost.
- More of everything—circuit facilities, mixing channels, amplifiers and performance. At least 20 exclusively new or greatly improved upon features.

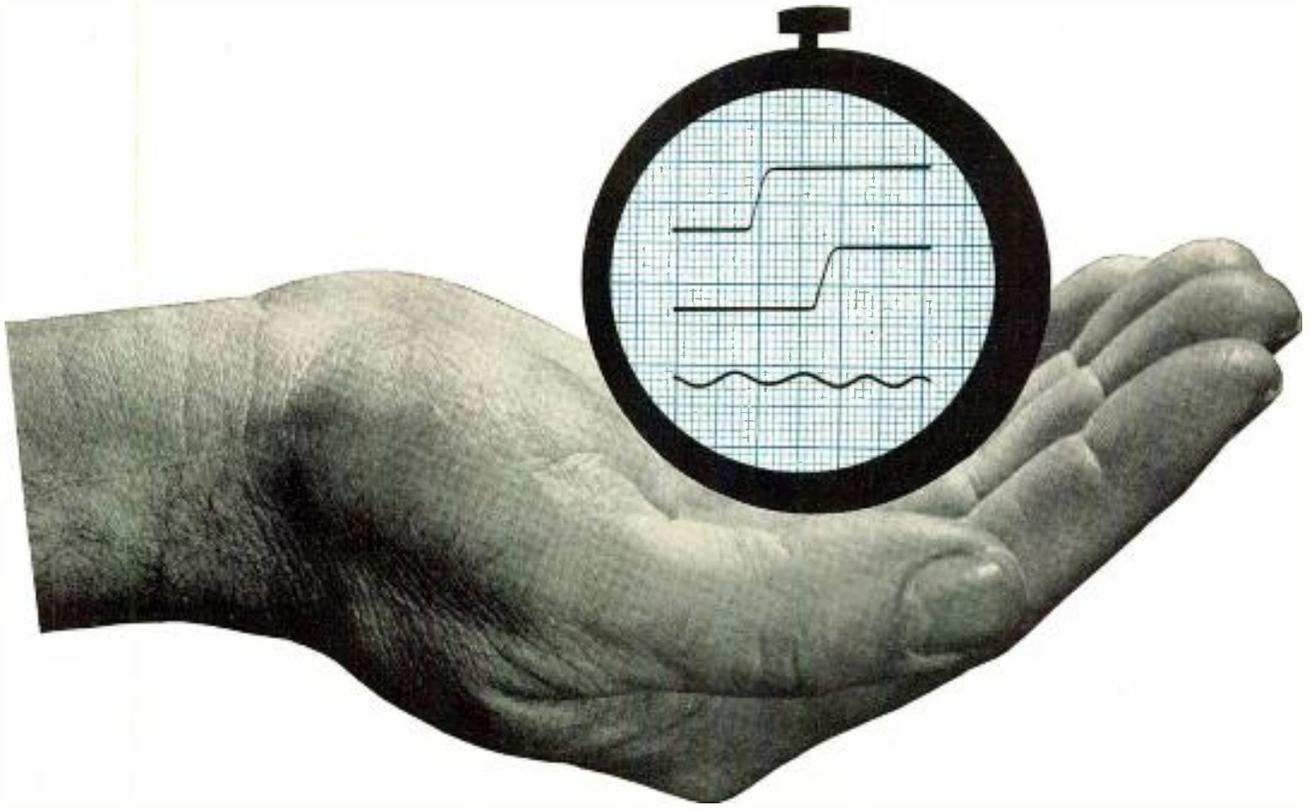
In the continuing parade of new, modern and up-to-date broadcast equipment, comes the new "Gatesway"—a speech input console that is new all the way! New functional design, new features never before incorporated in standard designs, new performance standards and new manufacturing methods, manufacturing engineering is the correct wording, that provides far more equipment for each dollar invested. — A brochure on this wonderful new product is ready for you now. Better yet—you can have a new Gatesway now!

GATES

GATES RADIO COMPANY - QUINCY, ILLINOIS, U.S.A.

Manufacturing Engineers Since 1922

OFFICES IN .... NEW YORK, WASHINGTON, ATLANTA, HOUSTON, and LOS ANGELES



time on our hands

Here's a handful of microtime... doled out in hundredths of a millimicrosecond. It's our new HELIDEL* delay line.

It's precise... wide-band ... continuously variable. This is not an adwriter's pipedream... it's an engineer's, come true.

Which means that definitions are in order.

Precise = delay increments of only 2×10^{-10} sec; resolution 0.01% and better; linearity "better than ±1%"... actually, so fine it can't be measured.

Wide-band = transmission of pulse signals up to 20 mc with negligible phase-distortion, overshoot, or distortion of waveshape.

Continuously variable = a distributed-constant, electromagnetic type ... dreamed up in 1946... developed in helical form since 1951, by Helipot and DuMont.

The HELIDEL is already used successfully in color-TV broadcasting and oscilloscopes... and as a trimmer in transmission systems.

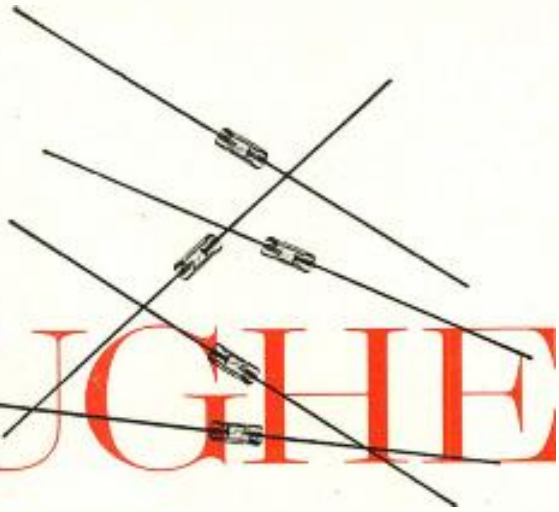
What can you dream up?

Helipot *first in precision potentiometers*

Helipot Corporation/South Pasadena, California
Engineering representatives in principal cities
a division of BECKMAN INSTRUMENTS, INC.

To help you dream, there's a 10-page technical paper on the HELIDEL, *presented at the 1954* WESCON... *and a new data sheet, with complete specs. For your copies, write for Data File 204.*

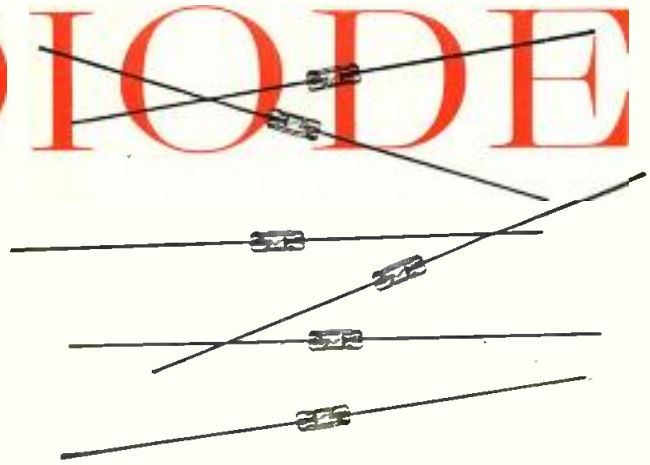
444 * TRADEMARK



HUGHES

GERMANIUM POINT-CONTACT

DIODES



ARE RIGHT FOR YOUR CIRCUIT APPLICATIONS

Hughes Semiconductors offers an extensive selection of standard diode types—both germanium point-contact and silicon junction. Available too are more than two hundred special types. Most electronic circuit requirements can be met by diodes selected from among these existing devices of standard manufacture.

Yet, every once in a while, a requirement arises for a diode embodying very particular electrical characteristics. Different applications might call for one or more specified characteristics, in varying combinations: Recovery Time . . . Forward Conductance . . . Voltage . . . Back Resistance.

For instance, while one application requires very fast recovery together with high forward conductance, another circuit might call for high forward conductance *at very low voltage* (less than one volt), and with moderate to good recovery.

With the knowledge gained from long experience and leadership in the semiconductor field, Hughes is able to modify standard production techniques to the degree necessary to produce devices with just such a delicate balance of special characteristics.

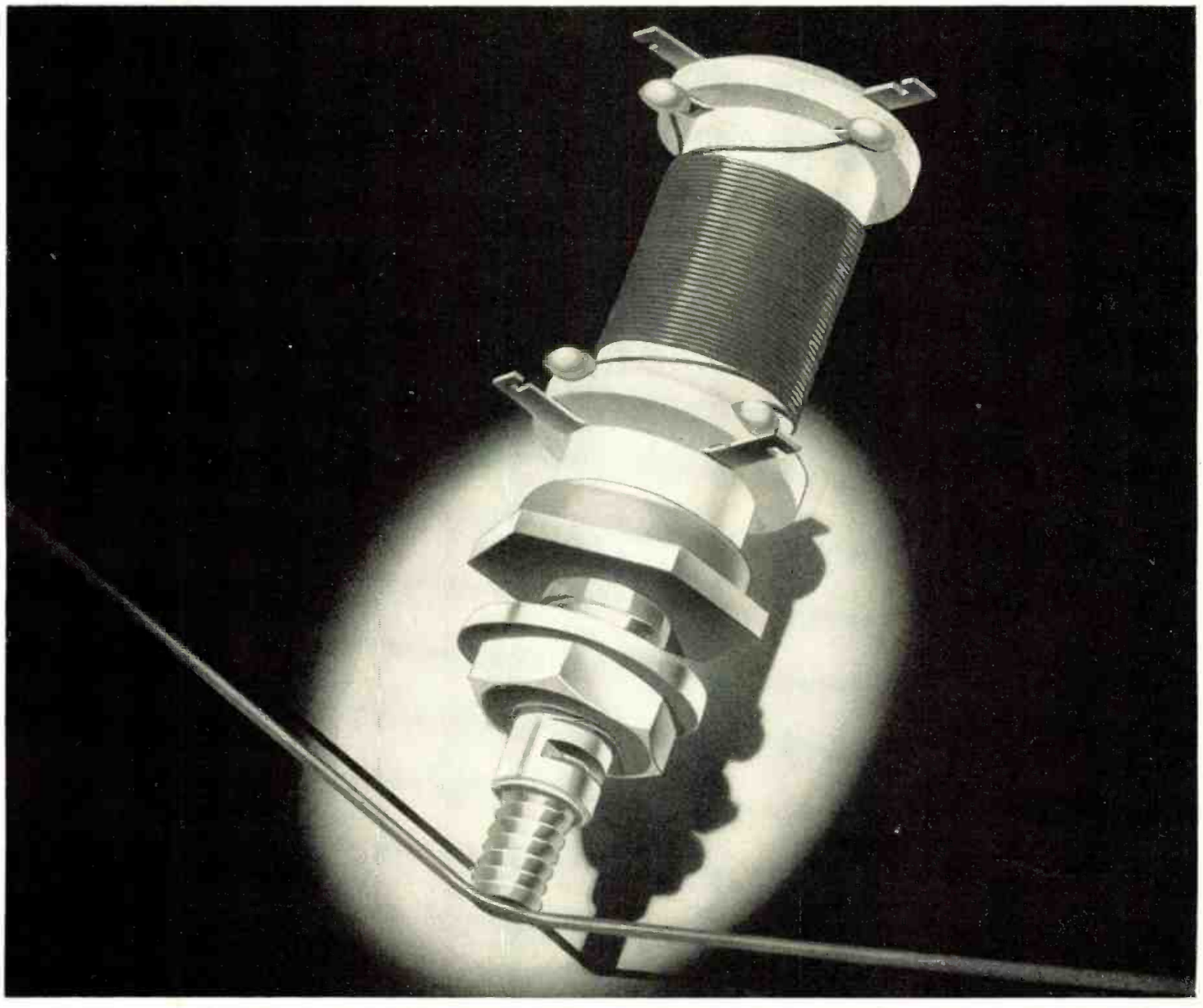
So let us know about your application problems. Most probably you will find just the right diode—the diode to fit your requirements perfectly—at Hughes. And, if it's a Hughes diode, you know that it's First Of All . . . For RELIABILITY.

Our field Sales Engineers will welcome the opportunity to discuss your particular semiconductor requirements. For the address of the office nearest you, or for descriptive product literature, please write:

HUGHES PRODUCTS DIVISION

Aircraft Company, Los Angeles 45, Calif. SEMICONDUCTORS

SEMICONDUCTORS
HUGHES AIRCRAFT COMPANY
PRODUCTS DIVISION
INTERNATIONAL AIRPORT STATION
Los Angeles 45, California



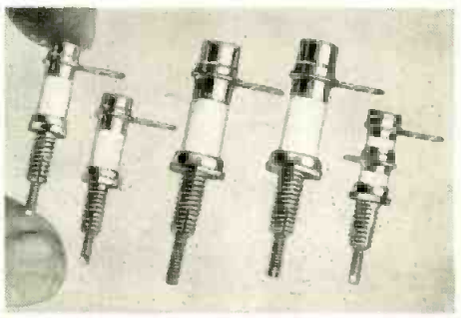
CTC Slug Tuned Coils are made in single layer or pie type windings to your specifications. Forms are of grade L-5 silicone impregnated ceramic. Mounting studs are cadmium plated brass; silicone fibreglas collars facilitate termination of simple or multiple windings.

Death-defying performance

You can depend upon CTC Coils to give a steady, star performance whether you use ten or ten thousand! They won't go dead even under severe temperature, climate or vibration conditions. Here's why:

All CTC coils are precision-made to meet individual specifications — and to meet, or better, government specifications. Continuous quality control is maintained. As a result, you get a *guaranteed* electronic component — custom or standard.

Precision-made CTC components that benefit from CTC high quality standards include terminals, terminal boards, capacitors, swagers, hardware, insulated terminals and coil forms. For all specifications and prices, write Cambridge Thermionic Corporation, 436 Concord Avenue, Cambridge 38, Mass. A West Coast stock is maintained by E. V. Roberts, 5068 West Washington Blvd., Los Angeles 16 and 988 Market St., San Francisco, Calif.



CTC Capacitor family: Metallized ceramic forms. From left to right — CST-50, in range 1.5 to 12.5 MMFD's. CST-6, in range 0.5 to 4.5 MMFD's. CS6-6, in range 1 to 8 MMFD's. CS6-50, in range 3 to 25 MMFD's. CST-50-D, a differential capacitor with the top half in range 1.5 to 10 MMFD's and lower half in range 5 to 10 MMFD's.

CTC

CAMBRIDGE THERMIONIC CORPORATION

makers of guaranteed electronic components custom or standard

As We Go To Press (cont.)

'Thumb-Size' RCA Mike Is Smallest Dynamic Type

The smallest dynamic microphone ever developed for radio and TV broadcasting, a "thumb-size" device which weighs 2.3 oz., is being introduced by the Broadcast and TV Equip. Dept., RCA.

The miniature microphone can be carried completely concealed in the hand, or can be worn conveniently

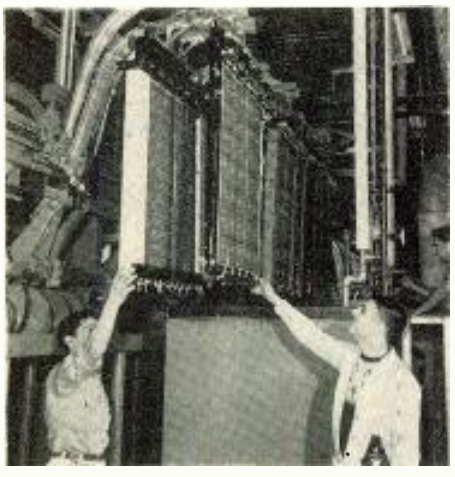
New mike fits in the palm of hand

around a performer's neck or clipped to lapel or dress.

Designed for walk-around operation, the BK-6B plugs directly into the studio console and requires no tubes or special power supply.

A pressure actuated type, the miniature "mike" has a frequency response of 80 to 12,000 cps. Complete with lanyard and a 30-ft. flexible cable, it measures 2 9/16 in. in length and 15/16 in. in diameter.

PRINTED WIRING



Heart of the printed wiring production line at GE is this 75 ft. long automatic plating tank, where the copper wiring pattern is electrolytically deposited on plastic boards. Line is expected to produce over 5 million individual boards in 1956.

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period February through April 19, 1956 that are of special interest to electronic engineers

Feb. 2-3: Symposium on Microwave Theory and Techniques, Univ. of Pennsylvania, Phila., Pa.

Feb. 6-12: National Electrical Week, sponsored by NEMA.

Feb. 7-9: Western Computer Conference and Exhibit, sponsored jointly by AIEE, IRE, and ACM, at the Fairmont Hotel, San Francisco, Calif.

Feb. 9-11: Southwestern Regional IRE Conference and Electronics Show. Municipal Auditorium, Oklahoma City, Okla.

Feb. 15-17: Conference on High-Speed Computers, at Louisiana State Univ., Baton Rouge, La.

Feb. 16-17: Conf. on Transistor Circuits, sponsored by the Prof. Gp. on Circuit Theory of IRE, and the Science and Electronics Div. of AIEE, at the Univ. of Pennsylvania, Phila., Pa.

Feb. 21: Conference of State Broadcasting Association Presidents, in Wash., D.C., sponsored by NARTB.

Feb. 22-25: RETMA's 1956 Industrial Relations Round Table, Gen. Oglethorpe Hotel, Savannah, Ga.

Feb. 27-29: Second Annual Electronics Conference and Exhibit, conducted by the AMA. Hotel Commodore, New York, N.Y.

Feb. 27-March 2: National Meeting of the ASTM, Committee Week at the Hotel Statler, Buffalo, New York.

Mar. 2-4: High Fidelity Music Show at the Shoreham Hotel, Washington, D.C.

Mar. 8-9: Fourteenth Ann. SPI Canadian Conference, Sheraton-Brock Hotel, Niagara Falls, Ontario, Canada.

Mar. 12-16: Corrosion Show, held in conjunction with the Twelfth Ann. Conference of the NACE, Hotel Statler, New York City.

Mar. 19-22: IRE National Convention and Radio Engineering Show, Waldorf-Astoria and Kingsbridge Armory, New York City.

Mar. 19-23: ASTE Convention and Industrial Exposition. International Amphitheatre, Chicago, Ill.

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

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

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

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

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

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

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

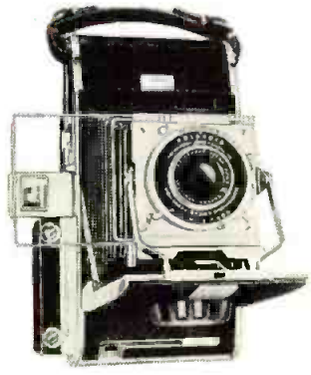
Abbreviations:

ACM: Association for Computing Machinery
AMA: American Management Association
ASTE: American Society of Tool Engineers
AIEE: American Institute of Electrical Engineers
ASTM: American Society for Testing Materials
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
MPA: Metal Powder Association
NARTB: Nat'l. Assoc. of Radio and TV Broadcasters
NACE: National Assoc. Corrosion Engineers
NEMA: National Electrical Manufacturers Assoc.
RETMA: Radio-Electronics-TV Manufacturers Assoc.
SPI: Society of the Plastics Industry, Inc.
SPE: Society of Plastics Engineers

NOW fast, low cost TV commercials and spot news in minutes!

GRAY TELOP III

POLAROID ®
LAND CAMERA
(Pathfinder model)



Use of the newly improved Telop III and the famous Polaroid (picture in a minute) Land Camera, now offer fast, extremely low cost production and projection of commercials and spot news for TV stations! This combination opens many new, profitable markets for TV time salesmen and is particularly helpful in meeting the budget requirements of local spansors.

Commercials can be changed DAILY and the Polaroid photograph inserted in the Telop III for immediate projection without further preparation.

Telop III projects on single optical axis, opaque cards, photographs, art work, transparent 3¼" x 4" glass slides, strip material, and can be used with any TV camera including the Vidicon. The Telojector, to project 2" x 2" transporencies, can be used with the Telop III.

Telop III holds 50 slides, with either manual or automatic, local or remote control. Write for booklet describing complete money saving features.

SPOT NEWS	COMMERCIALS
ACCIDENTS	CAR SALES
FIRES	RESTAURANTS
SPORTS	FLORISTS
CELEBRITIES	BEAUTY SHOPS

GRAY RESEARCH

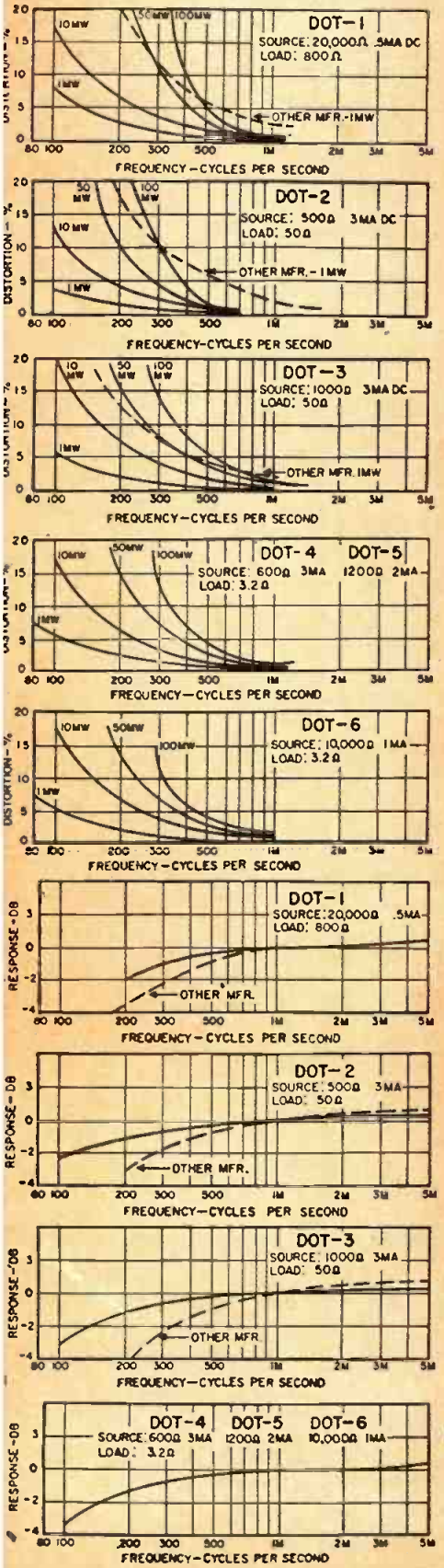
and DEVELOPMENT CO., Inc., Manchester, Conn.

Subsidiary of The Gray Manufacturing Company

Deci-Ouncer Transformers

DOTS for short

REVOLUTIONARY TRANSISTOR* TRANSFORMERS



UTC has been the leader in miniaturization for over twenty years. In view of this, it was surprising to many people that UTC did not quickly bring out a series of transformers designed for use and comparable in size to transistors. Unfortunately, extremely miniature transistor transformers of standard construction had poor general characteristics, poor reliability characteristics, and were woefully inadequate for a large number of applications. Instead, UTC started a development program to evolve a new transistor transformer structure designed to provide full performance in extremely miniature size. The culmination of this development is found in the new DOT series**. Listed below are the standard types of DOTS now being made and curves showing their general characteristics in typical transistor application. To fully appreciate the unprecedented performance of these revolutionary transistor transformers, the curves also show characteristics of similar size units now on the market.

Special DOT units (some even smaller in size) are available on production order.

High Power Rating . . . up to 100 times greater.
DOT-1 has 5% distortion at 100 mw, other mfr. 6% at 1 mw.

Excellent Response . . . twice as good at low end.
DOT-3 is down 1 db at 200 cycles, other mfr. is down 4 db.

Low Distortion . . . reduced 80%.
DOT-1 shows 3% distortion where other mfr. shows 20%.

High Efficiency . . . up to 30% better.
DOT-1 has 850 ohm pri. resistance, 125 ohm sec.; other mfr. approx. 1200 and 200.

Moisture Proof . . . processed to hermetic specs.
DOT units are hermetic sealed compared to other mfr. open structures.

Rugged . . . completely cased.
DOT units can withstand all mechanical stresses.

Anchored leads . . . will withstand 10 pound pull test.
Lead strain completely isolated from coil winding.

Printed Circuit Use . . . plastic insulated leads at one end.
Other variations available.

1.3 X ACTUAL SIZE

DOT CASE

Diameter . . . . . 5/16"
Length . . . . . 13/32"
Weight . . . . . 1/10 oz.

Type No.	Application	Level Mw.	Pri. Imp.	D.C. Ma. In Pri.	Sec. Imp.	Pri. Res.	Sec. Res.
DOT-1	Interstage	50	30,000 20,000	.5 .5	1200 800	850	125
DOT-2	Output	100	600 500	3 3	60 50	60	8
DOT-3	Output	100	1200 1000	3 3	60 50	115	8
DOT-4	Output	100	600	3	3.2	60	.5
DOT-5	Output	100	1200	2	3.2	115	.5
DOT-6	Output	100	10,000	1	3.2	1000	.7
DOT-7	Input	25	200,000	0	1000	3700	100
DOT-8	Reactor	3.5 Hys. at 2 Ma. DC, 630 ohms. DC res.					

*DOT units have been designed for transistor applications only . . . not for vacuum tube service **Pats. Pending

UNITED TRANSFORMER CO.

150 Varick Street, New York 13, N. Y. • EXPORT DIVISION: 13 E. 40th St., New York 16, N. Y.

CABLES: "ARLAB"

Electronic Industries News Briefs

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

EAST

THE NARDA CORPORATION has greatly expanded its production facilities by moving its plant to 160 Herricks Rd., Mineola, L.I.

PHILCO CORPORATION will devote its new plant, at Spring City, Pa., exclusively to the manufacture of transistors, diodes, and other semi-conductors. The company also announced the development of a high-speed silicon transistor.

RAYTHEON MANUFACTURING COMPANY, Waltham, Mass., has been awarded an additional $7,796,500 for research and development work in the field of guided missiles control systems, by the Army Ordnance Corps.

SEALECTRO CORPORATION, specialists in "Press-Fit" terminals, has expanded its engineering facilities with its office and plant at 186 Union Ave., New Rochelle, N.Y.

STERLING PRECISION INSTRUMENT CORPORATION has announced the formation of the Cambridge Engineering Lab., 229 Binney St., Cambridge, Mass., as a new facility of the Instrument Div., Flushing, N.Y.

TRANSITRON ELECTRONIC CORPORATION, Melrose, Mass., advises the trade that it is in no way related to Transitron Inc. which firm was recently purchased by the Van Norman Tool Company of Manchester, N.H.

WAVELINE, INC., Caldwell, N.J., has broken ground for a building expasion program covering a 10 acre tract adjacent to the Caldwell-Wright Airport at Caldwell, N.J.

AERONAUTICAL RADIO, INC. have moved their offices to 1700 K St., N.W., Washington 6, D.C.

HUNTER MANUFACTURING CORP., Bristol, Pa., has acquired all of the outstanding stock of Bristol Engineering Corp also of Bristol, Pa.

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS have started compiling a report on motion picture and TV instruction in colleges and universities in the U.S.

WATERS MANUFACTURING, INC., Waltham, Mass. is erecting a 10,000 sq. ft. plant on Boston Post Rd., Wayland, Mass.

SARKES TARZIAN, INC., Bloomington, Ind., has acquired all of the facilities of the Silicon Corporation of America, and will operate that company as part of the Rectifier Division.

INSTITUTE OF HIGH FIDELITY MANUFACTURERS, INC., New York, N.Y., reports that, with the addition of two new members, Reeves Soundcraft Corp., and Record and Sound Retailing, its total membership is now 53.

LAMBDA ELECTRONICS CORPORATION'S new plant, at 11-11 131 St., College Point 56, N.Y., provides additional manufacturing capacity for the company's expanding power supply sales.

BOWMAR INSTRUMENT CORP., Fort Wayne, Ind., has entered its fifth year of operation with the largest volume of business in its history. Plans for new building expansion were presented at the company's annual stockholder's meeting.

CANNON ELECTRIC COMPANY, Los Angeles, Calif., has completed negotiations for the purchase of facilities, physical assets, inventory in progress, and orders on hand of the Diamond Manufacturing Company, Wakefield, Mass.

MID-WEST

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY have relocated all of their office and factory facilities in their new plant at 8330 N. Austin Ave., Morton Grove, Ill.

ROBINS INDUSTRIES CORP., manufacturers of audio accessories, has moved its factory and offices to larger quarters at 214-26 41st Ave., Bayside, N. Y.

ELECTRO ENGINEERING WORKS, of Oakland, Calif., has broken ground for construction of a completely modern building, in San Leandro, Calif., to house their development and manufacturing facilities. A 4000 sq. ft. office building is also in the planning stage. Total cost for building and equipment is said to be over $300,000.

THE RAMO-WOOLDRIDGE CORPORATION, of Los Angeles, Calif., is directing an important technical bookwriting project involving the compilation of a 3-volume work entitled "Handbook of Automation, Computation and Control." The company also reports that it has secured options on 800 acres of land in Denver, Colo., to provide for the future erection of a manufacturing facility.

AUTOMATIC ELECTRIC COMPANY, 1033 W. Van Buren St., Chicago, Ill., is erecting a multi-million dollar factory, research lab., and gen. office structure on the 170 acre site of the former Westward-Ho golf course, located about 15 miles from downtown Chicago.

BENDIX AVIATION CORPORATION reports, from Detroit, Mich., the establishment of a new market research and development dept. directed by Crockett A. Harrison.

COLLINS RADIO COMPANY, Cedar Rapids, Iowa, has acquired ownership of Communication Accessories Co., Hickman Mills, Mo. designers and manufacturers of toroids, audio band-pass filters, pulse transformers, and magnetic amplifiers.

CONDENSER PRODUCTS COMPANY has moved its research and technical labs. to 6457 Sheridan Rd., Chicago, Ill.

MOTOROLA COMMUNICATIONS & ELECTRONICS DIVISION has relocated its Microwave and Industrial Products Dept. into expanded quarters at 1400 N. Cicero Ave., Chicago 51, Ill.

C. P. CLARE & CO., 3101 Pratt Blvd., Chicago 45, Ill., manufacturers of custom-built relays and switches have opened a new production unit at Fairview, N. C.

WEST

AMERICAN ELECTRONICS, INC. opened its Marketing Div. at 655 W. Washington Blvd., Los Angeles 15, Calif., under the direction of Charles Cosser.

CALIFORNIA TESTING LABORATORIES, INC. announces the completion of their new 5,000 sq. ft. building at 1724 Trinity St., Los Angeles, Calif., and its occupancy by the Research and Development Div.

ELECTRODATA CORPORATION, 460 Sierra Madre Villa, Pasadena, Calif., has dedicated the first of two new computer plant facilities in Pasadena's Hastings Ranch.

LOGISTICS RESEARCH INC., 141 S. Pacific Ave., Redondo Beach, Calif., announces that the ALWAC digital electronic computer is now available, on a contract basis, to organizations requiring the needs of a part-time computer. And to present computer users with extra-heavy work loads.

MAG-ELECTRIC PRODUCTS, INC., 12822 S. Yukon Ave., Hawthorne, Calif., has been acquired by National Aircraft Corp., Burbank, Calif., and will be operated at its present location as a wholly-owned subsidiary of that company.

WEBER AIRCRAFT CORP. announces the establishment of a new Electronics Div. at the company's Burbank, Calif. plant.

PYLON ELECTRONIC DEVELOPMENT COMPANY, LTD., 161 Clement St., Ville LaSalle, Montreal 32, Que., Canada, has acquired new premises with over 3,000 sq. ft. of plant and office space.

PACKARD-BELL COMPANY, Los Angeles, Calif., has been awarded a new Air Force production contract for electronic airborne navigation equipment in excess of $3,700,000.

SPERRY RAND CORPORATION has announced plans for the construction of an advanced flight research center and modern plant to develop and manufacture electronic equipment at Phoenix, Ariz.

FOREIGN

BOGUE ELECTRIC of CANADA, LTD. has opened new production and administrative headquarters in a modern plant recently completed at Gloucester, near Ottawa, Ontario, Canada.

ELECTRO-LABS, S.A., agents in Mexico for the Westrex Corp., Motorola's export distributor, recently inaugurated 2-way radio sales and service facilities in Mexico City, Mexico.

DU MONT TELEVISION & ELECTRONICS, LTD, and CANADIAN AVIATION ELECTRONICS LIMITED have concluded a patent agreement whereby the latter corporation has been appointed administrator and licensing agent in Canada for all Du Mont's Canadian patents.

Letters . . .

ELECTRONIC SOURCES—A HIT!

(Excerpts from a few of the many letters we have received in response to the new editorial feature "Tele-Tech's International Electronic Sources.")

"It gives me great pleasure to congratulate you in instituting the new and valuable editorial feature, 'International Electronic Sources.'
I am sure the condensed article will give ideal references to articles of special interest to design engineers."

C. W. Klosterman
Chief Engineer
American Phenolic Corp.
Chicago, Ill.

"I believe your new feature 'International Electronic Sources' will be of great help to our Librarian in setting up bibliographies for our research workers. It should also prove useful in patent research."

R. L. Wolff
Vice-President Engineering
Centralab Division
Milwaukee, Wisc.

"Your new editorial feature International ELECTRONIC SOURCES appearing in the January issue of TELE-TECH & ELECTRONIC INDUSTRIES was read in detail and was well received.
I am sure that this will prove to be a very desirable service for many engineers and management people.
I shall look forward to reading this new feature in your magazine each month."

C. E. Ramich
Manager of Engineering
Electronic Tube Division
Westinghouse Electric Corp.
Elmira, N.Y.

"I like the new section."

F. X. Lamb
Chief Engineer
Weston Electrical Instrument Corp.
Newark, N.J.

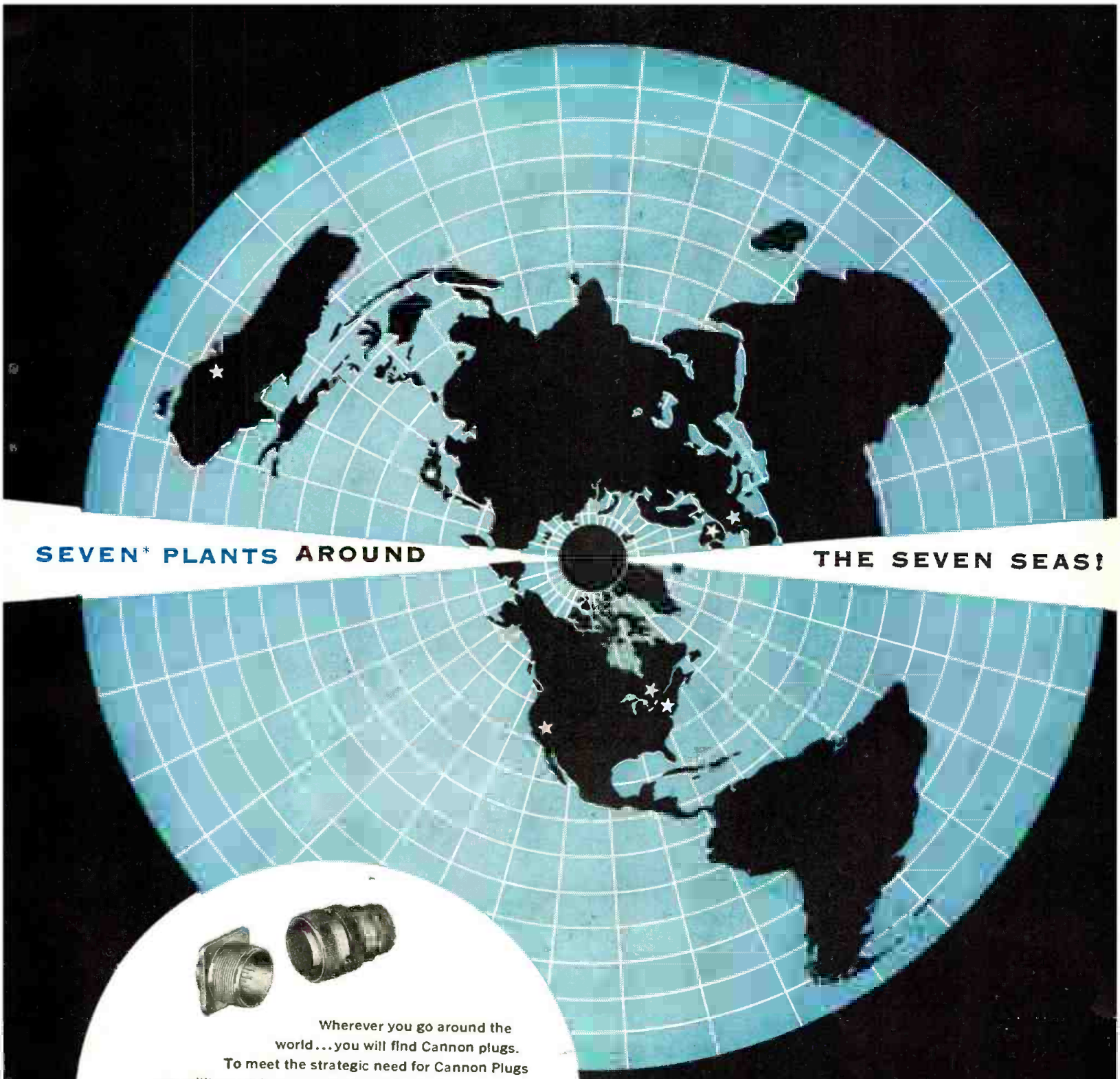
"Excellent idea, well prepared in the form you are publishing."

K. A. Hoagland
Engineering Manager
Cathode Ray Tube Division
Allen B. DuMont Labs.
Clifton, N.J.

"I am most favorably impressed by your initial International Electronic Sources feature in the January TELE-TECH."

J. B. Berkley
Light Military Electronic Equip. Dept.
General Electric Co.
Utica, N.Y.

(*Continued on page 28*)



SEVEN* PLANTS AROUND THE SEVEN SEAS!

Wherever you go around the world...you will find Cannon plugs. To meet the strategic need for Cannon Plugs on military and commercial aircraft, electronic gear, radio and TV installations and countless other types of electrical equipment the world over, Cannon Electric has established overseas manufacturing facilities with leading electronic manufacturers for area markets outside the U.S.A. Cannon pioneered the multi-contact electrical connector in the 1920's. Again Cannon is pioneering on an international scale as the largest exclusive connector manufacturer, with the widest variety of connectors available anywhere.

*With a group of 4 plants in the Los Angeles area, one in East Haven, Connecticut, one in Toronto, Canada, affiliates or licensees in London, Paris, Melbourne and Tokyo, Cannon actually has 10 plants; also, representatives in Cuba and Mexico.

SINCE 1915 CANNON ELECTRIC

CANNON PLUGS

CANNON INTERNATIONAL

please refer to dept. 201 CANNON ELECTRIC CO., LOS ANGELES 31, CALIFORNIA

FOR THE STORY ON THE FULL LINE...WRITE FOR THE "CANNON PLUG GUIDE"...YOUR INTRODUCTION TO QUALITY CANNON CONNECTORS AVAILABLE AROUND THE SEVEN SEAS!

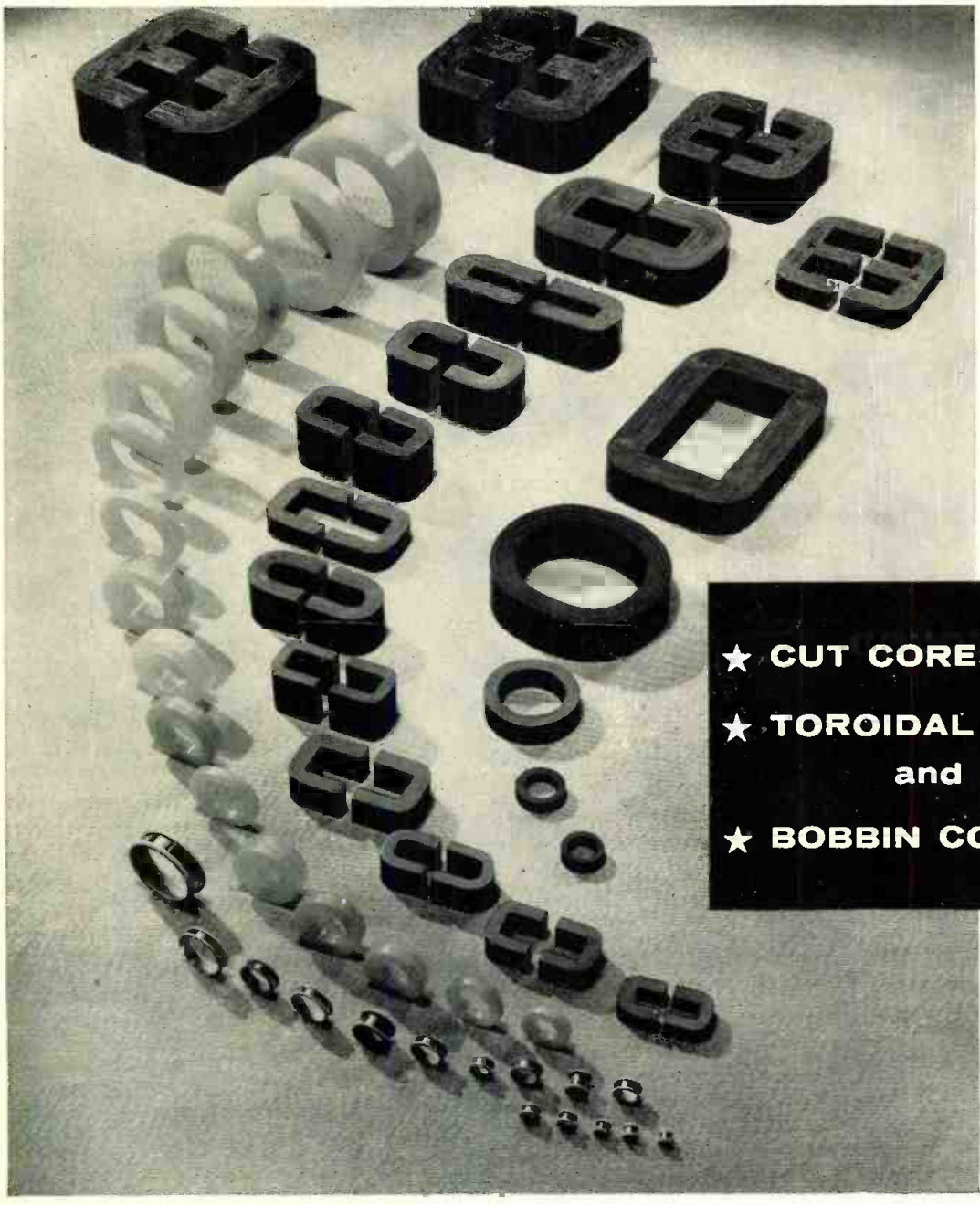
Military

All-purpose

Audio

Miniatures and Sub-Miniatures

"Unit-plug-in"



★ CUT CORES, Types C and E

★ TOROIDAL CORES, Cased and Uncased

★ BOBBIN CORES

It's ARNOLD for EVERYTHING in TAPE-WOUND CORES

Applications

Let us help you with your core requirements for Pulse and Power Transformers, 3-Phase Transformers, Magnetic Amplifiers, Current Transformers, Wide-Band Transformers, Non-Linear Retard Coils, Reactors, Coincident Current Matrix Systems, Static Magnetic Memory Elements, Harmonic Generators, etc.

For Complete Details

Write for Bulletins:

★ SC-107—Cut Cores, Types C and E
★ TC-101A—Toroidal Cores, cased and uncased
★ TC-108—Bobbin Cores

ADDRESS DEPT. T-62

MATERIALS: Deltamax, 4-79 Mo-Permalloy, Supermalloy, Mumetal, 4750, Monimax, Silectron, Permendur: all are available for tape wound core applications. The choice of material will depend upon the specific properties required.

GAUGES: The following standard tape thicknesses are available for Arnold tape wound cores in most of the magnetic materials mentioned above: .012", .004", .002", .001", .0005", or .00025". Bobbin cores are made from tape .001" to .000125" thick.

SIZES: Cores weighing from a fraction of a gram to many hundreds of pounds can be supplied. Toroidal cores are made in 27 standard sizes with nylon cases. Types "C" and "E" cut cores are made in a total of 530 standard sizes. Many special sizes and shapes of both gapless and cut cores are manufactured for unusual requirements. ● *Let us work with you.*

W&D 5618

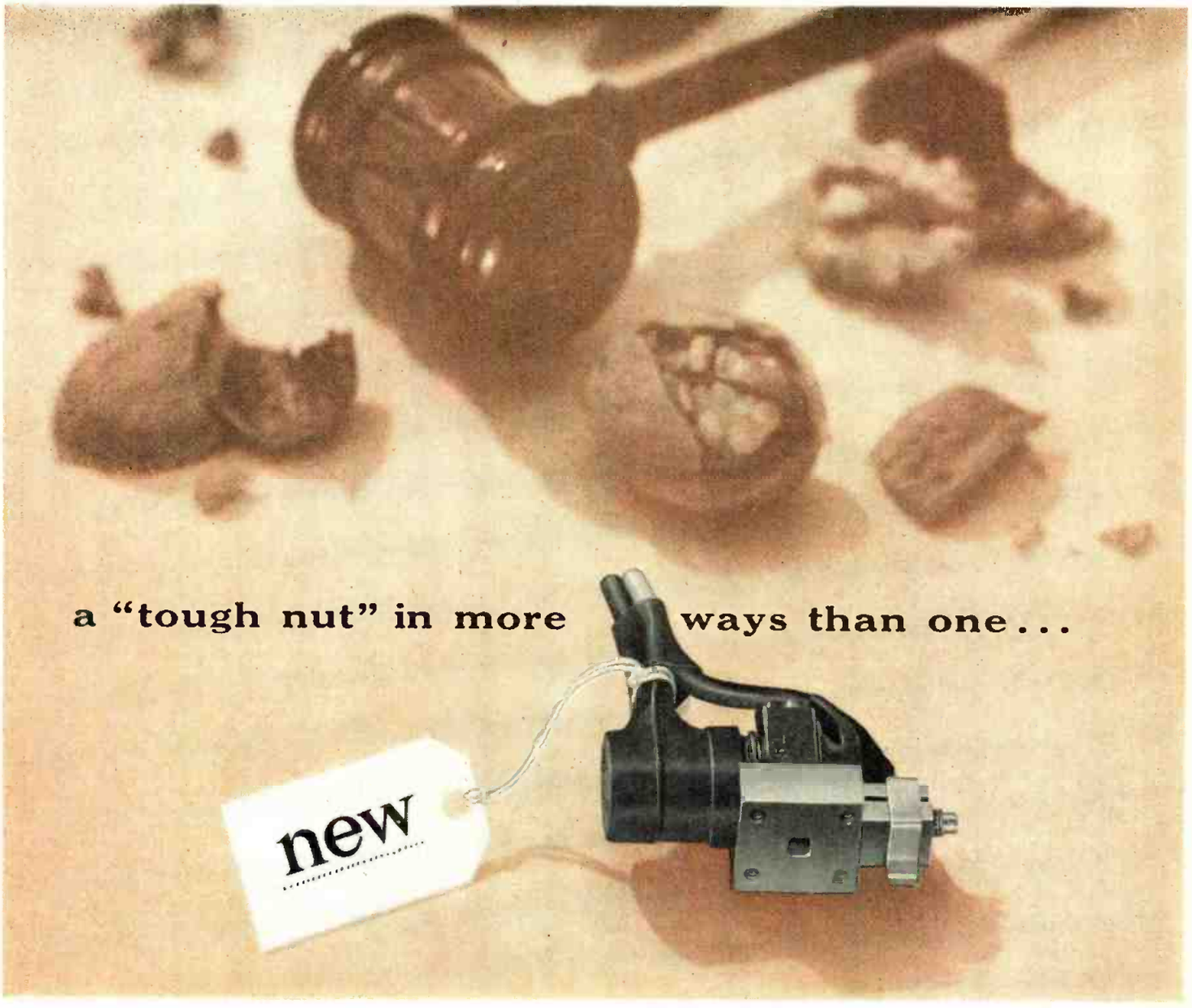
THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

DISTRICT SALES OFFICES . . . New York: 350 Fifth Ave.

Los Angeles: 3450 Wilshire Blvd. Boston: 200 Berkeley St.



IT'S THE NEW VARIAN VA-97 KLYSTRON . . . a tough, reliable local oscillator tube with performance and design features unmatched by any other klystron in the frequency range of 34.0 to 35.6 kMc . . . ideal as the microwave power source for airborne radar and similar applications.

RUGGED — provides reliable operation under severe environmental conditions.

COMPACT — small size and light weight takes up less high premium aircraft space.

HIGH PERFORMANCE AT LOW VOLTAGE — means better equipment design.

EXCEPTIONAL FREQUENCY STABILITY under all conditions, due to Varian's advanced external tuning cavity design.

SLOW TUNING — gives you more reliable system operation with less maintenance.

RATED FOR USE AT ANY ALTITUDE without pressurization.

These important features allow maximum latitude in equipment design and result in savings of time, space and money. A companion klystron — the VA-94 — is also available, providing comparable performance characteristics in a frequency range of 16.0 to 17.0 kMc.

	Frequency	Resonator Voltage	Power	Electronic Tuning Range
VA-97	34.0 - 35.6 kMc	400 V	15 mW	90 Mc
VA-94	16.0 - 17.0 kMc	300 V	40 mW	75 Mc

FOR TEST EQUIPMENT AND LABORATORY MEASUREMENT . . . Varian's V-39C and V-40C klystrons feature separate external cavities that afford an extremely wide tuning range for testing and laboratory research applications, in frequency ranges between 10.0 and 21 kMc.

NEW VARIAN KLYSTRON CATALOG . . . Now available, this fully-illustrated 16-page catalog describes the complete line of commercially available Varian klystrons and related microwave equipment.

Write for your copy today.

THE MARK OF LEADERSHIP

VARIAN associates

PALO ALTO 10 CALIFORNIA

Representatives in all principal cities.

KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, R.F. SPECTROMETERS, MAGNETS, STALOS, UHF WATERLOADS, MICROWAVE SYSTEM COMPONENTS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES

Letters . . .

(Continued from page 24)

"I would like to compliment your magazine on its spirit of pioneering in service to its engineering readers."
"Tele-Tech's new section Electronic Sources is a section which I and every engineer will consider 'must' reading."

J. T. Heller
Chief Engineer
The Gudeman Co.
Chicago, Ill.

"Congratulations! Tele-Tech has again recognized the problem confronting so many engineers today and done something about it."

K. J. Bassett
Section Engineer
General Electric Co.
Utica, N.Y.

"An excellent addition to your already fine publication."

W. E. St. Vrain
Chief Engineer
Mosley Electronics Inc.
8622 St. Charles Rock Rd.
St. Louis 14, Mo.

"International Electronic Sources—an excellent idea—very useful."

M. Nowogrodzki
Design Leader
RCA Tube Division
Harrison, N.J.

"Excellent idea.—Have put it to good use already."

A. MacDonald
Chief Engineer
Communications & Electronics Div.
Motorola Inc.
Chicago, Ill.

"Time saving and informative . . ."

J. L. White
Chief Engineer
Bell Sound Systems
Sub-Thompson Products
Columbus, Ohio

"I like the idea. . . . How about photocopy service?"

W. T. Freeland
Chief Engineer
Standard TV Tube Co.
New Orleans, La.

We're working on this. . . . Ed

"Hi-Fi TV"

Editors, Tele-Tech:
I have a suggestion to make. Why not "Hi-Fi" TV? We have FM, requiring a much wider bandwidth than AM, and serving a useful, if uneconomic purpose in providing music lovers with good music and minimum commercials. Recent tests have even been made with

(Continued on page 32)

CORPORAL E

MOTOROLA
control unit

MOTOROLA
R. F. unit

MOTOROLA
power supply

STAR PERFORMER
WITH PRECISION GUIDANCE

Motorola's precision engineering in the missile field has made a major contribution along with Jet Propulsion Laboratories in the development of Corporal E

navigational devices • radar • countermeasures • analog computers
communications equipment • digital computers • data transmission
data processing and presentation indicators
plotting systems • telemetering
remote control • servomechanisms
transistor circuitry • operations research
dynamic systems analysis • subminiaturization
solid state physics • semi conductor research • transistor development

carrier | *transmitters*
VHF | *receivers*
UHF | *multiplexing*
microwave | *systems*

Positions open to qualified Engineers and Physicists

MOTOROLA

COMMUNICATIONS & ELECTRONICS DIVISION

4501 AUGUSTA BLVD. • CHICAGO, ILL. • Laboratories • Phoenix, Arizona and Riverside, California

DESIGNERS

for MISSILE SYSTEMS

■ *New activities at Lockheed Missile Systems Division have created positions for Designers capable of performing* creative basic layout and design of structural, mechanical, electro-mechanical and electronic packaging of missile assemblies and components.

■ *Those who will qualify will cope with new problems in a field of scientific endeavor that grows daily in complexity.* A knowledge of new materials, finishes, specifications and experience on small precision devices will prove helpful in meeting the challenge of Missile Systems research and development.

Those possessing a high order of ability applicable to these areas of endeavor are invited to write:

VARIED ASSIGNMENTS

Designers are not limited to specific functions under Missile Systems Division's philosophy of operation. Diversified assignments provide stimulating challenge, enable Designers to acquire the broadest possible background in the field of missile systems design. For example: it is not uncommon for a Missile Systems Designer to work on diverse problems in structures, controls, hydraulics, pneumatics, electro-mechanical packaging, fuel systems and other fields within the span of a few months.

Lockheed **MISSILE SYSTEMS DIVISION**

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION • VAN NUYS, CALIFORNIA

dependable controls

. . . backed by dependable service in matching your specifications and delivery requirements.

STACKPOLE

Electronic Components Division

STACKPOLE CARBON COMPANY • *St. Marys, Pa.*

Letters . . .

(*Continued from page 28*)

FM and AM channels used for binaural sound transmissions. It seems to me that a real spurt would result in UHF TV business if somehow the channel assignments could be made wider in this range. Something like 800 line TV, for example, or some integer that would not be too drastic on set conversion. The main point being better resolution in pictures—it is my understanding that resolution is not limited by tubes at this time. The advertising potential of "HI-FI TV" would certainly be tremendous (save your eyes, see a quality picture, get hi-fi TV from your dealer today, etc.).

R. W. Johnson
Electronic Engineer
1202 Avoca Ave.,
Pasadena 2, Calif.

Dynistor

Editors, Tele-Tech:

I am writing you to suggest the use of the term "DYNISTOR" as a generic term to describe those substances, materials, etc., whose resistance characteristics vary with applied pressure. The term has an euphonious sound and is based upon a rational association of ideas.

C. J. Risney
Newark, N.J.

Neon Indicator

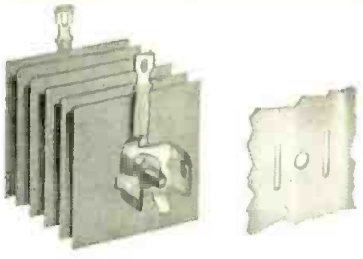
Editors, Tele-Tech:

I was very interested in your article on a neon Blown Fuse Indicator, which appeared in the October 1955 issue of TELE-TECH magazine, under "Cues for Broadcasters."

I would like to suggest that you caution your readers about their selection of a neon bulb. The use of a neon bulb requires a series resistance of about 125,000 to 220,000 ohms, on 125 v. circuits, to limit the current after the neon gas has been ionized. Without this resistance, the current will rise to a very high value and the bulb destroyed. In some instances the neon bulb is complete with an internal resistor, while in others, an external resistor must be added to provide proper operation. To make certain that this resistor is taken into consideration, it would be desirable to modify your wiring diagram to show the resistance in series with the neon bulb leg of the circuit.

As a matter of interest, the Bussmann Manufacturing Company, St. Louis, Missouri has several combination fuseholder and blown fuse indicating items, intended for just such application as you described.

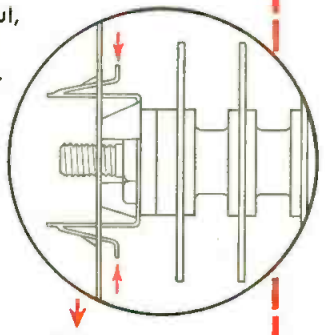
Nat Kronstadt
Engineering Representative
3009 Erie St. S.E.
Washington 20, D. C.



NEW Federal CLIP-IN RECTIFIERS

Spring-steel clip eliminates bolting rectifier to chassis!

Steel spurs and powerful, curved counter-springs grip chassis wall tightly. A rigidly-locked, wobble-free mounting results . . . yet the rectifier can be easily removed by compressing the release prongs.



Lock rigidly in place . . . yet are instantly removable!

ADVANTAGES FOR MANUFACTURERS:

- Cut production costs.
- Increase speed of assembly. (Using both hands, rectifiers can even be mounted *two at a time*.)
- Mounting nuts and lock washers are eliminated.
- No need for nut-driving power tools.
- No more stripped threads, jammed studs or skewed plates.
- Simple chassis cut-outs.

ADVANTAGES FOR SERVICEMEN:

- Rectifiers are easily removable from the accessible side of the chassis . . . unnecessary to pull the chassis.
- Clip-in mounts are self-adjusting to all chassis thicknesses.
- Terminals take both soldered and solderless connections.

Why not send for more information before you consider any further expenditures for tooling. Call NUtley 2-3600 or write to Dept. F-366.

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

Federal
A DIVISION OF I T & T

PERFORMANCE-GUARANTEED

Tape Wound Cores

COST NO MORE - WHY TAKE LESS?

You save, because there can be no waste with the industry's only *Performance-Guaranteed* Tape Wound Cores. You also get the widest choice of standard sizes, and for a slight additional cost can specify your tape wound cores in the remarkable Aluminum Core Box* in any size. For complete details, why not write for your copy of Magnetics, Inc. Catalog TWC-100 today?

MAGNETICS, INC., DEPT. TT-23, BUTLER, PA.

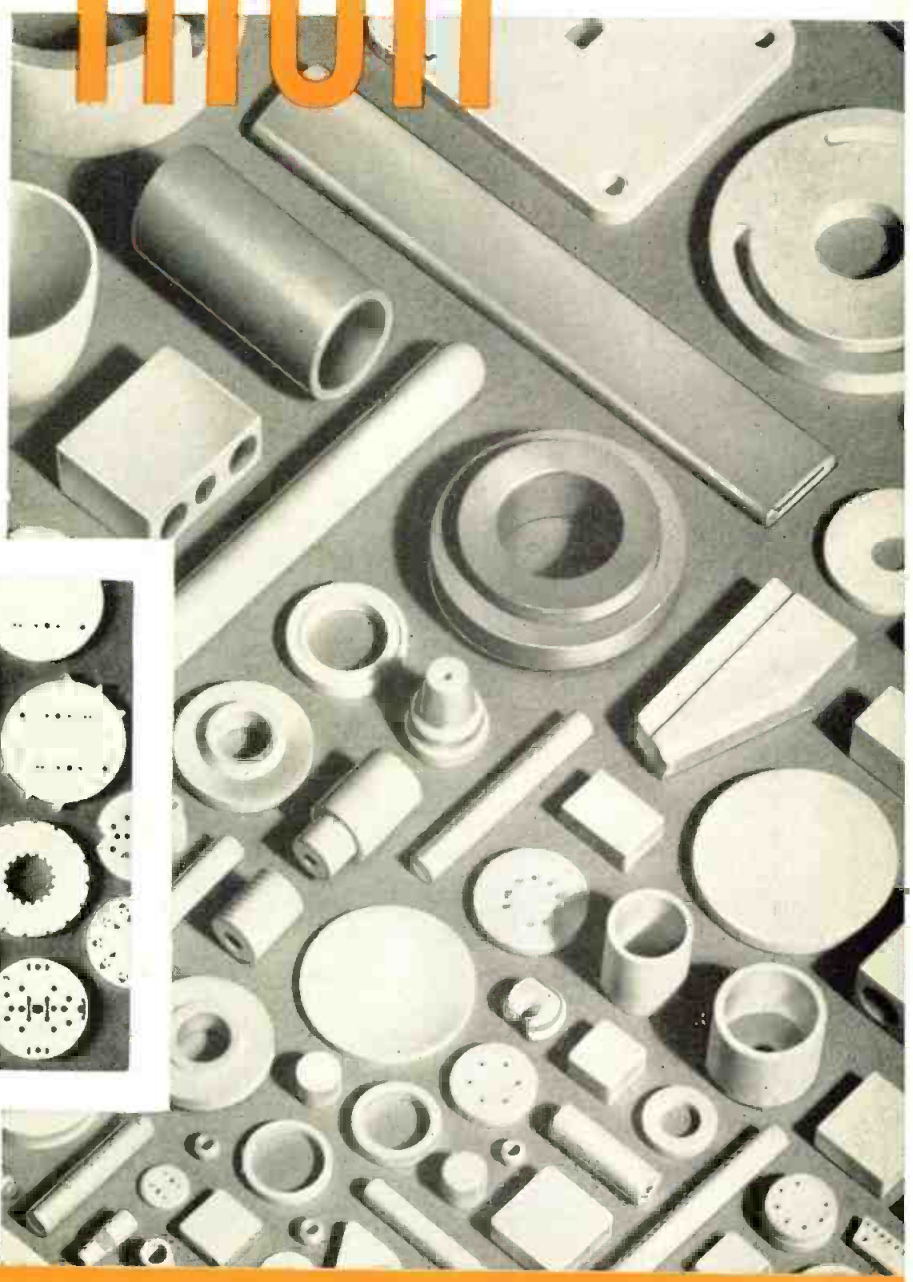
MAGNETICS inc.

*patent pending

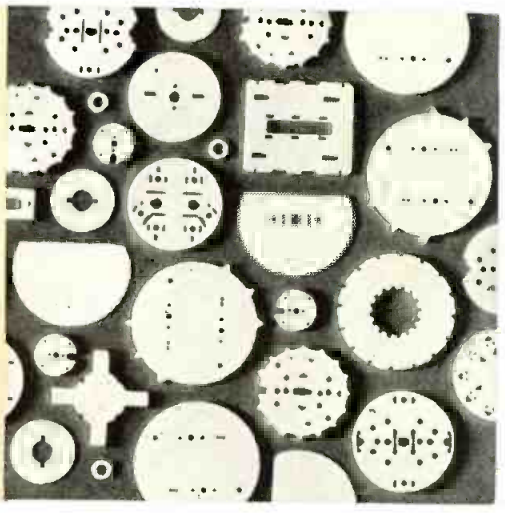
AlSiMag® advanced ALUMINA CERAMICS

with new HIGH temperature strength quality production

Greatly enlarged facilities now produce high quality, pace-setting AlSiMag Alumina ceramics in quantity lots. Complete range of up-to-the-minute Alumina compositions now permit you to design to higher temperatures and higher strengths. Advantages include improved electrical characteristics at elevated temperatures—beyond the melting point of most metals. Higher tensile and impact strengths. Greater resistance to corrosion and abrasion. Smoothness of texture. Close dimensional tolerances. Custom formulations for special needs.



Volume production in a complete range of precision parts, including electron tube shapes processed to be highly porous, readily degassed, thicknesses as low as .009".



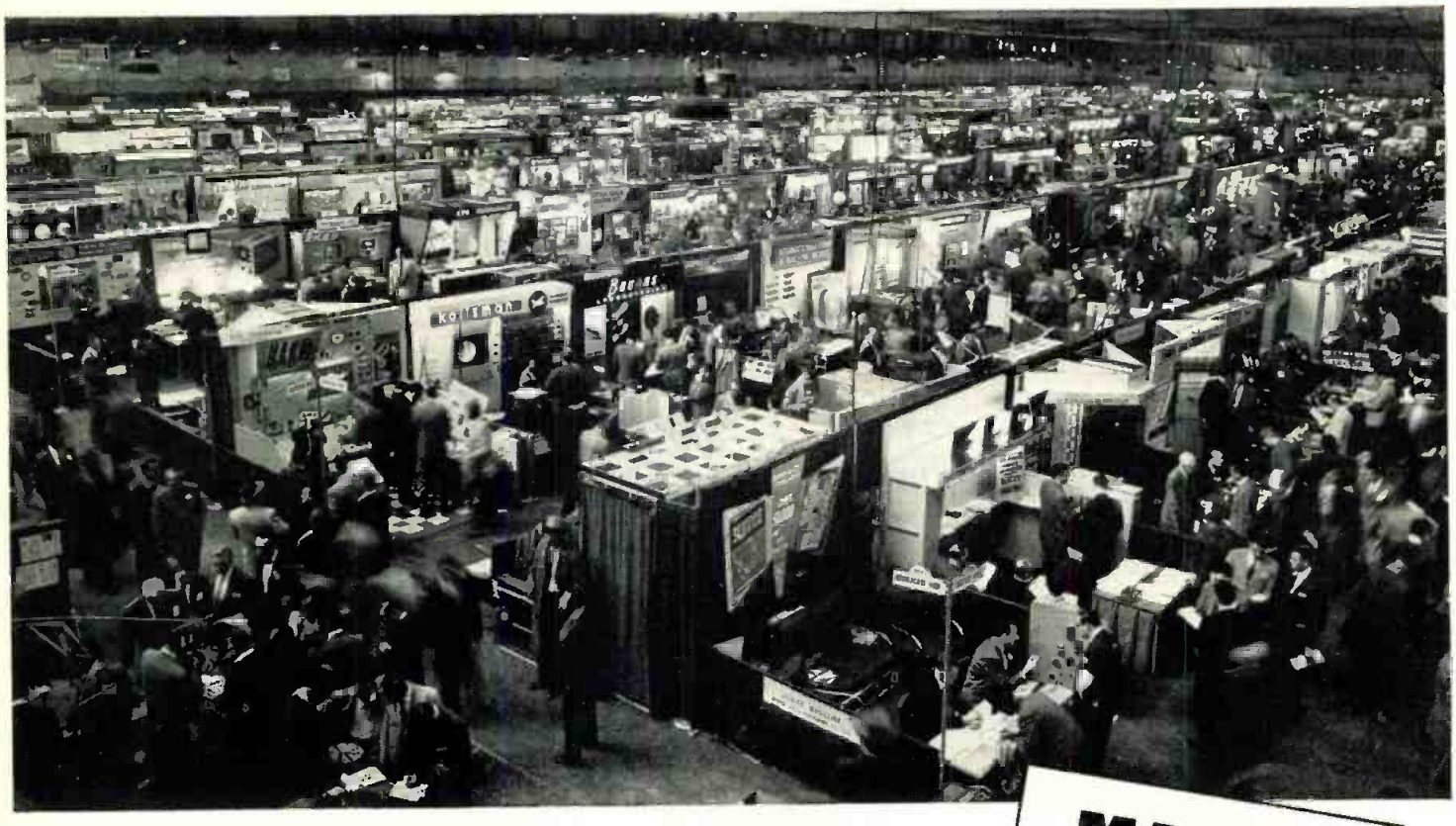
• An outline of your requirements, enclosing a blueprint or sketch, will bring you full details.

54TH YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE
A Subsidiary of
Minnesota Mining and Manufacturing Company

Branch offices in these cities (see your local telephone directory): Cambridge, Mass. • Chicago, Ill. • Cleveland, Ohio • Dallas-Houston, Texas • Indianapolis, Ind. • Los Angeles, Calif. • Newark, N. J. • Philadelphia, Pa. • St. Louis, Mo. • South San Francisco, Calif. • Syracuse, N. Y. • Tulsa, Okla. **Canada:** Irvington Varnish & Insulator Div., Minnesota Mining & Mfg. of Canada, Ltd., P. O. Box 757, London, Ontario. **All other export:** Minnesota Mining & Mfg. Co., International Division, 99 Park Ave., New York, N. Y.



MARCH 19 - 22

How BIG must the show be?

When a facetious critic asked, "How long should a man's legs be?" Abraham Lincoln replied, "Long enough to reach the ground!"

The 1956 Radio Engineering Show is big only because it *must be big* to be truly representative of a gigantic industry. 704 exhibitors, 1 out of every 5 firms manufacturing for the industry, will be present.

But these 704 firms represent over 80% of the industry's production. A smaller Show would give only an inadequate picture of the year's progress and new developments.

Being BIG pays off! This truly great event brings out the best...in people, effort and products!

Registration—IRE Members $1.00
Non-members $3.00

What you get out of it!

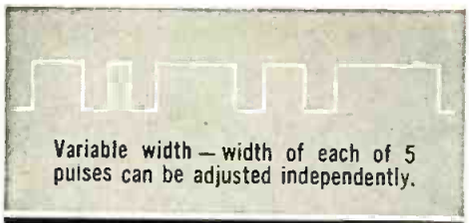
- You see what is new in radio-electronic products and engineering!
- You meet the men who make these products!
- You save time...seeing in days a whole year's productive effort!
- You hear the best technical papers in subjects of your own specialty!
- You meet old friends and make new ones, enjoy association and social events!

The IRE National Convention

Waldorf Astoria Hotel, New York City

and RADIO ENGINEERING SHOW

Kingsbridge Armory & Palace, New York City



Variable width — width of each of 5 pulses can be adjusted independently.

Variable delay—delay between each of 5 pulses can be adjusted independently.

CODE MODULATED MULTIPLE-PULSE MICROWAVE SIGNAL GENERATOR Model B

Pulse-time modulation—input provided in each of 5 pulse channels for external pulse-time modulation.

Variable repetition rate—repetition rate of each group of pulses can be varied.

CODE MODULATED MULTIPLE-PULSE MICROWAVE SIGNAL GENERATOR

Model B 950-10,750 mc

Generates multi-pulse modulated carrier for beacons, missiles, radar... provides 5 independently adjustable pulse channels, 4 interchangeable r-f oscillator heads, precision oscilloscope, self-contained power supplies ...all in one integrated mobile instrument.

The Polarad Model B is an essential instrument for testing beacons, missiles, radar, navigational systems such as DME, Tacan, H. F. Loran, etc., where multi-pulse modulated, microwave frequency energy with accurately controlled pulse width, delay, and repetition rate is required for coding.

A fully integrated self-contained equipment with these features:

Four Interchangeable Microwave Oscillator Units — all stored in the instrument... each with UNI-DIAL control... precision power monitor circuit to maintain 1 mw power output reference level... keying circuit to assure rapid rise time of modulated r-f output... non-contacting chokes.

Five Independently Adjustable Pulse Channels —each channel features variable pulse width and delay; has provisions for external pulse-time modulation.

Precision Oscilloscope with Built-In Wide Band RF Detector for viewing the modulation envelope and accurately calibrating the r-f pulse width, delay, and group repetition rate. Equipped with built-in calibration markers.

Self-Contained Power Supplies—Model B operates directly from an AC line through an internal voltage regulator. The coded multi-pulse generator is equipped with an electronically regulated low voltage DC supply. Klystron power unit adjusts to proper voltage automatically for each interchangeable band.

Contact your Polarad representative or write to the factory for detailed information.

SPECIFICATIONS:

Frequency Range:
- Band 1 . . . 950 to 2400 mc
- Band 2 . . . 2150 to 4600 mc
- Band 3 . . . 4450 to 8000 mc
- Band 4 . . . 7850 to 10,750 mc

Frequency Accuracy . . . ±1%
RF Power Output . . . 1 milliwatt maximum (0 DBM)
Attenuator:
- Output Range . . . D to —127 DBM
- Output Accuracy . . . ±2db
- Output Impedance . . . 50 ohms nominal

RF Pulse Characteristics:
- a. Rise Time . . . Better than 0.1 microsecond as measured between 10 and 90% of maximum amplitude of the initial rise.
- b. Decay Time . . . Less than 0.1 microsecond as measured between 10 and 90% of maximum amplitude of the final decay.
- c. Overshoot . . . Less than 10% of maximum amplitude of the initial rise.

Internal Pulse Modulation:
- No. of Channels . . . 1 to 5 Independently on or off
- Repetition Rate . . . 40 to 4000 pps
- Pulse Width . . . 0.2 to 2.0 microseconds
- Pulse Delay . . . .0 to 30 microseconds
- Accuracy of Pulse Setting . . . 0.1 microsecond
- Minimum Pulse Separation . . . 0.3 microsecond
- Initial Channel Delay . . . 2 microseconds from sync. pulse
- Internal Square Wave . . . 40-4000 pps (separate output)

Pulse Time Modulation:
- Frequency . . . 40-400 cps any or all channels
- Required Ext. Mod. . . . 1 volt rms min.
- Maximum deviation . . . ±0.5 microsecond

Power Input (built-in power supply) 105/125 v. 60 cps 1200 watts.

AVAILABLE ON EQUIPMENT LEASE PLAN

FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

POLARAD PROVEN RELIABILITY **ELECTRONICS CORPORATION** 43-20 34th STREET, LONG ISLAND CITY 1, N. Y.

REPRESENTATIVES • Albuquerque • Atlanta • Baltimare • Boston • Buffalo • Chicago • Dayton • Englewood • Fort Worth • Los Angeles • New York Philadelphia • San Francisco • Syracuse • Washington, D. C. • Westbury • Winston-Salem • Canada, Arnprior, Toronto—Export: Rocke International Corporation

TELE-TIPS

NEEDLE TALK. Cute sales pitch by prominent stylus manufacturer begins: "The story you are about to hear is true. Only the needle has been changed—to a Jensen—to protect the record."

TUBE PACKAGING MACHINE recently installed at Westinghouse' Elmira, N. Y. plant packages 200 receiving tubes per minute, 96,000 in an 8-hour day.

TOP CORPORATE EXECUTIVES last year failed to get salary raises proportionate to those they gave their hourly workers. Their incomes increased an average of only 1.8% while the hourly rates in the manufacturing industries increased 5%.

THE NARTB now has 1,999 members, a gain of 160 or 10.4% over a year ago.

JERKMETER devised by NBS to study the action of the human heart is a piezoelectric accelerometer utilizing a barium titanate sensing element. Electrical output is proportional to jerk, the time derivative of acceleration.

RETMA BULLETIN, now available through the Engineering Office, 11 West 42 St., N. Y. 17, describes 122 publications and charts covering standards and test procedures.

ELECTRONIC DATA INTEGRATING SYSTEM (EDIS), designed by Minneapolis-Honeywell for Esso Standard Oil's Bayway, N. J. refinery, incorporates computing and quality evaluation with conventional automatic data-handling operations. The system automatically logs temperature, pressure, flow, power consumption and product quality. At the end of the day it totals up the figures. When not recording, the system monitors a number of critical points.

ELECTRONIC COMPONENTS ten times more reliable than those produced a few years ago are needed for their electronic interceptor control systems, reports Hughes Aircraft Co.

(Continued on page 42)

Highest Frequency Transistor...

Commercially Available Today!

PHILCO S-B-T (Surface Barrier Transistor)

Available now! . . . in quantity . . . Philco Surface Barrier Transistors are opening entirely new fields for design engineers . . . are being incorporated in high frequency units *now in production!* Commercial, industrial and military thinking is swinging over fast . . . to complete transistorization.

Philco has gained a wealth of experience in the practical application of Surface Barrier Transistors. Make the Philco S-B-T a part of your forward looking plans—now.

FEATURES

- **Lowest Power Consumption**
- **Hermetically Sealed Resistance-Welded Metal Case with Leads Sealed in Glass**
- **Long Life and Reliability of Operation**
- **Uniform Characteristics Insured by Controlled Processing and Complete Testing**
- **Extremely Low Collector Cut Off Current for Stable Operation**
- **Extremely Low Output Capacitance for Ease of Neutralization**

For complete technical information on the PHILCO SB Transistor write Dept. TT

PHILCO CORPORATION

GOVERNMENT AND INDUSTRIAL DIVISION • PHILADELPHIA 44, PENNSYLVANIA

The Standard of Accuracy for

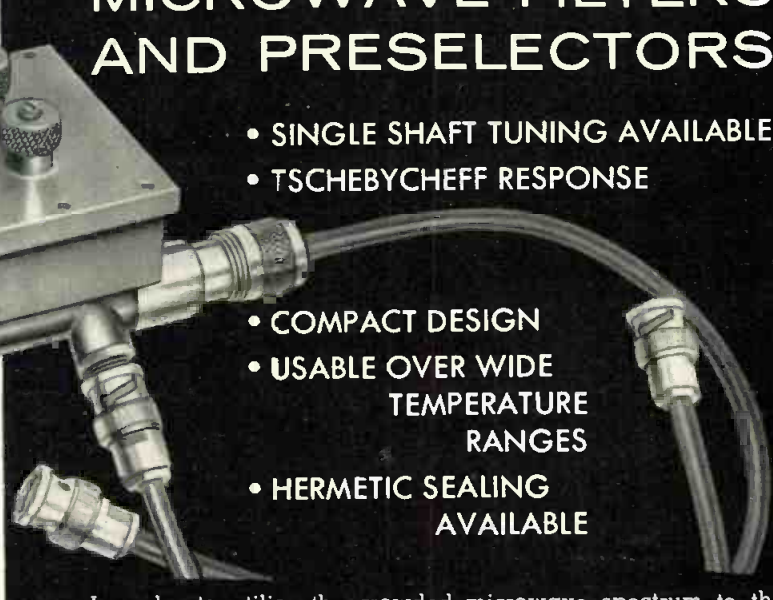
FREQUENCY MEASUREMENT and CONTROL

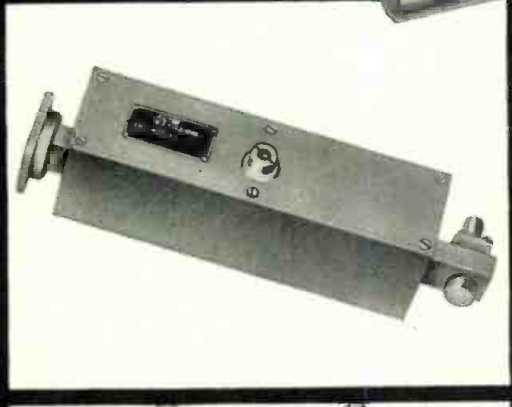
FREQUENCY STANDARDS

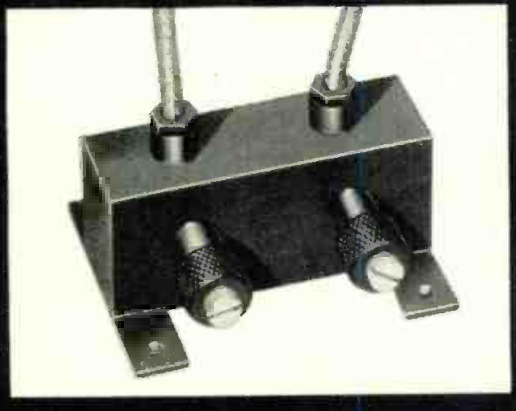
Offers a Comprehensive Line of—

MICROWAVE FILTERS AND PRESELECTORS

- SINGLE SHAFT TUNING AVAILABLE
- TSCHEBYCHEFF RESPONSE
- COMPACT DESIGN
- USABLE OVER WIDE TEMPERATURE RANGES
- HERMETIC SEALING AVAILABLE







In order to utilize the crowded microwave spectrum to the greatest possible advantage, Frequency Standards now offers a comprehensive line of filters and preselectors. These units are engineered and constructed with the same exacting care and precision which has made Frequency Standards' wavemeters a standard in the industry.

Frequency Standards is proud of its reputation to undertake development and production work in the fields of preselection, frequency measurement and control which approaches the "state of the art." Our engineering services are available at all times to assist you with your problems.

RESONANT FREQUENCIES AVAILABLE

	L	S	C	X
Bandwidth (Maximum available)	5%	3%	2%	1%
Number of Sections*	2, 3, 4	2, 3, 4	2, 3, 4	2, 3, 4
Insertion Loss (For % bandwidth)	≤ 1.5 db	≤ 1. db	≤ 1. db	≤ 1. db
Rejection ($F_0 \pm 2xBW$) (db)	24 36 48	24 36 48	24 36 48	24 36 48
Input VSWR (Matched Load)	≤ 1.5	≤ 1.5	≤ 1.5	≤ 1.5

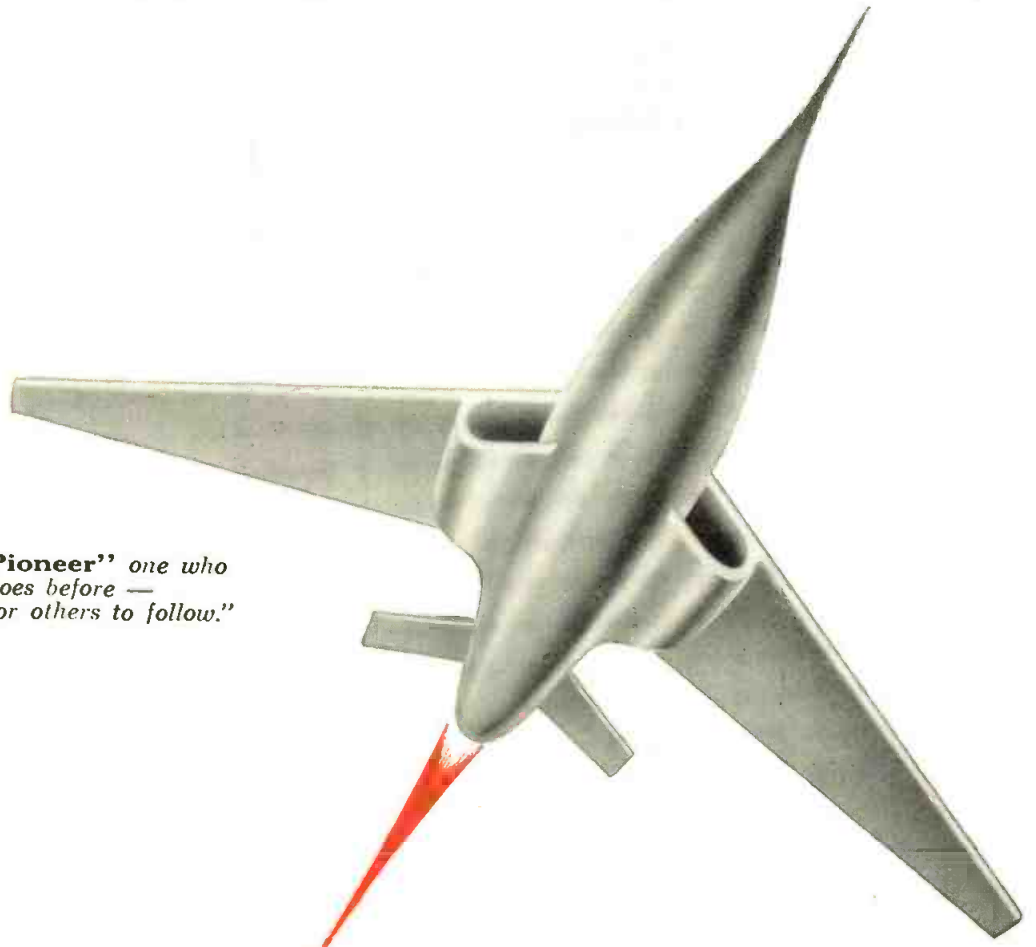
*More Sections Available without Gang Tuning.

NEW CATALOG ON REQUEST—Call or write for new Brochure with complete data on precision-built Microwave Filters, Preselectors, Frequency Meters and Field Test Instruments.

Frequency Standards

ASBURY PARK, NEW JERSEY

Please address inquiries to BOX 504A



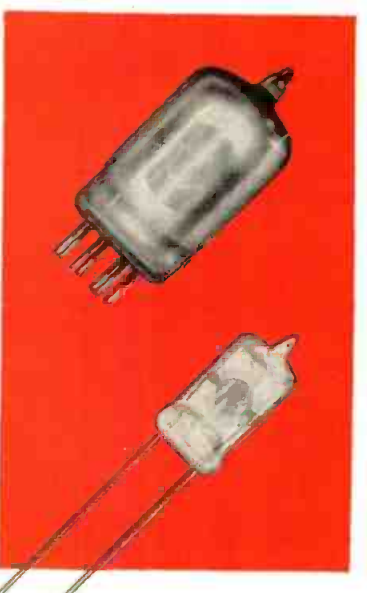
"Pioneer" *one who goes before — for others to follow."*

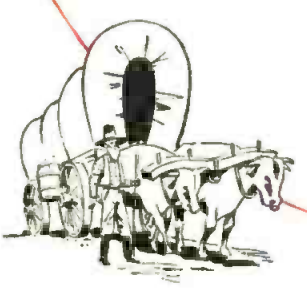
IF WEBSTER IS RIGHT —

Then Midland Has Done It Again, this time with

glass holders for crystals!

Absolute and permanent vacuum attainable *only* with glass, isolates the crystal from all factors detrimental to dependable performance. Truly, here are crystals designed with the future in mind — future requirements of application and design as well as the long life of the unit far into the future.





Midland MANUFACTURING COMPANY, INC.

3155 Fiberglas Road • Kansas City 15, Kansas

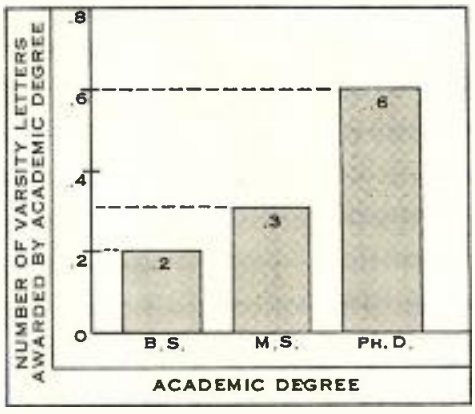
World's Largest Producer of Quartz Crystals

SIDELIGHTS ON THE SCIENTISTS *number* **3** *of a series*

Brain and Brawn

Some of the young fellows on our staff have been analyzing our files of personal data regarding scientists and engineers here at Hughes. What group characteristics would be found?

With additional facts cheerfully contributed by their colleagues they have come up with a score of relationships—some amusing, some quite surprising. We shall chart the most interesting results for you in this series.



Contrary to popular belief, higher academic study goes hand in hand with increased school athletic activity—as shown in the above chart. This is based on data obtained from a 20% random sample of the 2400 professional engineers and scientists of Hughes Research and Development Laboratories.

In our laboratories here at Hughes, more than half of the engineers and scientists have had one or more years of graduate work, one in four has his Master's, one in 15 his Doctor's. The Hughes research program is of wide variety and scope, affording exceptional freedom as well as exceptional facilities for these people. Indeed, it would be hard to find a more exciting and rewarding human climate for a career in science. Too, the professional level is being stepped up continually to insure our future success in commercial as well as military work.

Hughes is pre-eminent as a developer and manufacturer of airborne electronic systems. Our program includes military projects in ground and airborne electronics, guided missiles, automatic control, synthetic intelligence. Projects of broader commercial and scientific interest include research in semiconductors, electron tubes, digital and analog computation, data handling, navigation, production automation.

DUE TO THE *expanding use of Hughes electronic systems, new positions are open for engineers who have demonstrated ingenuity and inventive ability in the areas of product design.*

SCIENTIFIC STAFF RELATIONS

Hughes

RESEARCH AND DEVELOPMENT LABORATORIES

Culver City, Los Angeles County, California

TELE-TIPS

(Continued from page 38)

HAT-SIZE RADIO RECEIVERS have been ordered by the Newark, N.J. Police Dept. Two inches square, they fit inside regulation police caps, and provide one-way reception from HQ to the foot patrolman. Range is approximately 25 mi.

NEED A LAB? New or expanded lab facilities can be planned and financed through one agency. Service includes technical assistance and personnel recommendations as well, if desired. Write Chicago Apparatus Co., 1735 N. Ashland Ave., Chicago, Ill.

"ELECTRONIC GERM-KILLER" feature of Emerson's 1956 air conditioner is claimed to reduce airborne bacteria in a room to insignificant numbers.

TECHNICAL INFORMATION PROGRAM designed to keep American firms abreast of European technological developments is being undertaken by Armour Research Foundation. Program, called the "European Technical Observation Group," will be made available to a group of 16 noncompeting firms. The Foundation will set up an European office to funnel ideas and techniques of potential value in the American market to participating companies.

ULTRASONIC CLEANING METHODS have reduced the cleaning time of aircraft engine parts from several days to a matter of minutes.

3,800 MPH HURRICANES are produced in the new wind tunnel recently completed at Arnold Engineering Development Center, Tullahoma, Tenn. to test supersonic aircraft and guided missile equipment. Unit incorporates four Westinghouse motors totaling 216,000 hp.

"NOISE INDEX" for instrument cables, developed by NBS, provides readily-interpreted data for reducing cable noise produced by spurious voltages in hearing aids, phono pickups or crystal microphones.

Fifteen Watts Output

from 50 cycles to 15 kilocycles

The popular G-R Type 1233-A Power Amplifier is finding wide application in the electronics and electro-acoustic laboratory where a source of audio and r-f amplification of very high gain and flat frequency response is often needed.

The Type 1233-A Amplifier has three output combinations:
20 c to 20 kc with 15 watts from 50 c to 15 kc; 8 watts at 20 c and 20 kc
20 kc to 1.5 Mc with 15 watts from 20 kc to 0.5 Mc; 8 watts at 1.5 Mc
20 c to 3 Mc voltage output, 150 v balanced and 50 v grounded

VERY LOW DISTORTION: less than 3% at rated output on all ranges

LOW INPUT VOLTAGE: less than 0.2 volt for full output

NOISE LEVEL: 20 c to 20 kc range, 60 db below 15 watts output; 20 kc to 1.5 Mc, 70 db below 15 watts; 20 c to 3 Mc, less than 0.6 v peak-to-peak balanced

EXCELLENT TRANSIENT RESPONSE: 20 c to 3 Mc approximately 0.1 μsec. rise time, with negligible overshoot

THREE-RANGE OUTPUT VOLTMETER: 150, 50, and 15 volts, full scale; accuracy ±5% of full scale

In one instrument this power amplifier supplies a source of a-f and r-f amplification of high gain, good waveform and very wide frequency range normally possible only in several amplifiers which would have to be constructed at considerably higher final cost.

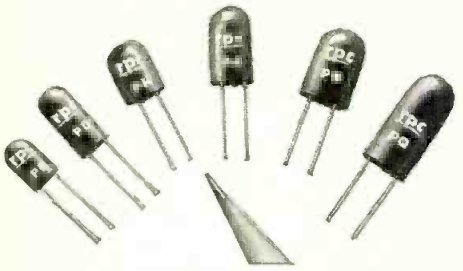
TYPE 1233-A Power Amplifier: $560.00

General Radio Company

275 Massachusetts Avenue, Cambridge 39, Massachusetts

90 West Street NEW YORK 6 — 8055 13th St., Silver Spring, Md. WASHINGTON, D. C.
1150 York Road, Abington, Pa. PHILADELPHIA
920 S. Michigan Ave. CHICAGO 5 — 1000 N. Seward St. LOS ANGELES 38

ADMITTANCE METERS
AMPLIFIERS
COAXIAL ELEMENTS
DISTORTION METERS
FREQUENCY MEASURING APPARATUS
FREQUENCY STANDARDS
IMPEDANCE BRIDGES
LIGHT METERS
MEGOHMMETERS
MODULATION METERS
MOTOR CONTROLS
NULL DETECTORS
OSCILLATORS
PARTS & ACCESSORIES
POLARISCOPES
PRECISION CAPACITORS
PULSE GENERATORS
R-L-C DECADES
R-L-C STANDARDS
SIGNAL GENERATORS
SOUND & VIBRATION METERS
STROBOSCOPES
TV & BROADCAST MONITORS
U-H-F MEASURING EQUIPMENT
UNIT INSTRUMENTS
VARIACS
V-T VOLTMETERS
WAVE ANALYZERS
WAVE FILTERS



NEW **Printed Circuit Precision Resistors**

To meet the requirements for printed circuitry, RPC has developed Type P Encapsulated Wire Wound Precision Resistors. Miniature, single ended units designed for easy rapid mounting on printed circuit panels with no support other than the wire leads. Many newly developed techniques are employed in the manufacture of Type P Resistors. These units can be operated in ambient temperatures up to 125°C. and will withstand all applicable tests of MIL-R-93A, Amdt. 3. Available in 6 sizes, rated from 1/10 watt to .4 watt. ¼" diameter by 5/16" long to ⅜" diameter by ¾" long. Resistance values to 3 megahms. Tolerances from 1% to 0.05%.

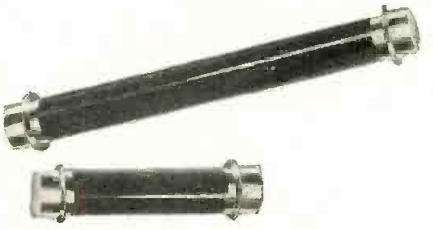
rpc

HIGH QUALITY RESISTORS FOR ELECTRONICS

RPC is a widely recognized supplier of high quality resistors to industry, Government Agencies and the Armed Forces. Advanced production methods, modern equipment and scientific skill enables RPC to manufacture resistors of *highest quality* in *large quantities* at *reasonable cost*. Modern manufacturing plant is completely air conditioned and equipped with electronic dust precipitators to insure highest production accuracy. RPC resistors are specified for use in instruments, electronic computers, radiation equipment, aircraft equipment and scientific instruments.

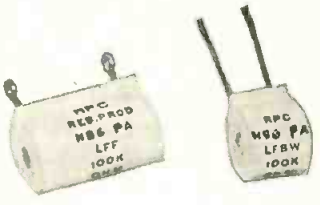
Test equipment and standards for checking and calibrating are equalled by only a few of this country's outstanding laboratories. Our ability to produce resistors of highest quality coupled with prompt delivery have established RPC as a leading manufacturer of resistors. Small or large orders are promptly filled.

Representatives in principal cities. For full information send for latest catalog.



Wire Wound Precision Meter Multiplier Resistors

Type MFA and MFB High Voltage Wire Wound Resistors are Hermetically Sealed in glazed steatite tubes with ferrule ends for maximum protection against all adverse environmental conditions. Fully meet all requirements of JAN-R-29. Special multi-section winding insures greatest safety factor due to low voltage gradient between sections. Standard resistors up to 6 megohms, 6 KV, 0.5% tolerance. Higher resistance and closer tolerances available. MFA 9-25/32 inches long x 1 1/32 inches diameter. MFB 5 5/32 inches long x 1 1/32 inches diameter.

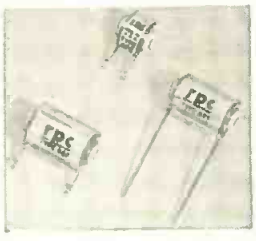


Encapsulated Precision Wire Wound Resistors

RPC Type L Encapsulated Resistars will withstand temperature and humidity cycling, salt water immersion and extremes of altitude, humidity, corrosion and shock without electrical or mechanical deteriaration. Type L resistors are available in many sizes and styles ranging from sub-miniature to standard with lug terminals, axial or radial wire leads. Available for operation at 105° C. or 125° C. ambient temperatures. These resistors will meet all applicable requirements of MIL-R-93A, Amdt. 3. Type L can be furnished with all resistance alloys and resistance tolerances from 1% to .02%.

High Voltage Resistors

Type B Resistors are stable compact units for use up to 40 KV. These resistars are used for VT voltmeter multipliers, high resistance voltage dividers, bleeders, high resistance standards and in radiation equipment. They can be furnished in resistance to 100,000 megohms. Available as tapped resistars and matched pairs. Sizes range from a 1 watt resistar 1 inch long x 5/16 inch diameter rated at 3500 volts, to a 10 watt resistor 6½ inches long x 5/16 inch diameter rated at 40 KV. Low temperature and voltage coefficients. Standard resistance tolerance 15%. Tolerances of 10%, 5% and 3% available. Tolerance of 2% available in matched pairs.



Wire Wound Precision Resistors

Type A Precision Resistors are widely used for all general requirements. They are available in a wide variety of sizes, styles and terminal types. They can be furnished with all resistance alloys in tolerances from 1% to .02%. Type A will meet the requirements of MIL-R-93A, Amdt. 2, Characteristic B. Special winding techniques, impregnation and thermal aging result in resistors of exceptional stability. Matched resistors, networks and special assemblies can be supplied.

High Megohm Resistors

Type H Resistors are used in electrometer circuits, radiation equipment and as high resistance standards. Resistance available to 100 million megohms, (10^{14} ohms). For utmost stability under adverse conditions Type HSD and HSK Hermetically Sealed are recommended. Eight sizes from ⅞ inch to 3 inches long are available. Voltage rating to 15,000 volts. Low temperature and voltage coefficients. Standard resistance tolerance 10%. Tolerance of 5% and 3% available. Also matched pairs 2% tolerance.

RESISTANCE PRODUCTS CO.

914 S. 13th Street
HARRISBURG, PA.

Leaders in Electronics rely on Good-All Capacitors

. . . whether for a critical fraction of a second or for a long life of trouble-free performance. Our technical and production people gain real satisfaction from working out capacitor problems with design and component engineers. The confidence of these engineers in Good-All "know-how" has contributed greatly to our rapid growth in the industry

Our engineers are ready to work with you on special applications. Write, wire or phone for specifications and quotations.

MIL TYPES

Good-All produces a broad line of hermetically sealed tubular and bathtub capacitors to specifications MIL-C-25A. Custom designs of various metal enclosed styles can also be provided to your individual specifications

MYLAR TYPES

The space-saving size and extremely high IR of Good-All Mylar* types are ideal for many special purpose applications. These are available in several metal enclosed designs as well as in ceramic or plastic impregnated tubes.

*DuPont's trademark for polyester film.

GOOD-ALL ELECTRIC MFG. CO. Goodall Bldg. • OGALLALA, NEBRASKA

PERSONAL

Dr. Louis N. Ridenour, internationally known physicist and electronics expert, has been appointed as director of the research laboratories of Lockheed's Missile Systems div., Van Nuys, Calif.

William McAulay has been named Manager, Application Engineering of Eitel-McCullough, Inc., San Bruno, Calif.

Dr. Louis N. Ridenour

William McAulay

Dr. A. M. Zarem has resigned his positions as ass't. director and manager of the Southern California div. of the Stanford Research Institute to open his private consulting office at 727 W. 7th St., Los Angeles, Calif.

M. C. Mack has been appointed manager of engineering services for the Westinghouse Electronic Tube Division at Elmira, N.Y.

Donald O. Schwennesen has been appointed to the executive staff of the Magnetic Metals Co., Camden, N.J.

John H. Howard has been appointed as Manager of the Engineering Services Div. of the Burroughs Corp's. Research Activity at Paoli, Pa.

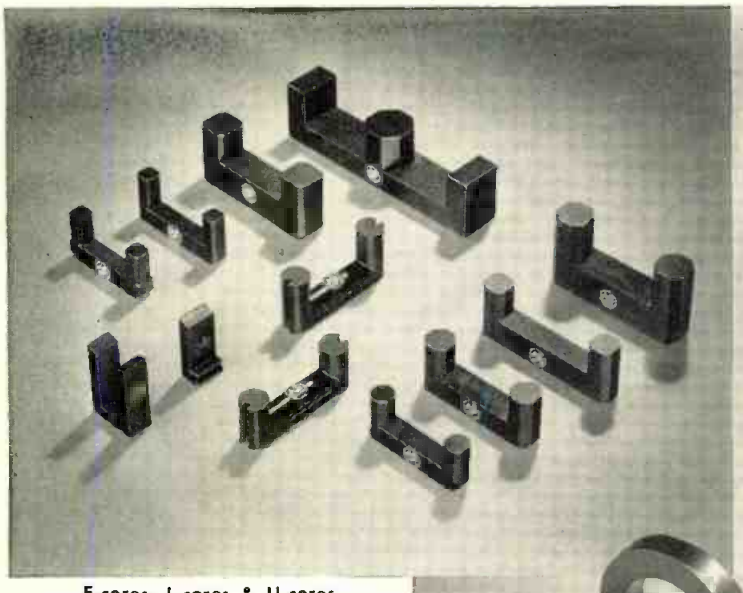
Donald O. Schwennesen

John H. Howard

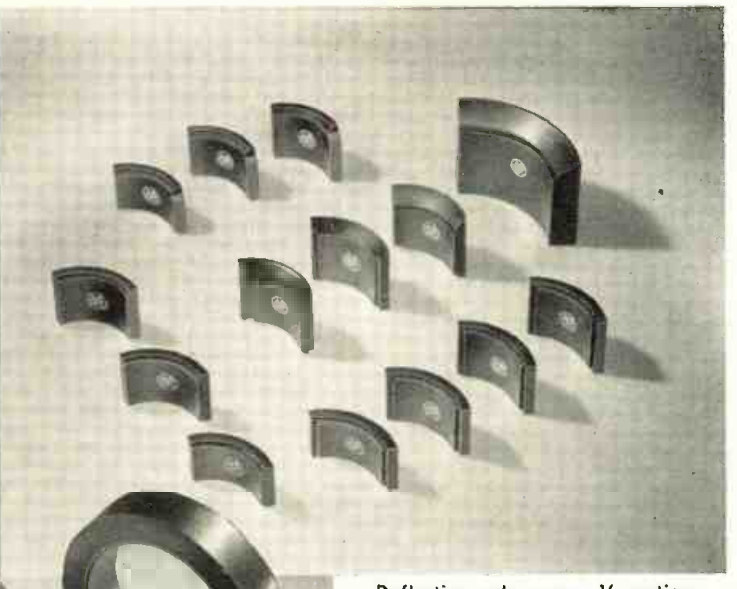
I. J. Kaar has been named to head the Color System Technical project designed to integrate the activities of several depts. involved in the color TV field at the General Electric Company.

Maurice L. Levy has been advanced to the post of Director of the Commercial Engineering Division at Emerson Radio and Phonograph Corp., New York City.

John Velesky, formerly Electronics Project Engineer, has been elevated to Chief Engineer at Wac Engineering Co., Dayton, Ohio.



E-cores, L-cores & U-cores



Deflection yoke cores—¼ section

Toroid, cylinder, & ring cores

HIGH EFFICIENCY FERRITE COMPONENTS

For TV and Electronic Circuits

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

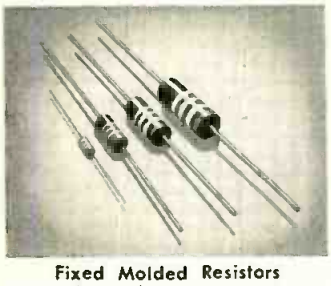
WO-1 and WO-3 are somewhat more efficient but are interchangeable with other makes of ferrite components.

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

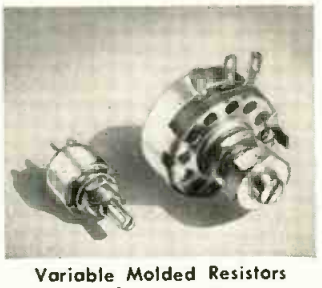
In some color TV circuits, Allen-Bradley WO-2 ferrites have eliminated two tubes and related parts. It will pay you to investigate the use of Allen-Bradley ferrites in your electronic circuits.

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

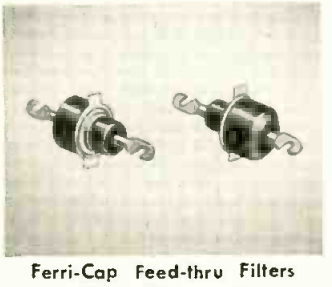
OTHER QUALITY COMPONENTS FOR RADIO, TV & ELECTRONIC APPLICATIONS



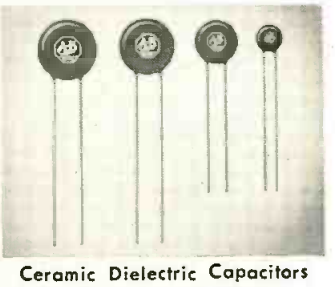
Fixed Molded Resistors
1/10, 1/2, 1 & 2 watt



Variable Molded Resistors
1/2 & 2 watt



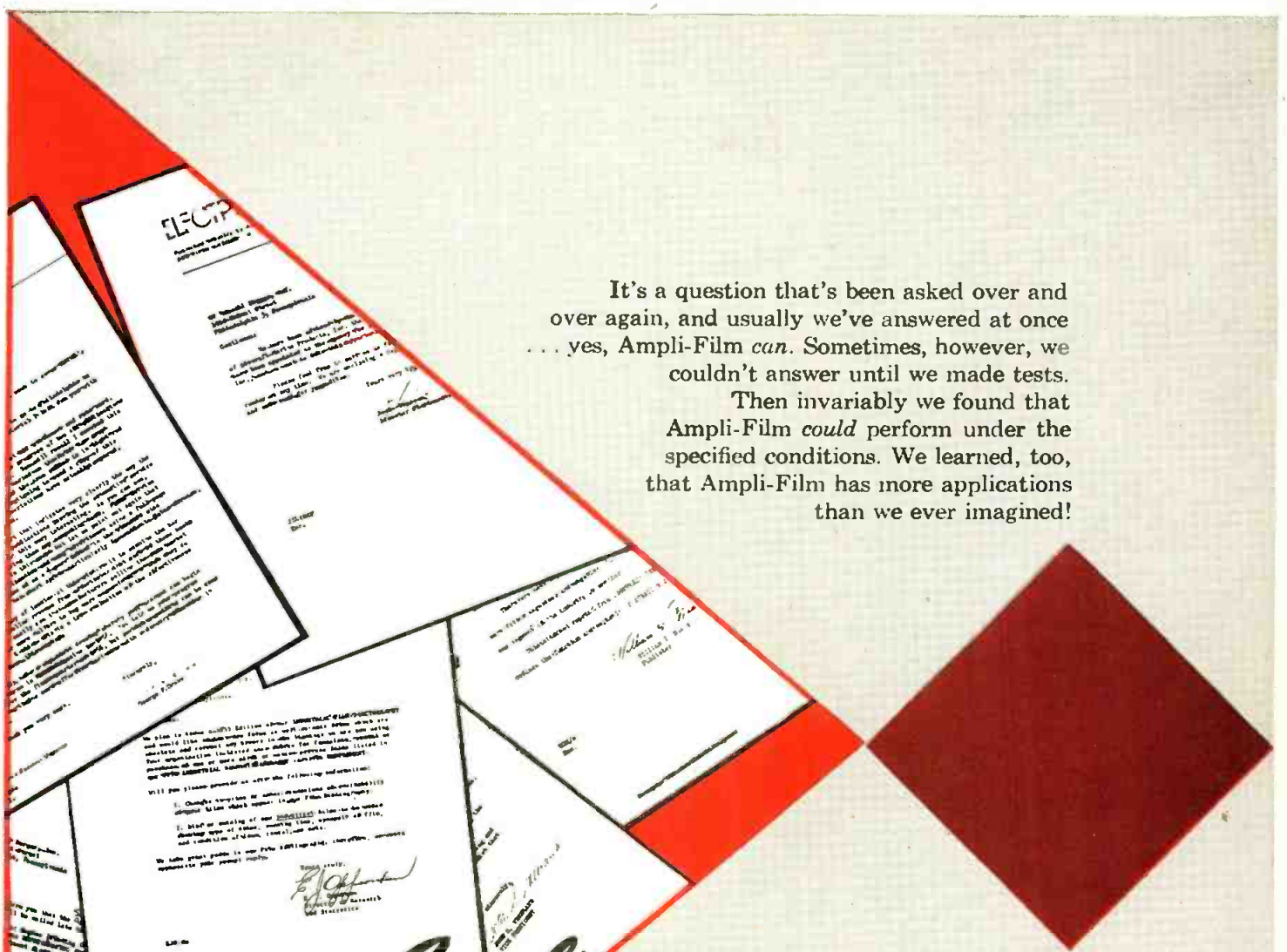
Ferri-Cap Feed-thru Filters
with ferrite material



Ceramic Dielectric Capacitors
for by-pass and filtering

ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS



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BOOKS

Color Television Standards

By Donald G. Fink. Published 1955 by McGraw-Hill Book Co., Inc., 330 West 42nd St., N.Y. 36, N.Y. 520 pages; price $8.50.

Based on the 18 mimeographed volumes recording the work of the National Television System Committee, this book is concerned with new advances in the TV field, and the technical methods needed for nationwide color TV service.

The book covers the development of color TV, the NTSC color TV standards, subjective views of color, the color video and synchronization signals, compatability field tests, color performance networks, transmission equipment, and definitions of color TV terms.

An appendix contains the FCC rules and regulations concerning monochrome and color broadcasting.

Fundamentals of Electroacoustics

By F. A. Fischer. Translated by S. Ehrlich and F. Pordes. Published 1955 by Interscience Publishers, Inc., 250 Fifth Ave., N.Y., N.Y. 186 pages, price $6.00.

Beginning with a discussion of purely electrical and purely mechanical oscillators, this book introduces the fundamental laws of electroacoustics by showing how electric or magnetic fields produce mechanical forces. The greater part of the book is spent on the theory and characteristics of electroacoustic transducers. Included is a discussion of the radiation of sound, beginning with a derivation of the fundamental equations of acoustics and of the propagation of sound.

The reader is assumed to have a basic knowledge of calculus, ac theory, and acoustics. Less well known concepts are discussed in detail.

Books Received

Framework for Atomic Industry

By Herbert S. Marks and George F. Trowbridge. Published 1955 by BNA Inc., A Div. of the Bureau of National Affairs, 1231 24th St. N.W., Wash. 7, D.C. Price $12.50.

Major revisions in the law brought about by the Atomic Energy Act of 1954, and the problems of atomic energy licensing and regulation are discussed.

Government Publications

U. S. Gov't Research Reports

Nonclassified AEC reports are now listed in a separate section of this monthly OTS publication, as they are released. Order from Sup't of Documents, U.S. Gov't Printing Office, Wash. 25, D.C. price $6.00 per year.

Radioactive Battery

A discussion of the theory, design and construction of a radioactive battery. Published July 1955, 39 pages. Order PB 111604 from OTS. U.S. Dept. of Commerce, Wash. 25, D.C., price $1.00.

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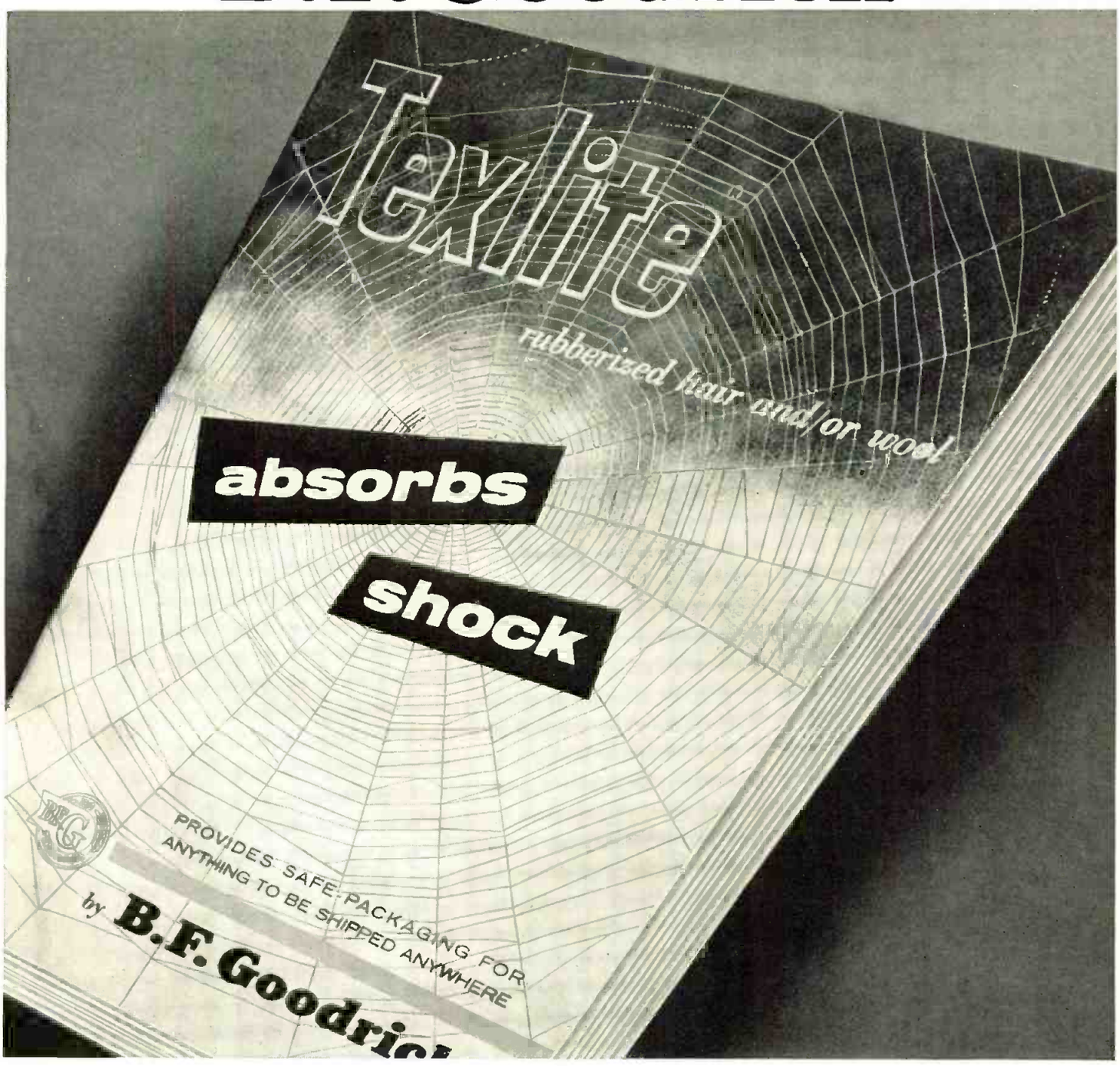

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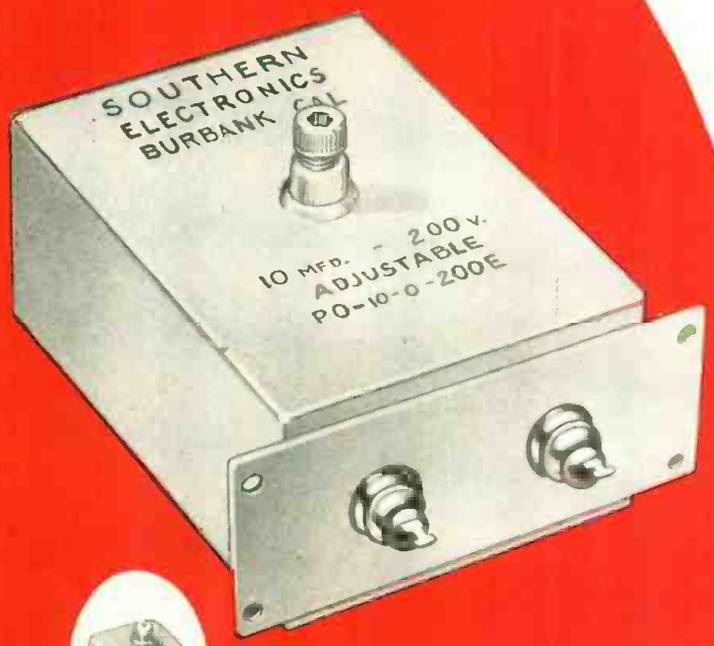

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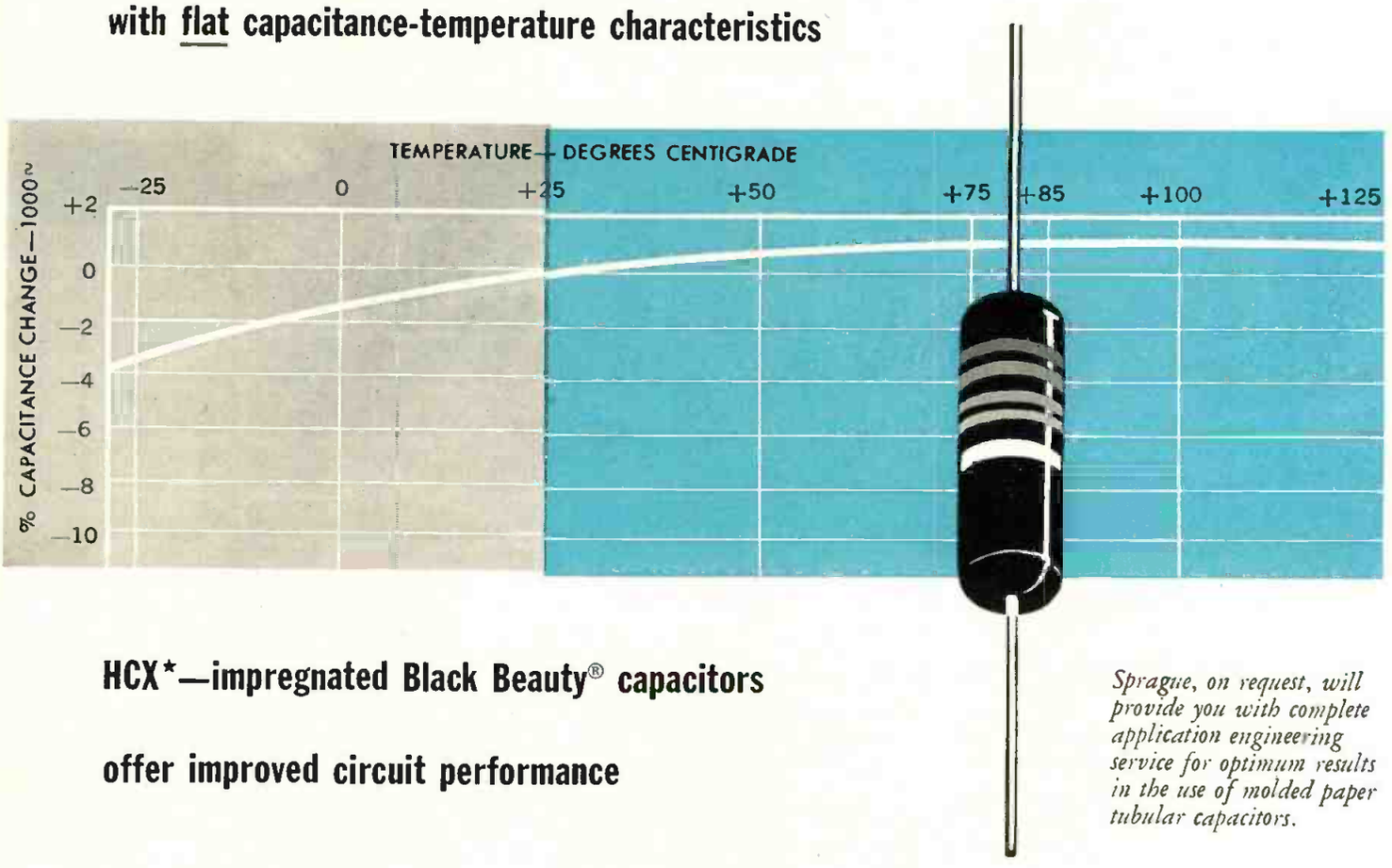

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Type 109P Black Beauty Telecaps are molded in non-flammable phenolic and are mechanically rugged. They make an ideal capacitor for all TV and auto radio operations and are well suited for automation assembly by machine since the lead concentricity is closely fixed and there is no outer wax dip to jam inserting heads or magazines.

Complete performance data covering the wide range of sizes and ratings are in Engineering Bulletin 223, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

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TELE-TECH
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ELECTRONIC MEDICAL AIDS

After forty, nearly everyone rates good health as man's most desirable asset. To-day thousands of electronic engineers are working on weapons, guided missiles, etc. where the end purpose is destruction. Why not a program for increasing the number of electronic engineers to work with the medical profession on equipment applications that will lengthen life and overcome disease and sickness? With our present and forecasted critical shortage of trained scientific manpower it also becomes vitally important to maintain the health of those now living.

Heart diagnosis has improved greatly due to new electronic methods. This is a challenging field for the researcher and a profitable one for the electronic instrument maker who takes the time and trouble to find what the medical field wants to do, then builds the electronic equipment to do the job. For example, electronic companies, in this way, brought the cost of efficient hearing aids within the financial reach of thousands of deaf persons. Sometime soon, a "radar" for the blind will be ready for market. Electronic aids to the physically handicapped should multiply when the engineer looks into the problems in this field. Dentists may save thousands of ulcerated teeth (worth millions to the loser) by VHF diathermy treatments. But these aids are now unknown to dentists.

The National Health Institute at Bethesda, Maryland, have laboratories well equipped with electronic scientists and apparatus, but such staffs and facilities should be multiplied manyfold nationally to more quickly bring to all of us more healthful living through electronic engineering.

CONVENTION PR

The 44th annual IRE Convention takes place as usual in New York City next month. All of us look forward to the event because of the opportunities it affords to make many personal contacts and to learn details of the latest technological developments at first hand. Because this show represents the prime electronic engineering event of the year it becomes a major cost factor to each of the exhibiting organizations. For those who are directly concerned with making this activity a success for their organizations, we thought the following suggestions might be helpful:

1. Does your booth clearly indicate what your company is selling? Lavish displays that fail to convey this factor clearly obviously are costly and wasteful.

2. Have all people who will be in attendance at the booth been thoroughly primed? Do they know how to sell the "company" as well as the "product." With so many things to see at the show and with so little time in which to see them, nothing is more frustrating to the visiting engineer than to find junior trainees manning impressive booths and totally unable to answer questions about the equipment on display. Proper advance training with well defined objectives will go a long way, too, in curbing any salesman's audible grumbling about being assigned to show duty.

3. How about periodic policing? If you invest in a prime location in a top show its very desirable to have either a constant or periodic policing system in effect. Hats and coats tossed on display cases, an area littered with paper, cigar and cigarette butts, empty coffee containers etc. are real deterrents to capturing and holding an audience.

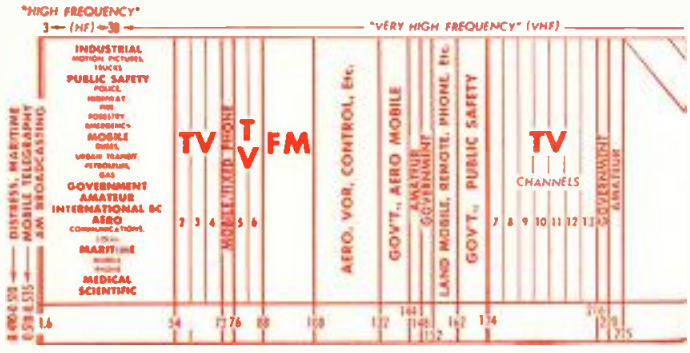
ELECTRONIC SOURCES-A HIT!

Since the first publication of Tele-Tech's International ELECTRONIC SOURCES (abstracts of the most important electronic articles appearing currently in worldwide engineering journals) last month many congratulatory letters have been received . . . and they are still coming in. We have reprinted a few of these letters starting on page 24 in this issue. ELECTRONIC SOURCES for this month begins on page 73.

We are glad to know that we are providing an industry service and we cordially invite your criticisms and suggestions telling us how we can make this new monthly attraction more efficient and more useful for you. We suggest, too, that you call the attention of your fellow engineer to this new information source. In design engineering a great deal of money can be saved by taking the time to check and determine where others have trod before. A running file of ELECTRONIC SOURCES can become one of your most important future assets!

RADARSCOPE

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



NEW HOPE FOR FM STATIONS is contained in the news that two stations have been granted permission by the FCC to broadcast their programs to paying customers without including the commercials.

THE AIR NAVIGATION PROBLEM will receive a great deal of attention this year. Increased air traffic has brought an acute need for a common navigation system. Action of the British Ministry of Transport and Civil Aviation last month in authorizing the Decca Navigation System as the official air traffic control and air navigation system for the United Kingdom area will spur renewed study of the problem. Bendix Aviation Corp., U.S. licensee for the Decca system, is currently engineering American versions for both commercial and military applications.

ELECTRONIC "ALERTNESS" INDICATOR announced last month marks a significant contribution to the medical field. The unit, a completely transistorized portable instrument, amplifies and differentiates bio-electric potentials which are picked up off the subject's forehead by delicate electrodes.

"HELIPOWER" ANTENNA

G-E engineers call this "the simplest TV broadcast antenna that you can hoist to a tower top." Designed for operation on Chs. 7 through 13, it has only three feed points as compared to the usual 16 points of the conventional antenna. The 3,500 lb, all-steel antenna has a gain of four, and will reportedly permit doubling the power of present stations.

A NEW SOURCE OF UHF POWER which may ultimately replace the klystron, will shortly be demonstrated. Designed on more conventional lines, the new tube reportedly generates up to 5 megawatts of UHF power.

THE GOVERNMENT is being advised to discontinue support of the present synthetic rubber research program. The recommendation was made in a report by the Special Commission for Rubber Research of the National Science Foundation.

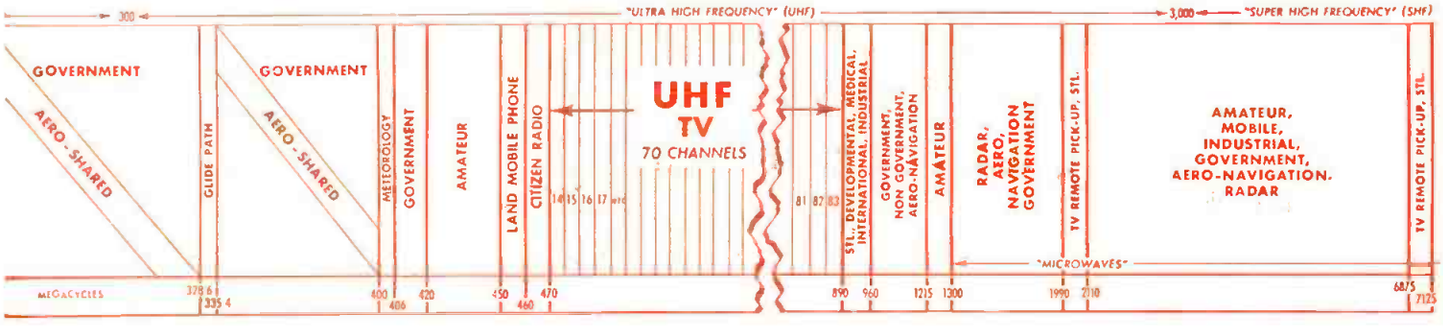
NEW ENGINEERING MATERIAL, "Tissuglass," will find many applications. An extra-soft, tissue-like film of microglass fibers, it can be as much as 95% air by volume providing a carrier sheet with only 5% inert carrier. Impregnations used successfully to date include epoxy, melamine, silicone, polyvinylchloride and polyesters. It is available in thicknesses from 0.5 to 13 mils and widths up to 40 in.

THE COPPER INDUSTRY is predicting that a balance will be struck between the supply and demand of copper during the first quarter of 1956. By the middle of '56 there may even be a slight surplus—if further strikes can be avoided.

NEW MINIATURE CAPACITORS developed by Bell Labs for low-voltage applications consist of a thin film of metallized lacquer. The dielectric is only 0.0001 in. thick and the finished capacitor is 1/7th the size of metallized paper capacitors. Breakdown voltage is nominally 50 v., making them useful for virtually all transistor applications.

NO COMMERCIAL 16 RPM RECORDS are foreseen this year but, with the automobile trade showing interest in the new speed, a number of phono manufacturers are including 16 as a fourth speed on formerly 3-speed changers.

THE FCC this year will ask Congress to set aside two 1952 amendments which are seriously impeding their operations. One of the amendments prohibits the Commission from consulting its own staff experts on adjudicatory cases, even when the staff members have no participating interest; the other requires that, in considering new services, the Commission hear protests by "parties in interest" however remote and meanwhile, stay any grant involved. The Commission has repeatedly proposed legislation to curtail these delaying tactics.



COLOR TV SALES PROGRAMS will feature very heavy local advertising. Saturation-type campaigns are scheduled for the more "ripe" areas, areas where the amount of color TV programming is considered sufficient to interest the public. Sales execs feel that enough money has been spent on the introductory phase, that further expenditures must be paid for by actual sales. Local campaigns will give them a quick return, dollar-wise, and also give them a quick warning, if the area refuses to accept it. One manufacturer, Raytheon, is planning a "city-by-city, market-by-market" campaign to sell their new line.

RUSSIAN RADAR EQUIPMENT has reportedly been reproduced here from specs supplied by the U.S. Air Force. They are being compared, performance-wise, with their American counterparts.

TRANSISTORS

NEW MANUFACTURING TECHNIQUE is being employed by Westinghouse to make improved types of junction-type p-n-p germanium transistors, and a special transistor, called a photodiode, which is claimed to be more than 10,000 times more sensitive to light than a conventional photo-electric cell. The germanium p-n-p transistors are reportedly capable of efficient operation at VHF frequencies.

The new technique eliminates the need for delicate temperature control which was formerly relied upon to achieve consistency in the finished product. In the usual process, a thin slice of n-type germanium is placed between two layers of the metal and heated. The metal atoms "dissolve" inward through the germanium, forming two outside layers of p-type germanium and leaving a very thin n-type layer between them. The thinner and more uniform the n-layer, the better the performance of the finished transistor.

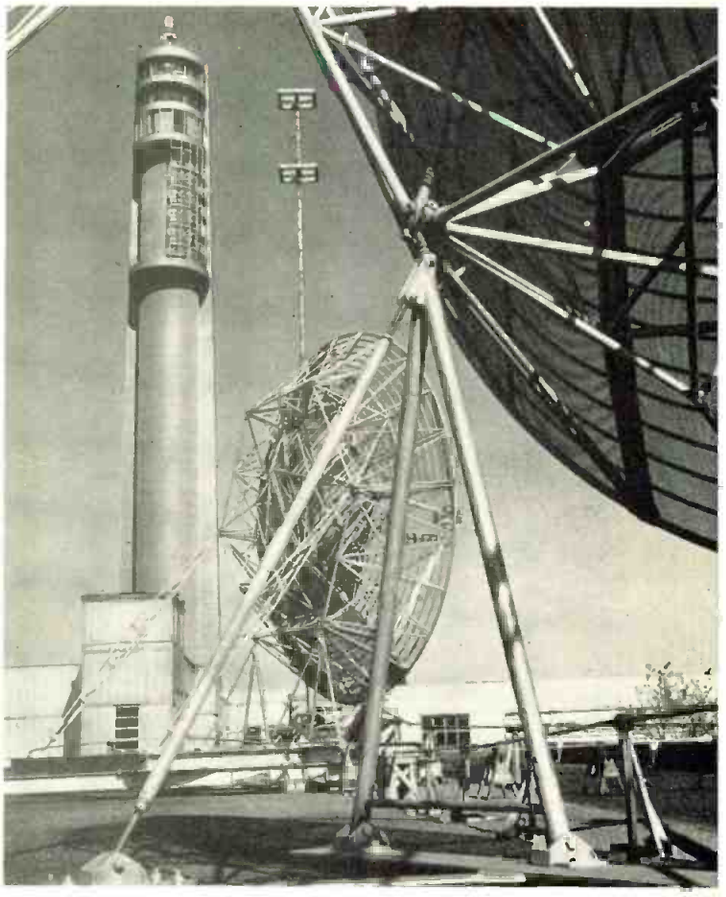
Too high a temperature causes the very thin layer of n-type germanium to melt away completely, leaving the transistor worthless. Too low a temperature leaves the n-layer too thick, giving a transistor with poor performance.

The new Westinghouse process allows the temperature to be virtually uncontrolled. The key to the new process is a "cooling off" period during the heating of the transistor. The process allows the critical n-layer to build up to the desired thickness and uniformity instead of being inexactly dissolved away, as in conventional methods.

SUPERCONDUCTIVITY applies to one of the least understood phenomena in physics. Materials such as lead, tin, aluminum and vanadium have two unusual characteristics at temperatures near absolute zero (−273°C). They have essentially no resistance within the limits of measurement, and also, they completely exclude magnetic flux when placed in a magnetic field. Scientists at Westinghouse Research Labs are tackling the problem from the angle of the specific heat (the amount of energy required to raise the temperature of a given amount of material one degree).

Superconductivity is already being applied in the construction of magnetic refrigerators which have created temperatures of the order of 0.001° absolute, available from Arthur D. Little Inc.

"SCATTER" EXPERIMENTS



Experimental parabolic antennas shown atop the Federal Telecommunication Laboratories, IT&T research center in Nutley, N. J. are used for communication with Southampton, L. I., 91 mi. away. Technique is being used in commercial links now under test in the Caribbean.

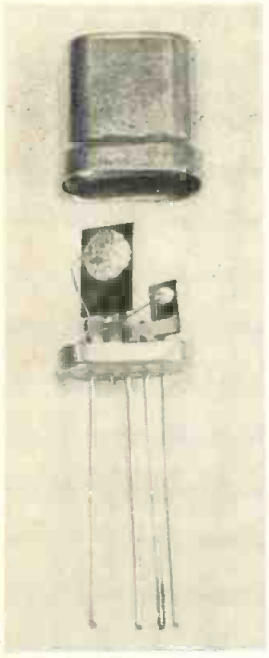


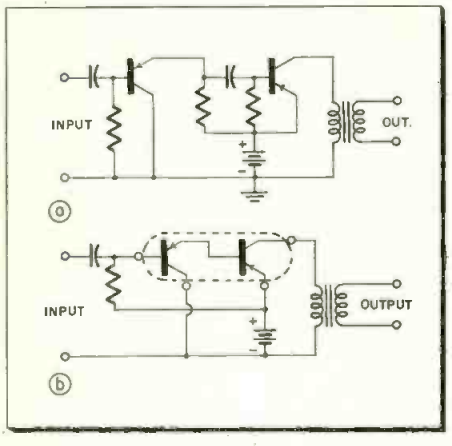
Fig. 1: Tandem transistors in common case

Applications For Tandem Transistors

By Dr. H. E. HOLLMANN

TRANSISTORS are characterized by their low impedance ratio. In contrast to vacuum tubes, the output impedance exceeds the input value so that efficient cascading requires step-down transformers. These matching devices may be conventional transformers with primary and secondary windings but, in addition, there also exists a useful type of dc transformer in the form of a transistor in common-collector connection. This configuration, less familiar than the common-base and common-emitter stages, may be compared to a cathode-follower tube type amplifier in that the input impedance exceeds greatly the output value and that the voltage gain is less than unity. Despite this, the common-collector configuration exhibits power gain although somewhat below that of the two other configurations.

Fig. 2a: Conventional RC coupled amplifier
Fig. 2b: Tandem transistor dc coupled amplifier



With this picture in mind, the use of a common-collector stage as the input device of a second transistor recommends itself. Fig. 2A indicates the schematic circuitry of a grounded-collector to grounded-emitter amplifier with conventional RC coupling. In a rough approximation, the power gain is given by the formula

$$PG_{db} = 10 \log \frac{R_L}{R_i} \frac{\alpha^2}{1-\alpha^4} \cdot \qquad (1)$$

Accordingly, high-alpha transistors provide values up to 50 db. This is less than the power gain of two common-emitter stages but affords a much higher impedance ratio.

The described amplifier is a cascade of two stages because each transistor forms a separate stage driven by its own power. In order to convert the first transistor into a true matching device, it may be connected according to Fig. 2B. First, the two transistors are dc-coupled; no extra loading and coupling elements are necessary. Second, the grounded-collector transistor replaces the base leak resistor of the grounded-emitter stage and is fed by the base current without the dissipation of extra supply energy.

The two transistors surrounded by the dotted line may be considered to be a unit. Hence, they may be housed in a single container so as to provide a "Tandem Transistor." Fig. 3 illustrates the mounting of two transistor elements on a five-lead socket while Fig. 1 is the photograph

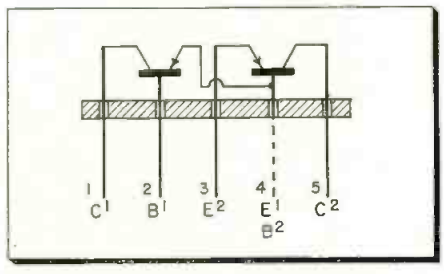
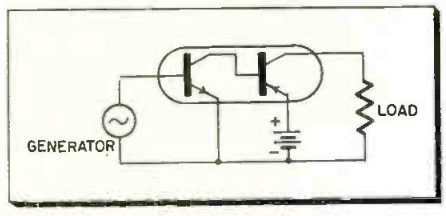


Fig. 3: Two transistor elements on 5 lead socket. Lead 4 is clipped after testing

Fig. 4: NPN type forming base return resistor of PNP type (or vice versa)



of such a tandem type before enclosure. Lead (4) serves for the testing of the individual transistors and is clipped after testing. In order to provide sufficient driving energy for the input transistor, the second transistor is somewhat larger, while the first element has small junctions for operation on a low energy level. Tandem transistors may be built of the NPN or PNP type, which then makes interesting combinations possible, e.g. of the complementary-symmetry form.

Principles

The principle of cascading transistors in a common container such that the one operates as the base leak for the next is applicable to

A common-collector transistor stage as the input device of a second transistor acts as a useful type of dc matching transformer. Power supply problem is simplified since first transistor represents the base leak for successor thus requiring no extra supply power. Tandem transistors, housed in a single case, may be utilized as oscillators, multivibrators, flip-flops, switching devices, etc.

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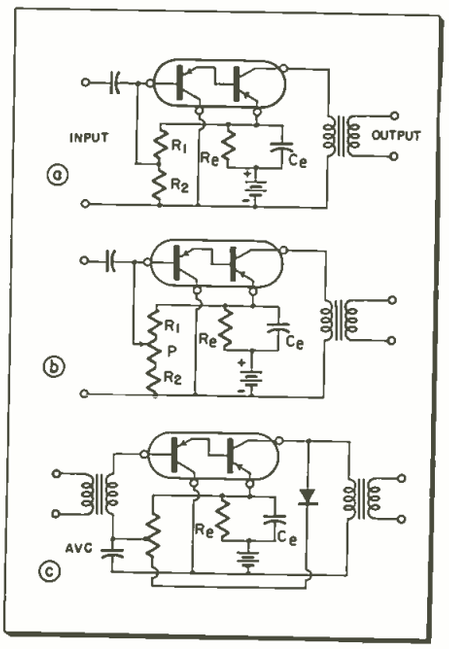


Fig. 5: Stabilization of tandem transistors. Potentiometer in B is simple gain control. C illustrates automatic gain control

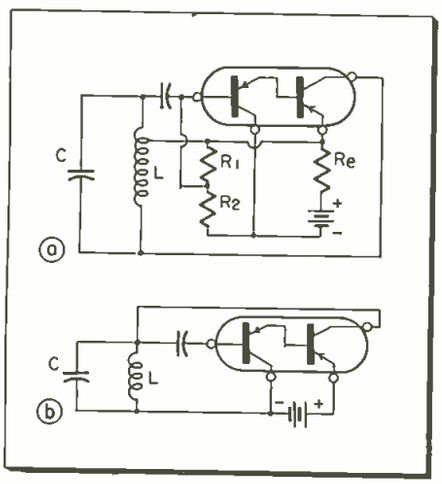


Fig. 6a: Tandem version of Hartley oscillator
Fig. 6b: Polarity reversal converts degenerative feedback into regenerative, causing oscillation

many modifications and other configurations. As an example, Fig. 4 illustrates the tandem form of two grounded-emitter transistors of opposite conduction, i.e., an NPN-type forming the base return resistor of a PNP-type or vice versa. With the aid of power transistors, a multiplicity of transistor stages may be cascaded in the explained manner so that triple and multiple transistors result. In the following, however, let us concentrate upon grounded-collector to grounded-emitter tandems with their high impedance ratio.

Once the four-pole parameters of the individual transistor elements under actual operating conditions have been measured with the aid of a conventional transistor tester, the over-all or tandem parameters can be found by means of the following conversion formulae

$$H_{11} = h_{11}^{(2)}\,\beta^{(1)}\,\beta^{(2)} \quad (2)$$

$$H_{12} = (h_{11}h_{22})^{(2)} - h_{12}^{(2)} \quad (3)$$

$$H_{21} = \beta^{(1)}\,\beta^{(2)}/(1 + \beta^{(1)}\,\beta^{(2)}\,h_{22}^{(2)}) \quad (4)$$

$$H_{22} = h_{22}^{(2)}\,\beta^{(2)}. \quad (5)$$

Most significant is the current amplification factor H_{21} which is somewhat below the product of the two values $\beta^{(1)}$ and $\beta^{(2)}$ of the individual transistors. In practice, current gains as high as 3000 are easily obtained. Moreover, it follows that the impedance ratio $H_{11}/H_{22} = \beta^{(1)}h_{11}/h_{22}$ is much larger than that of a single common-emitter or common-base transistor, namely h_{11}/h_{22}.

As in single transistor stages, stabilization of tandem types against fluctuations of supply currents and temperature is mandatory. For this purpose, the tandem transistor may be considered to be equivalent to a single transistor in common-emitter configuration and stabilized by means of dc feedback. Fig. 5A is the fundamental circuitry for tandem stabilization. First, the emitter resistor R_e, bypassed by capacitor C_e, provides a negative feedback without reducing the ac gain. Second, the bias voltage of the input base is stabilized by the attenuator R_1 in series with R_2 which, in turn, is large enough so as to avoid a loading of the input generator. Substituting the attenuator by the potentiometer P in Fig. 5B permits a simple and efficient gain control. As in the case of a variable-μ pentode, automatic gain control is easily performed in the way illustrated in Fig. 5C, whereby the AVC voltage sees into a high load.

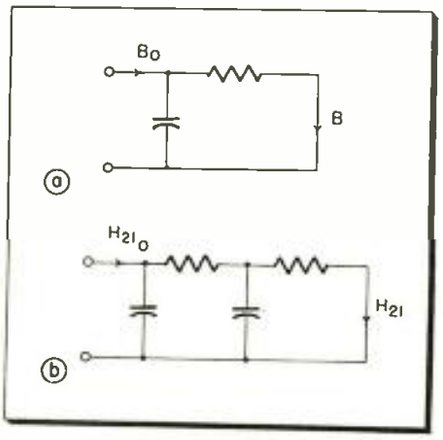
Tandem transistors may be utilized in various circuits similar to single grounded-emitter stages, e.g. as oscillators, multivibrators, flip-flops, switching devices, etc. Fig. 6A is the basic schematic of the tandem version of a Hartley oscillator. The high current gain and the reduced loading of the tank circuit result in a good frequency stability.

Feedback

During extensive studies of the optimum feedback and maximum stability, a peculiar type of oscillation was found in the circuit depicted in Fig. 6B, namely nega-

(*Continued on page* 113)

Fig. 7: Equivalent circuits simulating phase shift of single transistor (A) and tandem transistor (B)



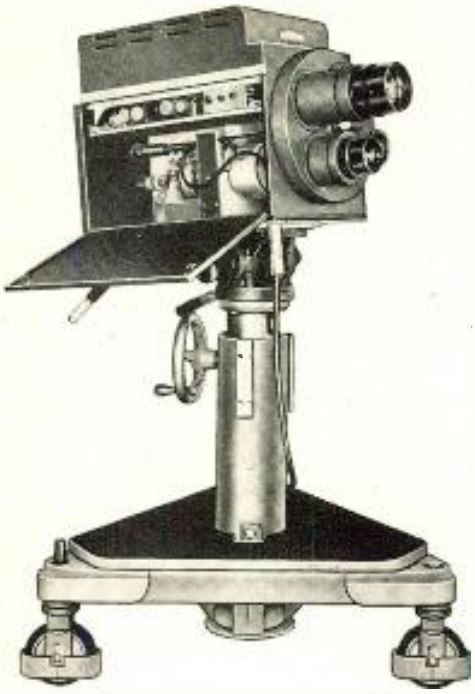


Fig. 1: Vitascan camera resembles standard monochrome TV camera

The "Vitascan" — New Color TV Scanner

By C. E. SPICER

TO achieve full benefit from network "colorcasts," the local broadcaster requires color origination. By surrounding one of the extravagant network color shows with color slides or color film for his clients, he greatly enhances the value of the color show to his viewers and his station. If, however, he can go one step further and add local live color, he is getting the maximum from color broadcasting.

Until recently the cost of this live color camera equipment has been beyond the means of all but the largest stations in the country, although the cost of equipment for color slide and color film origination is not prohibitive for most broadcasters. In addition, the complexity and the expense of its operation has put it beyond most station budgets.

"Flying Spot"

To eliminate the obstacles of expense and complexity, Du Mont has revived one of the oldest principles of TV—the elementary "flying spot" system. Many improvements in components and electronic techniques have occurred in the last 20 years to make this practical. The "spot" is no longer mechanically produced but is electronically generated in a high voltage cathode ray tube containing an extremely high light intensity, short persistence phosphor. The light is no longer picked up in a lead sulphide photocell but is now gathered by an end-fire phototube with a large diameter, extremely sensitive, photocathode, and with a 10-stage high gain electronic multiplier. Both the light source and the phototubes have been brought to a superior degree of performance largely because of their use for film pickup in the continuous motion type scanner equipment which has been used extensively for the last two years. These improvements have taken the flying spot scanner for live pickup out of the laboratory stage and made it a demonstrated, practical reality.

A detailed explanation of how it works will readily indicate why it is inexpensive and simple to operate. First, however, a brief refresher description of conventional telecasting is helpful.

Conventional TV

In a conventional broadcast studio, the scene is illuminated by floodlights. This light strikes the object being televised and a portion of it is reflected from the objects to the optical lens of the television camera. Light entering the camera through the lens is focused on the light sensitive element of an image-orthicon tube which, as the resulting charge image is scanned, generates a video signal. This signal is amplified, corrected for high frequency losses, and blanking is added in an external amplifier. This resulting composite video signal is passed on to the transmitter for broadcast.

A monochrome camera uses one pickup tube. A color camera uses three pickup tubes, one for each primary color (red, green, blue). The output of the three tubes must be precisely registered both opti-

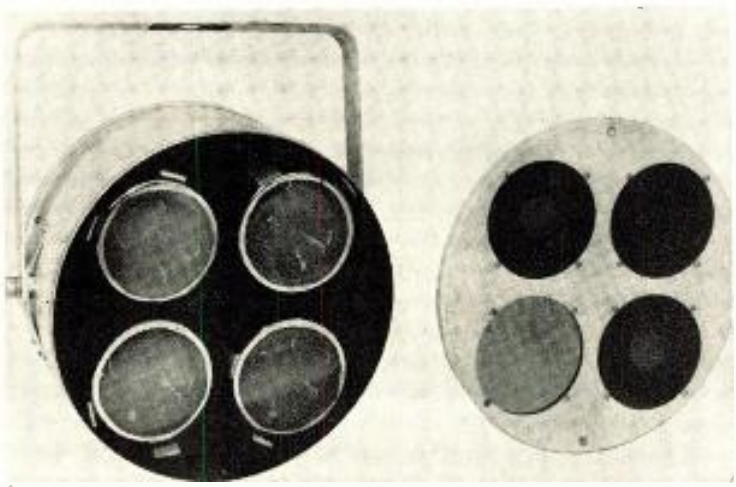


Fig. 2: Two red filters compensate for the lack of red in the spectrum of the CRT's phosphor. Only one blue and one green filter are used

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Employing the "flying spot" system for TV transmission, the Vitascan color camera is actually a source of light which is projected to scan the scene, is reflected, and then picked-up by fixtures which generate the video signal. It is literally a reversal of the usual transmission system

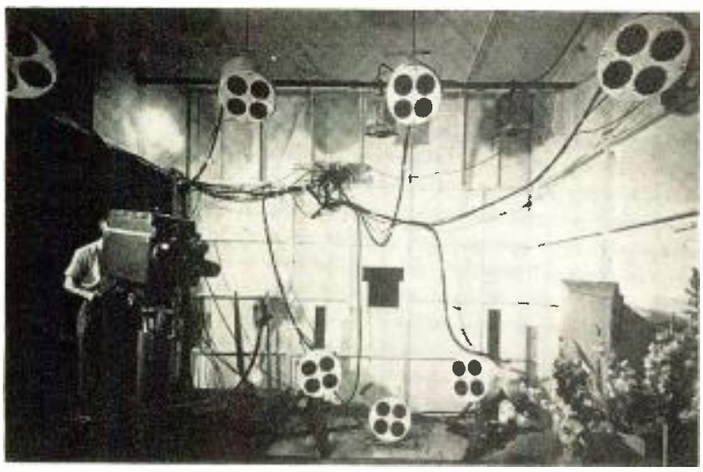

Fig. 4: Studio lighting is provided by pulsing separate lighting fixtures on, during the vertical retrace time of the TV signal, every 60th of a sec. for 1 msec

cally and electrically if the resultant color pictures are to be superimposed. Differential spurious shading in the three signals must be carefully corrected. These problems are quite complex in live color pickup using image orthicon tubes and require elaborate apparatus and skilled operation to give good results.

"Vitascan" Operation

The Vitascan differs from conventional systems in that the whole process of televising a scene is reversed. The Vitascan camera is, in reality, a source of light which is projected to scan the scene. This scanning light is reflected and enters pickup fixtures, which resemble studio lights in both appearance and location; these pickups generate the video signal. The following detailed description will make this analogy more obvious.

The System

The scene to be televised is "swept" at the standard TV rate horizontally and vertically by a constant-intensity bright spot of white light from the Vitascan camera. At any instant the light is reflected in the color of the object on which it rests. This light is gathered by photocells in front of which are placed either red, blue, or green filters. (Fig. 2) The cells in the individual (red, green, and blue) channels generate a video signal whose amplitude is determined both by the luminance (brightness of the scene) and the chrominance (hue and saturation).

The Camera

To sweep the scene, a 5 in. diameter CRT is mounted horizontally in a television "camera" case similar to a standard monochrome TV camera (see Fig. 1). This single cathode ray tube is one of the reasons for the low cost and simplicity of the system. The tube is inexpensive; only one is required; and its normal life expectancy is 1000 hrs. or more. The more conventional live color systems which utilize standard lighting and scan the charge pattern on the pickup device require three tubes of a much more expensive type, each with a normal life of 350 to 700 hrs. In addition, the three tubes and their optics and filters must be matched for good color fidelity.

A raster approximately 3 in. x 4 in. is developed on the face of the CRT. Only normal linearity and positioning accuracy is required since it is not being matched with two other tubes. An anode voltage of approximately 35 kv is used to provide the required light intensity. This voltage is developed in a pulse type supply to insure safety to personnel, and is located external to the camera for convenient servicing.

As in all flying spot applications, the spot constitutes a scanning aperture. This aperture is not ideal because, while the phosphor excitation has a practically instantaneous rise time, it has persistence or finite decay time. Videowise, this produces a lack of sharpness and smearing after transitions. In order to minimize these effects, a phosphor is used which has inherently a short decay. Thus, the P15 or zinc oxide phosphor has a decay time, to the 1/e point, of 0.5 μsec. In addition, to compensate for this decay time, circuit compensation is carried out in the video amplifier, as will be described later. The grain of the phosphor is also kept smaller than the spot size of the CRT so that it will not be evident in the video signal. The light output of the phosphor is primarily in the blue-green region of the spectrum, being down to about 25% of its peak in the red region. In order to partly compensate for this lack of red, two red cells are used for each green or blue photocell in the pickup equipment, as described later.

A simple scanning generator is included in the camera head, and a conventional electronic viewfinder is mounted on top of the head, to which video is fed from the control room.

Conventional lenses are used to project the raster on the scene. No dichroic mirrors, color filters, relay lenses, astigmatism correction, or matching of these optics is required. To provide a selection of viewing

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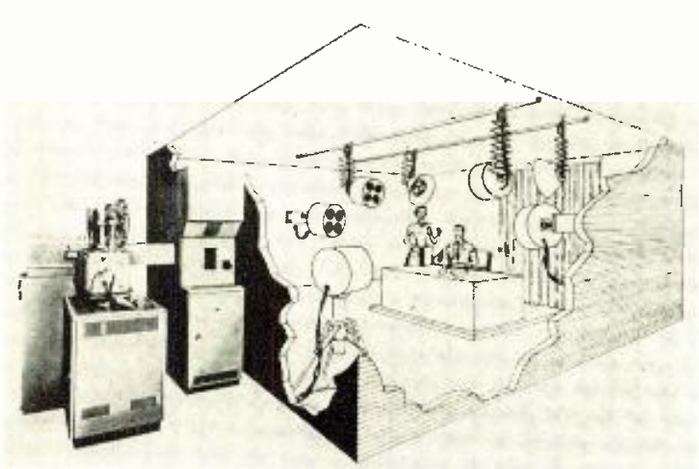

Fig. 3: Studio layout. Red photomultipliers in fixtures are all paralleled and fed to a single red video amplifier. Green and blue are treated in same manner

Fig. 1: Equipment for measuring Faraday rotation. Microwave energy from klystron signal source (l) enters wave guide containing two ferrite sections which rotate the propagation mode. Barretter (r.) feeds output energy to receiver

By M. B. LOSS

Using various configurations of ferrites, waveguides, isolators, phase shifters, attenuators, etc. can be designed which contain no moving parts and are electrically controlled. Increasing the bandwidth of Faraday rotation and phase shift of ferrites is discussed, and a new broadband technique described

Broadband Applications of

M. B. Loss

In recent years we have seen much activity in the microwave component development field as a result of the discovery of several important microwave properties of ferrites. Outstanding among these properties are the Faraday rotation and gyromagnetic resonance effects. Using various configurations of ferrites in rectangular or circular waveguides, the designer can build isolators, phase shifters, attenuators and so on, which contain no moving parts and which are completely electrically controlled.

If practical ferrite components are to be realized, one of the prime considerations encountered is the bandwidth of such devices. The bandwidth of a ferrite component is essentially the bandwidth of the ferrite property being utilized, so that an investigation into the frequency dependence of these ferrite properties must be made, and methods found to increase their bandwidth.

This article is a description of a method developed at Sperry for the Navy and concerns itself principally with the practical aspects of designing broadband ferrite components. All work described was performed in x-band .936 in. i.d. circular waveguides. All ferrites referred to are those of the General Ceramics Co.

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Faraday Effect

Until only recently, the most widely applied ferrite property was the microwave Faraday effect in which a microwave passing through

Fig. 2: Ferramic A-106 is more broadband than R-1. Solid curve shows broadbanding using both A-106 and R-1

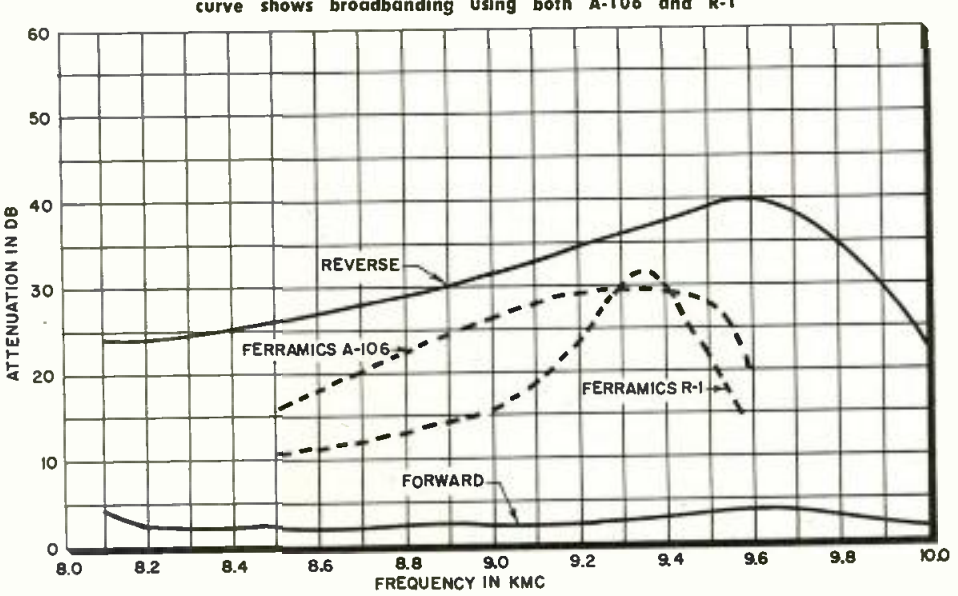


Table I:

Broadband Technique Using Samples of Ferramics A-106 and R-1

Frequency (KMC)	Θ of Ferramic A-106 (degrees)	Θ of Ferramic R-1 (degrees)	₀Θ of Two Samples Matched (degrees)	
			Theoretical	Experimental
8.5	70	−25	45	55
9.0	90	−35	55	60
9.6	120	−65	55	60

Table II:

Broadband Technique Using Two Samples of Ferramic R-1

Frequency (KMC)	Θ of Sample No. 1 (degrees)	Θ of Sample No. 2 (degrees)	Θ_0 of Two Samples Matched (degrees)		Θ of Equivalent Length of Ferramic R-1 (degrees)
			Theoretical	Experimental	
8.5	−115	165	50	70	50
9.0	−190	260	70	90	90
9.6	−295	370	75	100	160

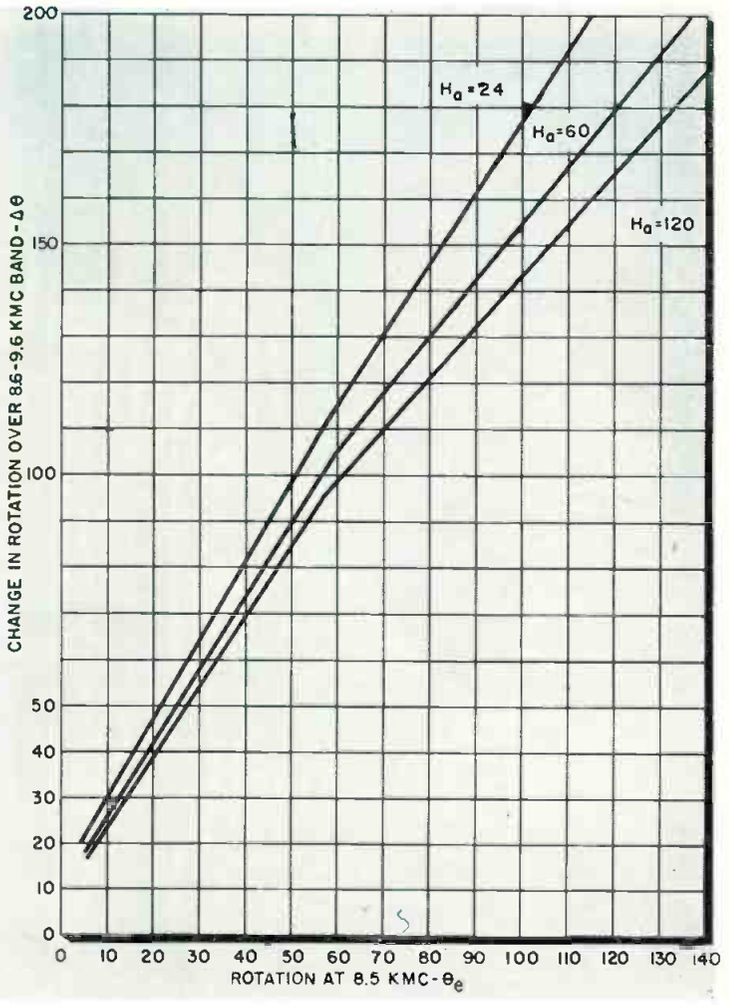


Fig. 4: M is independent of sample length for any particular value of applied field

Ferrites

a ferrite in a circular waveguide experiences a rotation of its plane of polarization. The magnitude of this rotation is dependent upon the dimensions of the ferrite, and the magnetic field which must be applied to cause the effects. In any waveguide case, this rotation is found experimentally to vary significantly with the microwave frequency. The curve of Fig. 5 shows a typical case. The change in rotation over the 8.5-9.6 KMC band for a sample 3 in. long is 110° for this ¼ in. diameter sample. The minimum rotation is 50° and occurs at 8.5 KMC.

This variation of Θ with frequency cannot be accounted for by the infinite medium-plane wave theory, since the boundary conditions are generally not the same in the waveguide case. This theory can be applied approximately, however, if a thin pencil of ferrite is used as shown by Hogan.[1] In this case, variations in Θ on the order of 10° are observed over the 8.5-9.6 KMC band. The variations in frequency sensitivity with sample diameter is thus apparent, and one would be tempted to use these smaller diameters for this reason. From a design standpoint, however, we must also consider the size of the magnetic field required to produce rotations of a useful magnitude, say 90°. Unfortunately, rotation decreases with decreasing diameter as shown in Fig. 3. Note that the rotation of the .122 in. diameter sample saturates well below 90°. In contrast, note that very high rotations are obtained with a .240 in. diameter sample. In this case a 90° rotation is obtained at an applied field of less than 10 oersteds. For this reason, more and more emphasis has been placed on the use of larger diameters and the development of methods to increase their bandwidth.

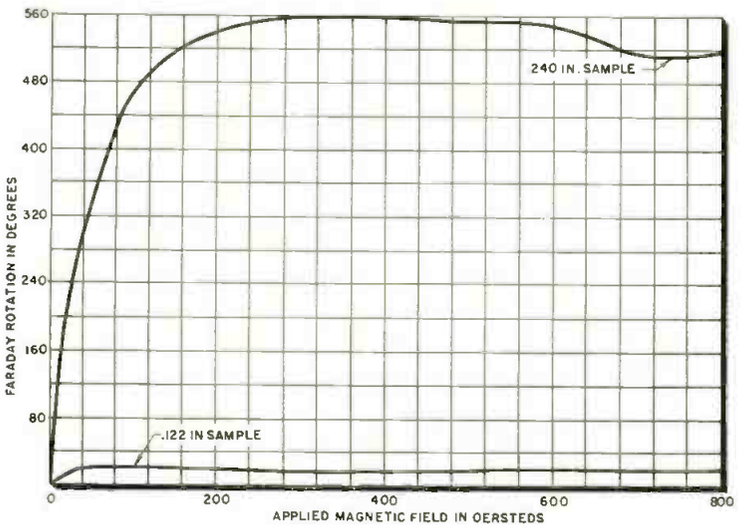


Fig. 3: Faraday rotation decreases with decreasing diameter. Note high rotation obtained with .240 in. sample

Figure of Merit

We now seek to define a figure of merit M which will measure the bandwidth per rotation of a ferrite. We choose M to be $\Delta\Theta/\Theta_e$, where $\Delta\Theta$ is defined as the change in rotation over the given band, and Θ_e as the value of rotation at the low end of the same band. The numerical value of M for the sample shown in Fig. 5 is approximately 1.5. This figure of merit thus defined is useful in helping one to select from a group of

(*Continued on page* 117)

Silver Migration

Fig. 1: Measuring the rate of migration. DC power supply varies applied voltage

Silver, commonly used in capacitors and printed circuits, has a tendency to migrate under ordinary conditions of humidity and potential, causing short circuits to be formed. Migration can be eliminated by the use of noble metals, or suppressed by noble metal barriers, by solder dipping, by electrocoating, or by rigorous cleaning before organic coating.

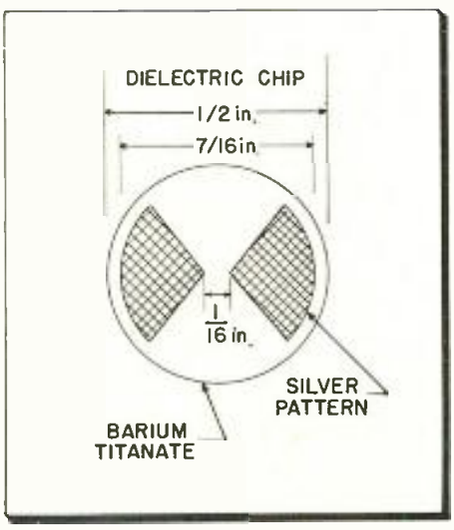
BECAUSE of its high electrical conductivity, resistance to corrosion and electrical conductivity of its corrosion products, silver has been used for many years in electrical circuits. It is particularly useful for switch contacts either as massive silver or as electrosilvered copper or brass. In more recent years silver has found wide use in printed electronic components. Capacitors using either mica or high dielectric constant titanates are printed with silver electrodes. Conductive paths for printed circuits are applied to ceramic or plastic base materials. These printed patterns are occasionally electroplated with more silver to increase conductivity, are solder-dipped to adhere to tinned copper leads, or are used without further treatment.

A study of the factors influencing migration of silver has shown that a continuous moisture film and an electric potential are necessary for migration to occur. It is caused by dissolution of silver ions at the anode and electrodeposition of silver metal at the cathode. Although no methods have been found for completely eliminating silver migration, a cleaning and coating process has been outlined which reduces migration tendency. In addition, a system of migration barriers has been developed. Where migration must be eliminated completely in the presence of high humidity, compositions containing gold, platinum or palladium may be used but the cost will be many fold higher.

Migration of Silver

When conditions of high humidity exist it is known that leakage paths or short circuits sometimes appear between two pieces or patterns of silver when a potential difference exists. These paths may be across the surface of a dielectric separating the electrodes or in the case of plastic insulators, may be through the dielectric itself. The short circuit paths are metallic, apparently silver that has migrated from one electrode to the other. They manifest themselves in several forms. When voltage is low a weak leakage current may flow. In radio and TV capacitors, this is frequently not noticed until complete burn-out occurs, since many capacitors are bypassed by resistors smaller than those produced by the leakage path. When voltages are higher, short circuits caused by migration burn out the instant they are formed. Repeated forming and burning out of short circuit paths lead to a noisy condition which may or may not be harmful depending on the use, but would be difficult to detect during a component check. Depending on whether the short circuit path is permanent or temporary, and on the resistance of the path, distortion of signals may occur even though parts test satisfactorily. On exposed electrodes, sparks can sometimes be seen, particularly in darkened rooms, at the instant a short circuit is formed by migration.

Fig. 2: Progress of migration was observed between silver patterns covered with water



Conditions

Laboratory tests were conducted to reproduce the migration experienced in use, to determine the conditions under which it occurred, to establish its mechanism, and to study means of prevention.

It has been found that the two most important causes of silver migration are a weakly conducting water film and an impressed electromotive force, either ac or dc. Under conditions of low humidity, migration does not occur. It is essential that the humidity be high enough to condense a film of water on the surface of the dielectric. This film may be extremely pure water, as might be obtained by thermal changes in a somewhat humid atmosphere, or highly conducting as would be produced by the presence of deliquescent salts. If the moisture film appears and disappears due to repeated condensation and drying the migration path may take longer to form but it will eventually appear.

Since electrical paths or capacitor plates are designed to carry electric current, a potential difference will always exist between adjacent patterns, so that this condition is al-

In Electric Circuits

By O. A. SHORT

O. A. SHORT, E. I. du Pont de Nemours & Co., Inc., Perth Amboy, N.J.

ways fulfilled. If this voltage is unidirectional, migration growths occur in one direction only, whereas alternating voltages cause growth to start from both electrodes and meet in the middle.

The mechanism of silver migration was established by observing the progress of migration across ceramic dielectrics between two silver patterns covered with a water film. The design of the test piece or chip is shown in Fig. 2. A power supply capable of producing 100 v. dc was connected to two binding posts on opposite sides of the stage of a binocular microscope. The applied potential could be varied from 0 to 100 V. A dc voltmeter was used to determine the applied potential, a dc microammeter was used to measure low currents, and a milliammeter was used to measure short circuit currents.

Observations

The following observations were made during the course of this study. (1) Migration of silver metal occurs from the cathode to the anode. (2) Two types of migration were observed: a. When the chip was covered with resin deionized water, migration took place as a cloud-like growth on the surface of the dielectric. This growth quickly spread across the gap and produced a high resistance short circuit. The migrating material was adherent to the ceramic and could not be rubbed off (Fig. 3). b. With water having about twice the conductivity of the deionized water used above, the growth took the form of trees or dendrites in the water film. This growth is more rapid, forms a dead short circuit, but is easily brushed away (Fig. 4). (3) With impure water (city tap water) having high conductivity, migration does not occur. (4) Migration takes place across a 1/16 in. gap with voltages as low as 1 to 2 v. dc in 15 sec. or less. (5) Before migration begins gas bubbles form at the cathode. (6) In the presence of chlorides a white precipitate forms at the anode. (7) With deionized water, clouds of brown precipitate frequently form at the anode. (8) Migration occurs with all ceramic bodies tested and with mica. (9) Migration occurs with fired-on silvers, air dry silvers and silver foil. (10) Growth is at the tips of the dendrite branches, rather than at the origin or base of the branch. (11) Migration starts slowly and increases in rapidity as the gap becomes smaller. The final closing of the gap is extremely rapid. (12) Currents are low initially and gradually increase as the gap becomes smaller. When short circuit occurs the current jumps to high values. (13) Subsequent resistance measurements may show an open circuit if the migration connection is burned out or may show nearly any resistance value between dead short circuit and open. (14) Migration can be delayed by solder dipping. (15) If one pattern is silver and the other a tinned copper wire, migration will take place from the copper wire when it is cathode but no migration occurs when the wire is anode.

Fig. 3: With deionized water, migration is a cloud like growth

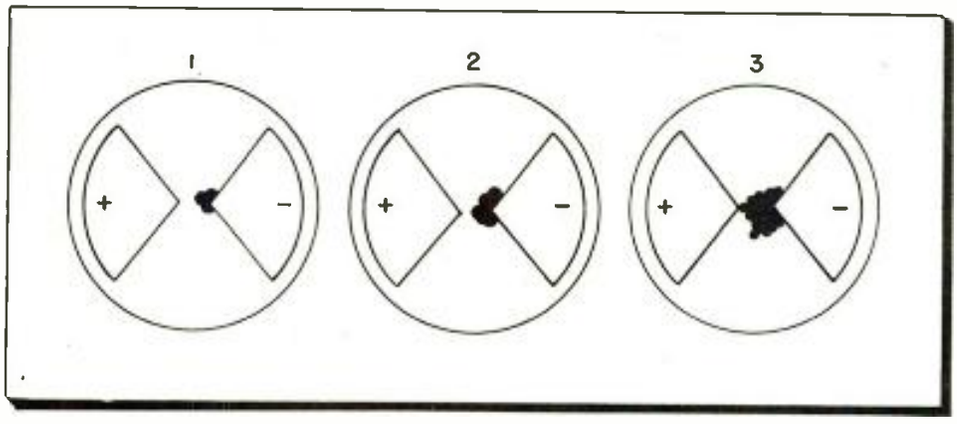
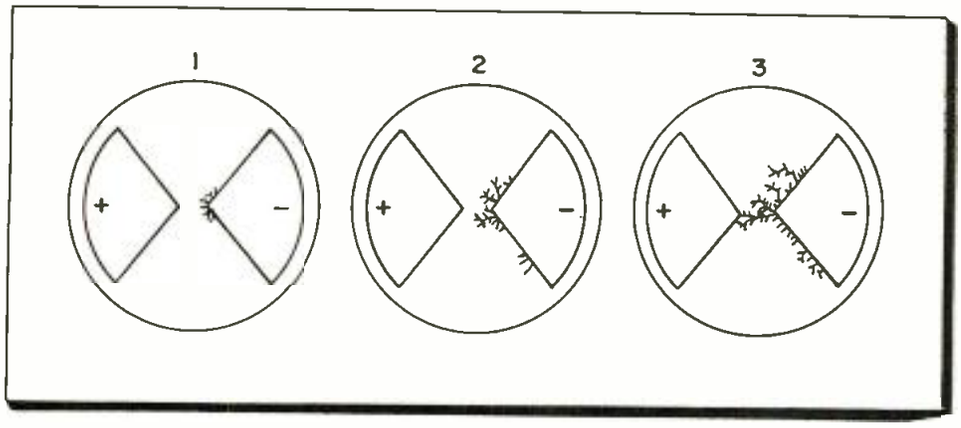


Fig. 4: With higher conductivity water, migration is tree-like



Mechanism

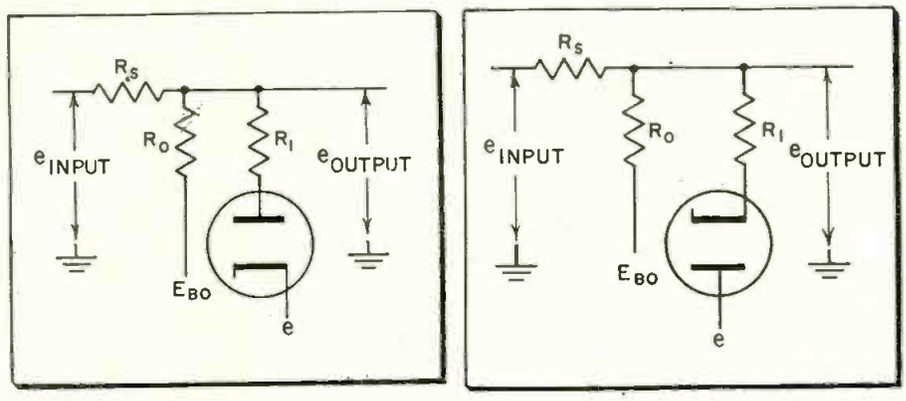
On the basis of these observations the following mechanism is proposed for the migration of silver. When a continuous water film exists between two silver patterns having a potential difference, an electrolysis is set up with the ions in solution. With pure water these ions may be only the H^+ and OH^- ions from the ionization of water. The hydrogen ion migrates to the cathode and is discharged as hydrogen gas (see (5) above). The OH^- ion migrates to the anode and dissolves silver as silver hydroxide. This material is somewhat soluble and ionizes to Ag^+ and OH^- ions. The presence of Ag^+ ions is indicated by formation of

(*Continued on page* 110)

Fig. 1: Basic networks consist of biased diodes. Diode polarity determines slope of output characteristic

Fig. 1A (l.): When output reaches or exceeds e, diode conducts, modifying transfer characteristic

Fig. 1B (rt.): Diode conducts until output reaches or exceeds e; diode is then cut off



Transfer Functions of Diode

Networks having a wide variety of transfer characteristics can be synthesized with the use of diodes and resistors. These networks are useful in analog computers where specific voltage functions or special mathematical operations are desired. A design of a logarithmic device to measure db on a linear scale is given

A. B. Jacobs

A. Schlang

WITH the use of diodes and resistors it is possible to synthesize networks that have any one of a wide variety of transfer characteristics. Networks of this type find applications in analogue computers where performances of specific mathematical operations or the generation of specific voltage functions are desired. Another application would be the use of such a network to predistort a video signal to compensate for the distortion TV phosphors introduce. At the end of this article an illustrative design is given of a logarithmic device to measure db on a linear meter scale. This linear db scale has the advantage over a non-linear scale in that a wide range of signal amplitudes can be accommodated on one scale as well as permitting more accurate readings of the lower db values.

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Basic Theory

The basic network building blocks are shown in Fig. 1. In Fig. 1A, as long as the output voltage is below bias voltage e, the diode is not conducting and the transfer characteristic is determined by R_s, R_o, and E_{BO}. However, when the output voltage reaches or exceeds e, the diode conducts, modifying the transfer characteristic. Prior to diode conduction, the output voltage is:

$$e_{out} = m_o e_{in} + e_{oo} \qquad (1)$$

This equation can be recognized as that of a straight line with slope (m_o) and intercept (e_{oo})

where:

$$m_o = \frac{R_o}{R_o + R_s} \qquad e_{oo} = \frac{R_s}{R_s + R_o} E_{BO} \quad (1a)$$

After diode conduction, the output still varies linearly as the input, but the slope and intercept now become:

$$m_I = \frac{R_o R_I}{R_o R_I + R_I R_s + R_o R_s}$$

$$C_{oI} = \frac{R_s [R_I E_{BO} + R_o e]}{R_o R_I + R_I R_s + R_o R_s} \qquad (1b)$$

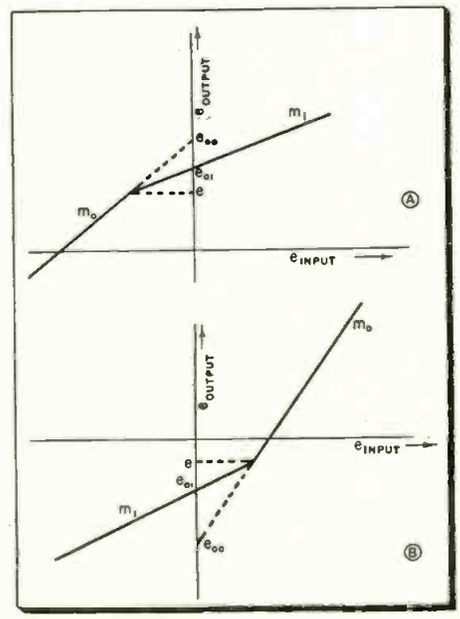
A typical plot of the output of Fig. 1A is shown in Fig. 2A.

In Fig. 1B, the diode is conducting provided that the output voltage is less than e. Eqs. (1), (1a), and (1b), still apply. However, as seen in the plot of 2B, slope m now comes before m_o. Thus we now have the building blocks for positive and negative curvatures as well as control over dc levels.

In order to design a particular circuit, the function to be synthesized is first plotted graphically and then approximated by drawing chords on the curve. The greater the number of chords chosen, the more exact will be the synthesis. However, the number of chords is only dependent upon the accuracy the designer requires. The choice of chord location is a matter of experience and experimentation.

As an example, let us consider the typical monotonically increasing

Fig. 2: Outputs of circuits shown in Fig. 1



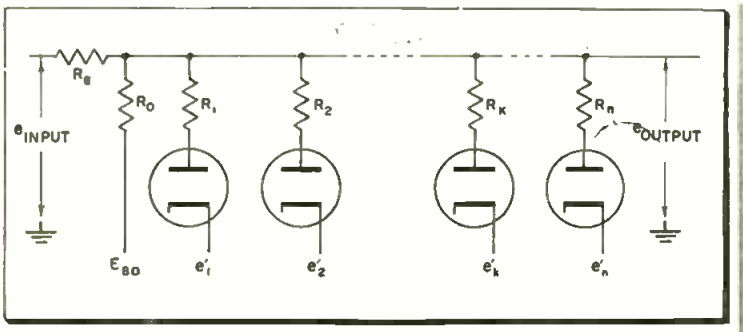


Fig. 3: As signal increases more diodes conduct, increasing attenuation

Networks

By A. SCHLANG
and A. B. JACOBS

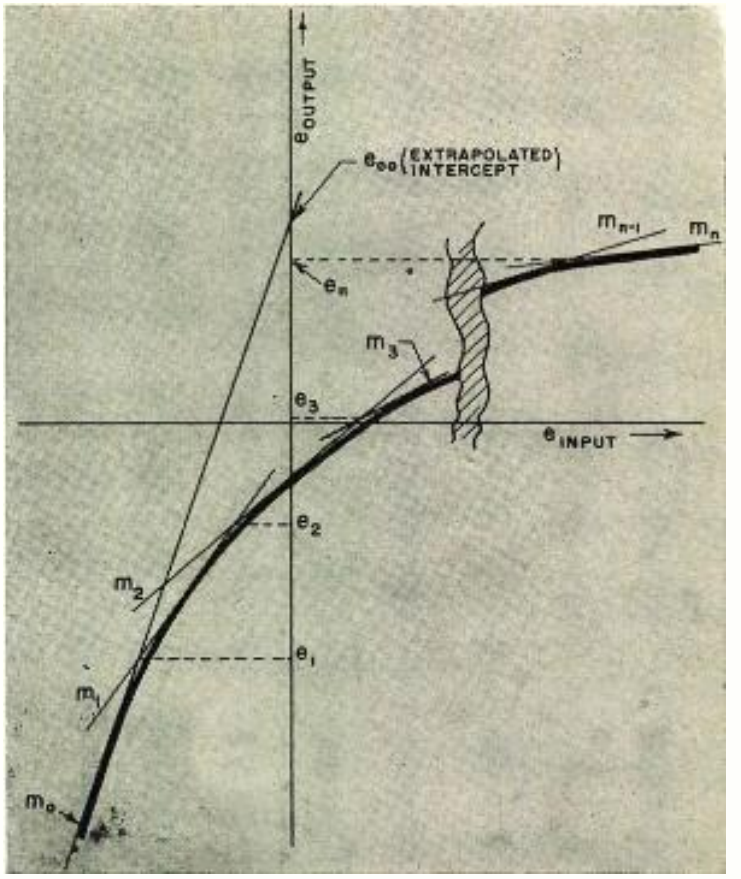


Fig. 5: Monotonically increasing function with negative second derivative

function of Fig. 5. In this example, the output voltage axis intercept is shown negative; however, it may just as well have been zero or positive. In addition the position of the breakpoints (points of chord intersection) can be either positive or negative as dictated by the curve to be synthesized. When the desired curve has been plotted and the chords chosen, breakpoint voltages e_1 to e_n, slopes m_0 to m_n, and e_{oo}, the m_0 output voltage axis intercept, are read off the curve and tabulated. The general network to form the monotonically increasing function of Fig. 5 which has a negative second derivative at every point is shown in Fig. 3 and is merely a number of cascaded units similar to that shown in Fig. 1A. To design this network, first assume values for R_0 and R_s, thereby introducing the scale factor α.

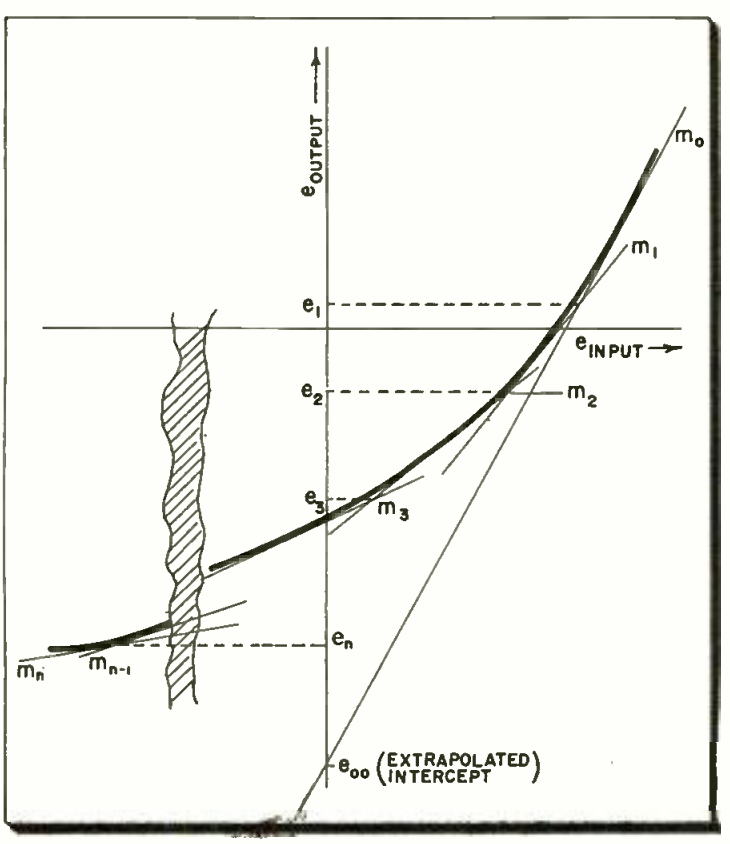


Fig. 4: Monotonically increasing function with positive second derivative

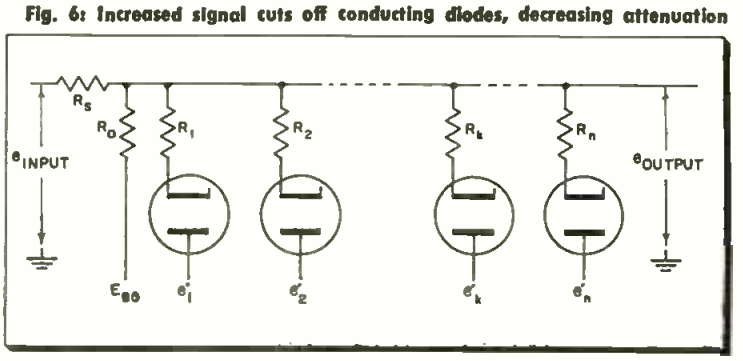
$$\alpha = \frac{R_0}{m_0 (R_0 + R_s)} \qquad (2)$$

Voltages e_0 to e_n and slopes m_0 to m_n must now be multiplied by this factor to obtain the network equivalent values. These adjusted values are indicated by the prime notation; i.e., e'_{oo}, e'_n, m'_0, and m'_n. Note that the largest adjusted slope, m'_0, cannot be greater than unity. This is consistent with the basic law stating that a resistive passive network cannot have gain. Note that under some conditions where $m_0 < 1$ the scale factor can be greater than unity.

In Fig. 3, $e'_k > e'_{k-1}$, so that as the signal increases, one diode after another in succession goes into conduction, introducing more and more attenuation. Resistor R_0 introduces the initial dc level as well as determining the initial slope m'_0. Voltages E_{BO} and e'_1 to e'_n are assumed to be zero impedance supplies.

From the preceding information, each resistor (R_1 to R_n) in turn is found from the expression:

Fig. 6: Increased signal cuts off conducting diodes, decreasing attenuation



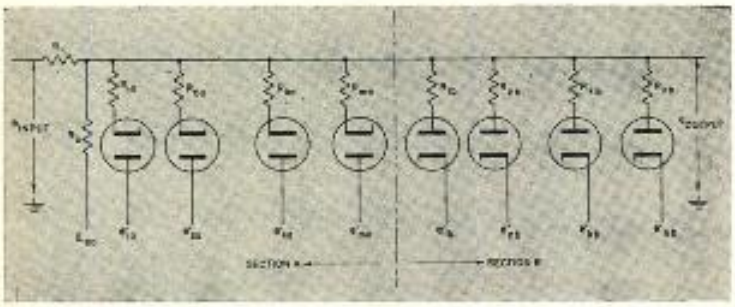


Fig. 7: New function is formed by cascading circuits of Figs. 3 & 6

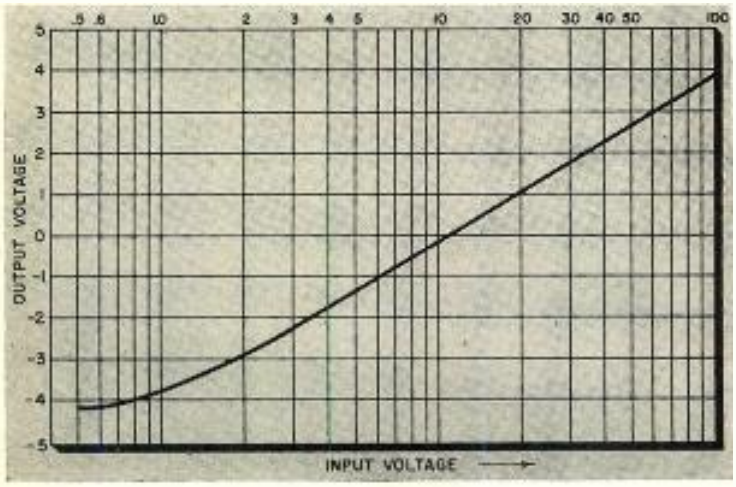


Fig. 8: Linearity of output characteristic indicates accuracy of db meter

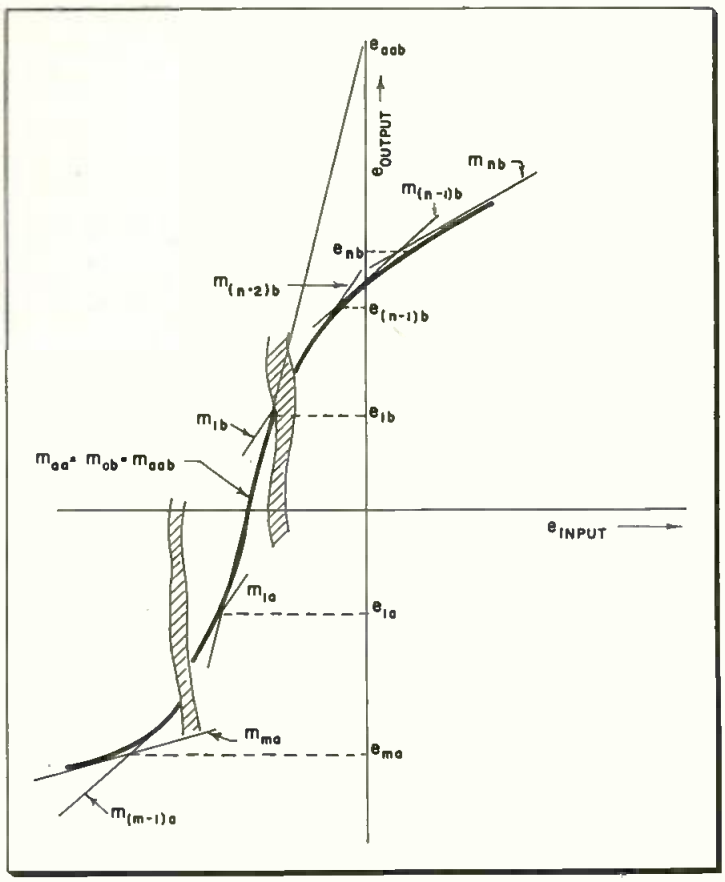


Fig. 10: Compound curve formed by cascading computer sections shown in Fig. 7

Transfer Functions (continued)

$$R_\kappa = \frac{m'_{\kappa-1}\, m'_\kappa}{m'_{\kappa-1} - m'_\kappa} R_s$$

where $\kappa = 1, 2, \ldots n$, $m'_{-1} = 1$ (3)

Bias voltage E_{BO} is given as:

$$E_{BO} = \frac{e'_{oo}\,(R_s + R_o)}{R_s} = \frac{R_o\, e_{oo}}{m_o\, R_s} \quad (4)$$

Actually the bias voltage E_{BO} can be determined from the intercept of any slope; however, calculations are simpler when the slope is used corresponding to the conduction of no diodes.

The second type of function to be synthesized is one that also increases monotonically but has a positive second derivative at every point, as shown in Fig. 4. Again e_{oo} and the break points may be negative, zero, or positive. The general network for this curve is shown in Fig. 6, and in this case it includes a number of cascaded units similar to that shown in Fig. 1B.

Here all diodes are initially conducting, providing maximum attenuation. As the input signal increases, one diode after another goes out of conduction, thereby decreasing attenuation. To design the network, one works backwards from the previously considered circuit (see Fig. 4). In both cases one works from the greatest slope to the smallest slope (m_o being the greatest slope). The scale factor is again given by Eq. (2), and Eqs. (3) and (4) are still applicable.

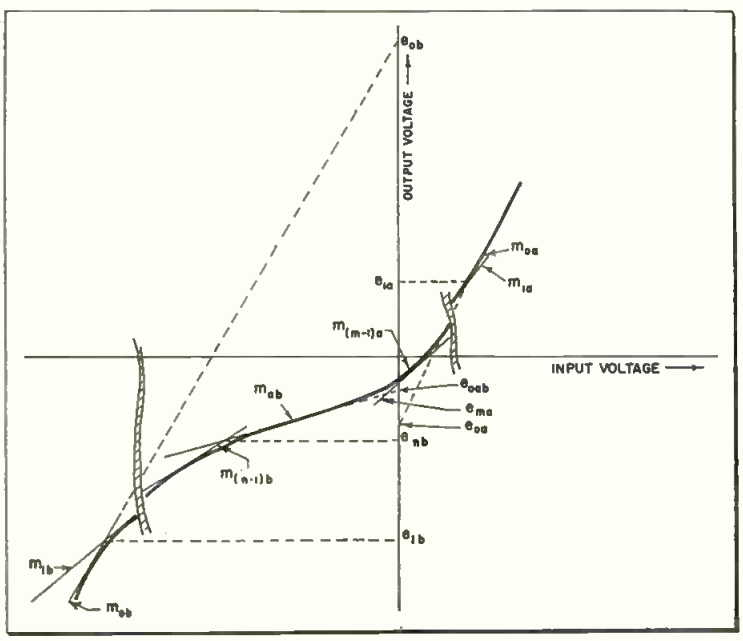


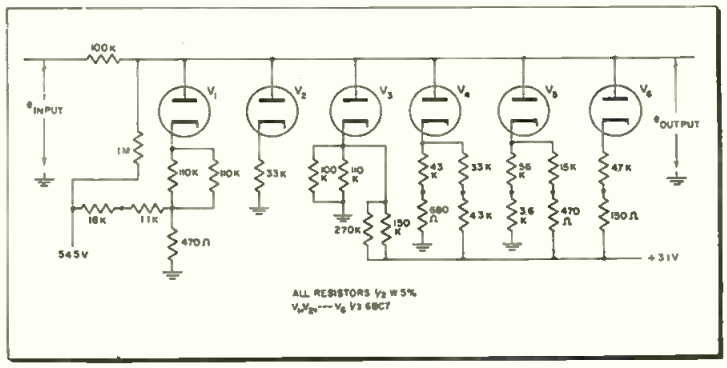
Fig. 9: Curve formed by circuit of Fig. 7 may require cathode follower isolation

Fig. 11: (below) Circuit diagram of db meter with linear scale

Cascaded Sections

A typical third type of function having a compound curve is shown in Fig. 10. This type of function may be formed by cascading two com-

(*Continued on page* 126)



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Turntable modification prevents closing of brake on clutch from spoiling cued-in start

45 RPM. Turntable Adapter Modification

THEODORE KALIN,
WEIM, Fitchburg, Mass.

IN installing the 45 RPM adapter kit as supplied by RCA for their type 70 series turntables, the following has been found helpful for easier operation. Following the instructions as supplied by RCA, the turntable tends to start the 45 RPM speed with a thud which sometimes jars the table enough to throw off the cue on the record to be played. This is caused by the brake arms closing on the newly installed clutch at the same time the microswitch starts the motor. It is these arms striking the clutch which jar the arm on the record spoiling the cued-in start for the record.

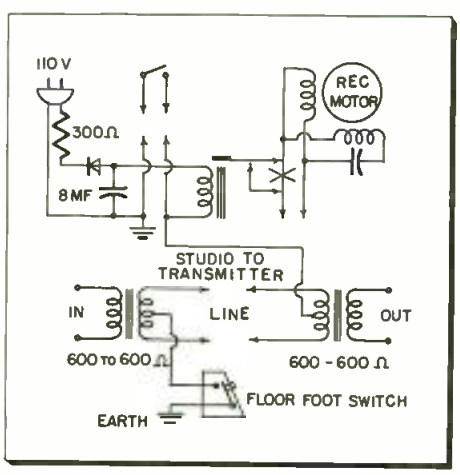
Per RCA's instructions, we removed the original mercury rotary start switch. Then, instead of discarding this switch, it is mounted directly to the right and slightly forward of its original location or at any other convenient spot. The power connections to this switch are left on it, and the connections to the microswitch as recommended by RCA are disregarded. The remainder of the RCA instructions are followed in installing the kit.

In operating the turntable, merely turn the newly installed knob to the 45 RPM speed. This moves the brake arms against the new clutch for playing 45's, before cueing them in. Then the motor can be started or stopped without moving the brake arms again. In playing 33 and 78, the knob is turned to 33-78 position, which leaves the brake arms not in contact with the shaft, and the motor once again can be started and stopped without changing the braking arms.

Remote Controlling The Tape Recorder

EARL R. WARD, Ch. Engr.
KGFF, Shawnee, Okla.

REMOTE control your recorder by using a relay to start and stop the drive motor. On the Magnecord the motor has 4 wires coming out of the drive motor, two of these wires are tied together and terminate on the switch that turns the drive motor on.



Relay control of tape recorder drive motor

Connect the relay contacts in series with this lead. A 24v. relay is easy to obtain and the selenium rectifier can be purchased from a TV parts jobber. The foot switch is the type that is "on" only when pressed down; it is mounted on a "V" shaped piece of metal. Our offices are not at the transmitter so it was necessary for us to use the method shown to control the recorder which is at the transmitter.

An extension can be put by the console to allow the announcer to turn the machines on without getting up. This is very helpful on tape recorded spots.

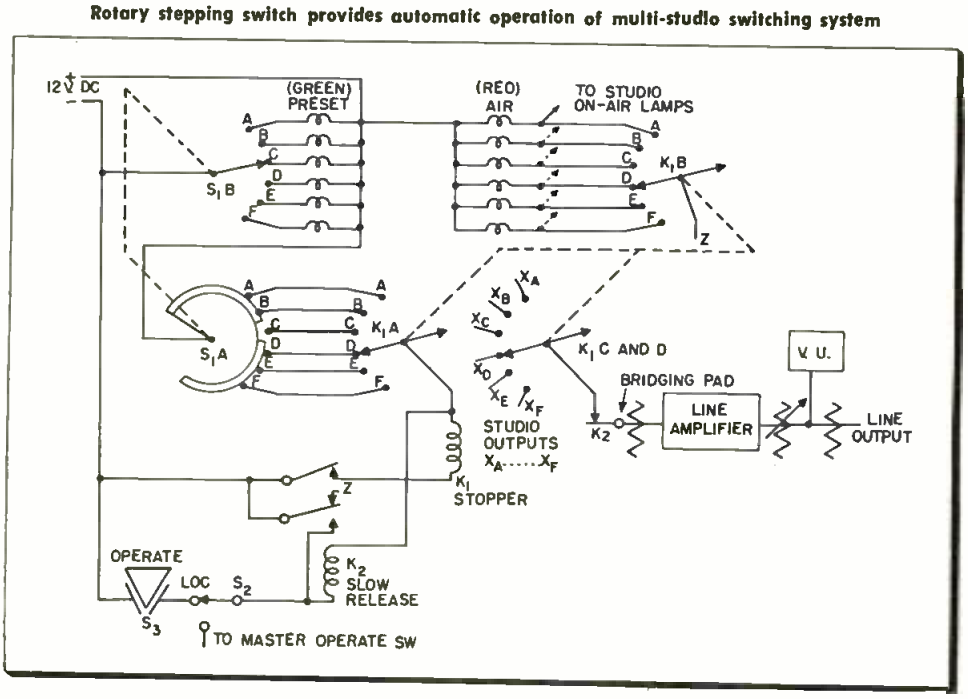
Studio Preset Control System

HERBERT MICHELS,
Ch. Engr. WHCU, Ithaca, N.Y.

IN broadcast studio design, the many advantages of a preset control system are often overlooked. By adding a simple preset arrangement to a station employing more than one studio and feeding more than one outgoing line, a large increase in operating efficiency may be accomplished. Last minute program switching-time complexity in a multi-studio installation is reduced to one simple operation. All of the "operator thinking" is done well before switching time—at the designated time (or on cue) all that is necessary is to depress the OPERATE pushbutton; the switching system performs its changeover accurately and automatically in less

(*Continued on page* 109)

Rotary stepping switch provides automatic operation of multi-studio switching system



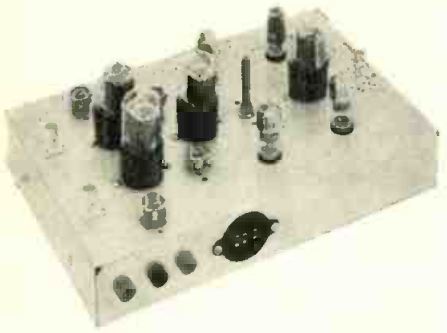


Fig. 1: Compact unit uses only eight tubes

Simple adapter provides a moving spot display, relating X-Y values, on the screen of an unmodified television receiver. Magnetization curves can be plotted by using the rectified envelopes of flux and magnetizing force voltages as inputs. Resistance rotation plots result if inputs are obtained from ganged linear and test potentiometers.

By B. R. BUDNEY

Automatic "X-Y" Plotter

B. R. Budney

THIS device, (Fig. 1), termed a "Function Display Adapter" enables electrical information in coordinate form (dc to a few cps) to be transformed to spot position on the face of an electromagnetically deflected cathode ray tube (in effect an X-Y display). The X and Y inputs may be of the order of magnitude of 0.1 to 10 v. and work into a high impedance circuit. The presentation is not a continuous curve for a P-4 phosphor, but is a spot (the spot will be stationary for a constant dc input to both axes).

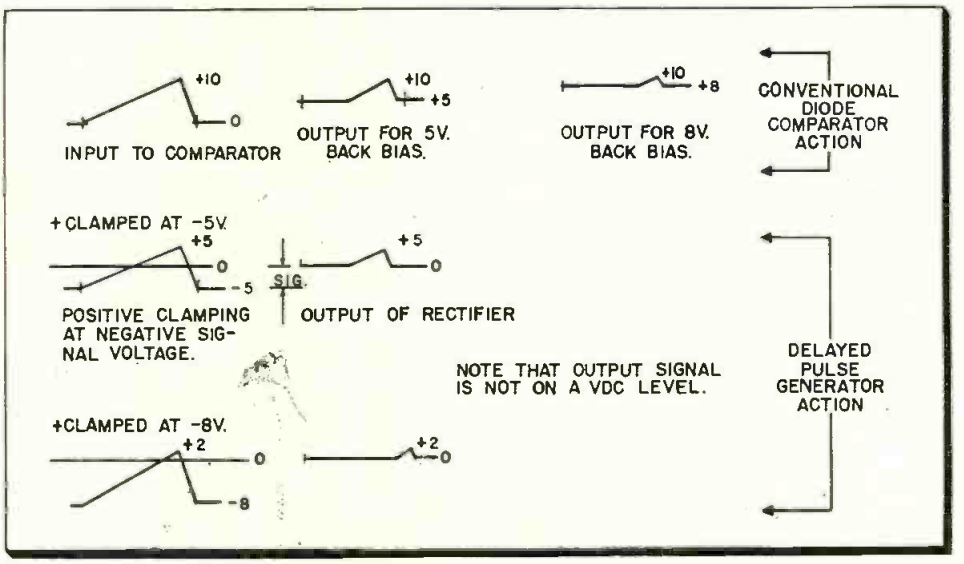
Circuit Operation

This adapter is used in conjunction with an ordinary TV receiver (usable without circuit modification) to perform a function heretofore possible only with much more costly equipment. It does not use variation of deflection coil current at the spot displacement rate and, therefore, can utilize tubes with low power rating.

Referring to Fig. 4, the Y linear time base generator output is fed into the delayed pulse generator to produce a pulse delayed with respect to the start of the vertical sweep for a time proportional to the amplitude of the Y input. The linear time base generator receives a vertical synchronizing signal from the TV receiver. The Y trigger generator sharpens the output pulse of the delayed pulse generator and triggers the gate generator. The appropriate X trigger is selected by this gate at the trigger selector. The X linear time base generator output is utilized in a similar manner with the exception that a horizontal synchronizing signal is obtained from the receiver. Since the receiver sweep current wave forms are synchronized with the X and Y linear time base generators, the Y gate generator selects an X trigger once during each vertical sweep. The selected X trigger occurs at a time after the start of the horizontal sweep proportional to the X input voltage. The output pulse is short enough to brighten only about 1% of the horizontal trace and is initiated by the trailing edge of the selected X trigger. The X and Y buffer stages enable the delayed pulse generator circuitry to work under fixed impedance conditions regardless of the impedance of the circuit feeding the buffer stages.

Referring to Fig. 3, the schematic diagram, the inputs to the Y channel are the signal voltage and a vertical synchronizing signal from the TV receiver. The sweeps in the receiver may be free running or may utilize the synchronizing pulses from a standard telecast to obtain

Fig. 2: Delayed pulse generator permits direct coupling to amplifiers V2 and V5



B. R. BUDNEY, Project Eng'r, Allen-Bradley Co., Milwaukee 4, Wisc.

FEBRUARY 1956

ABSTRACTS & REVIEWS of WORLDWIDE ELECTRONIC ENGINEERING

TELE-TECH's International ELECTRONIC SOURCES

PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name
Auto. Con.	Automatic Control
BBC Eng.	BBC Engineering Monographs
Bell Rec.	Bell Telephone Labs. Record
Bul. Fr. El.	Bulletin de la Societé Français des Electriciens
Con. Eng.	Control Engineering
El.	Electronics
El. Des.	Electronic Design
El. Eng.	Electronic Engineering
El. Eq.	Electronic Equipment
El. Mfg.	Electrical Manufacturing
El Rund.	Electronische Rundschau
Freq.	Frequenz
J. BIRE	Journal of the British Institution of Radio Engineers
Nach. Z.	Nachrichtentechnische Zeitschrift
Phil. Tech.	Philips Technical Review
Proc. AIRE	Proceedings of the Australian Institution of Radio Engineers
Proc. IRE	Proceedings of the Institute of Radio Engineers
Radiotek	Radiotekhnika (USSR)
RCA	RCA Review
Rev. Sci.	Review of Scientific Instruments
Tech. Haus.	Technische Hausmittelungen
Tele-Tech	Tele-Tech & Electronic Industries
Telonde	Télonde
Wirel. Eng.	Wireless Engineer

Also see government research reports and patents under "U.S. Government."

ANTENNAS, PROPAGATION

On the Calculation of Field Intensity of Ultra-Short Waves In the "Illuminated" Portion of Space, by A. Kalinin. "Radiotek," Sept. 1955. 9 pp. Approximation formulas are given which make it easier to calculate field intensity. Effect of curvature of earth is taken into consideration. Source 2/6-1

Angular Impingement of a Wavefront on a Wire Grid, by V. Yampol'ski. "Radiotek," Sept. 1955, 11 pp. Examination of diffraction of an electromagnetic wavefront on a grid of parallel, equidistant, thin wires where the wave impinges on the latter at an angle. Formulas obtained are conveniently used in engineering calculations. Source 2/6-2

Radiation Diagrams of Ring Aerials Having a Radiation Pattern of Rotational Symmetry in the Horizontal Plane, by H. Fastert. "Tech. Haus." No. 9/10, 1955 8 pp. A mathematical investigation of the radiation characteristics of circular antenna arrays with an infinite number of elements and with a finite number of elements for fixed phase and progressing phase are presented. Two-ring arrays and central radiators are also studied. Source 2/6-3

Radiation Characteristics of Axial Slots on a Conducting Cylinder, by J. Wait. "Wirel. Eng." Dec. 1955. 8 pp. Radiation patterns for a narrow axial slot, having a width less than about one tenth of a wavelength, on a circular cylinder having a circumference ranging from 0.1 to 21 wavelengths are presented. The numerical results and graphs presented are readily applicable to arrays of such slots. Source 2/6-4

Reflex and Disc Antennas for Decimeter Waves, by G. v. Trentini. "Nach. Z." Nov. 1955. 9 pp. Directional antennas consisting of a dipole, a reflector and a series of metal discs, small compared to the reflector and arranged between the reflector and dipole, are discussed. Experiments established a half-power beam width of 40° to 25° and a gain of 12 to 16 db; gain is comparatively high, side lobes are strong. Source 2/6-6

Ionospheric Echo Sounding with Variable Frequency at Oblique Incidence, by W. Dieminger, K. Gaisweid and H. Moeller. "Nach. Z." Nov. 1955. 9 pp. Synchronization problems and suitable equipment for this type of echo sounding are discussed. Results obtained during the years 1950 to 1954 are reported. Source 2/6-7

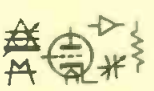
AUDIO

A Device for Changing the Duration of a Sound Record Reproduction, by A. Springer. "Elek. Rund." Dec. 1955. 3 pp. The device permits faster or slower play-back of a record without change of frequency. For slower play-back, sound track sections of specified length are repeatedly scanned; for acceleration, special sound track sections are omitted and the remaining sections joined together. Source 2/6-9

Characteristic Data of Pick-ups and Methods of their Measurements, by R. Kuehn. "Elek. Rund." Dec. 1955. 5 pp. Design and operation of electrostatic, electrodynamic and piezo-electric pick-ups are compared. The effects of resiliency, sensitivity, frequency response and non-linear distortion are studied. Source 2/6-10

A Comparison Between Reproduced and "Live" Music, by R. Vermeulen. "Phil. Tech." Dec. 1955. 7 pp. The problems involved in obtaining reproduced music of quality approaching that of "live" music. Results of comparative tests held in concert halls are given. Source 2/6-11

New Method of Measuring Nonlinear Distortions in Loudspeakers, by B. Belkin. "Radiotek." Sept. 1955. 4 pp. Method of measuring nonlinear distortions where both audio and supersonic signals are simultaneously impressed on the loudspeaker. Magnitude of distortion is assessed according to the change in the output of the amplifier based on the audio frequency beating against the supersonic frequency. Source 2/6-12



CIRCUITS

Transient Processes in a Powerful Class B Amplifier, by M. Khromikh. "Radiotek." Sept. 1955. 14 pp. Phenomena involving periodical, repetitive, transient processes in the low audio frequency range which are applicable to the push-pull circuit of the final stage of an amplifier with a transformer output operating in Class B. Effect of negative feedback is demonstrated. Connection between amplitude-frequency distortions and non-linear distortions caused by transient processes is established, on the basis of which a new criterion is given for calculation of output transformer inductance under no-load. Source 2/6-13

Synthesis of Function Generators by Continued Fraction Theory, by V. Bolie. "Tele-

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TELE-TECH's International Report of ELECTRONIC SOURCES

Integrator-Type dc Amplifier, by A. Gardiner and H. Johnson. "Rev. Sci." Dec. 1955. 3 pp. Condenser-charging principle is used in a dc amplifier to measure stars of any brightness. 15 tube device has automatic recording feature. Source 2/6-15

A Two-Wire Repeater with Negative Impedances, by T. Grewe. "Nach. Z." Nov. 1955. 8 pp. An equivalent bridge circuit (300 to 3400 cycles) having two single-stage transistor amplifiers is treated. Theory and experimental results are presented. Source 2/6-21

The Influence of Electron Inertia During Diode Detection and Frequency Transformation, by L. Gutkin and A. Kyz'min. "Radiotek." Sept. 1955. 17 pp. Analysis proceeds on the hypothesis that voltage at the anode is negative, i.e. for a setup which is optimum or close to optimum for frequencies which are not too high. Dependence of basic parameters of the detector and transformer on frequency, and problem limiting frequencies are clarified. Source 2/6-94

On the Calculation of Correction Circuits for Broad-Band Amplifiers with the Aid of RC Circuits, by I. Kushmanov. "Radiotek." Sept. 1955. 12 pp. An examination is made of low-frequency and high-frequency correction circuits. Frequency and phase characteristics lead to general equations for all circuits. Given are formulas and steps in the calculation of the basic elements of the circuits on the basis of the application of a family of curves. Source 2/6-16

Designing a Self-biased Video Amplifier for Printed Circuit Techniques, by M. Crothers. "El Des." Dec. 1955. 2 pp. There is a limiting value to the size of the capacitor which can be printed, and in a video amplifier the largest capacitor value used is in the self-bias circuit. This article, in presenting a new concept of using a low-frequency compensating network, shows how it becomes possible to ignore the capacitor value as a factor in low frequency response. Source 2/6-17

Biasing Large Amplifiers, by W. Wadey. "El." Jan. 1956. 1 p. Type 845 tube is employed as a variable grid leak for type 6401 triode, thus yielding a constant grid bias over a wide range of grid-current demands. Twenty-two 6401's are used in the Yale linear accelerator. The bias supply is designed to provide as much as 100 ma up to 1000 volts. Source 2/6-18

Stability Problems in Low Frequency Amplifiers with Negative Feedback Stages, by W. Langsdorff. "Freq." Nov. 1955. 11 pp. This first installment relies on Bode's concept of minimum phase-shift networks for a given attenuation-frequency dependence. Simple measurements on class B push-pull amplifiers establish that negative feedback stabilizing networks of suitable design may be treated as minimum phase-shift networks. Source 2/6-19

Saturable-Reactor Frequency Divider, by G. Court and C. Scollay. "Wirel. Eng." Dec. 1955. 12 pp. A simple saturable-reactor, resistor, capacitor network is described which was designed to provide synchronizing pulses for a radar modulator at half the frequency of the sinusoidal power supply. Division by factors other than two is possible. Source 2/6-20

On Tube Amplifiers for Extremely Low Frequencies, by W. Ruppel. "Nach. Z." Nov. 1955. 8 pp. This is a report on DC amplifiers. A high-gain, two-triode voltage amplifier and a four-triode current amplifier with low output impedance are discussed in more detail. Source 2/6-22

Equivalent Equalizer Networks, by R. Rowlands, "Wirel. Eng." Dec. 1955. 5 pp. The equivalence of differentiating circuit equalizers and constant-resistance equalizers is established. A table listing the equivalence conditions is included. Source 2/6-23

A Locked-Oscillator Quadrature-Grid FM Sound Detector, by J. Avins and T. Hardy. "RCA Rev." Dec. 1955. 8 pp. FM detection using a low cost pentode having a sharp cutoff suppressor characteristic. Source 2/6-24

The Compensation of Wide-band Amplifiers at High Frequencies, by P. Rohan and J. Weislitzer. "Proc. AIRE." Oct. 1955. 9 pp. Minimizing amplitude and phase distortion at the high frequency end of the band of video amplifiers, by use of RC, RLC, and special 2 and 4 terminal coupling networks. Source 2/6-25

Transient Response of Detectors in Symmetric and Asymmetric Sideband Systems, by T. Murakami and R. Sonnenfeldt. "RCA Rev." Dec. 1955. 32 pp. Analysis, characteristics and performance of a synchronous detector used in symmetrical and asymmetrical sideband systems. If transmission system is linear, detector output and original modulation are linearly related. Source 2/6-26

Disc-Seal Circuit Techniques. Part 1—Microwave Disc-Seal Amplifiers, by J. Swift. "J. BIRE" Dec. 1955. 16 pp. Lead inductance and radiation losses are greatly reduced at very high frequencies when electrodes of triodes or tetrodes are brought out of the vacuum envelope through metal to glass or ceramic disc-seal. Microwave disc-seal amplifiers, resonators, coupling elements, testing, etc. are covered. Source 2/6-27

The Diode Pump Integrator, by J. Earnshaw. "El. Eng." Jan. 1956. 5 pp. An average (integrated) dc signal is obtained from a train of pulses by causing each pulse to place a definite charge on a capacitor. Capacitor average potential is function of pulse repetition rate. Application in frequency sensitive relay circuit is given. Source 2/6-28

The Design of Filters Using Only RC Sections and Gain Stages, by A. Thiele. "El. Eng." Jan. 1956. 5 pp. Theoretical analysis and practical circuit considerations of RC filters within a feedback loop. 12, 18, and 24 db/octave slope filters. Variable filters, low and high pass filters, etc. Source 2/6-29

COMMUNICATIONS

The "Peiltakt-Phenomenon," by W. Stanner. "Elek Rund." Dec. 1955. 3 pp. When displaying a directional signal from a keyed transmitter, it had been observed that the C.R. picture fluctuates in the rhythm of the keying. This phenomenon is attributed to scattering. Source 2/6-30

A New Low Power Single Sideband Communication System, by E. Laport and K. Neumann. "RCA Rev." Dec. 1955. 13 pp. High frequency single sideband system for simplex or duplex telephone operation. Usable for telegraphy, telephony and teletypewriting. Source 2/6-32

Space Diversity Arrangement for Radio Teletypewriters, by E. Sepe. "Bell Rec." Dec. 1955. 5 pp. The original message capacity of a 6 teletypewriter single sideband channel is doubled by the use of space diversity reception. Each channel is allotted one tone for "mark" instead of two. Two separate receivers insure against fading. Source 2/6-34

Noise Characteristics of Pulse-Slope-Modulation, by J. Das. "El Eng." Jan. 1956. 6 pp. Analysis of random noise. Effects of noise on slope. Noise voltage distribution. Lab set-up for measuring signal-to-noise ratio. Bandwidth considerations. Impulse noise. Source 2/6-35

COMPONENTS

Precision Electronic Switches for Analog Computers, by C. Edwards. "El. Eq." Dec. 1955. 5 pp. Design of several electronic switches for use in electronic analog computer applications. Source 2/6-36

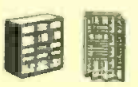
Evaluating Electronic Components for Reliability Plus, by J. Lamb. "El. Mfg." Dec. 1955. 5 pp. Ratings of reliability, availability, compatibility, economy, and reproducibility determine the applicability of electronic components. Typical case history illustrates the RACER component evaluation system. Source 2/6-37

Producing Motion With Magnetostrictive and Piezoelectric Transducers, by L. Petermann. "El. Mfg." Dec. 1955. 5 pp. The behavior of these materials which change dimensions in the presence of electric or magnetic fields. Appendix gives formulae for a number of different configurations. Source 2/6-33

Antenna Matching with Controllable Inductors, by A. Kaufman. "El. Des." Dec. 1955. 4 pp. Matching the characteristic impedance of feeder cables is accomplished with an r-f saturable reactor termed the "Increductor." The unit features a high Q, wide inductance range, rapid tuning with no moving parts. Source 2/6-40

Dielectric Absorption at High Temperatures, by R. Silbiger. "El. Des." Dec. 1955. 4 pp. To define a capacitor as having 1% dielectric absorption is to provide a statement of limited accuracy since it is not descriptive of the conditions encompassing a wide range of temperatures. This article points out the practical consequences in design work and presents simple test procedures. Source 2/6-41

Electrically Variable Gas-Dielectric Capacitor, by J. Gordon. "El." Jan. 1956. 3 pp. Circuit design details for a controllable capacitor that provides a high ratio of capacitance change to the total capacitance and which thus finds applications in the frequency control of self-excited oscillators. In between the plates of an air capacitor a neon diode varies the dielectric constant. Source 2/6-42



COMPUTERS

The Program-Controlled Electronic Computer in Munich (PERM), First Installment. "Nach. Z." Nov. 1955. 7 pp. A block diagram illustrates the basic design of this binary digital computor which uses flip-flop circuits to represent zero and unity, and has a 8000 word memory, each word consisting of 50 bits. The information is fed to the computor either manually or by a photoelectric device working from a perforated band. Source 2/6-43

Communication Theory in Digital Systems, by M. Leifer and N. Blachman. "Con. Eng." Jan. 1956. 6 pp. Communication theory as applied to computers, including information theory, storage, rate, capacity, error, etc. Source 2/6-44

Flight Simulation With a Computer, by J. Forester and C. Sullivan. 'Auto. Con." Dec. 1955. 3 pp. The response of pilot action under various simulated flight conditions is studied with an aircraft control system connected to an analogue computer. Source 2/6-45

Basic Digital Computer Principles, by G. Nye. "El. Mfg." Dec. 1955. 9 pp. Binary numbers, binary to decimal conversion, computer computation, and basic terminology and symbols for computing machines. Source 2/6-46

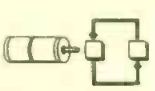
Applying Punch Cards to Time-Based Programming. "El. Mfg." Dec. 1955. 6 pp. Control of timing operations is accomplished by a punch card system. Timing cycle is changed by inserting a new card in the programmer. Description includes circuit diagram. Source 2/6-47

Simplified Analog Computer, by V. Corey. "El." Jan. 1956. 4-pp. A description of a new unit applicable to the solution of closed loop problems in the laboratory, in the analysis of regulating systems or devices, or to the control or monitoring of industrial processing. The unit comprises ten operational amplifiers, a detachable problem board and power supplies. Extreme accuracy is sacrificed but equipment is versatile. Source 2/6-48

Transfer Functions of Diode Networks, by A. Schlang and A. Jacobs. "Tele-Tech" Feb. 1956. 4 pp. Networks having a wide variety of transfer characteristics are designed with the use of diodes and resistors. Useful in analog computers where specific voltage functions or mathematical operations are desired. Design of a logarithmic device to measure db on a linear scale is given. Source 2/6-49

Using an Electronic Analog Memory, by R. Close and G. Thogerson. "El. Des." Dec. 1955. 2 pp. A description of a relatively inexpensive and compact integrating amplifier for long term memory applications in precision analog computers and tracking systems. Basically the amplifier design is for integration and storage of very short sequence pulses. It accepts charge through an electronic switch keyed by the signal to be stored. Source 2/6-50

Analog-to-Digital Data Converter, by S. Rigby. "El." Jan. 1956. 4 pp. A variable-frequency pulse oscillator with a four decade range is described. Gating the pulse oscillator into a fixed interval counter converts the analog voltage into a digital quantity. The counter operates with 20 v pulses at 0.5 μsec. into 100 ohms. Source 2/6-51



CONTROLS

Two Capacitor Method of Phase Shifting, by S. Davis. "Con. Eng." Jan. 1956. 1 p. Simultaneous adjustment of voltage magnitude and phase on the main winding of ac servosystems is accomplished, using two capacitors for phase adjustment. Source 2/6-53

Time-Delay Magnetic-Amplifier Servo, by J. Behr. "El. Eq." Dec. 1955. 2 pp. Design of an adjustable exponential time delay servo which transmits input shaft position with a required delay characteristic. Source 2/6-54

Putting Stabilization to Work, by G. Davidson and L. Nashman. "Con. Eng." Jan. 1956. 7 pp. Stabilizing and damping techniques for improving servo operation. Typical network design problem is given. Source 2/6-55

Servo Amplifier Uses Silicon Power Transistors, by J .Lacy and P. Davis, Jr. "El." Jan. 1956. 2 pp. Circuit description for servomotor drive amplifiers utilizing closed-loop negative feedback overall. Push-pull output stage permits power outputs of better than 5 watts. With a 3.5 watt output, amplitude distortion is under 10%. Source 2/6-56

Fuel Cut-Off Control for Guided Missiles, by G. Zomber and D. Macmillan. "El." Jan. 1956. 2 pp. This relay designed to cut off missile fuel is actuated by a low frequency audio signal. Small precious metal band containing a microgram of radium glued around neon tube voltage regulator acts as built-in low power gamma-ray source to stabilize its operating potential. Source 2/6-57

INDUSTRIAL ELECTRONICS

Four Steps to Practical Machine Control Design, by T. C. Cameron. "Con. Eng." Jan. 1956. 7 pp. Analysis and setup of control circuits for automatic sequential machine tool operation. Source 2/6-58

Ultrasonic Soldering Techniques, by B. Carlin. "El. Eq." Dec. 1955. 4 pp. Design and application of ultrasonic soldering irons and pots, using magnetostrictive transducer elements. Source 2/6-59

Magnetic Amplifiers in Industrial Control Systems-II, by S. Campbell. "El. Mfg." Dec. 1955. 7 pp. Selection of magnetic amplifiers for a number of applications in signal comparing systems. Circuit diagrams are included. Source 2/6-60

Ultrasonic Machining of Brittle Materials, by M. Hartley. "El." Jan. 1956. 4 pp. A description of the elements comprising an ultrasonic impact grinding system. Boron carbide abrasives are employed. High speed impact grinding makes possible a great variety of shapes with high precision in slicing or cutting quartz, ferrites, silicon, germanium etc. Source 2/6-61

Getting More For Your Engineering Dollar, by D. W. Karger. "Tele-Tech" Feb. 1956. 3 pp. Set-up used by medium sized electronic manufacturer to operate an efficient, well planned industrial engineering department. Savings realized in space, machinery, tools, materials, and manpower, etc. Source 2/6-62

Report of the 25th Week of the Discussions of the S.F.E., "Bul. Fr. El." Nov. 1955. 56 pp. The topics discussed included: synchronous and asynchronous alternators, distribution of electric power, magnetic amplifiers, problems concerning insulating oils, dielectric properties of insulating oils, theoretical questions and considerations concerning the systems of electrical systems. Source 2/6-63

MATERIALS

Broadband Applications of Ferrites, by M. Loss. "Tele-Tech" Feb. 1956. 3 pp. Using various configurations of ferrites, waveguides, isolators, phase shifters, attenuators, etc. can be designed which contain no moving parts and are electrically controlled. Increasing the bandwidth of Faraday rotation and phase shift of ferrites is discussed and a new broadband technique described. Source 2/6-65

Silver Migration in Electric Circuits, by O. Short. "Tele-Tech" Feb. 1956. 3 pp. Silver, commonly used in capacitors and printed circuits, has a tendency to migrate under ordinary conditions of humidity and potential, causing short circuits to be formed. Migration can be eliminated by the use of noble metals, or suppressed by noble metal barriers, by solder dipping, by electrocoating, or by rigorous cleaning before organic coating. Source 2/6-66

Photoeffects in Intermetallic Compounds, by H. Frederikse and R. Blunt. "Proc. IRE" Dec. 1955. 7 pp. Photoconduction, photovoltage, and photoelectric-magnetic effect of compounds with the zincblende and fluorite lattice crystal structure. Source 2/6-68

Nonlinear Dielectric Materials, by E. Jaynes. "Proc. IRE" Dec. 1955. 5 pp. Fundamental physics of nonlinear dielectrics, particularly ferroelectrics. Source 2/6-71

Some Aspects of Ferroelectricity, by G. Shirane, F. Jona, and R. Pepinsky. "Proc. IRE" Dec. 1955. 56 pp. Dielectric behavior of ferroelectrics and antiferroelectrics, and their crystal and domain structure. Source 2/6-72

Research Progress in Dielectrics—1955, by A. Javitz. "El. Mfg." Dec. 1955. 9 pp. Review of research and engineering studies of electrical insulation and dielectrics presented at the Conference on Electrical Insulation, National Academy of Sciences-National Research Council, Oct. 1955. Source 2/6-73

MEASURING & TESTING

Automatic "X-Y" Plotter, by B. Budney. "Tele-Tech" Feb. 1956. 3 pp. Simple circuit provides moving spot display, relating X-Y values, on screen of unmodified TV receiver. Magnetization curves obtainable by using rectified envelopes of flux and magnetizing force as inputs. Resistance rotation plots result if inputs are obtained from ganged linear and test potentiometers. Source 2/6-74

Electronic Device for Measuring Reciprocal Time Intervals, by E. MacNichol Jr. and J. Jacobs. "Rev. Sci." Dec. 1955. 5 pp. Train of electric impulses is converted into succession of hyperbolic wave forms of amplitude proportional to interval between successive pulses. CRO display shows rapid changes in signal frequency. Fast response to sudden changes in frequency; averaging over several cycles not necessary. Source 2/6-76

How to Make a Function Generator, by C. Belsterling. "El Des." Dec. 1955. 2 pp. This equipment produces voltage waveforms as a single or multiple valued arbitrary function of a linear time sweep or a controlled variable voltage. The design is based on the photo-former, which is essentially a closed-position feedback loop containing an amplifier, a CR tube and mask, and a photo tube. Source 2/6-78

A Test-Signal Generator for Measurements of Television Transmission Systems, by O. Macek. "Freq." Nov. 1955. 7 pp. The instrument described supplies test signals recommended by the (Funk-Betriebs-Kommission) Electronic-Organization Office in Germany. Signals submitted by the 3rd Studying Commission of the CCIF (International Consulting Telephone Committee) are mentioned for comparison. Source 2/6-79

Leakage Testing of Sealed Electronic Enclosures, by D. Bedwell and E. Meyer. "El. Mfg." Dec. 1955. 7 pp. Measurement of leakage through seals in electronic enclosures. Discussion includes methods, instruments, and evaluation of seals according to materials and sealant. Source 2/6-80

A Simple Psychogalvanometer, by W. Withers. "El. Eng." Jan. 1956. 1 p. Emotional disturbance in humans is accompanied by changes in skin resistance. Circuit described records these changes. Source 2/6-89

Controls Bottle the Stratosphere, by J. Segraves. "Auto. Con." Dec. 1955. 3 pp. Steady state, transient, and environmental tests are performed on jet and turboprop aircraft engines and accessories at the Naval Air Test Station at West Trenton, N. J. Instrumentation and operation of the laboratory. Source 2/6-81

Null Reading Flip-Coil Fluxmeter, by H. Fechter and S. Rubin. "Rev. Sci." Dec. 1955. 4 pp. Two flip-coils give a precision measurement of the ratio of separate magnetic fields when rotated through 180°. Output voltages, connected in opposition, are balanced in a potentiometer, using a null indicator. Readings are reproducible to within 0.01%. Source 2/6-82

Cathode-Ray Oscilloscope Intensity Modulator, by R. Kemp. "Rev. Sci." Dec. 1955. 2 pp. Electronic system for modulating beam intensity of CRO so as to reduce variations in trace brightness due to differences in writing speed. Improved waveform photographs are obtained. Source 2/6-83

Measuring Phase and R-F and Video Frequencies, by Y. Yu. "El." Jan. 1956. 3 pp. To indicate the phase difference of two input signals this instrument functions essentially as a comparison device. Continuously variable delay line as a standard phase shifter is employed and a sensitive balanced detector indicates the phase difference. Measurement of time delay or phase angle between two sine waves over a 10 kc to 20 mc range can be accomplished with 0.1 degree accuracy. Source 2/6-84

Magnetic-Switch Transient Analyzer, by W. Geyger, "El." Jan. 1956. 2 pp. In studying the dynamic properties of high-speed magnetic amplifiers, synchronously operated mechanical switches have proven useful. A frequency tripler and magnetic switch provide high accuracy of response time measurements. Variation of switch firing point in relation to test waveform is accomplished through a phase shifter. Source 2/6-85

Phase Shifter Circuits Test Power Meters, by P. Rao. "El." Jan. 1956. 2 pp. A description of a portable universal electronic meter tester. By applying rated voltages to the potential coils and variable currents through the current coils the loads are simulated. Power-factor meters, watt meters and watt-hour meters can be tested over 40-60 cps range. Source 2/6-86

The Recording of High-Speed Single Stroke Electrical Transients (Part 1), by D. Hardy, B. Jackson, and R. Feinberg. "El. Eng." Jan. 1956. 5 pp. Progress made: in the past 20 years in field of high-speed transient oscillography; in the design of oscillograph cathode ray tubes; in types of deflector systems. Source 2/6-87

A Harmonic Generator with Tuning Fork Drive, by W. Penton and G. Court. "El. Eng." Jan. 1956. 2 pp. Sinusoidal harmonic frequencies are obtained from the output of a tuning fork oscillator. Internal filter passes desired harmonic. At fundamental frequency of 560 cps. 10th harmonic can be obtained. Source 2/6-88

Digital Presentation Vacuum-Tube Voltmeter, by A. Nutt and C. Munsey. "El." Jan. 1956. 2 pp. This instrument has no warm up drift and is insensitive to line voltage variations. It provides a three-digit numeral presentation with both a polarity and decimal indication. A chopper is employed to sample the signal from a self-balancing pot. DC occinacy 1%. Source 2/6-90

Wide-Band Three-Phase RC-Generators for Complex Measurements of Two-Poles and Four-Poles, by G. Thirup. "J. BIRE" Dec. 1955. 9 pp. Parameters of 2 and 4 pole networks are determined using 3 phase RC oscillators, from which 3 voltages are derived. Theory and practical design of a low frequency (20 cps to 22 kc) and a high frequency (22 kc to 10 mc) instrument is given. Table gives connections and formulae for measuring parameters. Source 2/6-91

RADAR, NAVIGATION

Contributions of "Siemens" to Safety in Flying and to Aviation Electronics in the Years 1930 to 1945, by H. Zetzmann. "Freq." 10 pp. This last installment contains a report on navigation instruments such as directional antennas, distance indicators, automatic steering control and radar signal transmission. A 1944 table listing some of the instruments and their data is included. Source 2/6-92

The ASV 23. "Telonde" No. 4 (Sept.-Dec.) 1955. 15 pp. Description of aircraft blind landing system using four radio beams whose intersections define a straight line in space, or landing axis. Distance meter in cockpit continuously monitors distance to runway with accuracy better than 150 meters between 1 and 7.5 km. Source 2/6-93

SEMICONDUCTORS

Applications of Tandem Transistors, by H. Hollmann. "Tele-Tech" Feb. 1956. 2 pp. A common-collector transistor stage as input device of a second transistor acts as useful type of dc matching transformer. Power supply is simplified since first transistor acts as base leak for second, thus requiring no extra supply power. Tandem transistors, housed in single case, are utilized as oscillators, multivibrators, flip-flops, switching devices, etc. Source 2/6-95

The "Hushed" Transistor Amplifier, Part 3 of 3 parts, by W. Volkers and N. Pedersen. "Tele-Tech" Feb. 1956. 4 pp. Operating PNP junction transistors at a very low supply voltage is found to greatly reduce collector noise, and results in noise factor lower than that of triode vacuum tubes. Describes typical operation. Both collector and base voltages are identical, eliminating noise normally contributed by collector junction. Voltage gains of 2.5 to 10 are achieved. Source 2/6-96

Increasing the Cut-off Frequency of Transistors, by H. Ruehl. "Nach. Z." Nov. 1955. 2 pp. The cut-off frequency of a transistor is increased by neutralizing the collector capacity by means of an inductor. Experimental results are reported. Source 2/6-97

Theory and Experiments on a Basic Element of a Storage Light Amplifier, by J. Rosenthal. "Proc. IRE" Dec. 1955. 6 pp. Analysis of the performance of the basic element of a storage light amplifier permits determination of the operating characteristics necessary to make storage possible. Experimental data and theory compare favorably. Model with large display area is constructed and explained. Source 2/6-98.

An Electroluminescent Light Amplifying Picture Panel, by B. Kazan and F. Nicoll. "Proc. IRE" Dec. 1955. 10 pp. Light amplifier using a photoconductive layer electrically in series with an electroluminescent phosphor layer. Audio frequency exciting voltage causes increase in amplifier gain. Source 2/6-99

Opto-Electronic Devices and Networks, by E. Loebner. "Proc. IRE" Dec. 1955. 10 pp. Fundamentals of electroluminescense and photoconductivity. Opto-electrical device, the "optron," is constructed and operated. Source 2/6-100

Cathodoluminescence, by G. Garlick. "Proc. IRE" Dec. 1955. 4 pp. The physics of luminescence excitation by electrons. Phosphor deteriation and efficiency are outlined. Source 2/6-101

Electroluminescence and Related Topics, by G. Destriau and H. Ivey. "Proc. IRE" Dec. 1955. 31 pp. Intrinsic electroluminescence, carrier-injection electroluminescence, and electrophotoluminescence, their theory and application. The dependence of various phenonema upon operating parameters are reviewed and explained wherever possible. Source 2/6-102

Performance of Photoconductors, by A. Rose. "Proc. IRE" Dec. 1955. 19 pp. Analysis of the increased conductivity of a material due to exposure to radiation. Includes observations on noise currents. Source 2/6-103

Junction Transistor Electronics, by J. Moll. "Proc. IRE" Dec. 1955. 12 pp. The physics of junction transistors and their application in switching circuits. Appendix has related formulae and definitions of symbols. Source 2/6-105

A Diode's "Zener" Voltage Suits it for Two-Speed Data Switching, by R. Kramer and W. R. Porter. "Con. Eng." Jan. 1956. 1 p. Two silicon diodes back to back are used in data switching circuits. Source 2/6-106

Photoconduction in Germanium and Silicon, by M. Schultz and G. Morton. "Proc. IRE" Dec. 1955. 10 pp. Theory and behavior of germanium and silicon photoconducters. Source 2/6-108

Developing a High-Frequency Transistor, by A. Kordalewski. "El. Eq." Dec. 1955. 2 pp. Material properties, dimensions, and alloying conditions are successfully controlled to design a high frequency PNP junction transistor. Source 2/6-109

Transistorized Sync Separator Circuits for Television Receivers, by H. Goodrich. "RCA Rev." Dec. 1955. 18 pp. Design and performance of a transistor sync separator meeting commercial performance standards and requiring less circuitry than conventional vacuum tube circuits. Source 2/6-110

Junction Phototransistors, by J. Shive and P. Zuk. "Bell Rec." Dec. 1955. 5 pp. Theory, description, and application of the 1N85 p-n junction phototransistor. Ordinarily a photoconductive device, unit can be used as a photovoltaic generator. Source 2/6-111

Transistors Up Reliability of Broadcast Remotes, by P. Wulfsberg. "El." Jan. 1956. 4 pp. This remote pickup amplifier contains four-channels and uses as a power supply either a conventional power line or internal batteries. The use of printed circuits has aided materially in holding the weight of the unit to 17 lbs. To prevent loss of program an automatic cut-over relay is provided. Source 2/6-112

Transistor Characteristics for Circuit Designers, by S. Schwartz. "El." Jan. 1956. 12 pp. Design data tables for 218 types of transistors which include: 12 photo transistors, 46 high frequency triodes, 23 high power units, 106 junction triodes and 25 point-contact units. Maximum electrical ratings, average characteristics for grounded-base, grounded emitter, grounded collector and switching circuits, as well as small-signal low-frequency parameters are included. Source 2/6-113

The Electronic Energy Band Structure of Silicon and Germanium, by F. Herman. "Proc. IRE" Dec. 1955. 30 pp. Introduction to the quantum theory of crystals. Relationship between the energy band and the electrical and optical properties. Source 2/6-107

TELEVISION

Critical Considerations on the Optical Compensation with Rotating Polygon Prisms in Television Film Scanners, by H. Grabke. "Tech. Haus." No. 9/10, 1955. 5 pp. It is suggested to use polygonal assemblies with at least 24 surfaces and a built-in glass corrector with either rigid or non-rigid film-polygon coupling. Source 2/6-114

Television Sync-Pulse Spectrum. Editorial, "Wirel. Eng." Dec. 1955. 3 pp. The frequency spectrum for a composite waveform may be found by considering the waveform as originating by the superposition of periodically recurring pulse series, selected sections of which have been gated out, and accordingly adding and multiplying the known Fourier series for the simple waveforms. Source 2/6-117

A Television Receiver Suitable for Four Standards, by H. Berkhout. "Phil. Tech." Dec. 1955. 10 pp. The design of a TV receiver suitable for operating under various standards used in Europe, 625 or 819 lines, positive or negative picture modulation, AM or FM audio, and different sync signals. Source 2/6-118

Improvement in Color Kinescopes Through Optical Analogy, by D. Epstein, P. Kaus, and D. VanOrmer. "RCA Rev." Dec. 1955. 6 pp. Causes and correction of misregister between the phosphor dots and the electron spots of color kinescopes. Radial misregister is corrected by interposing a lens between the light source and the shadow mask during exposure of the phosphor screen. Source 2/6-119

High-Output Video Amplifier, by W. Clapp. "El. Eq." Dec. 1955. 2 pp. Amplifier increases picture tube acceleration grid voltage from 300v. to 450v., giving sharper spot size. Source 2/6-121

The "Vitascan"—New Color TV Scanner, by C. Spicer. "Tele-Tech" Feb. 1956. 3 pp. Employing the "flying spot" system for color TV transmission, The "Vitascan" camera is a source of light which is projected to scan the scene. This scanning light is reflected and enters pickup fixtures which generate the video signal. Usual TV transmission system is literally reversed. Source 2/6-122

The Development and Design of an Underwater Television Camera, by D. Coleman, D. Allanson, and B. Horlock. "J. BIRE" Dec. 1955. 17 pp. Electronic, mechanical, and optical considerations of marine TV equipment. Both diver controlled and deep sea cameras. Problems of underwater illumination. 525 and 625 lines are used. Source 2/6-123

The Visibility of Noise in Television, by R. Maurice, M. Gilbert, G. Newell and J. Spencer. "BBC Eng." No. 3, Oct. 1955. 18 pp. In three sections. Clarifies effects on visibility of random noise fluctuations due to TV nonlinearity. Grey scale section covers cameras with high and low velocity beams, and film scanners with high and low gain cells. Section on noise as frequency function studies subjective reactions to noise in seven narrow bands from 0 to 3 mc. Photographic section relates picture to noise levels. Source 2/6-127

TRANSMISSION LINES

Magneto-Optical Phenomena in a Rectangular Waveguide Filled with an Electron Gas, by A. Mikaelyan. "Radiotek." Sept. 1955. 12 pp. Examination of waveguide filled with gas which is being acted upon by a constant magnetic field oriented perpendicularly to direction of wave propagation. Equations are derived for propagation in boht complete and partially filled waveguide. Source 2/6-124

Strip Transmission Lines, by C. Bowness. "El. Eng." Jan. 1956. 6 pp. Design, development, difficulties, properties, losses, etc. of strip transmission lines. Comparison with waveguides. Application in microwave systems, usually where low cost is more important than perfect performance. Source 2/6-125

Adjustable Equalizers for the L3 Coaxial System, by R. Graham and J. Kinzer. "Bell Rec." Dec. 1955. 4 pp. Equalizers compensate an arbitrary coaxial transmission line characteristic by using the harmonics of cosine functions. Any loss-frequency characteristic may be compensated. Source 2/6-126

TUBES

Harmonic Analysis of the Plate Current Pulse of a Generator in the Approximation of the Plate-Grid Characteristics of a Tube with a Discontinuous Characteristic Curve, by B. Kravchenko. "Radiotek." Sept. 1955. 5 pp. Approximation of plate-grid characteristics of an electronic tube with a discontinuous curve, consisting of an arbitrary number of straight sections with various angular coefficients S (steepness). Computational formulas are derived for the harmonics of the plate pulse when a sine-wave is impressed on the grid. Source 2/6-128

Gas Tubes Protect High-Power Transmitters, by W. Parker and M. Hoover. "El." Jan. 1956. 4 pp. A description of electronic crow bar circuits used to protect high power tubes from internal flash-arc effects. Using a gas tube shunted across the d-c supply extinguishes the arc before serious damage occurs. Circuits can protect systems up to 5 megawatts. Source 2/6-129

Glow-Discharge Stabilizers, by F. Benson and L. Bental. "Wirel Eng." Dec. 1955. 7 pp. The impedance-frequency characteristics of glow-discharge voltage-regulator tubes have been measured from 20 cycles to 100 kc. A helium-filled glow-discharge stabilizer is recommended to eliminate low-frequency ripples and a neon-filled stabilizer if a high-frequency component is present. Source 2/6-130

The Characteristic Performance of Hot-Cathode Rectifier Tubes with Different Gases, by R. Huebner. "Elek. Rund." Dec. 1955. 4 pp. Pertinent performance data for thyratrons, mercury vapor tubes, and rectifier tubes with rare-gas filling are given and compared. Source 2/6-131

Currents and Conductance Values for Triodes in the Transit Time Region, by H. Kosmahl. "Elek. Rund." Dec. 1955. 4 pp. This article is concerned with the current induced by the space charge fluctuations in high frequency triodes. Conductance values due to this phenomenon are derived for triodes having the output resistance between anode and cathode or between anode and grid. Source 2/6-132

Interception Noise in Electron Beams at Microwave Frequencies, by W. Beam. "RCA Rev." Dec. 1955. 29 pp. Partition noise current and velocity produced by nonuniform interception of an electron beam of finite or infinite cross section. Source 2/6-133

Studies of Externally Heated Hot Cathode Arcs—Part IV, by E. Johnson. "RCA Rev." Dec. 1955. 35 pp. Theoretical and experimental investigations of low voltage arcs. Measurements with different gases, pressures, tube sizes, and currents substantiate analytical predictions. Source 2/6-134

Experimental High-Transconductance Gun for Kinescopes, by F. Nicoll. "RCA Rev." Dec. 1955. 6 pp. Fine mesh on the control grid aperture reduces cutoff and increases transconductance of electron guns. Source 2/6-135

An Accurate Electron Multiplier, by S. Sternberg. "RCA Rev." Dec. 1955. 17 pp. Time division multiplier maintains 0.01% accuracy at switching rate of 10 kc. Accuracy is suitable for analog computer applications. Source 2/6-136

U. S. GOVERNMENT

The following research reports designated LC after the prices are available from the Library of Congress. They are photostat (pho) or microfilm (mic), as indicated by the notation preceding the price. Prepayment is required. Use Complete title and parenthesized number following title when ordering. Unless noted otherwise, make check or money order payable to "Chief, Photoduplication Service, Library of Congress," and address to Library of Congress. Photoduplication Service, Publications Board Project, Washington 25, D.C.

All reports reviewed here were announced in Dec. 1955 as being available.

Integration Method of Detection and Its Application to the Transmission of Teletype Signals (PB 118617), by H. Harmuth, Signal Corps. May 1955. 101 pp. Mic. $5.70, pho $16.80. (LC) Design considerations for teletype operating under severe interference conditions. Coding and detecting problems are treated. Source 2/6-139

Discontinuities in Open-Wire Lines (PB 111700), by R. King, Harvard U. July 1954. 62 pp. Printed $1.75. Order from OTS, U.S. Dept. of Commerce, Washington 25, D.C. Discontinuities may be rectified by introducing junction-zone networks of lumped series and shunt elements. Simple closed formula is obtained. Source 2/6-140

Study of Surface Wave Transmission Lines. Final Report for Period June 1, 1954 to May 31, 1955 under Contract DA 36-039-sc-56734 (PB 118618), by E. Schiebe, Wisconsin U. June 1955. 65 pp. Mic $3.90, pho $10.80. (LC) Topics covered include loss measurements, effect of rain, parallel plane resonator and coupled surface wave lines. Source 2/6-141

Analysis of Angular Accuracy in Search Radar (PB 118291), by R. Bernstein, Columbia U. May 1955. 171 pp. Mic $8.10, pho $27.30. (LC) Analysis treated as problem in estimating statistically the value of population parameter. Computer constructed which duplicates radar process. Source 2/6-142

Analysis of Clipper Diode Conditions (PB 118587), by M. Zinn, Signal Corps. May 1955. 21 pp. Mic $2.70, pho $4.80. (LC) Conditions imposed on high vacuum diode serving as clipper in line type resonant charging pulse modulator circuit. Emphasis on resistive clipping. Source 2/6-143

Analysis of the Spiral Beam Traveling-Wave Magnetron (PB 118569) by W. Lear, Fla. Eng'g and Ind. Experimental Station. Nov. 1954. 22 pp. Mic. $2.70, pho $4.80. (LC) Gain expression for a traveling wave magnetron in which waves and electrons are moving in synchronism along a spiral path. Source 2/6-144

Antennas of Discontinuous Radius (PB 118-374), by C. Faflick, Harvard U.. Sept. 1954. 74 pp. Mic. $4.50, pho $12.30. (LC) Measurements of input impedance of several antennas having a single discontinuity. Source 2/6-145

Backward-Wave Oscillator Efficiency (PB 118564), by R. Grow, Stanford U. Nov. 1954.

142 pp. Mic. $7.20, pho $22.80. (LC) The factors which determine the oscillation level in a backward-wave oscillator and which will permit the design of an oscillator to produce a given amount of r-f power. Source 2/6-146

Cross-Wound Twin Helices for Traveling-Wave Tubes (PB 118565), by M. Chodorow and E. Chu, Stanford U. Oct. 1954. 69 pp. Mic $3.60, pho $9.30. (LC) A cross-wound twin helix which overcomes the disadvantages of a conventional helix for high voltage traveling-wave tubes. Source 2/6-147

Electromagnetic Transmission Characteristics of a Lattice of Infinitely Long Cylinders (PB 118574), by Z. Kaprielian, California U. Nov. 1954. 72 pp. Mic. $4.50, pho $12.30. (LC) Four approaches to the general problem and the advantages, disadvantages, and realms of validity of each. Source 2/6-150

Ferromagnetics and Ferroelectrics (PB 118-884), by A. von Hippel, MIT. Aug. 1955. 45 pp. Mic. $3.30, pho $7.80. (LC) Comparison between the two. Detailed examples of nickel, barium titanate, and magnetite. Topics include domain rotation, domain-wall nucleation and motion, resonance and relaxation effects, and fabrication parameters Source 2/6-151

Experimental Investigation Preliminary to the Design of a Model HF Shipborne Antenna Pattern Range (PB 118731), by J. Wong, National Research Council of Canada. Jul. 1955. 11 pp. Mic. $2.40, pho $3.30. (LC) Experimental investigation using scaled model techniques for the purpose of obtaining information in the design of a model HF shipborne antenna pattern range. Effects of parameters on the circularity of the measured radiation pattern. Source 2/6-152

Further Investigations Into Iterated Sine- and Cosine-Integrals and Their Amplitude Functions With Reference to Antenna Theory (PB 118577), by E. Hallen, Sweden. 1955. 46 pp. Mic $3.30, pho $7.80. (LC) Periodicity of third order functions. Tables for iterated sine-and cosine-functions and their amplitude functions up to the third order. Source 2/6-153

Huygen's Principle as an Exact Physical Concept (PB 118573), by V. Rumsey, California U. Nov. 1954. 34 pp. Mic $3.00, pho $6.30. (LC) Physical concept of Huygen's principle which is of great value in boundary value problems, such as scattering and diffraction of electromagnetic waves. Source 2/6-154

Methods for the Kinetic Study of Fast Electrode Reactions (PB 118556), by T. Berzins and P. Delahay, Louisiana State U. Dec. 1954. 41 pp. Mic $3.30, pho $7.80. (LC) Two reports. First: potential is initially adjusted; departure from this initial potential (only a few mv.) caused by the flow of current is studied. Second: kinetics of absorption of neutral organic substances on an electrode whose potential is a sine function of small amplitude (5 mv.) Source 2/6-155

Microwave Research. Quarterly Progress Report No. 10, May 1, 1955—Aug. 1, 1955, (PB 118645), by W. Nielsen and W. Gordy, Duke U. Sept. 1955. 38 pp. Mic $3.00, pho $6.30. (LC) Abstracts of current projects and 3 technical reports on electronegativities of the elements, effects of absorbed oxygen on paramagnetic resonance of X-irradiated Teflon, and 3 mm wave radiation from the sun. Source 2/6-156

Network Compensation of Error-Sampled Feedback Control Systems (PB 118409), by J. Sklansky, Columbia U. Apr. 1955. 111 pp. Mic $6.00, pho $18.30. (LC) Two new techniques for designing lumped parameter networks to compensate error-sampled feedback control systems, with 3 illustrative samples. Source 2/6-157

Noise Studies on CW Klystrons for the Period 1 May 1954 to 31 May 1955, Under Contract No. AF 19-(604)-1080 (PB 118466), by G. Espersen, R. La Plante, and J. Rogers, Philips Labs. June 1955. 30 pp. Mic $2.70, pho $4.80. (LC) Techniques for fabricating new tube designs to minimize vibrational noise. Test equipment and measuring techniques. Non-microphonic PKX-4 klystron shows considerably less noise than diaphram type PKX-2 klystron. Source 2/6-158

Optimum Synthesis of Sampled-Data Systems (PB 118436), by J. Ragazzini, Columbia U. May 1955. 87 pp. Mic $4.80, pho $13.80. (LC) Derivation of the optimum transfer functions in the least squares sense for a particular class of sampled-data systems. Source 2/6-159

Parasitic Sleeve Antenna (PB 118375), by C. Faflick, Harvard U. Sep. 1954. 86 pp. Mic $4.80, pho $13.80. (LC) Theoretical and experimental treatment of the parasitic sleeve antenna, consisting of a coaxial sleeve mounted on a cylindrical antenna center driven over an image plane. Source 2/6-161

Performance of High-Current-Density Electron Guns (PB 118864), by H. Arnett and R. Keyser, NRL. Aug. 1955. 8 pp. Mic $1.80, pho $1.80. (LC) Experimental evaluation of electron guns to produce an electron beam having a minimum perveance of 1.6 micropervs and beam voltage of 1600 v. Comparison of empirically modified Pierce gun and Heil guns of modified form. Source 2/6-162

Research in Physical Electronics. Quarterly Progress Report No. 10 Under Contract AF 19(604)-524 for the Period 15 Dec. 1954 to 15 Mar. 1955 (PB 118292), edited by H. Foerster and L. Goldstein, Electrical Engineering Research Lab, Urbana, Ill. Apr. 1955. 65 pp. Mic $3.90, pho $10.80. (LC) High speed oscillography and micro-time analysis: UHF modulated electron beams traveling wave tubes; power folded transmission line tubes. Gaseous electronics: Interaction of electromagnetic waves, cross modulation, and associated effects; Magnetic properties of a free electron gas; Quenching of the afterglow with low level microwave signals. Source 2/6-163

Some Reliability Aspects of System Design (PB 118407), by F. Moskowitz and J. McLean, USAF. May 1955. 42 pp. Mic $3.30, pho $7.80. (LC) Systematic development which leads to formulas, charts, and guide rules for engineers involved in the design of systems and equipments. Examples illustrate the use of formulas and principles derived. Source 2/6-164

Thermionic Emission From Surfaces With Adsorbed Active Centers (PB 117509), by G. Hass, NRL. Mar. 1955. 24 pp. Mic $2.25, pho $4.00. (LC) Thermionic emissions, electrical properties of surfaces, and emission of tungsten-thorium cathodes. Source 2/6-166

Traveling Wave Amplification of Millimeter Waves (PB 118674), by H. Heffner, Stanford U. July 1952. 127 pp. Mic $6.30, pho $21.30. (LC) Suitability of heavily loaded waveguides for millimeter wave amplifiers. Expected gain in the vicinity of low frequency cut off. The easitron, a resonant wall surrounding an electron beam, forms a high gain narrow band amplifier. Source 2/6-167

UHF Filtering Networks. Final Scientific Report Under Contract AF 19(604)-962 for Period 1 May 1955 to 30 June 1955 (PB 118-623), by D. Mode, Lehigh U. June 1955. 13 pp. Mic $2.40, pho $3.30. (LC) UHF filters, waveguide filters, band-pass filters, and r-f detectors. Source 2/6-168

Corona and Dielectric Losses in Pulse Transformers. Final Report for the Period 1 Apr. 1951 to 30 Apr. 1954, Under Contracts DA-36-039-sc-5552 and DA-36-039-sc-52659 (PB 118804), by W. Hoover, Stanford U. May 1954. 63 pp. Mic $3.90, pho $10.80. (LC) Corona Intensity Meter, Model 2, and Pulsed Sinusoidal Wave Train Source. Summary of both contracts. Source 2/6-169

Investigation of the Nonlinear Operation of Ramey's Fast-Response Magnetic Amplifier (PB 118803), by W. Riemer, Polytechnic Institute of Brooklyn. Dec. 1954. 26 pp. Mic $2.70, pho $4.80. (LC) The mechanism by which Ramey's Fast-Response Magnetic Amplifier becomes nonlinear under conditions of large control circuit resistance. Comparison between calculated and experimental data. Source 2/6-170

Automatic Noise-Factor Meter (PB 118581). by H. Wallman, Chalmers U., Sweden. 1955. 19 pp. Mic $2.40, pho $3.30. (LC) Simple instrument for automatic and direct indication of noise factor of amplifiers. As servo-system based on a null method, noise factor is not affected by detector characteristic or by variations in amplifier gain. Source 2/6-171

Effect of Diffraction on Sound Velocity Measurement in an Idealized Acoustic Interferometer (PB 118866), by J. Parker, NRL. Aug. 1955. 27 pp. Mic $2.70, pho $4.80. (LC) Effect of diffraction is shown to cause the measured or apparent velocity to be in excess of the actual velocity. Excess is a monotonic decreasing function of the source-reflector separation. Source 2/6-172

Miniature Condenser Microphone Employing a Flexible Diaphram Controlled by Air Stiffness (PB 118377), by T. Schultz, Harvard U. Sep. 1954. 62 pp. Mic $3.90, pho $10.80 (LC) Microphone with extremely regular amplitude and phase response as a function of frequency, up to 15 kc. Theory, design considerations, construction, and test results. Source 2/6-173

Note Concerning a New Device for Localizing and Ranging High Frequency Interference Sources for Aerial Antenna Networks (PB 118272), translated and edited by F. A. Raven, International Special Committee on Radioelectric Disturbances. May 1955. 24 pp. Mic $2.40, pho $4.80. (LC) Locators of radio interference, monitoring of electric lines, and measuring instruments—Switzerland. Source 2/6-174

Summary of Component Life in the Logistics Computer (PB 118558), by D. Ream, Engineering Research Associates. Nov. 1954. 4 pp. Mic $1.80, pho $1.80. (LC) Computers-components, tubes, and replacements. Source 2/6-176

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, U.S. Patent Office, Dept. of Commerce, Washington 25, D.C.

Magnetrons, #2,727,185. Inv. F. Thompson, M. Esterson and A. Crook. Assigned English Electric Valve. Iss. Dec. 13, 1955. Magnetron with axial cathode and concentric multiple anode has end cap adjacent to discharge space to prevent electrons from straying. Source 2/6-177

Permeability Tuning System, #2,727,147. Inv. H. Craumer. Assigned Corning Glass. Iss. Dec. 13, 1955. Combined inductance-capacitance tuner employs helical coil and two tubular axially aligned electrodes. Source 2/6-178

Ultra High Frequency Tuner, #2,727,148. Inv. M. Slate. Assigned DuMont Labs. Iss. Dec. 13, 1955. Axially aligned stator and rotor is designed with slot and strap arrangement to effect tuning. Source 2/6-179

Electronic Rectifier Tube and Ignitor Assembly, #2,727,168. Inv. D. Marshall, G. Lewin and E. Goldman. Assigned Westinghouse. Iss. Dec. 13, 1955. Ignitron contains annularly confined arc-striking surface on sponge cathode, and spring-loaded ignitor pressed into contact with arc-striking surface. Source 2/6-180

Ion Trap for a Cathode Ray Tube, #2,727,171. Inv. J. de Gier. Assigned Hartford National Bank. Iss. Dec. 13, 1955. Bent electrode system has ferromagnetic material in envelope to guide stray flux generated by magnetic deflection to point of inflection. Source 2/6-181

Background Reduction in Image Tube, #2,-727,173. Inv. R. Longini and R. McIntosh. Assigned Westinghouse. Iss. Dec. 13, 1955. High potential is applied between curved conductor and conducting beads strung on said conductor. Source 2/6-182

Electrostatic Lens System, #2,727,177. Inv. H. Dalley and C. Scullin. Assigned Westinghouse. Iss. Dec. 13, 1955. Electron emissive filament comprises trough shaped shield and thoriated tungsten ribbon. Source 2/6-183

Calutrons, #2,727,150. Inv. E. Lawrence. Assigned U.S. AEC. Iss. Dec. 13, 1955. Face plate associated with tank in magnetic field has ion source mechanism connected to it. Electric shields effect control on curved ion path. Source 2/6-184

Proximity Fuse Adjusting Means, #2,727,140. Inv. R. Bell. Assigned Philco. Iss. Dec. 13, 1955. System for testing operation of radio proximity fuse simulates time variation of fuse's antenna conductance as fuse moves toward earth. Source 2/6-185

Travelling Wave Tube, #2,727,179. Inv. P. Lally and L. Barash. Assigned Sperry Rand. Iss. Dec. 13, 1955. Tube with electron stream along longitudinal axis has coaxial transmission line extending parallel to helix. Line's center conductor terminates to helix in end of tube. Source 2/6-186

Ceramic Mosaic for Camera Pick-Up Tube, #2,727,170. Inv. W. Rudy. Assigned RCA. Iss. Dec. 13, 1955. Ceramic sheet with photosensitive mosaic on one side and conductor on other is made of mixture of titanates and zirconates to provide dielectric constant of 28. Source 2/6-187

Microwave Reactance Tube, #2,727,180. Inv. M. Wheeler. Assigned Westinghouse. Iss. Dec. 13, 1955. Spiral beam tube with rectangular resonator having parallel slots has electrons directed from one slot to the other. Source 2/6-188

Servo Controlled Tri-Color Television Tube, #2,727,184. Inv. T. Miller and K. Fromm. Assigned Westinghouse. Iss. Dec. 13, 1955. Secondary emission of line phosphors combined with modulation on scanning beam in addition to video modulation provide correction voltage to keep beam in color sinc. Source 2/6-189

Signal Discrimination in Pulse Radar Systems, #2,726,386. Inv. G. Camp. Assigned Meipar. Iss. Dec. 6, 1955. Distance measuring system generates successive oscillatory pulses having low decay rates, with receiver increasing the effective decay rates. Source 2/6-190

Bearing Signal Quality Detector, #2,726,387. Inv. J. Allison. Assigned IT&T. Iss. Dec.6, 1955. Receiving system for determining the bearing of a detected signal compares detected signal with reference source, and produces output according to resulting ratio. Source 2/6-191

Antenna System Combinations and Arrays, #2,726,388. Inv. A. Kandoian and R. Felsenheld. Assigned IT&T. Iss. Dec. 6, 1955. System with one antenna supported above the other has special radiators and isolating means. Source 2/6-192

Antenna Unit, #2,726,389. Inv. I. Taylor. Assigned IT&T. Iss. Dec. 6, 1955. Vertically polarized antenna has rotating cylinder mounted concentrically around it. Source 2/6-193

Cathode Ray Recording Oscilligraph, #2,726,-918. Inv. C. Hathaway and W. Tilton. Jr. Assigned Hathaway Instrument. Iss. Dec. 13, 1955. Recording drum mechanism produces electrical impulse to intensify crt beam for a predetermined time. Thyratron interrupts circuit at end of time interval. Source 2/6-194

Drum Recording Mechanism for Oscillographs, #2,726,919. Inv. C. Hathaway and W. Tilton, Jr. Assigned Hathaway Instrument. Iss. Dec. 13, 1955. Drum recorder has electromagnetically operated shutter to control light striking drum. Source 2/6-195

Suppressing Galloping Conductors, #2,727,085. Inv. E. Tornquist and C. Becker. Iss. Dec. 13, 1955. Special damping member mitigates wind-induced galloping oscillations in antenna conductors. Source 2/6-196

Colour Television Apparatus, #2,727,090. Inv. F. Okolicsanyi. Color TV system utilizes optical filter with alternate colored and noncolored strips, and time-delayed index signal to produce desired signal. Source 2/6-197

Anti Cross-Talk Multitrack Magnetic Sound System, #2,727,096. Inv. K. Singer. Assigned RCA. Iss. Dec. 13, 1955. Interference preventing system for magnetic film has plurality of heads and bias oscillators to impress leakage signal in reverse phase on adjacent channel heads. Source 2/6-198

Apparatus for Translating Sound Waves into a Signal for Reception by a Light Sensitive Part, #2,727,099. Inv. C. Roberts. Iss. Dec. 13, 1955. Vibrating mirror connected to aluminum foil diaphragm and pair of light valve grids are actuated by sound to modulate light beam. Source 2/6-199

Panoramic Receiver with Unwanted Signal Rejector, #2,727,139. Inv. R. Hollandbeck. Assigned Westinghouse. Iss. Dec. 13, 1955. In radio receiver with local oscillator controlled by a sweep generator, a filter arrangement alters sensitivity within a predetermined frequency interval. Source 2/6-200

Wideband Phase-Splitter, #2,727,141. Inv. R. Cheek. Assigned Westinghouse. Iss. Dec. 13, 1955. Broadband single sideband apparatus has plurality of phase splitters operating over different bands from a common input. Source 2/6-201

Ultra High Frequency Signal Generator, #2,727,181. Inv. A. Haeff and C. Smith. Iss. Dec. 13, 1955. Electron tube has coaxial tunable cylindrical resonant chamber coupled to hollow resonator closely surrounding tube envelope. Source 2/6-202

Image Transformer with Electron-Optical Image Projection, #2,727,182. Inv. J. Francken. Assigned Hartford National Bank. Iss. Dec. 13, 1955. Coil arrangement permits variable magnification of image on collector in tube having photoelectric cathode. Source 2/6-203

Voltage Stabilizing Systems, #2,727,204. Inv. M. Haine. Assigned General Electric. Iss. Dec. 13, 1955. Stabilizing system for high voltage supply has electrons accelerated to velocity dependent on output voltage. Collector intercepts portion of beam to stabilize voltage. Source 2/6-204

Device for Measuring Magnetic Field Intensity and Pole Direction, #2,727,207. Inv. J. Jones. Iss. Dec. 13, 1955. Metal cylinder filled with conducting fluid has diaphragm over one end for vibrating fluid. Coil and permanent magnet act with diaphragm. Source 2/6-205

Bridge Circuit, #2,727,208. Inv. C. Spaulding. Assigned Consolidated Engineering. Iss. Dec. 13, 1955. Circuit for sensing small changes of capacitance employs as one circuit element a capacitor having a flexible diaphragm as one plate. Deflection of diaphragm electrostatically balances bridge. Source 2/6-206

Precision Time Interval Measuring System, #2,727,209. Inv. H. Mayer. Assigned General Electric. Iss. Dec. 13, 1955. Voltage developed by timing capacitor controls charging current through said capacitor. Source 2/6-207

Method and Apparatus for Controlling High Frequency Current, #2,727,211. Inv. G. Dewitz. Assigned CGS Labs. Iss. Dec. 13, 1955. Control winding on saturable reactor controls current by changing skin-effect resistance. Source 2/6-208

Time Delay Network, #2,727,213. Inv. J. Lucas. Assigned Zenith. Iss. Dec. 13, 1955. Lumped-parameter network is made up of coil form with series of apertures, distributed windings and dielectric core member. Source 2/6-209

Acoustic Delay Line Using Solid Rods, #2,727,214. Inv. H. McSkimin. Assigned Bell Labs. Iss. Dec. 13, 1955. Combination of input and output piezoelectric crystals connected to solid rods defined by a number of reflecting surfaces. Source 2/6-210

Sweep Control Circuit for Cathode Ray Tube Indicators, #2,727,224. Inv. J. Adkins, G. Burnie and H. Jackson. Assigned Westinghouse. Iss. Dec. 13, 1955. Plan position indicator radar voltage supply uses winding arrangement in conjunction with antenna rotation to apply voltage to sweep circuit capacitors. Source 2/6-211

Radar Navigational System for Aircraft, #2,727,229. Inv. J. Anast and G. Minshall. Iss. Dec. 13, 1955. Airborne search radar and directional antenna send pulses reradiated by ground repeater. Resulting crt indication is related to map overlay by coordinating antenna and indicator sweeps. Source 2/6-212

Electronically Tunable Cavity Resonator, #2,727,230. Inv. M. Wheeler. Assigned Westinghouse. Iss. Dec. 13, 1955. Microwave source with plurality of waveguides and loads has reactance tube connected to guide. Reactance cavities are voltage tuned to source frequency. Source 2/6-213

Amplitude Control Unit, #2,726,368. Inv. L. Himmel. Assigned IT&T. Issued Dec. 6, 1955. Bridge circuit with transmission line arms varies r-f output amplitude while maintaining phase and impedance to energy source constant. Source 2/6-217

Negative Impedance Converters Employing Transistors, #2,726,370. Inv. J. Linvill and R. Wallace, Jr. Assigned Bell Labs. Iss. Dec. 6, 1955. Transistor with forward biased emitter and reverse biased collector is employed in circuit with two terminal pairs and two terminating networks. Source 2/6-218

Connector for Joining the Ends of Flexible Insulated Wires, #2,726,374. Inv. M. Lipton. Assigned U.S. Army. Iss. Dec. 6, 1955. Body member with longitudinal bore has slotted fingers at each end to fold and securely anchor wires. Source 2/6-219

Angular Adjustment of Synchros, #2,726,382. Inv. J. Bell. Assigned Muirhead. Iss. Dec. 6, 1955. For testing synchros, a plate, radius arm and micrometer screw permit adjustment at a number of fixed angular positions on plate. Source 2/6-220

Frequency Modulated Radio Distance Measuring System, #2,726,383. Inv. T. Dunn. Assigned RCA. Iss. Dec. 6, 1955. FM signals are reflected from remote surface to produce beat frequency. Modulation rate is controlled as inverse function of distance. Source 2/6-221

Automatic Frequency Response Controls, #2,726,384. Inv. L. St. Jean. Assigned Raytheon. Iss. Dec. 6, 1955. FM device for measuring distance produces voltage whose magnitude is proportional to signal frequency. Source 2/6-222

New Tech Data for Engineers

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

Mica Mat

The story of G-E mica mat, a new electrical insulation material, is told in a new full-color sound-slide film produced by GE, Laminated and Insulating Products Dept., Section NR-1, Coshocton, Ohio. A 20-page booklet, describing the film, presents key pictures from the film sequence.
(Ask for B-2-2)

Test & Measuring Instruments

New 4-page bulletin of the Kay Electric Co., 14 Maple Ave., Pine Brook, N.J., contains specifications and prices for their line of electronic test and measuring instruments.
(Ask for B-2-3)

Engineering Assistance

A 2-color booklet, explaining how their new service offers important engineering assistance in such fields as: Telemetering, Electro-Mechanical Controls, Missile Guidance Systems, Computers, Servomechanisms, etc., has been published by Shock and Vibration Research Inc., 820 Hammond Bldg., Detroit, Mich.
(Ask for B-2-4)

Shaded Pole AC Motors

New condensed catalog, F 4271-6 from Barber-Colman Co., Small Motors Div., 1200 Rock St., Rockford, Ill., describes the company's line of shaded pole ac motors for use in servomechanisms, communication equipment, and other applications.
(Ask for B-2-5)

Magnetic Shielding

The Magnetic Shield Div. of the Perfection Mica Company, 1322 N. Elston Ave., Chicago, Ill., has published newly completed studies on its "Fernetic" and "Conetic" magnetic shielding. Material includes 8 charts showing increased efficiency of different thicknesses of the various shielding products manufactured by the company.
(Ask for B-2-6)

Silicone Reference Guide

1956 Reference Guide to silicone products has just been published by Dow Corning Corp., Midland, Mich. The new edition describes almost 150 of the most generally used silicone products, 18 of which were introduced within the last 12 months.
(Ask for B-2-7)

Meter-Relays

The compact 24-page instruction booklet of Assembly Products, Inc. Chesterland, Ohio, contains general description, and pertinent data for meter-relay handling.
(Ask for B-2-8)

Tube Specs

American Radio Co., 445 Park Ave., New York, N.Y., has available a new specification sheet for a line of "miniatrons," 14 long-life preferred reliability miniature tubes.
(Ask for B-2-9)

Rectifier Replacement

Copies of a new 28-page Selenium Rectifier Replacement Guide (Bulletin 213) listing Radio Receptor specifications and replacement requirements for all radio and TV sets using rectifiers have been published by Dept. E, Semiconductor Div., Radio Receptor Co., Inc., 251 W. 19th St., New York, N.Y.
(Ask for B-2-10)

Electrical Resistance

Of interest to design engineers is the new Alloy Handbook of Electrical Resistance, issued by the William B. Driver Co., Newark, N. J. This 150 page brochure contains complete electrical and mechanical information on a variety of metals and alloys used for resistive purposes. Metric equivalents, conversion tables, ASTM standards, etc. are included, along with a pictorial description of the company' facilities. (Ask for B-2-60)

Dial Graduates

Brochure offered by Photomechanical Corp., 170-84 S. Van Brunt St., Englewood, N.J., describes, for example, how they have successfully divided circles from 1 to 12 in. diam. into as many as 2000 lines/peripheral in. 4-page, 2-color folder explains how this technique may be applied to any form, such as: complex wave forms, digital computer coding discs, and sine wave frequency standards. (Ask for B-2-13)

Capacitors

Bulletin AB-20B from the Astron Corp., 255 Grant Ave., E. Newark, N.J. gives full technical information and application data on Astron's Blue Point (R) molded plastic capacitor and the new patented technique by which they are manufactured. (Ask for B-2-14)

Switches

Grayhill, 561 Hillgrove Ave., La Grange, Ill., presents tech. data, and prices of their line of miniature tap switches, and push button switches in their 6-page, illustrated Catalog No. M-200. (Ask for B-2-15)

Ceramic Terminals

Physical characteristics, installation techniques, and other pertinent data concerning their line of high temperature ceramic terminals are covered in a 4-page bulletin published by The Ceramaseal Company, P.O. Box 25, New Lebanon Center, N.Y. (Ask for B-2-16)

Transistor Power Supplies

Electronic Research Associates, Inc., 67 E. Centre St., Nutley, N.J., have published a new 4-page, 2-color catalogue describing their expanded line of tubeless and transistor power supplies. Several new models, including all-transistor semi-conductor power units, are covered in this Catalogue PS 11-15-55. (Ask for B-2-17)

Test Units

Units for over potential testing and power supply use, standard meters, high voltage voltmeters, shunts, transformers, phase sequence indicators, and other special electrical/electronic equipment comprise the new line of Davenport Manufacturing Co. which is announced in their new 20-page catalogue from Dept. TTN, 1713 N. Ashland Ave., Chicago 22, Ill. (Ask for B-2-18)

Time Planner

1956 Time Planner and Appointment Guide for the Electronics Industry, conveniently arranged in 6-page folder, has been published by Sprague Electric, 233 Marshall St., N. Adams, Mass. (Ask for B-2-19)

Magnetic Amplifier

Bulletin from Polytechnic Research & Development Co., Inc., 202 Tillary St., Brooklyn 1, N.Y., contains specifications for company's low level magnetic amplifier, transistor-magnetic servo amplifier, and tubeless demodulator. (Ask for B-2-20)

Development Facilities

Facilities for research, development, and production of electronic equipment are described in an illustrated 28-page brochure published by the Technical Products Div., Packard-Bell Company, 12333 W. Olympic Blvd., Los Angeles 64, Calif. (Ask for B-2-21)

Potentiometers

"A Symposium of Technical Articles" is the title of a new brochure, covering all phases of precision potentiometer design and application, available from Borg Equipment Div. of The George W. Borg Corp., Janesville, Wisc. (Ask for B-2-22)

Transmitting Tubes

Brochure from Penta Laboratories, Inc., 216 N. Milpas St., Santa Barbara, Calif. describes line of power tetrodes, thyratrons, beam pentodes, and vacuum relays. (Ask for B-2-23)

Mobile Tape Recording

AMPEX Series 800 mobile equipment, for easier acquisition of accurate test data aboard moving vehicles is described in a 8-page bulletin from the AMPEX Corp., 405 Lexington Ave., New York 17, N.Y.
(Ask for B-2-12)

Ceramics

8-page bulletin describing the ceramic products and facilities of Frenchtown Porcelain Co., 101 Muirhead Ave., Frenchtown, N.J., is available. (Ask for B-2-50)

Selenium Rectifiers

A 12-page booklet, "Federal Selenium Rectifier Design Data Guide," giving design data of industrial and military rectifiers has been compiled by Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N.J. (Ask for B-2-51)

Couplings

Quick-Seal Hose Couplings, designed to handle any material (chemicals, greases, gases, liquids, etc.) which will flow in a line, are described in a 20-page booklet which has been released by Titeflex, Inc., Industrial Products Div., Hendee St., Springfield, Mass. (Ask for B-2-52)

Relays

Cat. No. R-55 describing high speed and sensitive relays especially designed for aircraft electronic equipment is available from the Electronics Division of Iron Fireman Mfg. Co., 2838 S. E. 9th Ave., Portland, Ore. (Ask for B-2-53)

Single Sideband

New 24-page bulletin, "Single Sideband" has been made available by Eitel-McCullough, Inc., San Bruno, Calif. It gives single sideband ratings for Eimac tubes and discusses other pertinent tech. information. (Ask for B-2-54)

Sound Equipment

A 20-page catalog for the communications industry containing a complete listing of speaker enclosures, grilles, mounting accessories and complete intercom equipment enclosures has been compiled by Lowell Manufacturing Co., 3030 Laclede Station Road, St. Louis, Mo. (Ask for B-2-55)

Basic Research

"Fund for Basic Research in the Physical Sciences," a 20-page booklet published by the Alfred P. Sloan Foundation, Inc., summarizes the condition of pure scientific research in the United States today, and outlines the Foundation's new program to encourage basic scientific research. (Ask for B-2-56)

Pressure Resistor

Clark Electronics Laboratories, Palm Springs, Cal., has available a bulletin on variable pressure resistors for use in electronics and power fields. (Ask for B-2-57)

Hermetic Seal Plugs

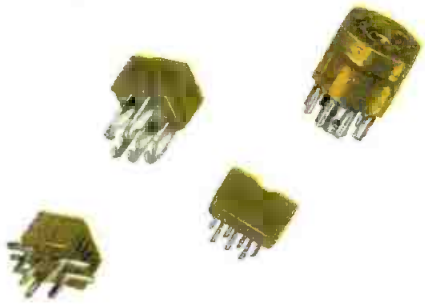
Four page brochure, "Hermetic Seal Plugs," describing the "Type S" line of glass insulated connectors is offered by Seals, Inc., 1010 Mission St., South Pasadena, Cal. (Ask for B-2-58)

Dual Impregnators

Red Point Products, Inc., 1907 Riverside Drive, Glendale, Cal., has available a bulletin describing dual impregnating machines designed for vacuum impregnation of electrical windings, metal castings, textiles, etc. (Ask for B-2-59)

CINCH ☆ STANDARD COMPONENTS

AUTOMATION... automatically made, therefore made with precision metal and electrical components. CINCH automatically assembled parts assure the uniformity and quality mandatory for use in AUTOMATION in the end users equipment.



CINCH SUB-MINIATURE SOCKETS insure positive electrical contral, hald tubes securely in place, permit easy maintenance replacement, yield maximum insulatian and minimum high frequency loss.

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CINCH MANUFACTURING CORPORATION
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TUBE (RECEIVER, TRANSMITTER AND SPECIAL): BATTERY, ALL TYPES
C-R TUBE
CRYSTAL
ELECTROLYTIC
GLASS TYPE; 4 TO 7 PRONG
LAMINATED
INFRA-RED RAY TUBE
HIGH ALTITUDE AIRBORNE TYPES
KINESCOPE; MAGNAL, DUODECAL, DIHEPTAL
LOKTAL-MINIATURE-MULTIPLUG-
NOVAL-OCTAL (MOLDED BAKELITE, STEATITE, TEFLON, KEL-F AND LAMINATED)
PLEXICON
PRINTED CIRCUIT
SPECIAL SOCKETS TO SPECS
SUB-MINIATURE; HEARING AID TYPES
TV; 110V CIRCUIT BREAKAWAY
VIBRATOR
PENCIL TUBE TRANSISTOR
DIODE

Cinch components available at leading electronic jobbers —everywhere.

Centrally located plants at Chicago, Shelbyville, Pasadena and St. Louis.

Quantity production of low loss Mica components. Finest molding machines and equipment operated under most experienced guidance and engineering supervision with adequate and unequaled facilities has advanced CINCH to the foremost in production of low loss Mica components in quantity.

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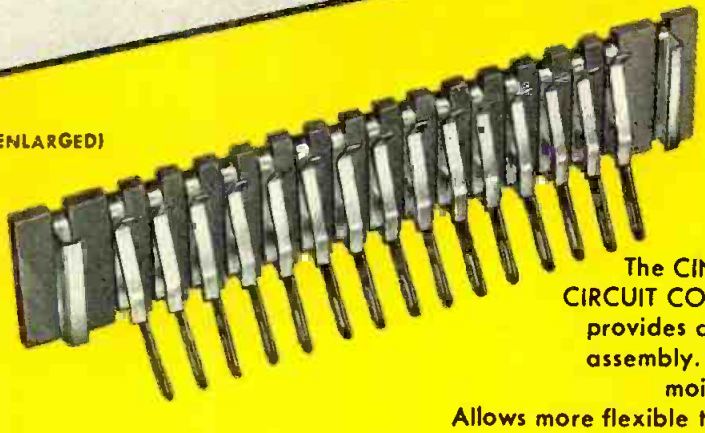

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CINCH-ERIE PLEXICON VACUUM TUBE SOCKET:
With built-in ceramic condensers, Plexicon Tube Sockets, no larger than standard receiver socket, provide the most effective method of by-passing . . . with condenser close to tube element providing shortest path to the ground . . . capacity up to 1,000 MMF — the tube element may be grounded or by-passed as desired.

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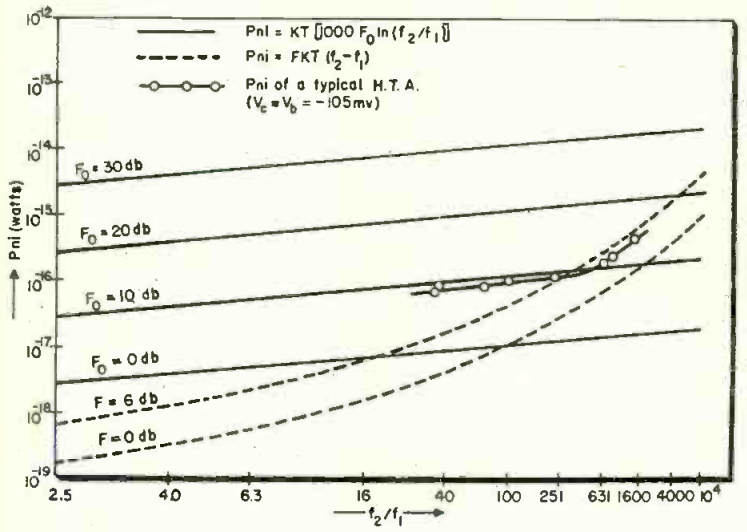


Fig. 13: Comparison of 1/f noise power and thermal noise power. F_1 was held constant at 23 cps.

"Hushed" Amplifier

(*Continued from page 72*)

by the amount ϵ_X which is the equivalent RMS voltage of all other noise voltages developed anywhere in the amplifier and referred to the input. The actual noise voltage across the input can therefore be expressed as

$$\epsilon^2 = (\epsilon_\rho)^2 + (\epsilon_X)^2 \qquad (6)$$

or,

$$\epsilon^2 = 4KTBR_G\left(\frac{R_I}{R_G + R_I}\right)^2 + (\epsilon_X)^2 \qquad (7)$$

Our Noise Figure F is then, by definition,

$$F = \frac{(\epsilon)^2}{4\ KTBR_G\left(\frac{R_I}{R_G + R_I}\right)^2} \qquad (8)$$

or,

$$F = 1 + (\epsilon_X)^2 \frac{(R_G + R_I)^2}{4\ KTBR_G\ (R_I)^2} \qquad (9)$$

Now let us assume that, contrary to our definition of noise figure, the internal input resistance R_I is a thermal resistance, in other words, that generator ϵ_{RI} is active, and not shorted, the switch being now in position b. In this case our thermal voltage drop across the input terminals is created by both R_G and R_I and the square of our thermal voltage drop across the input terminals is

$$(\epsilon_{\rho T})^2 = 4KTB\frac{R_G \cdot R_I}{R_G + R_I} \qquad (10)$$

If again we have our extra noise voltage ϵ_X referred to the input, in series with ϵ_ρ, we can express our "true thermal noise figure" F_{TT}, that is, a noise figure in which R_I does generate thermal noise in accordance with Nyquist's theorem (as R_G does):

$$F_{TT} = \frac{\epsilon^2}{(\epsilon_{\rho T})^2} = \frac{\epsilon^2}{4KTB\left(\frac{R_G \cdot R_I}{R_G + R_I}\right)} \qquad (11)$$

We can now define our "minimum possible thermal noise figure", as the result of the discrepancy between physical conditions, that is, R_G and R_I generating noise power, and, our definition for noise figure, ruling that R_I is not permitted to generate thermal noise. It is the ratio of F over F_{TT}, or

$$F_{MPT} = \frac{F}{F_{TT}} = \frac{R_G + R_I}{R_I} \qquad (12)$$

This is the curve which we have plotted in Fig. 10. In many confirming experiments we have seen that the hushed transistor actually can have a noise figure which is below this minimum possible thermal noise figure.

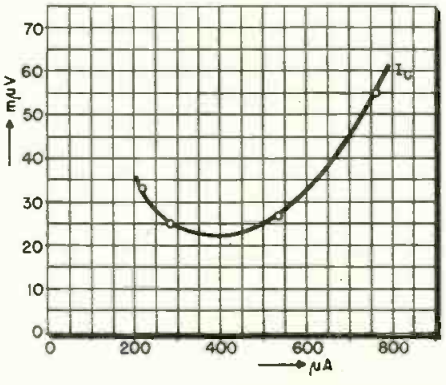
An explanation of this seeming violation of Nyquist's theorem is possible:

Dynamic vs. Ohmic Impedance

Our measured input impedance is a dynamic impedance. It is affected strongly by the feedback characteristics, inherent in transistor action. The stronger the effect of the feedback characteristic, the larger becomes the dynamic input impedance.

On the other hand, if we consider the ohmic input properties of a transistor, there are essentially two main resistances to be considered. They are the ohmic base resistance and the ohmic emitter junction resistance, the latter being paralleled by the series connection of collector resistance and the load resistance. The last two resistances mentioned together are so much larger than the emitter resistance that, in this particular consideration, they may be neglected.

Fig. 14: Noise voltage vs. collector current



The base resistance usually has a nominal value of from 75 ohms to 350 ohms. The emitter resistance is nominally a few tens of ohms.

Therefore, our ohmic, noise-creating input resistance cannot be higher than anywhere between 100 to 500 ohms. In other words, it is substantially lower than the 1.2K dynamic input impedance which we measured.

This explains, in our opinion, the reason why our measurements showed us input noise voltages, input noise power, and noise figure values which on occasions fell below the calculated minimum possible noise figure, which was based on the assumption that the dynamic input impedance of the transistor is a thermal resistance which it is not, or at least not entirely.

Therefore, while as said before, the transistor seemed to be placed in an unfavorable competitive position with a vacuum tube because it is endowed with an unavoidable, relatively low input impedance, the difference between ohmic and dynamic input impedance now turns the tables, at least to some extent, favoring the transistor (at least in grounded emitter operation) and its noise figure.

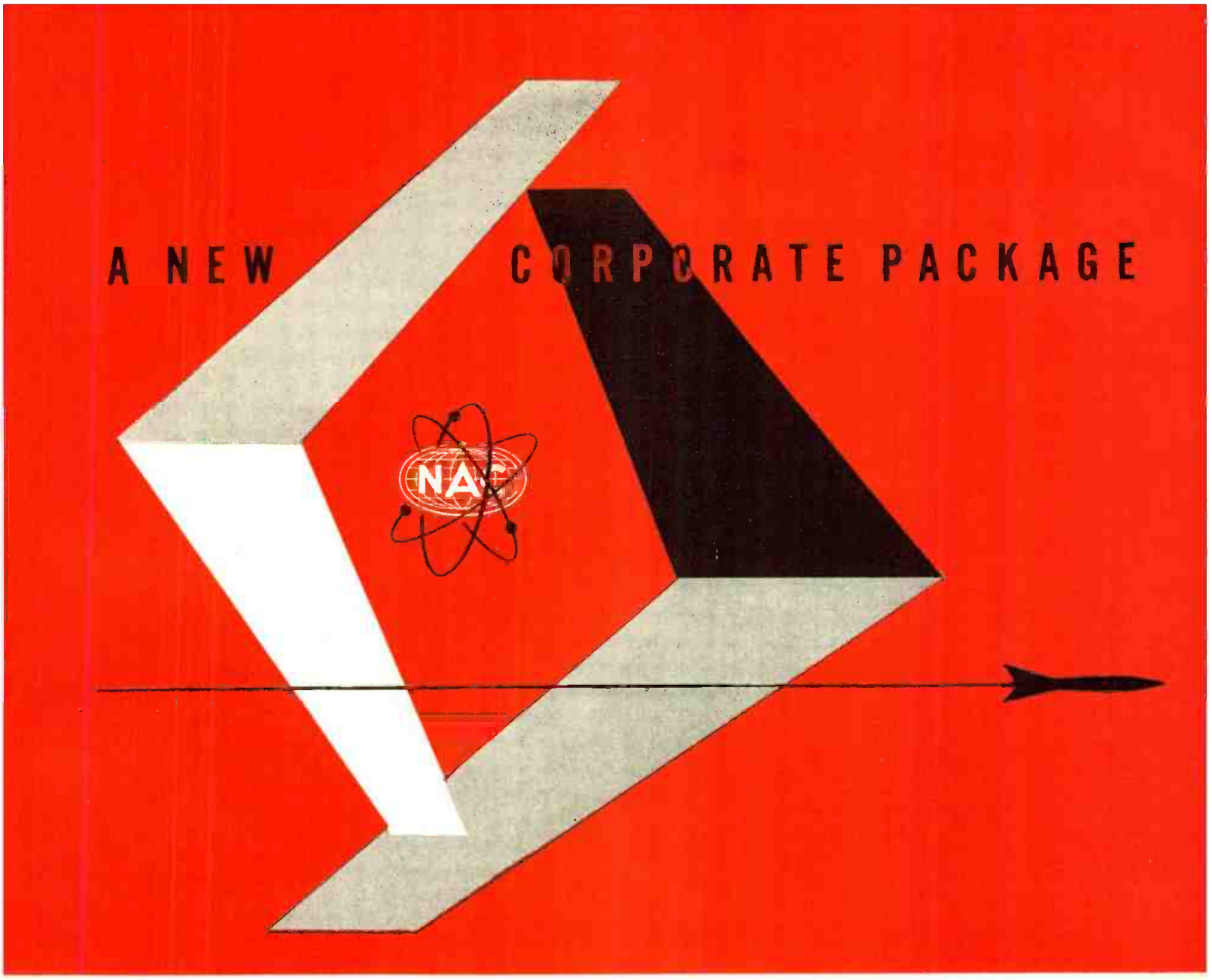
Noise Voltage

Fig. 12 shows the final result of our relative noise voltage and noise figure measurements with both frequency and generator resistance being varied. Diagram A shows relative noise voltage curves, referred to the input circuit in hushed condition; zero generator resistance is used as our zero DB reference. Diagram B shows the corresponding relative noise voltage for the unhushed condition, zero generator resistance in the hushed condition being again our reference.

The hushed and the unhushed transistor both show a nearly constant noise voltage above 750 CPS, if the input is shorted, or nearly shorted (in this case the generator resistance happened to be 10 ohms.) Below 750 cycles, noise voltage rises in both cases at a rate of approximately 2 db per octave.

Noise voltage in the unhushed con-

(*Continued on page 129*)



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Getting More for Your Engineering Dollar

By D. W. KARGER

An efficient, well planned Industrial Engineering Department can more effectively utilize space, machinery, general facilities, tools, material, and manpower. The set-up used by a medium-sized electronic manufacturer, presented here, should aid others in successfully setting up and operating such a department

THE Industrial Engineering Department described in this article has given its company direct returns in improved performance although requiring less than average manpower. This department is operated in a medium sized factory of a multi-plant organization which employs a total of approximately 2,500 workers.

Manufactured in the plant are electronic products of almost every conceivable type, precision instruments, and electrolytic capacitors. These products involve both precision and non-precision assembly, very complicated electronic testing and adjustment, both high and low precision machining, related inspection, chemical processing, plating, painting, coil winding, riveting—virtually all of the Industrial processes common to American industry.

The above information is given as background material to enable you to better evaluate the material which will follow.

It is generally accepted that the chief responsibility of an Industrial Engineering Department is that of obtaining the most effective utilization of space, machinery, general facilities, tools, material, and manpower.

Industrial Engineering is also essentially considered to be a specialized staff function designed to achieve this overall responsibility.

According to the first premise, it would seem logical to combine within this department all of the staff specialists directly and indirectly related to this objective.

It is, of course, obvious that such a department would contain most of the managerial, supervisory, and specialized personnel in the plant. It is here where the second basic premise needs to be brought into action.

While each plant department, such as Material Control, is concerned with a certain phase of the overall problem, the Industrial Engineering Department is a staff function of specialists actively concerned with the overall problem. It must of necessity work with, and make use of the facts provided by these other departments or functions. One of its major tasks is to gather, coordinate, and help develop the facts concerning a problem in conjunction with the other departments. In addition, however, it must then analyze the facts and initiate the various actions required to accomplish the responsibility listed at the beginning of this article.

Mechanical Assembly and Test Processing

Probably the most accepted functions of Industrial Engineering are those of methods and processing. We will, therefore, consider these functions first. Reference to Fig. (1) will indicate that we have in our department two basic processing sections, one called Mechanical and Assembly Process, and the other Test Process. Each combines methods work and processing.

These two sections were organized as separate groups because of the wide diversion of specialized knowledge required in each.

The Test Processing Section is principally concerned with the testing and adjusting required for the very complicated electronic apparatus. It must contain individuals with a great amount of technical knowledge concerning electronics in order to devise tests and procedures to make this gear meet specifications. Essentially, the men in this section must be college graduates with at least a bachelors degree in electronic engineering with a communication or electronic major.

Contrasted to this, the Mechanical and Assembly Process group can effectively utilize Industrial Engineers, Mechanical Engineers, etc., and in addition, men who have come up through the ranks who are well versed in the arts of machine shop practice, tool and die making, etc.

From an organization viewpoint, we believe that this latter group should be as well diversified as possible. Represented in our group are graduate Industrial, Mechanical, and Electrical Engineers, Business Administration Graduates, Tool and Die Makers, and Production Foremen.

In reference to the latter two categories, they are men with the basic backgrounds indicated but having the aptitudes for, and specialized training in, Industrial Engineering. The men in the latter two groups not only make a very valuable direct contribution to the efforts of the department but also serve to keep it on a very practical basis. Were they not present, we believe that some of the results would tend to become theoretical and unpractical in the eyes of the shop men who need to use tools, processes, plant layout, general facilities, etc., developed by this processing and methods group.

This basic idea of trying to keep within the various group, both college trained and shop trained personnel, permeates the entire organization. These shop background men are, however, in the minority because few individuals exist with both the practical shop background plus the aptitude and specialized training required to make them valuable as

D. W. KARGER, ch. plant and industrial engr., Magnavox Co., Fort Wayne, Ind.

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3. Stable, uniform characteristics (special selection unnecessary)
4. Low input impedance
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TYPICAL CHARACTERISTICS

Characteristic	2N156	2N158
System voltage	12	28 volts
Current amplification Ic = .25 amp. Ic = 1.0 amp.	 48 33	 45 27
Collector dissipation*	5	5 watts
Collector peak inverse voltage	−40	−80 volts
Max. junction temperature	−40—85°C	−40—85°C

*With suitable heat sink

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Engineering Dollar

(*Continued from page 84*)

Industrial Engineers. To be effective as Industrial Engineers, they need a variety of background information on accounting, common organization practice, a burning desire to get the most out of what is available, etc.

It perhaps should be mentioned that promising production foremen in the plant are, when possible, offered the opportunity of coming into the Industrial Engineering Department.

Specific duties and responsibilities for mechanical and assembly process engineers are essentially covered in the items outlined in Fig. 1.

Junior and associate engineers do not, of course, require the same degree of work experience. They should, however, be potentially able to work up to Assistant Engineers. Other requirements are generally the same as outlined for Assistant Industrial Engineers.

Most of the items outlined in the functional breakdown of the Standards Department are almost unanimously conceded to be a part of the conventional industrial Engineering Department.

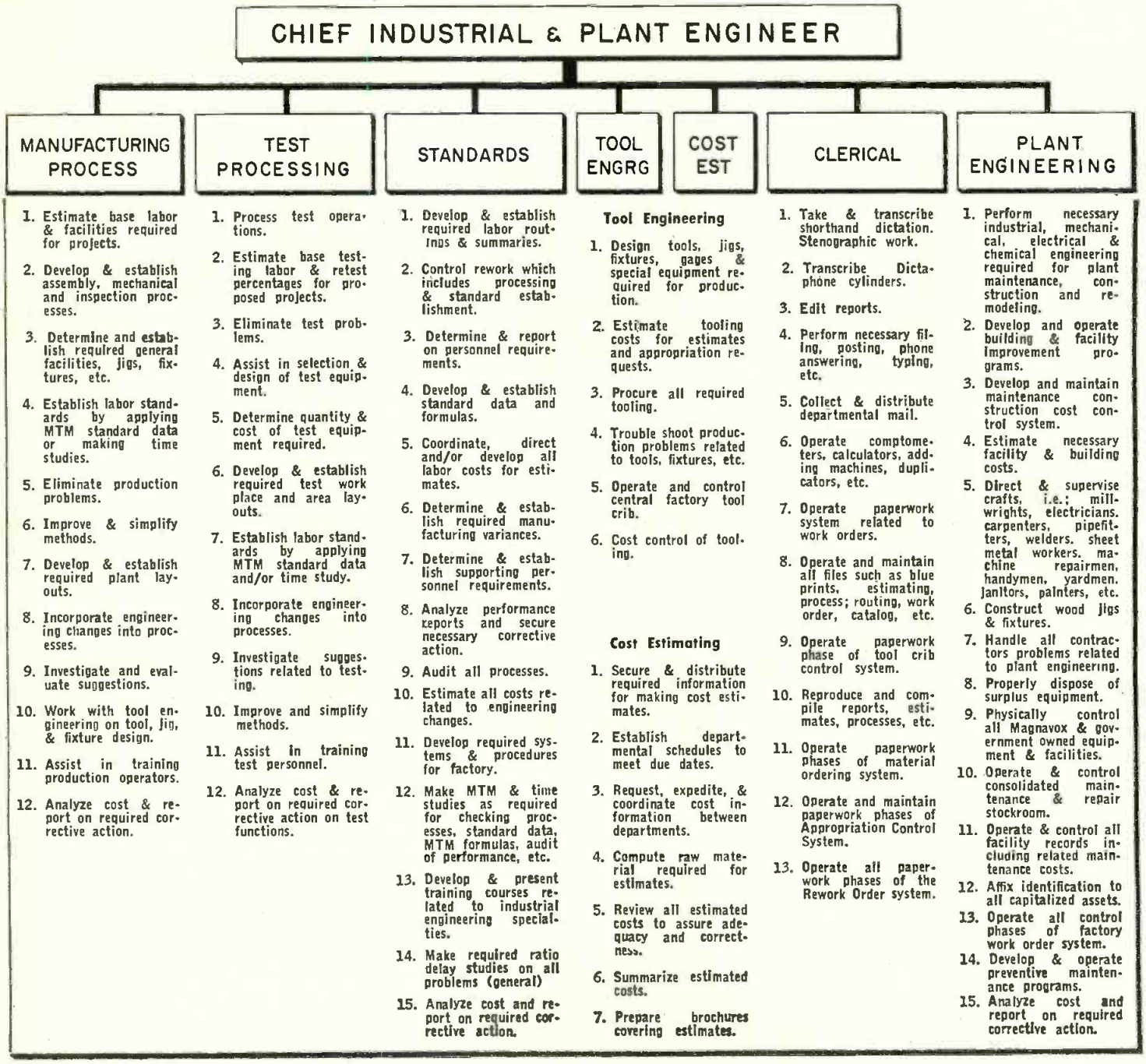
The founders of our American Constitution designed into our form of Government a system of checks and balances. Observing the fine results achieved through their endeavor, we borrowed from this experience and tried to build into our Industrial Engineering Activity a similar system of checks and balances.

Our Standards Activity has as a major responsibility the auditing and evaluation of the processing activities. In other words, we have a "check and balance" arrangement. In like manner, the processing sections evaluate the standard data and time formulas given them to apply. Similar action is provided concerning manufacturing variances, supporting personnel allowances, etc.

To some extent the standards section also evaluates the tools supplied by our Tool Engineering Section. The Mechanical and Assembly Processing Section, however, provides the major audit of tool engineering designs.

In addition to the auditing activity, the Standards Section is certainly a very important operating activity of Industrial Engineering. It supplies basic time information to the processing groups and at the same time utilizes their processes to develop what we call routings. These provide the basis for the establishment of

(*Continued on page 120*)



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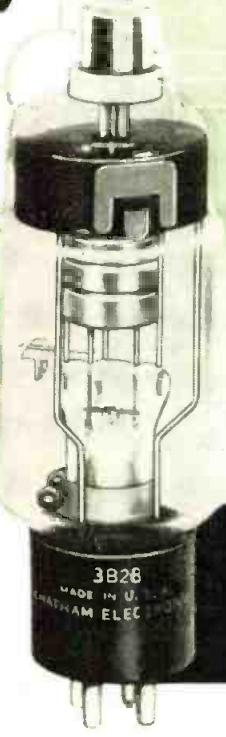

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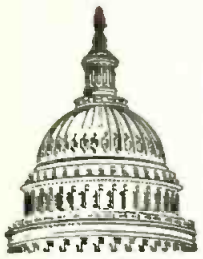

WASHINGTON
News Letter

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

SENATE TV PROBE—The Senate Interstate & Foreign Commerce Committee was slated to commence hearings on January 17th in its long-scheduled investigation of TV networks and UHF-VHF problems. Senator Warren G. Magnuson (D., Wash.), Committee Chairman despite the fact that he is running for reelection next fall, has evinced a significant interest in television matters and has ordered a comprehensive series of hearings to obtain the complete situation so as to aid expansion of this greatest medium of mass communication. Spokesmen for the TV networks and UHF-VHF major TV stations, together with the FCC Commissioners and top staff officials, were slated to present their views. Proponents of subscription TV were likewise to testify.

BEST SPECTRUM USE—Leading federal government agencies which have a major interest in electronics and radio have formed an ad hoc committee under the chairmanship of Maj. Gen. Jerry V. Matejka (USA ret.), assistant director for telecommunications of the Office of Defense Mobilization, to make a long-range survey of the VHF portion of the radio spectrum to ascertain the best uses of that frequency space by the government and military services. The objective will be to determine the possibility of releasing by the government and military services of some of its VHF spectrum space for additional television channels. FCC Chairman George C. McConnaughey, Assistant Secretary of Commerce George Moore and the top Defense Department telecommunications official are members of the committee.

TV ALLOCATION PLAN—The FCC's task in producing an allocation plan for competitive nationwide television is its most important assignment for this year from the standpoint of improving TV service for the American public but also is an objective for which a solution is being urged strongly by Congress and the leadership of both political parties. The "best brains" of the broadcasting industry are cooperating with the FCC in this task and this was exemplified by the plans and proposals for the advancement of television from more than 200 broadcasting groups—the networks, leading stations, engineers and lawyers—which have been filed with the Commission. The industry proposals range from deintermixture of VHF and UHF, use of directional antennas to reduce interference and reduced separations to permit 200-odd additional VHF channels.

OVER 6,000 STATIONS LICENSED—For the first time in FCC history broadcast-TV authorizations as of last July 1 have exceeded the 6,000 mark, the Commission's annual report to Congress said. At the close of the FCC fiscal year July 1 there were 6,257 stations licensed, an increase of 419 over the 1954 fiscal year. The 458 operating commercial television stations as of mid-1955 (a total of 582 were licensed), the FCC report stated, provided service to more than 90% of the people in the United States with about 75% of the population being served by two or more stations. Thirty-four educational TV stations had been licensed with 11 operating. AM broadcasting stations authorized totaled 2,840 with 2,732 on the air, but commercial FM stations lagged in the broadcasting upsurge with a total of 552 licensed. Remote pickups, auxiliary and other electronic devices accounted for 2,122 authorizations.

ELECTRONIC TELEPHONE SWITCHING—The Bell System's latest development—the replacement of existing dial central office equipment with electronic switching systems, which is slated to start at one exchange on a test basis in the next two or three years—is being studied by the FCC staff which as a result has revised depreciation for five Bell companies that are planning to install electronic telephone exchanges on an experimental basis of operation at the outset. The electronic telephone switching system will use transistors instead of vacuum tubes. Dial switching operates in a thousandth of second where the electronic switching system can increase this speed up to a millionth of a second.

RADIATION RULES—On Feb. 1 the new FCC rules to regulate incidental and restricted radiation devices in order to avoid their interference with authorized radio services between 30 and 890 megacycles became effective. The rules are expected to cut down appreciably the interference from electric motors, automotive ignition systems, electric switches etc. to FM and TV receivers, it is anticipated by the FCC. Limitations on permissible radiation from communications and broadcasting-television receivers in the 30-890 MC bands were also set forth in the new FCC rule on radiation. Receiver manufacturers have closely cooperated wtih the FCC on the radiation problem.

INDUSTRIAL HEATING—In connection with the FCC proposal to allocate 915 MC for industrial, scientific and medical electronic-radio usage, General Electric informed the Commission that electronic heating processes using this frequency had a great potential. There is a demand of 250,000 units annually, GE stated, and electronic industrial heating will make significant contributions to many commercial and military products.

National Press Building
Washington, D.C.

ROLAND C. DAVIES
Washington Editor

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Uniformly higher in ripple current rating than other standard types of electrolytics, FP's often can carry *double* the current rating expected for a given capacitance and voltage rating. The reason for this superiority is the unique FP construction. The fabricated plate compresses a lot of effective area into minimum volume . . . so that more electrolyte and more capacitance can be placed in a smaller size container. This compact construction has improved heat dissipation. In addition, separator, etched cathode, end seal and air space are designed for 85° C. operation.

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The Mallory FP is a capacitor that needs no de-rating at 85° C., and that can take heavy ripple current without overheating and with normal life expectancy. A Mallory capacitor specialist will be glad to consult on the use of FP capacitors in your specific circuit . . . or to send you detailed technical data.

Typical Ripple Current Ratings for FP Capacitors

The following ratings represent values obtained by tests on single section units at 85° C. ambient, on 120 cycle ripple.

Capacitance	Voltage	Ripple Current Rating	
		Mallory FP	Usual Industry Expectation
80 mfd	450 VDC	670 MA	480 MA
60	450	620	440
100	350	820	500
200	150	1290	525
150	250	1030	515

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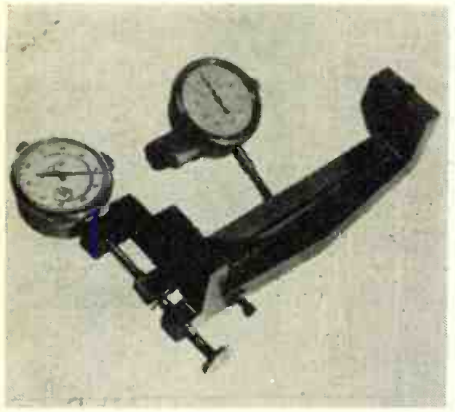
investigations. It permits measurements of ac or dc potentials in the microvolt region, and dc measurements at the highest sensitivity over long periods of time. The oscillograph employ a Type 5ARP-cathode-ray tube. The same linear-sweep generator drives both beams so that there is negligible relative error on the time scale. **Technical Products Div., Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-29)

AUTOMATIC PHASE INDICATOR

Model DAB-101 attaches to the conventional slotted line and provides direct readings of relative phase in terms of guide wavelength. It contains two indicating devices, the slope indicator and the phase indicator. Impedance or admittance measurements relative to a fixed point in the line can also be simply and accurately measured with the Model DAB-101. Repeated meas-



urements at different frequencies can be made without resetting the phase indicator at each frequency. Calibration of the device is permanent. **Sage Laboratories, Inc., 30 Guinan St., Waltham, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-35)

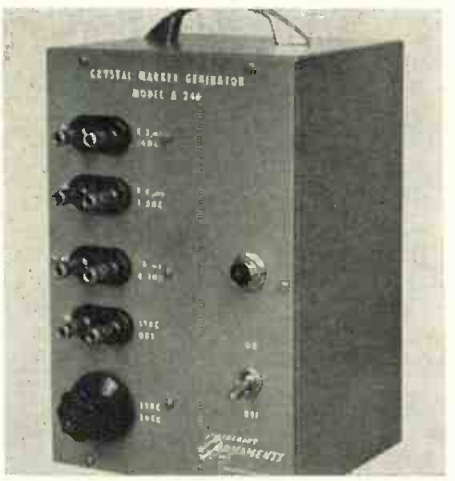
POWER SUPPLY

Model 711A, power supply, offers a voltage range of 0 to 500 v. and no-load to full-load regulation of better than ±0.25% or 0.5 v. Ripple is less than 1 mv. There are separate current and

voltage meters, with new push-button range switching for accurate measurement of very small voltages and currents. Additional features include complete overload protection and grounding of either positive or negative dc terminals. The instrument weighs 18 lbs., and is priced at $225. **Hewlett-Packard Co., Dept. P, 395 Page Mill Rd., Palo Alto, Calif.,** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-24)

MARKER GENERATOR

The A246 Marker Generator provides crystal controlled pulse outputs having repetition frequencies of 100 kc, 1 mc and 10 mc, giving time markers at intervals of 10, 1.0 and 0.1 microsecond, respectively. A pulse generating circuit, locked to an integral submultiple of the 100 kc frequency, provides scope trigger of approx. 1 kc repetition frequency. The A246 is useful for calibrating and marking scope sweeps, delay line calibration, and pulse width



and rise time determination. As a frequency standard, it provides an abundance of harmonics for receiver, signal generator and wavemeter calibration. **Aircraft Armaments, Inc., Cockeysville, Md.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-39)

FREQUENCY METER

No plug-in attachments are needed for direct digital freq. readings from 1 cps to 42 mc with the Model 5571 Frequency Meter. It functions also as a freq. ratio meter, a 0-1 mc period

meter, 1 microsec.-10,000,000 sec. time interval meter, 0-2 mc events-per-unit-time meter, and a high speed straightforward counter. Accuracy is ±1 count (of unknown freq., event, or time base interval), ± crystal stability (1 part in 10^7, short term). Input sensitivity is 0.1 v. rms, with pos. or neg. trigger slope. WWV connection provided for time base standardization. **Dept. NR 31, Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-9)

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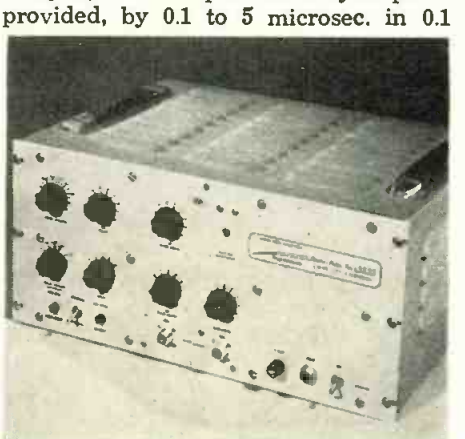
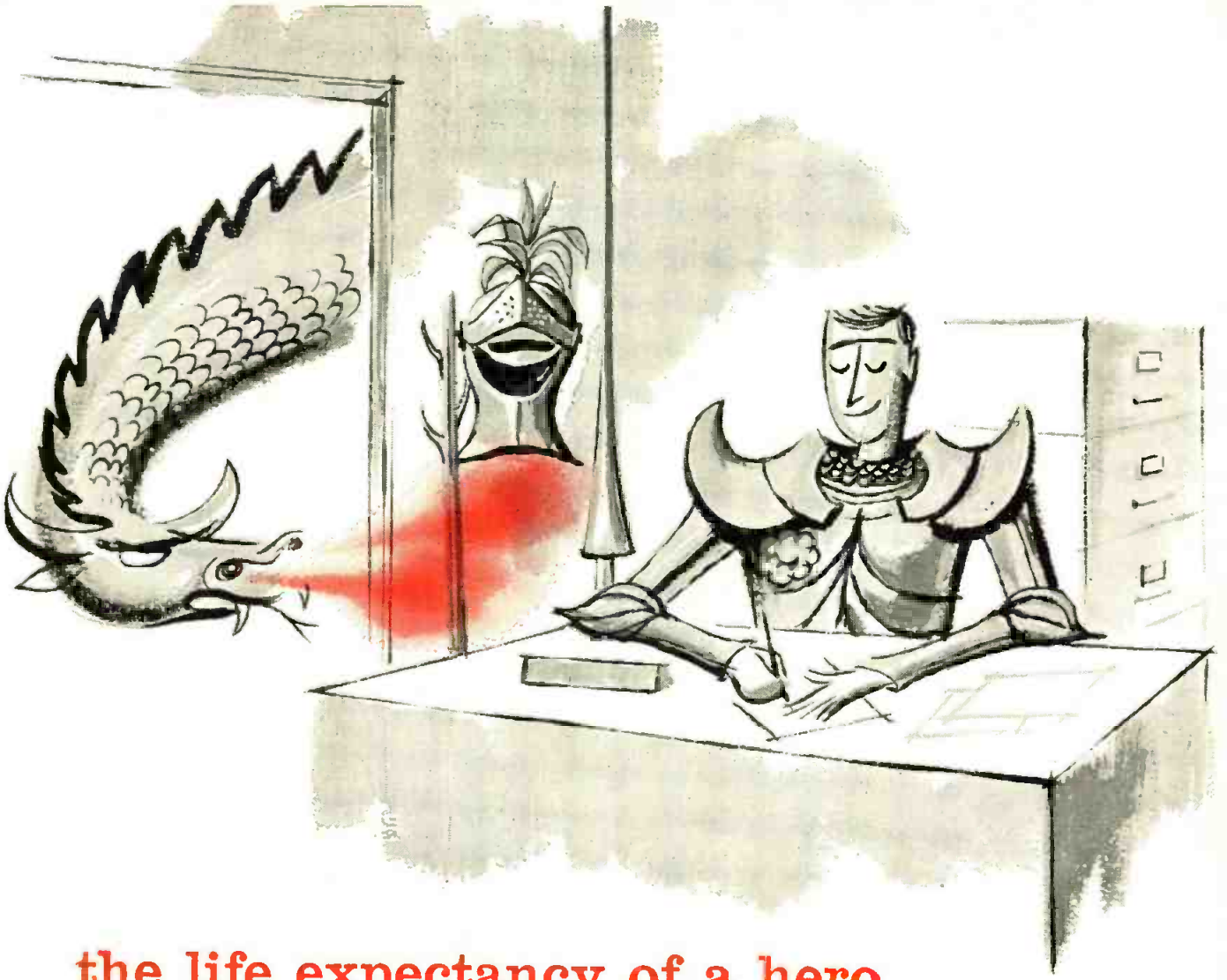


steps. Instrument may be operated from internal trigger, variable from 20 cps to 2 mc in 5 decade ranges, or from external triggers. **Electro-Pulse, Inc. 11861 Teale St., Culver City, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-19)



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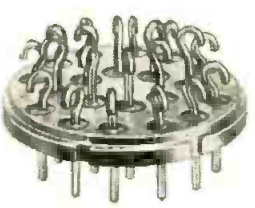

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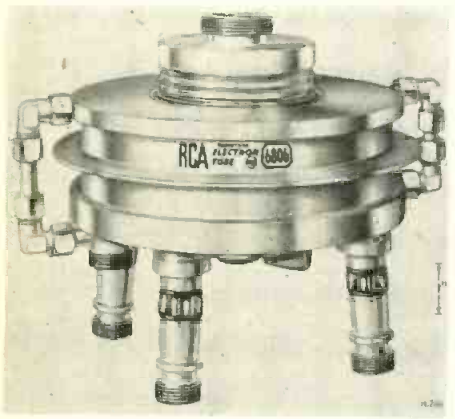
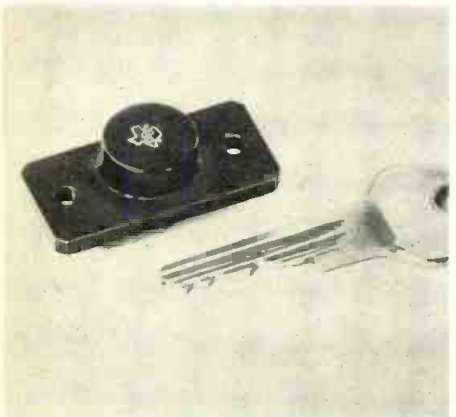


white TV service. It may also be used as a continuous-wave amplifier in class C telegraphy to provide a useful power output of 25 kw. at 400 mc. In single-sideband service, it will provide max. signal power output of 15 kw. at 550 mc. The new tube employs a coaxial-electrode structure in which the centrally located plate is surrounded by a symmetrical array of unit electron-optical systems. **RCA Tube Division, Harrison, N.J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-16)

SILICON POWER TRANSISTORS

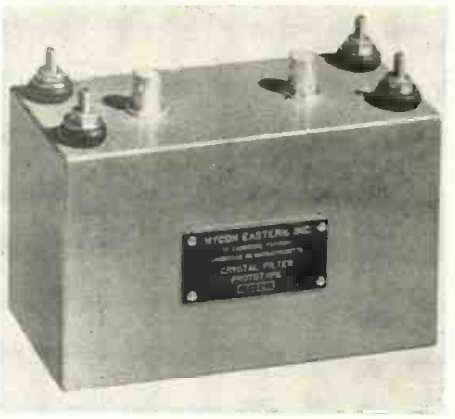
Type 970 is silicon power transistor, with a max. power dissipation of 3.5 w. at 100°C. The transistor weighs less than ¾ oz. complete and is hermetically sealed in a disc approx. ½ in. in diameter by ½ inch high. The transistor is of the grown junction, N-P-N type construction. Power dissipation is 8.75 watts maximum at 25°C. Power gain at 100°C ranges from a guaranteed 28 de-



cibels at one watt output, Class A operation, to a guaranteed 18 decibels at 2.5 watts output, Class B operation. **Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Tex.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-23)

CRYSTAL FILTER PROCESS

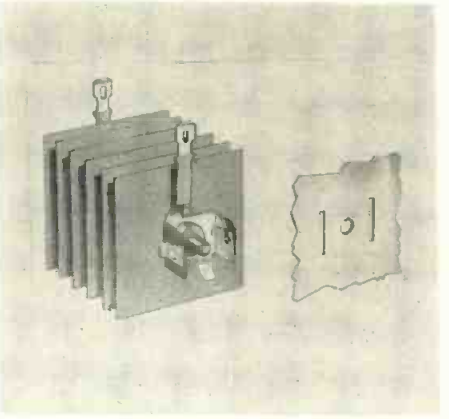
A new technique for the synthesis of quartz crystal filters has just been announced. Filters can be produced on short notice in large or small quantities to meet exact performance require-



ments at any frequency from 10 kc to 10 mc. Throughout this range the attenuation characteristic can be tailored to meet almost any desired specification within the bandwidth limits from 0.01% to 14% of center frequency. For applications where absence of phase distortion is essential, crystal filters can be designed with a high degree of phase linearity. **Hycon Eastern, Inc., 75 Cambridge Parkway, Cambridge 42, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-70)

CLIP-IN RECTIFIER

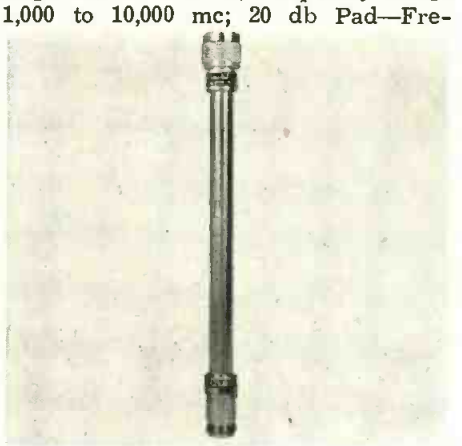
Selenium rectifiers equipped with a new spring-steel, snap-action mount permitting greatly increased ease of assembly are now available. The mount, self-adjusting to all standard panel thicknesses, is assembled to the rectifier's center stud or bolt. When the rectifier is snapped into two parallel slots in the chassis, the chassis wall is gripped between two barbs and two curved counter springs of the mount.



The new mount can be adapted to rectifiers rated from 25 to 195 v. and from 65 to 750 ma. **Components Div., Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-30)

ATTENUATOR PAD

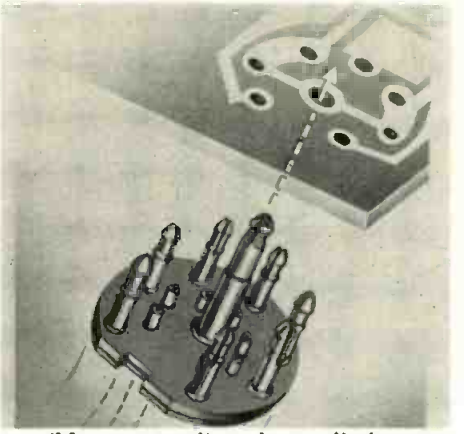
Specifications for Model 210, are as follows: Coaxial Attenuator Pads, —50 ohm impedance; Available in 1 db steps from 1 to 10 db; Frequency Range 1,000 to 10,000 mc; 20 db Pad—Fre-



quency range 2,000 to 10,000 mc. At 3 db is rated for an input of 5 w. average with a peak power of 10 kw. High Absolute Accuracy: at 4,000 mc at room temperature ± .1 db (1-10 db) of nominal value. Small Temperature Coefficient: plus .00043 per db per °F. Average 3 db pad changes plus .3 db between 1000 and 10,000 mc. **Weinschel Engineering Co., Inc., 10503 Metropolitan Ave., Kensington, Md.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-31)

PRINTED CIRCUIT SOCKET

Designed expressly for automation, this new socket offers positive locking action and outstanding heat dissipation. It uses bullet nose terminals for quick location and insertion, plus notched terminals to prevent the socket from loosening under vibration or handling. Copper foil on the entire circumference of the chassis hole provides good contact with the terminals. Opening between the socket and chassis makes

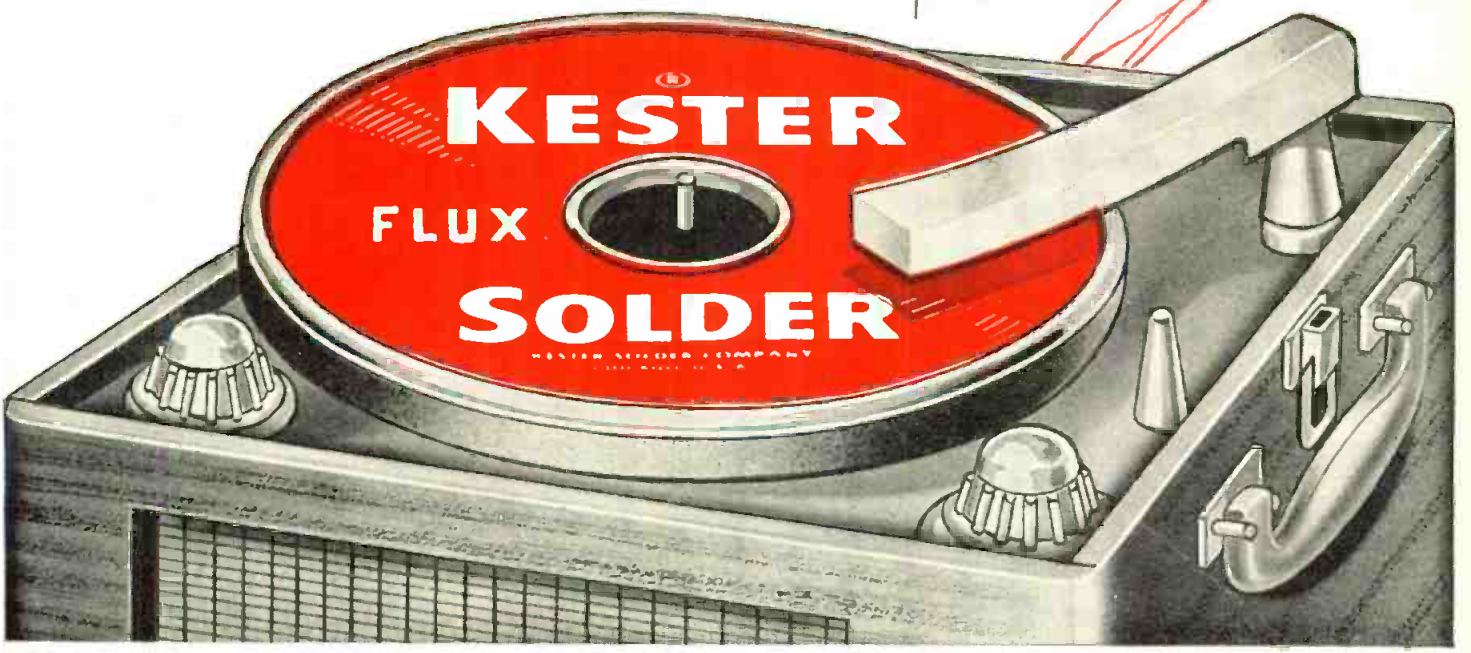


possible outstanding heat dissipation. Sockets are available with 7 or 9 pins, and tube shield clip. **Industrial Hardware Manufacturing Co., Inc., 109 Prince St., N.Y.C.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-7)

tunes UP TIRED ASSEMBLY LINES

"44" RESIN, "RESIN-FIVE" and PLASTIC ROSIN—Kester Flux Core Solders belong at the very top of the solder hit parade when it comes to quality, speed, uniformity and economy. An unbroken record of dependability is what makes Kester a sure-fire "cure" for lagging production. Better switch now to Kester . . . a real production record maker!

WRITE TODAY for Kester's NEW 78-Page Informative Textbook, "SOLDER . . . Its Fundamentals and Usage."



KESTER SOLDER COMPANY

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

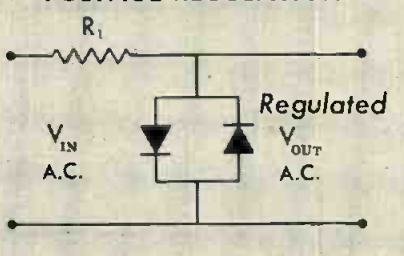
NOW
a *new* rectifier source

IRC Miniature MICROSTAK Selenium Rectifiers are available in a variety of types for many standard and special applications, in sizes as small as .060" diameter. IRC's processing technique makes possible uniform, high grade, long-life, low capacitance cells with performance characteristics not available elsewhere.

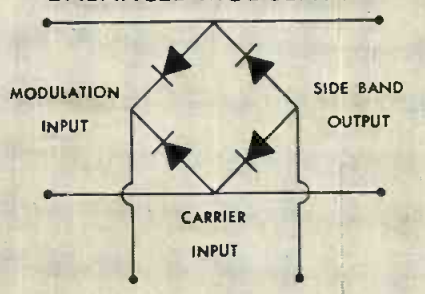
Cell thickness to ± .001. Less than 1% unbalanced voltage on bridge circuits. Hermetically sealed types available.

TYPICAL ADVANCED APPLICATIONS

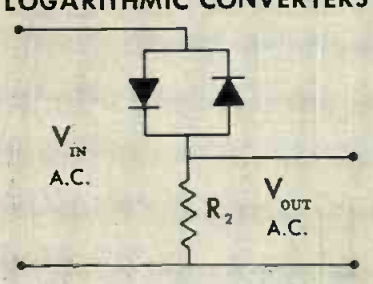
VOLTAGE REGULATION



BALANCED MODULATOR



LOGARITHMIC CONVERTERS



SEND COUPON FOR BULLETIN SHOWING CHARACTERISTICS, SPECIFICATIONS AND TYPICAL APPLICATIONS.

Voltmeter Multipliers • Boron & Deposited Carbon Precistors • Insulated Composition Resistors • Power Resistors • Volume Controls • Low Wattage Wire Wounds •

Wherever the Circuit Says

Precision Wire Wounds • Ultra HF and HI-Voltage Resistors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals •

IRC

INTERNATIONAL RESISTANCE CO.

Dept. 581, 401 N. Broad St., Philadelphia 8, Pa.
In Canada: International Resistance Co., Ltd., Toronto, Licensee

Please send Technical Bulletin SR-2 describing MICROSTAK Selenium Rectifiers.

Name_____

Title_____

Company_____

Address_____

City_____ State_____

NOW

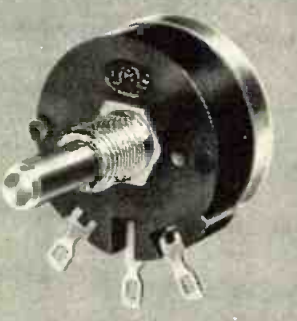
a *new* wire wound potentiometer

The mechanical and electrical features of Type 2W Rheostat-Potentiometer are designed for current and future electronic circuits. This modern, 2 watt unit offers maximum application adaptability plus typical IRC superior performance.

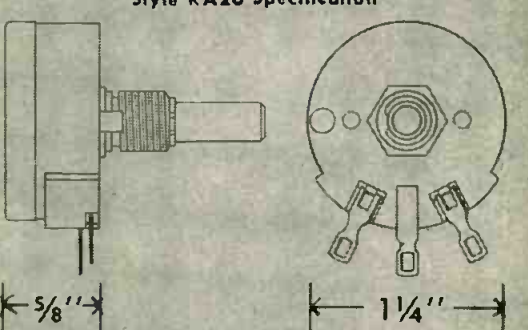
Electrical operation is improved by one-piece center terminal and collector ring, and direct contact between collector ring and contactor. Advanced mechanical design anchors winding securely to strip, locks element into position, and assures accurate location of terminals.

IMPROVED DESIGN FEATURES

- **Better Heat Dissipation**
- **Greater Dust Protection**
- **Increased Mechanical Rotation**
- **Increased Electrical Rotation**
- **More Resistance Values**
- **Double and Single Taps Available**



Equivalent To JAN-R-19
Style RA20 Specification



New IRC Design
Smaller and More Compact

2 Watt Power Rating — Based On 60°C. Rise Above 40°C. Ambient

SEND COUPON FOR DATA BULLETIN

Voltmeter Multipliers • Boron & Deposited Carbon Precistors • Insulated Composition Resistors • Power Resistors • Controls and Potentiometers • Low Wattage Wire Wounds • Germanium Diodes

Wherever the Circuit Says

Precision Wire Wounds • Ultra HF and HI-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals

IRC

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Dept. 581, 401 N. Broad St., Philadelphia 8, Pa.
In Canada: *International Resistance Co., Ltd., Toronto, Licensee*

Send Bulletin describing Type 2W Potentiometers:

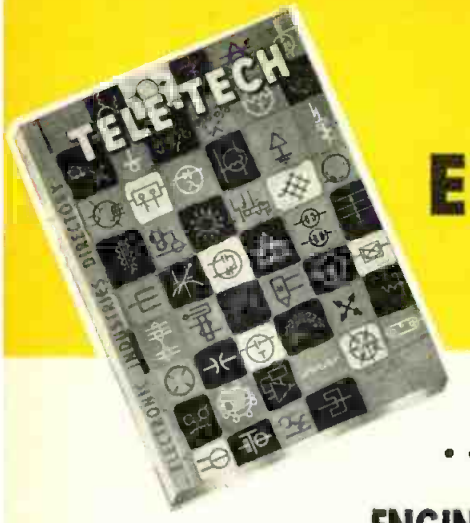
Name_____

Title_____

Company_____

Address_____

City_____ State_____



TELE-TECH's annual ELECTRONIC INDUSTRIES DIRECTORY

...a valuable where-to-buy source book for

ENGINEERS, PURCHASING AGENTS AND MARKETING EXECUTIVES

published in the June Issue of

TELE-TECH & Electronic Industries

The **"ELECTRONIC INDUSTRIES DIRECTORY"** is the most complete, accurate, up-to-date directory in the electronic-TV engineering field. It serves the 27,000 top-level engineers who receive **TELE-TECH** regularly each month and have the responsibility to specify and purchase products. Over 4,000 manufacturers are listed, and all editorial listings are FREE.

DIRECTORY FEATURES . . .

- **PRODUCT FINDING INDEX**—listing thousands of electronic and allied products alphabetically, referring you to classified listings which give manufacturers' names and addresses.

- **PRODUCT LISTINGS**—a section listing electronic products, names and addresses of manufacturers, and symbols to show the types of products made by each manufacturer. No other directory lists so many products.

- **ALPHABETICAL LIST OF MANUFACTURERS**—this section lists over 4,000 manufacturers, about 1,000 more than any other directory of the electronic industries.

- **DIRECTORY OF ELECTRONIC DISTRIBUTORS**—a complete geographical listing of distributors, giving names, addresses and telephone numbers. All are listed alphabetically under states and cities. Manufacturers can group their distributors by states in advertisements in this section. Brand-name logotypes are also accepted.

- **DIRECTORY OF REPRESENTATIVES**—gives the names, addresses and telephone numbers of representatives. The list is arranged alphabetically under states and cities.

- **BRAND AND TRADE NAME INDEX**—Contains thousands of trade names of electronic and related products. The alphabetical arrangement makes it easy to find a manufacturer when only the trade or brand name is known.

- **CONSULTING ENGINEERS**—a section composed exclusively of consulting engineers known to be active in the TV-radio-electronic field. Helps manufacturers and station owners who need consultant service.

- **ENGINEERING SOCIETIES**—This section gives the names and addresses of the organizations in or closely allied to the industry, including names of presidents and secretaries.

And the EXCLUSIVE LOCALIZER INDEX

Paid listings to provide quick and direct contact between buyer and seller—between the purchaser and the manufacturer's branch office or local representative.

HOW IT WORKS: Immediately under the firm name, listed free in the Alphabetical List of Manufacturers, the firm can list its local representatives, branch or regional offices, executive and engineering personnel, etc. Names, addresses, telephone numbers, representatives arranged alphabetically by cities can be included. Additional localizer listings are available in the Directory of Distributors to show at the end of each state a list of manufacturer's distributors in that state.

LOCALIZER LISTINGS CUT COSTS, INCREASE SALES. They minimize long distance telephone and telegraph charges, reduce time-consuming correspondence, increase the number of inquiries, speed service to the customer.

Listings are available by the inch. All forms of Localizer space are subject to agency commission when ordered by recognized agencies.

TELE-TECH
& Electronic Industries

INDUSTRY NEWS

A. R. Weckel, vice-president, has been named to the new post of manager, Special Missile Systems Division of Sperry Gyroscope Company, Great Neck, N. Y.

The appointment of **Leopold M. Kay** as President of the Transdyne Corporation, Maspeth, N. Y., has been announced by the firm's Board of Directors.

Dr. Sherrerd B. Welles has been appointed manager of the Missile Systems Laboratory at Sylvania's Waltham, Mass., Laboratories.

I. I. Ser has been appointed to the position of company Sales Manager for the Astron Corporation, East Newark, N. J.

The appointment of **Wallace F. Baker** as assistant general sales manager has been announced by the Westinghouse Electronic Tube Division, Elmira, N. Y.

Len Mayberry, former Director of Engineering at Hoffman Laboratories Inc., has opened an office as an Electronics Consulting Engineer, at 9617 Crenshaw Blvd., Inglewood, Calif.

Joseph A. Frabutt. General Sales manager of Federal Telephone and Radio Co., has been appointed a vice-president in charge of Federal's Pacific Div. in Los Angeles, Calif.

Andrew L. Hammerschmidt, Associate Director of Technical Operations for NBC, has been appointed Chief Engineer for the National Broadcasting Company.

In a planned program of expansion of the Engineering Dept. of CBS-Columbia, **William Vassar** was named Director of Engineering. Other additions to the dept. include: **Ludwig Zucker** as Chief Mechanical Engineer, **Walter Lukas** as Chief Electrical Engineer, and **Martin Perry** as Chief Radio Engineer. The company has also announced the promotion of **Anthony Dillon** to manager, Market Development.

Robert A. Hall has been elected a director of Skiatron Electronics & Television Corp., New York, N. Y.

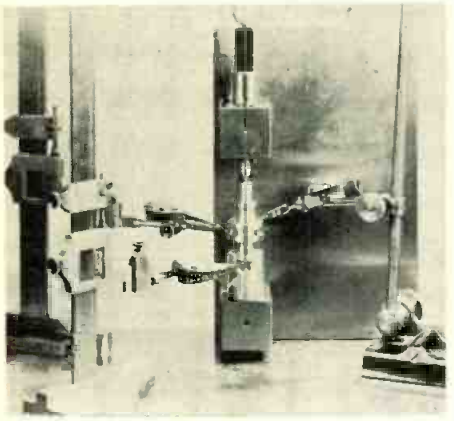
R. L. McCormack has been appointed manager of the newly-created Special Tube Division of the Raytheon Manufacturing Company, Waltham, Mass. The appointment of **John M. Palmer** as manager of manufacturing for the company's receiving tube plants in Newton and Quincy, Mass., was also announced.

(Continued on page 104)

New Plant & Lab Equipment

BENCH CENTER

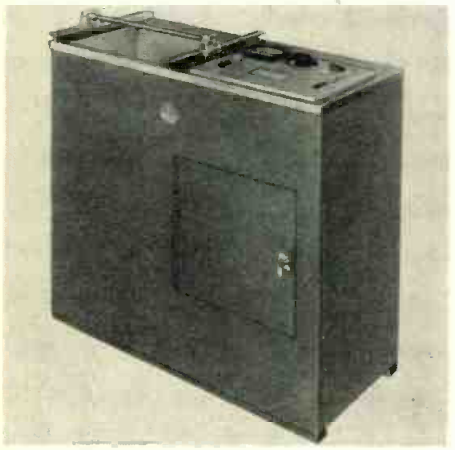
Placed upright against angle surface plate and set up with commercial feeler gages, this miniature portable, precision bench center indicates shoulder deviations on a small (2½ in.) ma-



chined part. Originally intended as a production-inspection check on Transicoil's own tiny electrical components, the convenience of this 16 lb. bench center has extended its use throughout metalworking and manufacturing industries. **Transicoil Corp., Worcester, Montgomery County, Pa.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-70)

PLATING PLANT

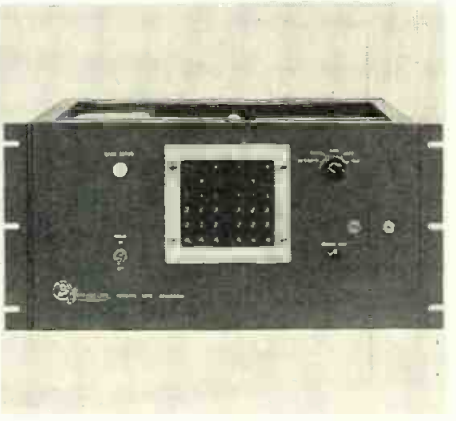
The new Sel-Rex JET PLATER is a complete electroplating plant in a compact, portable unit. Fully automatic, it consists of a Sel-Rex selenium rectifier with automatic timer, stainless steel tank (which may serve as the anode) fitted with a water jacket for temp. control; a movable work rack which will accomodate a portable plating barrel; a centralized control panel equipped



with Weston Ammeter and Powerstat control; a filter; and a drip-proof pump with motor. Standard models require only approx. 18 in. x 38 in. of floor space, and are available in 10, 20 and 30 gal. capacities. **Bart-Messing Corp., 229 Main St., Belleville, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-73)

CONVERTER

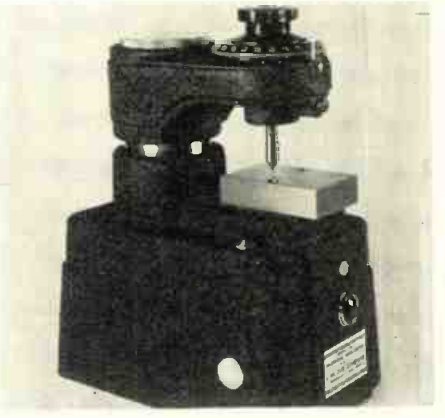
Punched Card Converter, Model 250, translates the decimal code punched into cards into an analog signal for automatic point plotting by Librascope X-Y Plotter and Recorder Model 200-A.



This precision relay converter accepts information from various IBM equipments transforming this information to a resistance divider suitable for the X-Y Plotter. Also accepts information from the Model 227 Decimal Keyboard as an aid to calibration. Accuracy is 0.1% when used alone and 0.25% when used with a plotter. Plots 60 cards/min. **Librascope, Inc., 808 Western Ave., Glendale, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-71)

MICROMETER

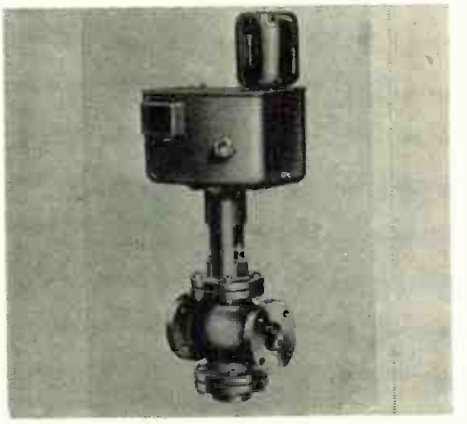
Direct accurate measurements of any electrically conductive part are obtained with this Model H micrometer. Operation is automatic and high speed. Micrometer is stopped before any pressure is exerted on the work. Max.



Error at max. range is less than 0.0001 in. and no more than 0.00005 in. for measurements under 0.250 in. Range of micrometer screw is 1 in.; with standard micrometer tip shown, measuring range is ¾ in. Throat depth is 2 in. Accepts work with a max. dimension of 3 in. **J. W. Dice Co., Englewood, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-74)

VALVE ACTUATOR

New self-contained electro-hydraulic valve actuator increases the utility of electronic control systems. Outside connections consist of the signal wires from the controller and a power sup-

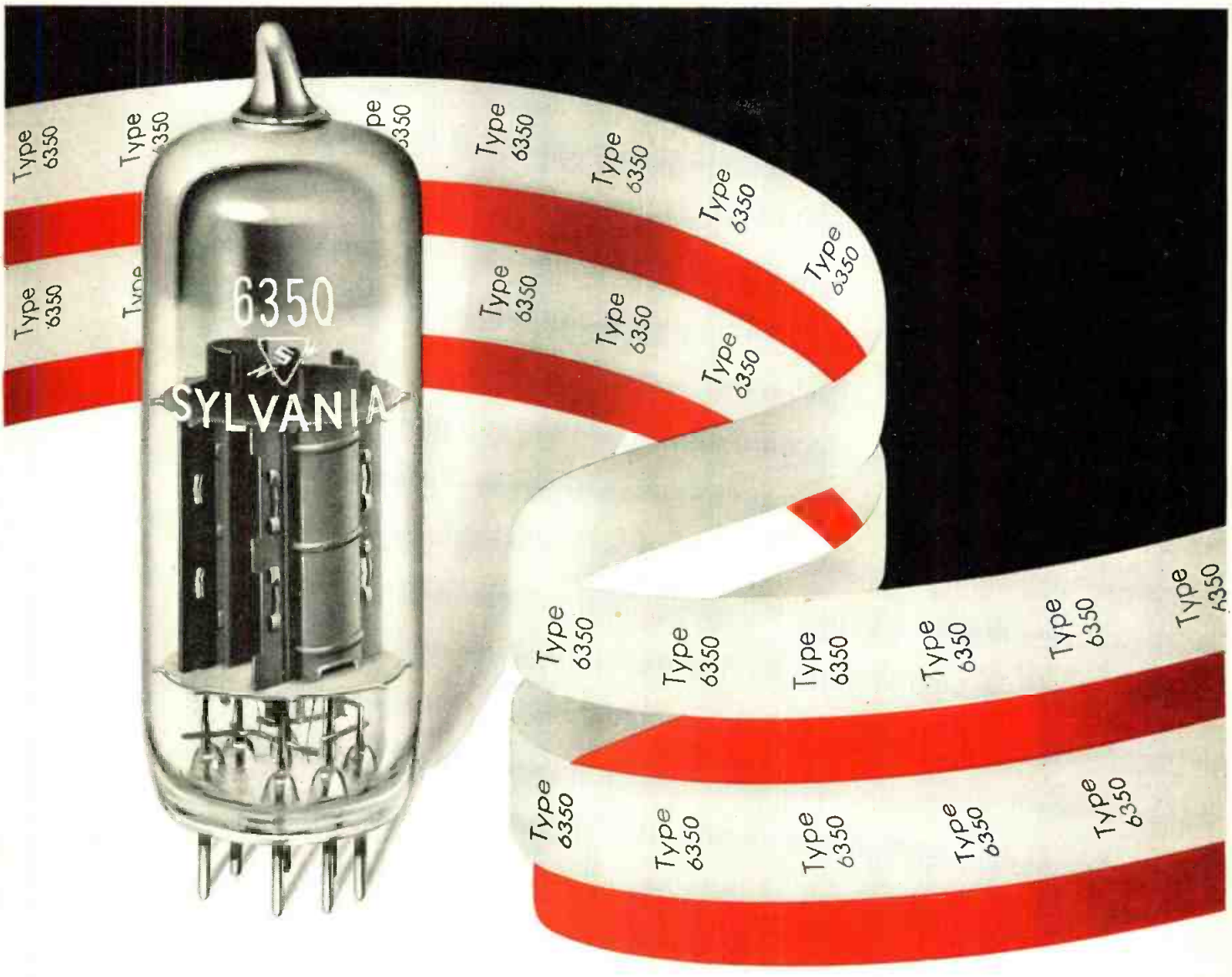


ply. Signal current is applied to a high-resistance coil which moves in a magnetic field. Linked to the coil is jet pipe which converts an electrical signal of less than 50 mw into the powerful stroke of a control valve which moves at a speed of better than one in./sec. **Askania Regulator Co., 240 East Ontario St., Chicago 11, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-72)

AC LINE REGULATOR

This tubeless Magnetic Amplifier Regulated 1 KVA AC Line Voltage Regulator contains no moving parts or vibrating contacts and has the following specs. Input Voltage Range: 95 to 135 v. Output Voltage: nominal 115 v.—can be adjusted from 110 to 120 v. Regulation Accuracy: ±0.25% for any combination of line or load. Freq. Range: 60 cycle, ±10%. Wave Form Distortion: 3% max.

Power Factor Range: 0.5 lagging to 0.9 leading. Response Time: 0.2 sec. Max. Load: 1.0 KVA. Model MLR1000 is used for lab. and prod. testing and in unattended microwave installations. **Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-75)



More "soup" where you need it...

to drive magnetic cores, drums, computer read-outs

HERE IS a high perveance twin triode designed for heavy duty computer applications. It is capable of delivering peak cathode currents of 300 ma and will dissipate up to 7 watts.

The Sylvania type 6350 features separate cathodes for each section and controlled grid cutoff. Separate cathodes provide maximum flexibility in equipment design.

Cutoff is held to close tolerances facilitating the design of circuits for optimum cutoff signals. Minimum interface formation assures operation even after periods of extended cutoff.

DESIGN CENTER RATINGS FOR THE 6350

Peak Positive Plate Voltage (Abs. Max.)	1000 Volts
Peak Negative Grid Voltage	400 Volts Max.
Peak Positive Grid Voltage	13 Volts Max.
Peak Positive Grid Current	100 Ma Max.
Peak Cathode Current	300 Ma Max.
Plate Dissipation	
Each Plate	3.5 Watts Max.
Both Plates	7.0 Watts Max.

OTHER SYLVANIA COMPUTER TYPES

Type 5844	Medium mu triode
Type 5965	Medium mu twin triode
Type 6211	Medium mu twin triode
Type 5687	Low mu twin triode
Type 7AK7	Sharp cutoff pentode
Type 5915A	Dual control heptode
Type 6145	Sharp cutoff pentode
Type 6814	Medium mu triode

SYLVANIA®

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
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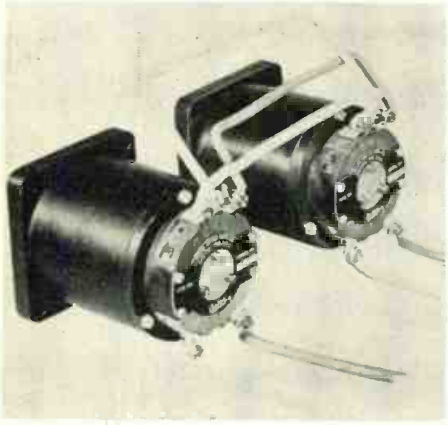
LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

SEE SYLVANIA IN BOOTH NOS. 168-172 AT THE 1956 I.R.E. SHOW

New Technical Products

60 CYCLE SYNCHRO

Type 3J-4222, "ruggedized" size 23 60 cycle synchro torque transmitter-receiver, meets the shock and vibration test of BuShips Spec 40T9, withstands a 2000 hr. operating life at 1200 RPM



with no maintenance, and meets humidity specs of BuShips 16E4 without degradation of operation. Pull out torque is 1.7 oz.-in. min. over a speed range of 0 to 1600 RPM at 25°C. Electrical accuracy of a two unit system is ±1°. Other performance data include 15 V input voltage, 17 V maximum output voltage, 3.5 w. power input at no load and 0.120 a. current at no load. **John Oster Manufacturing Co., Avionic Div., 1 Main St., Racine, Wisc.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-26)

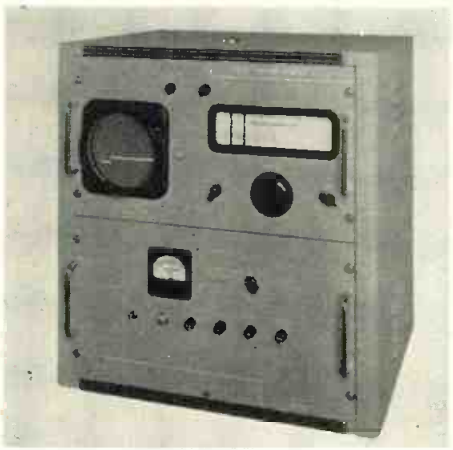
MAGNETIC SOUND-ON-FILM CAMERA

Auricon "Filmagnetic" is a high-fidelity Sound-On-Film recording system, for lip-synchronized "Talking Pictures" and music of quality, on 16mm black & white or color film pre-striped for magnetic sound before it is exposed to light. The outfit consists of a Twin-Head Camera Recording Unit, with

Record and Instant-Monitor Magnetic Heads, a 3 Input Amplifier, High-Fidelity Microphone, cables and self-contained batteries. **Berndt-Bach, Inc., 6900 Romaine St., Hollywood 38, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-18)

PANORAMIC RECEIVER

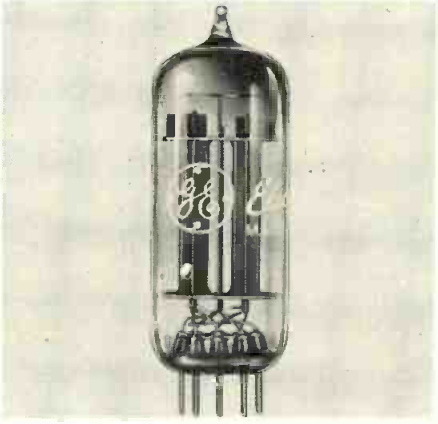
Covering the range from 100 to 150 mc, this TRAK receiver (Model PAN-1) features 3 controllable inductor tuned RF stages in a double-superheterodyne circuit which provides more



than 60 db attenuation of all spurious responses and a noise figure no greater than 13 db throughout the tuning range. Seven tracked INCREDUCTOR Controllable Inductor tuned circuits operate without moving parts. A precision marker circuit permits freq. measurements to an accuracy of better than 1%. **CGS Laboratories, 391 Ludlow St., Stamford, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-8)

MINIATURE TWIN TRIODE

The 6CG7—a 9-pin twin triode miniature equivalent of the 6SN7-GTB—has been added to the line of 600 ma. controlled warm-up tubes developed by the GE Tube Dept. Max. plate voltage of this twin triode is 300 v.; and plate dissipation of each plate is 3.5 w. In typical operation as a Class A1 amplifier with 250 plate v. and minus 8 grid v., each section has an amplification



factor of 20, plate resistance of 7700 ohms and transconductance of 2600 microhms. The 6CG7 has a controlled heater warm-up characteristic of 11 sec. **Tube Dept., General Electric, Schenectady, N.Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-13)

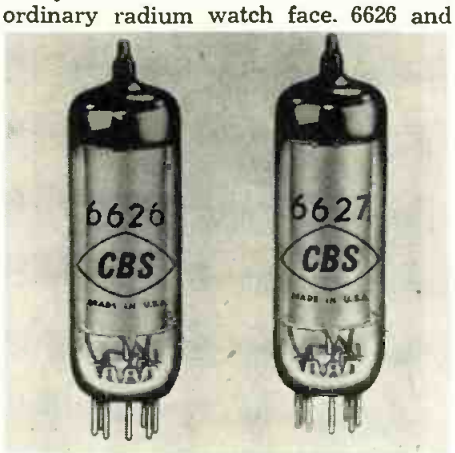
RECORDING TAPES

All Irish Recording Tapes are being delivered with a new improved 7 in. reel featuring 32 sq. in. of indexing area. Threading is made easy with two greatly enlarged side openings. Lab

tests show the new reel to be 28% more rigid than the former standard reel. Injection molding techniques plus new precision molds have produced one of the flattest and most warp-free reels available. Scraping of tape against the reel is eliminated. The new Irish reel is designed to operate with equal efficiency on all tape recorders on the market. **ORRadio Industries, Inc., T-120 Marvyn Rd., Opelika, Ala.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-2)

VR TUBES

Tube types 6626 and 6627 are a pair of highly versatile gaseous voltage regulator tubes featuring improved reliability. They replace the earlier OA2 and OB2 respectively. The new tubes incorporate a small amount of radio-active nickel in the starting electrode. The amount of radiation, while adequate to insure uniform starting voltages, is actually less than that obtained from an ordinary radium watch face. 6626 and



6627 are currently recommended in such critical applications as voltage reference circuits where extreme stability and repeatability are vital factors. **CBS-HYTRON, Danvers, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-3)

For Almost Everything...

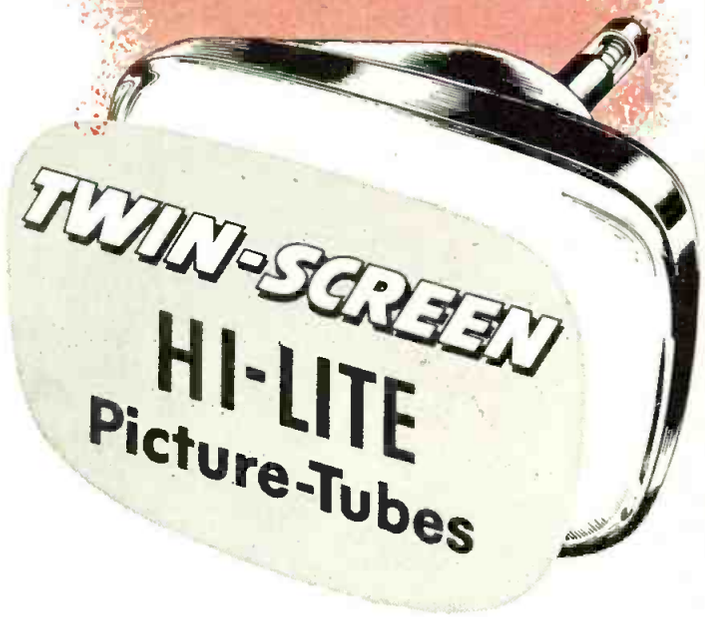
there is the

PERFECT REPLACEMENT

Some things can't be revitalized, no matter how many "boosters" are used—you have to face it, you can't get that original quality back again.

However, a worn out, faded television picture can be done away with—because Du Mont has a *Perfect Replacement* for an old picture tube. To go even further, a Twin-Screen Hi-Lite* picture tube will give a brighter, sharper, sparkling new picture—for a cost no greater than that of ordinary aluminized picture tubes. For picture perfection, for the *perfect replacement*, insist on Du Mont.

**The ultimate in aluminized picture tubes.*



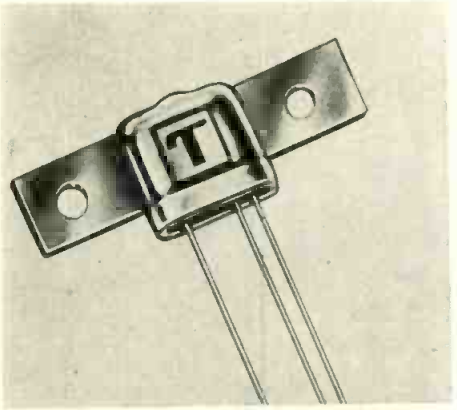
DU MONT®

CATHODE-RAY TUBE DIVISION, ALLEN B. DU MONT LABORATORIES, INC., CLIFTON, N. J.

New Electronic Components

TRANSISTOR

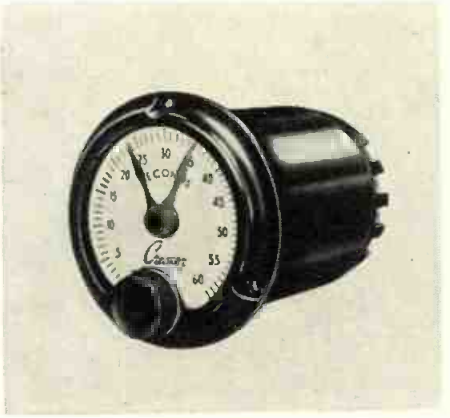
Type 2N85, 2N86, 2N87, new medium power transistors, are designed for high power dissipation with linear operation over a wide collector current range. Hermetically sealed under vac-



uum to insure reliability under the most severe operating conditions. Efficient thermal connections provide greater thermal dissipation at elevated temp. (up to 750 mw at 25°C). Intended for Class A or B output or driving stages. Will provide high output with min. of distortion. Approx. 1.5 w. output can be obtained from a pair of push-pull class B Type 2N86's, at 70°C. **Transitron Electronic Corp., Melrose, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-80)

TIME DELAY RELAY

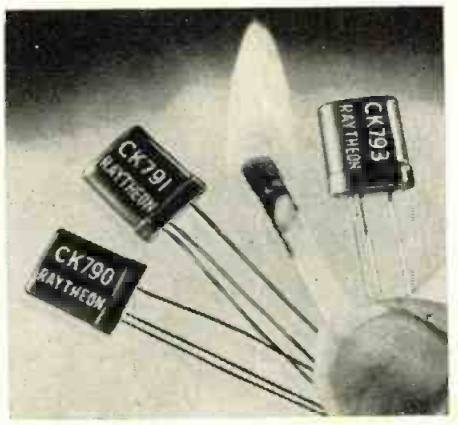
New synchronous motor driven time delay relay with two SPDT and one SPST heavy duty open blade Cramer contacts provides positive quick make, quick break operation. Contacts, rated



15 a. at 125 vac., have low contact resistance, and can handle high inrush current. Accuracy of Type 412 is within ±0.5% of full scale. Repeat accuracy is ±0.25% of full scale on timers with 30 sec. and longer ranges; ±0.5% on shorter range units. Offered in 14 time ranges from 6 sec. to 24 hours., in 115 and 220 v., 25, 50, and 60 cps. Life in excess of one million operations. **R. W. Cramer Co., Inc., Centerbrook, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-81)

PNP SILICON TRANSISTORS

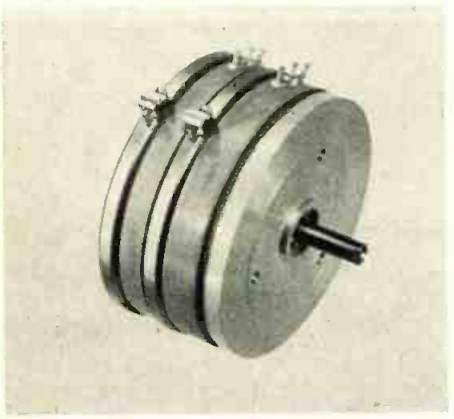
These junction transistors manufactured by Raytheon's fusion-alloy process are hermetically sealed in metal cases having a volume of about 0.05 cu. in. At 20 mils collector current, satura-



tion voltage averages 1 v. or less. Collector cutoff current is below 0.2 microamps. Collector dissipation at 135° C is 50 milliwatts. Max. reverse emitter voltage is 22 v. Power gains in a typical audio amplifier are 32 db for the CK790 and 34 db for the CK791. Current gains are 14 and 24 times, respectively. **Technical Information Service, Raytheon Manufacturing Co., 55 Chapel St., Newton 58, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-38)

POTENTIOMETER

New potentiometer offers high accuracy in resistance range of 80 to 150,000 ohms. Standard linearity tolerance for the Type 748-E "pot" is ±0.10%; special order linearity up to ±0.05% can be obtained on higher resolution windings. Low starting torque only 1.0 oz.-in. per cup. Special clamp band feature provides unrestricted tapping area allowing up to



33 taps and presents a simplified means of phasing units in ganged assembly without disassembling the units. Diameter of 3⅛ in. max. and a cup width of .984 in. **Fairchild Camera & Instrument Corp., Syosset, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-82)

TRANSISTOR BATTERIES

Type VS300 is a 9 v. unit which is designed for all-transistor portable receivers. Weight: 4 oz. Size: 2 in. L; x 1 in. D. Snap fastener connection. List price is $1.35. Type VS301 weighs approx. 1½ lbs., and is 8 in. long, 1⁹⁄₁₆ in. wide and 2¹³⁄₁₆ in. high. Voltages of 3, 6, and 9 v. may be obtained from a 4-hole socket mounted flush with the battery case. List price is $1.35 Type

VS088, developed as a power supply for transistors, consists of 15 separable 1.4 v. alkaline-type dry cells. **Radio Corporation of America, RCA Tube Division, Harrison, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-83)

RESISTORS

A complete line of Vitreous Enameled Wire Wound Resistors ranging from 2 w. to 2,000 w. inclusive is being manufactured in L. A. The resistors are wound with a high grade resistance wire on special designed steatite cores and are then covered with two coats of vitreous enamel. All electrical connections are silver soldered. A tolerance of ±10% is considered standard; however,

a closer tolerance can be maintained. Special resistors and assemblies can be engineered at no extra charge. **L. A. Resistor Co., Inc., 14742 Arminta St., Van Nuys, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-84)


Ampex


Ampro


Bell


Bell & Howell


Berlant-Concertone


Columbia


Crescent


"Crestwood"


"Crown"


De Jur


DuKane


"Educorder Dual"


"Ekotape"


"Electro-Dual"


EMC


Fairchild


FME


Livingston


Magnecord


"Magnemite"


"Masco"


"Memocorder"


"Midgetape"


Mitchell


Pentron


Presto


Rangertone


"Reporter"


Revere


Stancil-Hoffman


"Synchrotone"


"Tapak"


"Tapesonic"


TDC "Stereotone"


"Telectrotape"


"Tri-Fy"


Viking


V-M


Warren


"Webcor"

INDUSTRY NEWS

(*Continued from page 97*)

Joseph Frank has been elected president of Astron Corporation, East Newark, N.J.

In addition to his duties as vice-president and a director, **Stanley F. Patten** has been elected treasurer of Allen B. Du Mont Laboratories, Inc., Clifton, N.J.

Thomas P. Walker has been named to head the Los Angeles Council of the West Coast Electronic Manufacturers Association for 1956.

Dr. Jesse E. Hobson, director of Stanford Research Institute since March 1948, has submitted his resignation, effective March 31.

Albert Hansen Jr. has been appointed manager of engineering for General Electric's Rectifier Department.

Increasing cooperative activities between NARTB and state broadcaster associations has led to the assignment of **Howard H. Bell**, Assistant to the President, as coordinator of staff activities in the Washington, D. C., area.

Charles W. Alexander has been named Vice-President of Mohr Associates, Inc., advertising and public relations firm, New York, N. Y., and will be account supervisor on electronics and savings and loan accounts.

Appointments of **John M. Miller Jr.** as works manager, and **Stanley R. Scheiner** as director of engineering of the TV and broadcast receiver div. of Bendix Aviation Corp. have been announced.

Edward S. Maury has been appointed General Sales Manager of the Marion Electrical Instrument Co., Manchester, N.H.

Norman L. Winter, former director of federal contracts at Sperry Gyroscope Co., Great Neck, N.Y., has been promoted to the post of General Sales Manager.

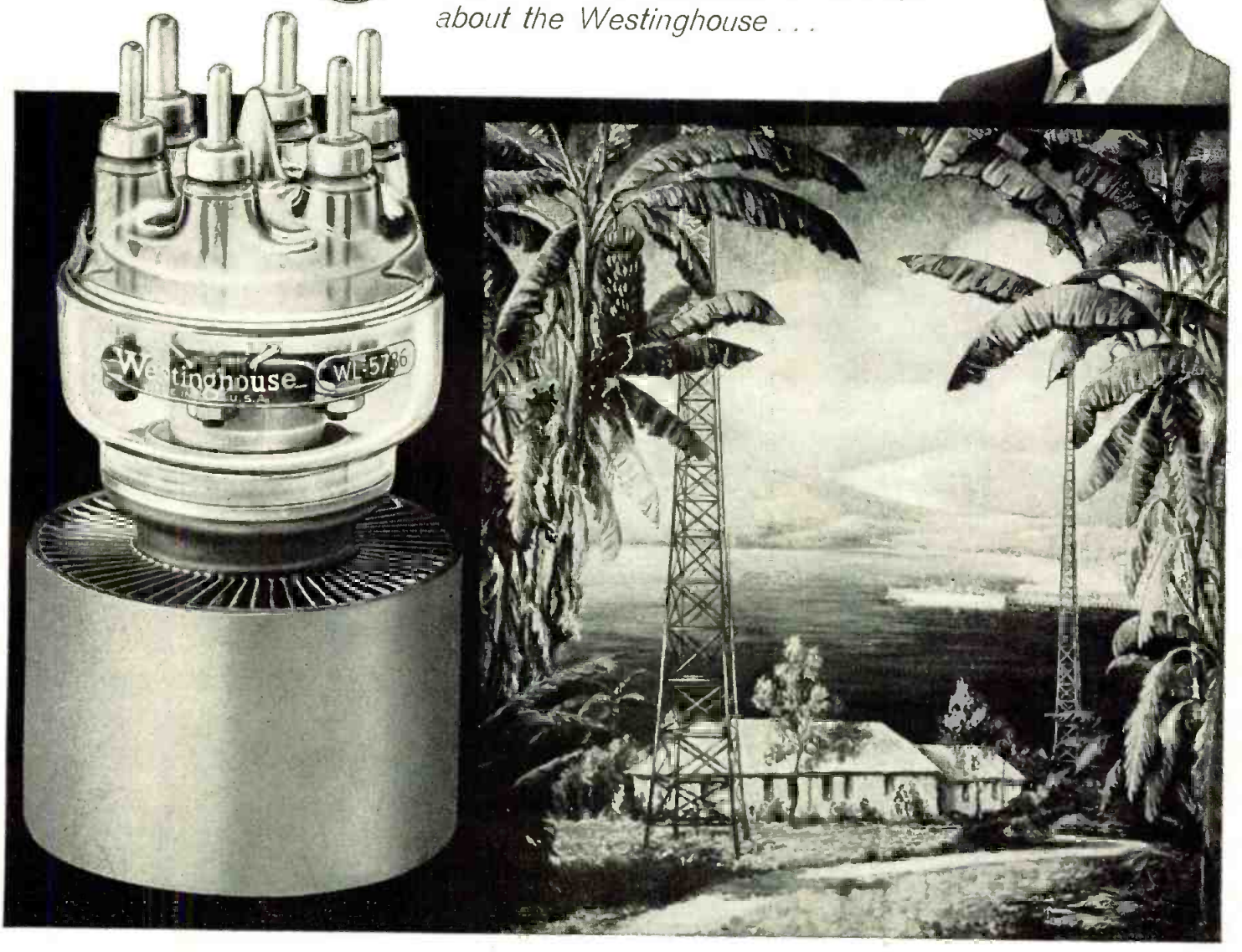
Lonnie D. Harrison, has been appointed to fill the position of vice-president and treasurer of National Aircraft Corp., Burbank, Calif.

Rear Admiral Frederick R. Furth, U.S.N. (Ret.), who has served for the past two years as Chief of Naval Research, has joined IT&T as special assistant to the president of its Farnsworth Electronics Co., div., Fort Wayne, Ind.

Lester L. Libby has rejoined the Sierra Electronic Corporation, San Carlos, Calif., as Assistant Chief Engineer.

"Reliability where it counts,"

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



WL-5736 POWER TUBE

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

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

Wherever you need 2.5 kilowatts RF in a small, dependable package, you too will find its performance unbeatable.* Write today for full design data. Commercial Engineering Dept., Westinghouse Electric Corporation, Elmira, N. Y.

ENGINEERS! For challenge, security, growth potential, investigate career opportunities now being offered by Westinghouse Electronic Tube Division. Write Technical Placement Director today.

6ET-4106

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

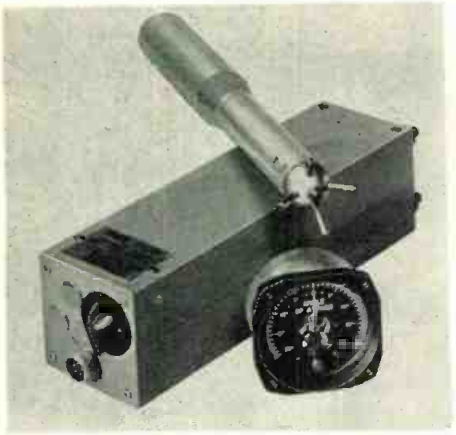
YOU CAN BE SURE...IF IT'S Westinghouse RELIATRON® TUBES

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

New Avionic Equipment

CRUISE CONTROL AID

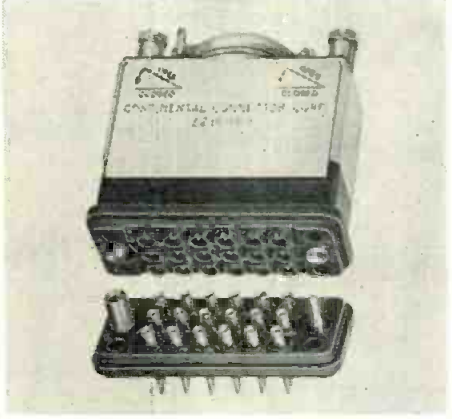
A member of the B8-1 series of Differential Pressure Flight Angle Computers which use the Giannini differential pressure pickup probe for sensing attack angles, this flight angle comput-



ing system has no moving parts or vacuum tubes. Pressure data from the probe actuates standard Giannini Pressure Transducers, the outputs of which are combined in a passive network computer to provide pilot indication of angle of attack. System accuracy is as high as ±0.1° over a range of ±20° at speeds up to Mach 2.0. **G. M. Giannini & Co., Inc., 918 E. Green St., Pasadena, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-6)

POLARIZING SCREWLOCKS

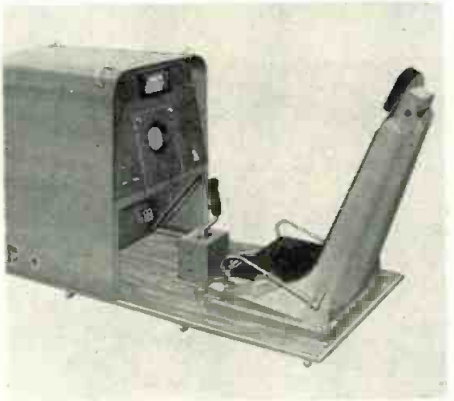
Continental E-Z release power connectors can now be supplied with the polarizing screwlock feature to provide a positive mechanical means of locking plug and receptacle against vibration or accidental disconnection. Series E-Z 16 is available in 12, 18, 24 and 34 contacts with solder cup for #16 AWG wire or solderless wiring taper pin for "AMP Series 53." Individually spring loaded



pin contacts assure quick release with low insertion force and practically no disengagement force. **Electronic Sales Div., DeJUR-AMSCO Corp., 45-01 Northern Blvd., L. I. City 1, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-34)

ATTACK SIMULATOR

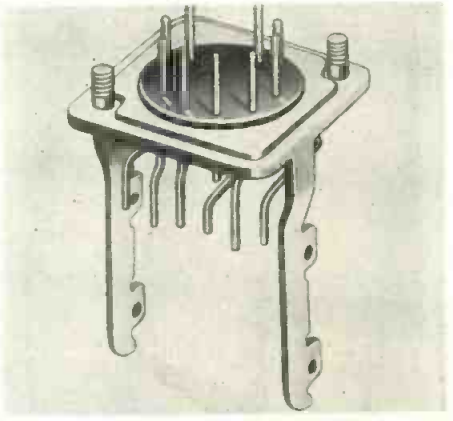
Model 9 Radar-Interceptor Attack Simulator is designed to provide simulation of the critical attack phase flown by the F86D, F94C and F89D radar equipped interceptors. The simulator



makes possible repeated and intensive practice of the attack, since the pilot can fly a new attack under a new set of conditions in each minute of training time. An automatic scorer shows the pilot how well he has done. The Model 9 comprises a simulated cockpit with its control stick and CRT display, a programmer, a scoring device, and a precise electronic computer. **West Coast Electronics Co., 5873 Rodeo Rd., Los Angeles 16, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-21)

RELAY HEADER ASSEMBLY

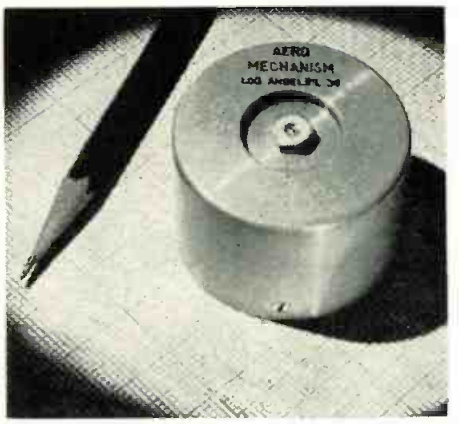
This hermetically sealed Relay Header Assembly introduces a new high in simplified production techniques by eliminating: buying or producing square cover plates with studs attached; stamping the hole in the cover plate for the hermetically sealed header; attaching and shaping pigtails; soldering or brazing the mounting bracket to the cover plate; mounting the seal in the cover plate. Manufacturer can also



supply: Multi-Headers with studs attached shaped to fit enclosures or cans, Color-Coded Terminals with studs attached. **Hermetic Seal Products Co., 29-37 S. Sixth St., Newark 7, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-28)

ALTITUDE SWITCH

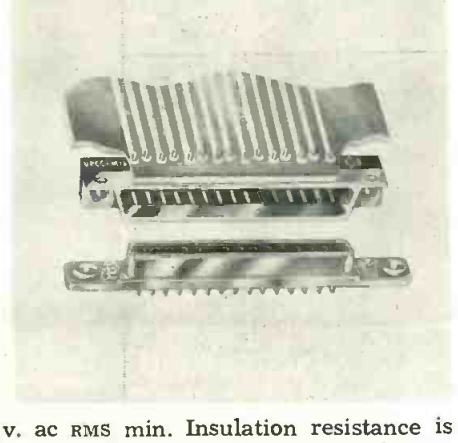
New miniature light-weight pressure switch actuates on very small changes in altitude and can be set to operate anywhere in the 2,000 to 50,000 ft. range with an accuracy of better than 2% of



range setting. The switch is a SPTD rated at 10-amps ac or dc and will withstand high temperatures, shock and vibration. It may be obtained as an absolute ambient or as an absolute or differential pressure switch with standard fittings. **Aero Mechanisms, Inc., Dept. TT-6, Box 34628, Los Angeles, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-40)

PRINTED CONNECTOR

High compression moldings of asbestos filled melamine within trapezoidal polarized aluminum die cast shell, permit flexible and assured mechanical and electrical performance with this new printed card connector. Contacts are rated at 5 a with creepage between contacts and contact to shell 7/64 in. min. Voltage breakdown between contacts and ground at 50,000 ft. is 900 v. ac RMS min. Test voltage at sea level is 1800 v. ac RMS min. and 50,000 ft. 675

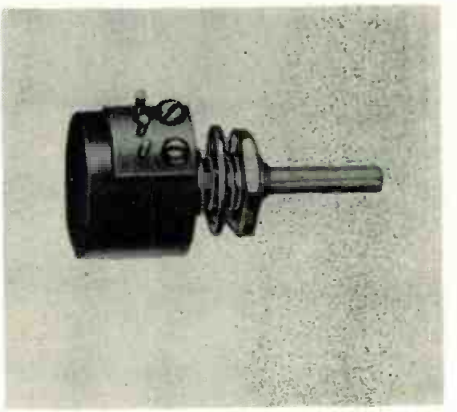


v. ac RMS min. Insulation resistance is over 100,000 megs and individual contact retention force with .040 pin is 4 oz. min. and 8 oz. max. **U.S. Components Inc., 454 E. 148th St., N.Y.C.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-4)

New Products

PRECISION POTENTIOMETER

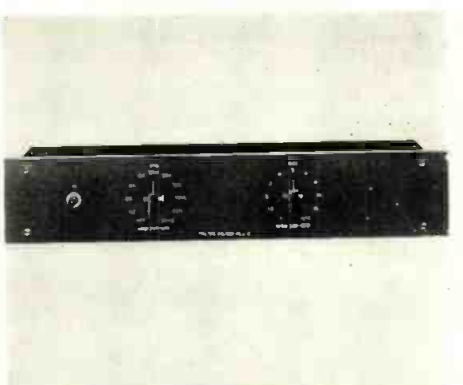
New miniature 5/8" diam., 3/8 oz., potentiometer of excellent precision, lists as model RVG-10. Metal-housed, it features good linearity and very dependable performance, particularly in severe



duty applications involving high temperatures and vibrations. It is availabe in single as well as multi-gang constructions. They may be had with winding resistances from 20 to 30,000 ohms, minimum resolution of .09% and linearity of .25% where specified. Max. continuous operating temperature is 150°C (302°F) and the units meet applicable MIL-E-5272A specs. **The Gamewell Company, Newton Upper Falls 64, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-43)

HIGH and LOW PASS FILTER

Twenty-two cut-off frequencies ranging from 50 cps to 12 kcs make the PULTEC HLF-3 High and Low Pass Filter ideal for reduction of rumble, hum, noise and distortion in music and program material. Better sound effects are possible because of more mid-range frequencies. Low cut-offs are: 50, 80, 100, 150, 250, 500, 750, 1000, 1500 and 2000 cps. High cut-offs are: 1, 1.5, 2, 3, 5, 6, 8, 10, 12 kcs and Off. Circuit is



Constant "K", 18 db per octave, 600 ohms. Shielded toroids minimize hum pickup. Rack mount 3½ in. panel. Price $232.50. **Pulse Techniques, Inc., 1411 Palisade Ave., W. Englewood, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-11)

Cues for BROADCASTERS

(*Continued from page* 69)

than a fifth of a second.

For the unit shown, a rotary type stepping relay is required. This relay should have a double set of wiping arms and be of the continuously rotating (one direction) type. Four switching circuits are required on the relay, and it should have at least as many step positions as there are studios or inputs to be switched. The selection of this relay will depend upon the individual requirements for the switching unit.

Selector switch S1 is a two deck rotary type. The A section of switch is a circuit opening type; the B section of S1 is a conventional circuit closing type. The number of switch positions required is the same as the number of positions on the stepper. For simplicity, the dc circuits are shown in their entirety while the audio circuits are reduced to block diagram form. The operation of the circuit is as follows:

Assuming studio D to be on the air (K1 at rest on step D), and studio C is next to feed the channel (S1 set to position C). On the red (ON AIR) lamp bank the studio D lamp is lit and on the green (PRESET) lamp bank the studio C lamp is lit. When switching time arrives, the operator momentarily depresses the OPERATE pushbutton. K2 immediately energizes (receiving power through the stepper contacts and the selector switch). Contacts on relay K2 open the audio circuit, hold itself energized (should the operator release the pushbutton too soon), and energize the stepping relay, K1. The stepper rapidly rotates clockwise step by step until it finds an opened circuit to "home" on; in this case it is position C. K2 then de-energizes, thereby restoring the amplifier to operation in feeding the output line. Additional contacts on the stepper provide tally light provision for the unit and individual studios.

Increased Pilot Lamp Life

DYLE J. MILLER, Ch. Engr.
WNCC, Barnesboro, Pa.

WITH high or fluctuating line voltages, pilot lamps burn out quickly, and tube life is shortened. The use of a Series Resistor will increase Lamp life by 3 to 4 times.

(*Continued on page* 110)

Cues for BROADCASTERS

(*Continued from page* 109)

With the commonly used 6S6, 110 v, 6 w lamp, a 500 ohm, 5 w resistor will do the trick. With the 6 and 12 v. lamps, use a 1 w. resistor of suitable value (depending on current drain) to drop voltage 1 to 2v. You can also increase the life of all but the high power handling tubes by keeping these filaments at, or slightly below, rated voltage.

A check on some of our equipment showed filament voltages running as high as 7.5 v. Tube life has been doubled by dropping voltages to 5.5 or 6 v. level.

Silver Migration

(*Continued from page* 65)

white silver chloride when Cl^- ion is present (see (6) above). As silver continues to dissolve beyond its saturation point, silver hydroxide precipitates (see (7) above). Silver ions migrate through the water film under the potential difference to the cathode, where they are electrodeposited as silver metal. Further silver deposition occurs at the ends of previously deposited crystals (see (10) above), until a complete conducting path connects the two electrodes. As the gap becomes smaller the resistance of the solution becomes less and the current increases, increasing the migration rate (see (11) and (12) above). When short circuit occurs, the high current that flows may burn off the connection which is immediately formed again (see (13) above).

Other Metals

Although the above discussion has been limited to silver, other metals should also migrate depending on the solubility of their salts, particularly the hydroxide. Silver however is unique among the metals in that its hydroxide is more soluble than that of the other noble metals, its oxide and hydroxide are less stable than those of many of the less noble metals, and its corrosion products (principally the sulfide) are not electrical insulators. Gold would not cause serious migration difficulties because of its insolubility, but, for equal conductivity, it would require $96.00 worth of gold to do the same job as $1.00 worth of silver.

(*Continued on page* 111)

Silver Migration

(*Continued from page* 110)

Prevention

Extensive studies have been carried out to find a means of preventing silver migration or to find a suitable substitute for silver that would not migrate under conditions of high humidity. To date no alloys of silver or additives to silver compositions have been found that eliminate or reduce migration without also degrading other electrical properties. For example, a small amount of antimony will increase the time for migration failure as much as 20-fold, but, at the same time, the resistance of silver patterns is increased, the power factor of silver ceramic condensers is increased, and solder wettability is completely lost. This is believed to be caused by the oxidation of the antimony which insulates the silver particles, causing increased resistance which lowers the migration current. At the same time it forms a protective film that prevents solder-wetting.

Fig. 5: Humidity Cabinet with cover removed. Chips (Fig. 2) are shown mounted in test racks

Metals less noble than silver, whose corrosion products are insulators, cannot be used as silver substitutes. The more noble metals cannot be used because of the cost ratio as described above. On special jobs where migration is a serious threat and where a 100-fold increase in price can be absorbed, gold, platinum and palladium compositions are available as conductive coating substitutes.

As pointed out above (observation 14) solder coating of silver patterns delays migration. It is essential that this solder coating be complete and that there are no exposed silver

Silver Migration

(*Continued from page* 111)

edges. Even so, migration has been observed to take place in time from under the edge of the solder coating. Ceramic capacitors that are solder-dipped to attach tinned copper leads are thus protected against migration failure for extended periods, even under adverse conditions. Very little work has been done on electroplating of silver electrodes to eliminate migration, but several encouraging leads have been uncovered and further investigation into this problem is warranted. Electrodeposited gold over the silver was ineffective since the gold did not cover the edges of the silver pattern. Chromium plating on the other hand was quite effective. All solder connections to the silver had to be made before chrome plating and the effect of the acid chrome bath on the electrical properties of the coated part is not known.

Migration Barriers

Electrically conducting non-migrating metal barriers can be placed between two silver patterns to reduce migration tendency. For example, a narrow gold line placed between the patterns will function as a migration barrier. Migration will take place rapidly from the barrier to the anode, then migration will stop. It is therefore desirable to connect such a barrier electrically to the anode. A single barrier of this type must be used in a circuit having a unidirectional potential. It is necessary that the anode always remain anode, even if an alternating potential is superimposed on a direct potential. Between two electrodes carrying only alternating current, each electrode must be supplied with a barrier.

Organic Coatings

It is common practice to coat silver ceramic and silver-mica capacitors with organic coverings. Since all organic films are somewhat pervious to water vapor, these coatings retard, but do not eliminate migration, and might be highly ineffective under extremely humid conditions and widely fluctuating temperatures.

Soluble salts or hygroscopic materials left on the surface of the capacitor can be highly effective in causing the formation of a conductive water film even after the chips are covered with a resin coating. In a highly humid atmosphere, water vapor will penetrate the organic coating to condense on or dissolve the hygroscopic material below it.

This film of moisture will be difficult to remove even with high temperatures, and will rapidly recondense on the hygroscopic material when cooled. If on the other hand all soluble salts are removed before coating, condensation of a liquid film from the water vapor is prevented.

The following procedure was followed in the laboratory to remove soluble salts before coating with organic films. After the soldering operation, the capacitor chips were washed thoroughly with acetone to remove solder flux (rosin) and grease. While still wet with acetone they are boiled for one hr. in resin deionized water to hydrolyze any salts present. The water was then poured off and the chips washed three times with deionized water and dried in an oven at 110° C., in the absence of all acid fumes. Subsequent handling was avoided as much as possible. When it was necessary to store the chips before coating, this was done in a clean, dry, empty, desiccator away from all acid fumes. The organic coating was then applied. Test chips prepared in this manner did not fail in 120 hrs. at 100% relative humidity and 50° C. whereas chips not cleaned in the described manner failed in 20 to 50 hrs.

To minimize migration failure on parts subjected to extremely adverse conditions it is essential that all soluble salts be removed. The most probable source of these salts is from the perspiring hands of the operators in a manufacturing plant although the solder bath, the resin coating dip or a contaminated atmosphere may leave them on the chips.

Tandem Transistors

(*Continued from page 59*)

tive-resistance oscillations. At frequencies much below f_α, the feedback is degenerative and no oscillations occur. With increasing frequency, however, the current amplification factor H_{21} becomes complex, as in the case of a single transistor. As is well known, the lagging phase of a single transistor, in first order approximation, can be expressed in terms of the RC-network shown in Fig. 7A. Accordingly, the ladder network depicted in Fig. 7B simulates the phase shift of a two-stage cascade of the tandem type. Hence, the complex current amplification factor of a tandem transistor may be written:

$$H_{21} = \frac{H_{21_0}}{\left[1 + j\left(\frac{\omega}{\omega_\alpha} H_{21_0}\right)\right]^2} \qquad (6)$$

Tandem Transistors

(*Continued from page* 113)

or, after the separation of the real and imaginary terms,

$$H_{21} = H_{21_o} \frac{1 - \left(\frac{\omega}{\omega_\alpha} H_{21_o}\right)^2}{\left[1 + \left(\frac{\omega}{\omega_\alpha} H_{21_o}\right)^2\right]^2} - j \frac{2 \frac{\omega}{\omega_\alpha} H_{21_o}}{\left[1 + \left(\frac{\omega}{\omega_\alpha} H_{21_o}\right)^2\right]^2} \quad (7)$$

If $\omega > w_\alpha / H_{21_o}$, the real part reverses its polarity and still remains large enough for converting the original degenerative feedback into a regenerative one.

The phenomenon of inverse feedback is equivalent to the oscillations of higher modes due to the transit time effects in vacuum tubes such as cathode ray tubes, positive-grid oscillators, magnetrons, klystrons, etc. After such higher-mode oscillations have been found in a tandem type oscillator, similar phenomena have been observed with single transistors.

The "Vitascan"

(*Continued from page* 61)

angles, three different lenses are mounted on a turret similar to conventional cameras, and the operator focuses the camera with a focus handle which moves the tube similar to conventional monochrome cameras. The camera is mounted on a standard dolly and pan head, see Fig. 1, and, since it is about the same weight as a standard monochrome camera, it is very easily maneuvered.

The light from the spot which forms the raster is focused on the scene and reflected from it in all directions, in varying color and intensity, depending on the hue, saturation and luminance of the scene at any given point. Once it is reflected, it can be gathered by as many multiplier photocells as is convenient, and they can be placed at any desired location. In order to increase the efficiency of the pickup system, the light can be reflected from studio walls or from reflectors and into the photocells. Varying transit times of the light rays are no problem since they are infinitesimal compared to the finite speed of the scanning operation.

The photocells used are the Type 6364. They have a 5 in. photo-cathode with a sensitivity of about 60

μa./lumen and are of the end-fire configuration. In the neck of the tube is located a 10 stage electron multiplier which has a gain of approximately 215,000 at 105 v./stage.

In the Vitascan system, the photocells—covered with appropriate filters—are used in groups of 4, as shown in Fig. 2, namely two red, one blue and one green. No normal lighting fixtures are required and since there is no heat from these pickup units, studios can be operated at comfortable temperatures with little or no air-conditioning required. Since a standard 40 ft. x 50 ft. color studio requires 200 KVA of lighting plus 70 tons of air-conditioning, this means a significant reduction in operating power costs.

Each group of 4 photocells is called either a Pickup Scoop or a Pickup Spot because of its analogy to normal lighting fixtures. This analogy between these pickups and lighting fixtures is startlingly real. For instance, for a set 10 ft. wide, about 8 pickups are used—two about 12 ft. above the floor pointed downward for "top lighting," two about eye level for "base lighting," and two close to the floor for "fill lighting." A master gain control is provided for each pickup which varies the dynode voltage on the multiplier stages. Varying the gain control on any given pickup readily indicates that it produces the same effect as raising or lowering the voltage to a lighting fixture in a standard studio. Pickups are made into either scoops or spots by using various reflectors or barn doors.

Channel Equipment

All red photomultipliers are paralleled and fed to a single red video amplifier, and the blue and green photomultipliers are connected in the same fashion to a blue and a green amplifier. The three video amplifiers are identical small rack mounted units, each 8¾ in. high, which amplify the signal to the standard 1 v. peak to peak level, provide gamma correction, aperture correction, phosphor correction, and add the blanking signal. The video signals from these amplifiers are perfectly standard and can be routed to standard encoders or to unencoded color switch units.

An important part of the Vitascan system is the phosphor correction. To accomplish this correction, the video amplifier has an amplitude-frequency characteristic which rises from 100 KC to 7 MC. This characteristic can be varied throughout this range and, for most camera tubes, the voltage gain at 6 MC is about 30 times the gain at 100 KC. Another

The "Vitascan"

(*Continued from page* 115)

method of describing the phosphor correction is to consider the waveforms involved. If a square wave as shown in Fig. 5A is fed to a Vitascan video amplifier, the output signal would look like Fig. 5B. Now when the spot from the camera scans across a narrow white line against a black background, a signal is generated by the photomultipliers as shown in Fig. 5C.

When such a transition is scanned on a time basis the spot has an exponential shape because of the exponential function of the phosphor decay curve and its changing position. The light input to the photocell is proportional to the integral of the original light decay characteristic.

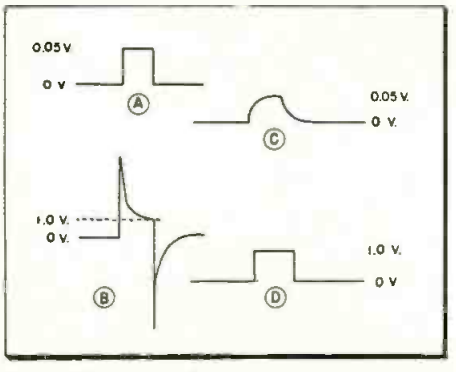


Fig. 5: Waveforms describe phosphor correction

Thus, as the scanning spot moves from black to white and then from white to black, both the rise and follow signals follow the same exponential law, resulting in waveform 5C. Because the decay function is a complex exponential, several RC combinations are required for satisfactory equalization. This is accomplished in the amplifier to give the required output waveform in Fig. 5D. In addition, additional aperture correction is also applied which consists of simple high frequency peaking, phase corrected by a bridged-T all-pass constant impedance network.

This same set of video amplifiers processes the video signal no matter how many Vitascan cameras are used. This feature coupled with the fact that the phosphors are the same on all camera tubes means there is no "matching" of cameras required —any color in the scene will produce exactly the same color from all cameras.

Studio Illumination

Any light in the studio, other than that produced by the flying spot, is not useful and produces noise in the video signal. Therefore, the studio must be light tight—a condition easily arranged in most studios if it does not already exist. Sound locks are excellent light locks and control room windows are either covered (as they are in many cases where directors prefer to operate blind) or the control room can be lighted as will be described for the studio.

The light from the raster, although bright enough to produce video signals from the photomultipliers, is not bright enough for the convenience of the performers. General lighting is therefore provided by pulsing separate lighting fixtures on during the vertical retrace period of the TV signal. This occurs every 60th of a second for about one msec. The synclite fixtures, as they are called, are similar in appearance to standard fluorescent fixtures except that each houses 5 small inexpensive xenon gas lamps. Each fixture requires 350 v. which is applied to the anodes of the gas tubes plus a 50 v. ignition pulse. This pulse is amplified to 10 kv in a small step-up transformer mounted on each fixture and pulses the tubes into conduction. Only three no. 18 wires with 600 v. insulation are required for interconnection to fixtures. Four of these fixtures supply adequate lighting level to a 12 ft. square set, and there is no limit to the number of fixtures which can be used for larger studios.

Camera Switching

When more than one camera is used in a studio, the switching from camera to camera is accomplished by turning the CRT's on and off, and laps and fades are accomplished by lapping and fading the two rasters. A control panel, similar to standard video switching and fading panels, is located in the control room for the video operator. This panel includes two horizontal rows of push button busses, with the familiar double lever fader at the right of the rows. The control grid of each camera tube is connected to a pair of buttons which either switch the tube on or off, or connect it to the fader pots for lapping and fading.

Switching and Special Effects

The Vitascan system lends itself admirably to special effects such as montages, keyed insertions, and a new unique form of rear screen projection. To achieve these effects, a translucent screen is placed at any point where it is desired to insert separate background signals. The screen can be the complete backdrop of a set; it can be inside a window, or inside a puppet stage. Beyond the screen is located a photocell (or cells) which gather any light which is not intercepted by the foreground objects. The signal

from this cell (or cells) is amplified and shaped to form a keying signal which is routed to any standard special effects switching and mixing equipment. This keying signal can then insert slides, film, or live signals from another camera into the studio picture. This means that the standard projection room can be used to accomplish rear screen work, rather than bulky projectors requiring long throw distances. The video which is inserted is always the same high quality as is normally produced in the projection room and is completely independent of the position of studio cameras. No balancing need be done between foreground lighting and the rear screen projector as is required by conventional rear screen techniques.

Ferrites

(*Continued from page* 63)

ferrites those which give the greatest rotations with the minimum of variation with frequency. The ferrite having the smallest M is thus more broadband per degree of rotation.

Studies made on Ferramic R-1 have indicated that the figure of merit M is independent of ferrite sample length. This is shown in Fig. 4 which shows a plot of $\Delta\Theta$ as a function of Θ_e with the applied magnetic field H_a as a parameter. Θ_e was varied by varying the length of the sample. It is evident from the figure that the slope of these curves is constant. Since the slope of these curves is $\Delta\Theta/\Theta_e$ (or the figure of merit M) we see that the value of M is independent of sample length for any particular value of applied field.

Similar curves could be plotted for other ferrite types. From such plots we would find that although the curves would behave the same, the slope M would be different. Whereas Ferramic A-105 has an M of 1.5, Ferramic A-106 has an M of about 0.7. The fact that Ferramic A-106 has a smaller M than Ferramic R-1 indicates that it is more broadband per degree rotation than is Ferramic R-1. The truth of this is evident in Fig. 2 where a comparison is made between a Faraday type ferrite isolator using Ferramic A-106 and one using Ferramic R-1. A minimum isolation of 20 db is maintained over a 9% band in the case of the Ferramic A-106 but only a 3% band in the case of R-1, so that by using Ferramic A-106 we have tripled the bandwidth.

Broadband Effects

We shall now show that by the use of two samples of ferrite, we can

Ferrites

(*Continued from page 117*)

achieve excellent broadband effects over very large bands. Consider now, two ferrite samples A and B in Fig. 6A. Suppose that the variation of rotation with frequency for these two samples is as shown. Let us now consider the possibility of adding the rotations of A and B algebraically and in such a way that the change in rotation with frequency will cancel over the entire band. To do this we simply make the rotation of sample B negative with respect to that of sample A by reversing the applied field on sample B. In practice this can be done in a section of circular waveguide as shown in Fig. 6B. With the applied fields in the directions shown, the rotations of Sample A and B will subtract. For perfect broadbanding, we require that the change in rotation over the band for sample A be the same as that for B (i.e. b-a = d-c in Fig. 6A). With this condition, the net rotation of the combination of A and B will be a perfect broadband value of a-c as shown in Fig. 6C.

Assume that we need a broadband rotation of Θ_0. The conditions that

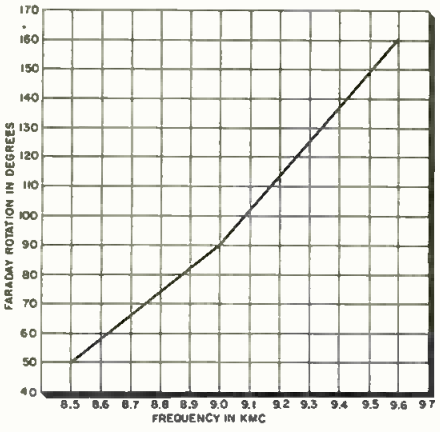


Fig. 5: Change in rotation for a sample 3 in. long by ¼ in. Dia. is 110° over 8.5-9.6 KMC

this value be broadband using this method are

$$b-a = d-c \qquad (1)$$

$$a-c = \Theta_0 \qquad (2)$$

The question now arises "can we find a pair of ferrites which will satisfy both of these conditions?" There is certainly one pair, namely two identical ferrites of the same material, dimensions and with the same field applied to both. As a consequence of being identical their change in rotation over the given band will be equal (i.e. b-a will equal d-c) and the rotation at every point in the band will be the same for both. In particular, the rotation of each at the low end of the band will be the same (i.e. a will equal c). Therefore, the net rotation of the pair will be a-c or zero. Thus we have a broadband rotation of 0° as a trivial case.

Application

Let us examine the possibility of finding pairs of ferrites for which Eqs. (1) and (2) are satisfied in a non-trivial way. To do this we use the following argument; the conditions for a broadband value of rotation are given by Eqs. (1) and (2). But, according to our definition of figure of merit M, we have for the two samples of Fig. 6A.

$$M_a = \frac{b-a}{a} \qquad M_b = \frac{d-c}{c} \qquad (3)$$

If now Eq. (3) is substituted in Eqs. (1) and (2), and Θ_0 solved for, we obtain

$$\Theta_0 = a\ (1 - \frac{M_a}{M_b}) \qquad (4)$$

If this equation can now be satisfied, we are guaranteed a perfect broadband effect over any frequency range, so long as the variation of rotation is linear with frequency over this same range. If Θ_c is to be non-zero, we have immediately that M_a cannot be equal to M_b. We must now find under what conditions the M's can be different.

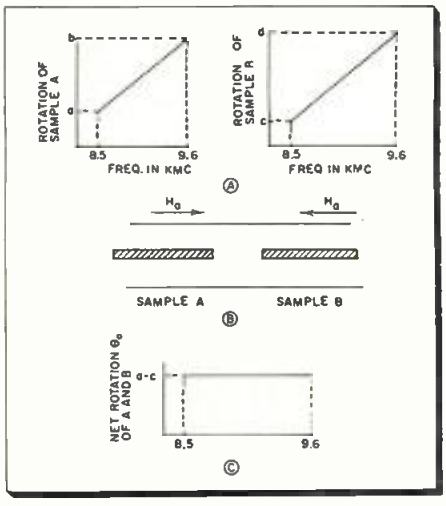


Fig. 6: Rotation of combinations of ferrites is varied by changing polarity of samples

There are three important ways in which this can be done. First, we can use two samples of the same ferrite type and utilize the fact that the value of M for each sample varies with the magnetic field applied to it, as shown in Fig. 4. Thus the M's can be made different. Second, we can use two samples of different ferrite types and rely on the fact that the value of M for each sample will be different since the ferrite types are different. Third, we can use samples of different diameters. In each case we should get a broadband effect.

Ferrites

(*Continued from page* 118)

In order to verify these conclusions, various pairs of ferrites were tested in a circular waveguide section identical to that shown in Fig. 6B. The results of testing Ferramics A-106 and R-1, both 3 in. long and ¼ in. in diameter, are shown in Table I.

The figures in the second and third columns show the rotation of each sample measured alone in the waveguide. The figures in the fourth column show the algebraic sum of the rotations shown in the second and third columns. We see that the actual sum measured and shown in the fifth column closely agrees with the algebraic sum. Particularly note that the conditions (1) and (2) for broadbanding are not exactly satisfied by this pair. For example, the $\Delta\Theta$ of the Ferramic A-106 is 50° and that for the Ferramic R-1 is only 40°. The bandwidth nevertheless has been greatly increased. If the rotation of this pair is set to a broadband 45° and used in the Faraday type isolator described earlier, the solid curves of Fig. 2 are obtained. In this figure, a 20 db isolation is maintained over at least a 20% band, as compared to the 9% band of the Ferramic A-106 by itself.

An identical series of tests were made using two samples of Ferramic R-1 to show that broadbanding is possible in this case as well. The results are shown in Table II.

These results are not as good as those obtained for the Ferramic A-106 and Ferramic R-1 pair, but the bandwidth has been noticeably increased. It should be pointed out here that the data shown in either Table I or II does not necessarily represent the optimum performance. The combinations of lengths and applied fields used in these tests were arrived at empirically, rather than by the systematic use of Eqs. (3) and (4).

We have seen that the principle of this technique is based on the subtraction of the rotations of two ferrite samples. Since some ferrites are known whose rotation is negative with respect to the rotations of ferrites in general, the possibility exists of using these ferrites in the same method previously described. The only difference will be that the applied magnetic field will be in the same direction on both samples.

Reference

1. C. L. Hogan—"The Ferromagnetic Faraday Effect at Microwave Frequencies and its Applications." *Reviews of Modern Physics*, Vol. 25, No. 1, Jan. 1953.

Engineering Dollar

(*Continued from page* 86)

Standard Labor Costs by the Accounting Department and establish standards of measurement for such classes of labor as material handling, group leaders, etc.

In order for the standards group to be effective, they must have within the group men who can perform effectively in both manufacturing processing and test processing. In addition, the need for accounting knowledge, development of reports, etc. are of prime importance. Essentially they must be able to handle many processing responsibilities and in addition have specialized knowledge related to their activity.

Ratio delay studies, whole indicated as being in the Standards group are also carried out by the Process Engineering Group. It is an effective Industrial Engineering tool and is used frequently by us to help solve existing problems. The Standards Activity uses this tool on the more general problems whereas the Processing Group applies it to specific assembly manufacturing problems.

No discussion of the Standards Activities within an Industrial Engineering Department would be complete without at least some general comments on the subject of time standards or labor standards. Objectively, the Standards Activity endeavors to develop as much standard data and M.T.M. time formulas as possible, so that actual time studies or M.T.M. studies on the floor are kept to a minimum. As a result of this activity, the amount of floor study activity is very small, and in general, is confined to the investigation of complaints, operator performance, and the handling of unusual situations not readily covered by standard data.

Cost Estimating

This activity has acquired section importance principally because of the volume of estimating required. The relatively large volume is principally the result of the fact that a major portion of our production in the Fort Wayne plant goes directly to the Armed Services of our country. Obviously bids must be submitted on new contracts in order to maintain a satisfactory sales and production volume. Estimating the cost of products aimed at the civilian market in order to establish prices prior to production and to guide both sales and engineering is also an important part of this activity.

Since we are the headquarters plant of the company and secondly a headquarters plant for our division of the company, we naturally become involved in estimating the cost of products at our other plants. This poses an additional estimating burden. All new products and/or major estimates for our division's other plants are handled in this Section.

You will have noticed by this time, that Cost Estimating is mentioned in the Section activities of Industrial Engineering previously covered. You will also find that it appears in all of the other section activities which are to be discussed.

Basically the head of Cost Estimating is both a coordinator and an operating member of the Industrial Engineering supervisory team.

In addition to working within the Industrial Engineering Department, he must work with Design and Development Engineering, Purchasing, Accounting, etc.

The basic reasons for placing this activity in its present form within Industrial Engineering are as follows:

1. It was believed by Management that more product cost information and manufacturing know-how existed within the Industrial Engineering Function than in any other function of the company.

2. Industrial Engineering, prior to the expansion of the Cost Estimating Activity, was already involved in estimating labor, tools, and facilities.

3. In order to provide for an audit of all estimates by other departments, the handling of purchased material prices, engineering expenses, etc. was placed within the group so that all of the basic computations would be done by this one group. The accounting audit can then be performed by the Cost Accounting activity.

Cost Estimating is a sporadic activity. It, therefore, would be difficult to staff it with an adequate amount of personnel to handle all of the problems that are involved. Our approach, therefore, has been to head it with a well qualified Industrial Engineer having those qualities to make him both an effective coordinator and an effective organizer and supervisor. His only immediate staff is an accountant. He draws additional personnel, as required, from the other sections of the Industrial Engineering Department.

He must work very closely with all of the Industrial Engineering sections in helping them discharge their responsibilities regarding cost estimating, and at the same time provide an internal Industrial Engineering audit of their results.

To some extent it is difficult to tie

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"X-Y" Plotter

(*Continued from page 71*)

The time base generators have adjustable grid resistors to permit approximate frequency adjustments. The X and Y level setting potentiometers set the 0 signal bias on the clampers so that the square law region of the crystals does not cause deterioration of the transfer function linearity. The excursion of the input level is limited by the peak voltage available from the X and the Y linear time base generators. For the X channel the variation in input voltage should be between 0 and approximately —8 v. The Y channel variation should range from 0 to —12.5 v. It is recommended that curves similar to those shown in Fig. 6 be run as an overall check on the Adapter.

A convenient method of obtaining data for these curves is to externally synchronize an oscilloscope to the output of the linear time base generator and view the appropriate trigger at V6. Set the "X level set" potentiometer wiper voltage at approximately —0.25 v. and the "Y level set" potentiometer wiper voltage at approximately —0.6 v. Inputs outside the ranges specified will have to be either amplified or attenuated.

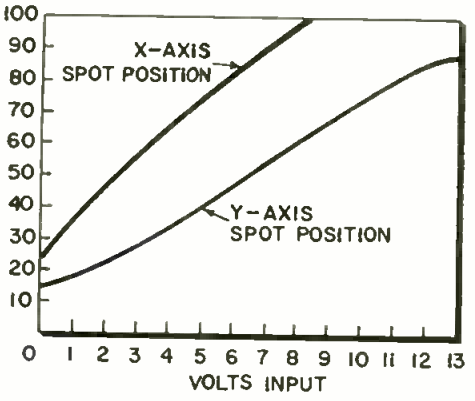

Fig. 6: Linearity of both X and Y channels. Y-axis—position as % of vert. trace time

In the TV receiver used for this system, it was found to be convenient to obtain the vertical synchronizing signal from the vertical blocking oscillator and the horizontal synchronizing signal from the horizontal multivibrator. The system stabilizes in approximately 10 min. Small corrections in spot position with 0 signal inputs may be made by means of the level set potentiometers. The adjustments should not reduce the 0 input voltage on the wiper arms of the "level set potentiometers" below approximately —0.25 v. however. The diodes should not be mounted adjacent to the vacuum tubes or any heat generating circuit elements.

The dc input voltages may be picked up from any transducer possessing suitable electrical output, e.g., the wiper arms of potentiometers. A linear or logarithmic resistance curve in the potentiometer would provide linear or log scales as a function of linear rotation of the potentiometer shafts. A tolerance curve or standard can be engraved on a plastic graticule or may be marked directly on the face of the cathode ray tube with a grease pencil. This procedure would supplant curve plotting as a part of production testing. Applications of this include tracing the resistance curve of potentiometers as a function of shaft rotation, plotting diode characteristics, tracing magnetization curves, or presenting a plot of any two slowly varying parameters that have been changed in form to slowly varying dc voltages. A third dimension can be realized by intensity modulation of the spot. Use of a very long persistence phosphor enables an actual curve to be displayed. The limits of the actual physical size of the presentation are governed by the CRT tube itself.

Reference

1. Chapter 9, Waveforms, *Rad. Lab. Series*, McGraw Hill Book Co., Inc., N. Y., N. Y.

News of MANUFACTURERS' REPS

REPS WANTED

Manufacturer of telephone plugs made to JAN-P-642 specs., and spring-loaded contact pins seeks representation in all territories except New England, New York, and the Philadelphia-Washington area. (Ask for R-2-1)

The Electro-Acoustic div. sales organization of Telex, Inc., St. Paul, Minn., has named four manufacturers reps. The **Al Engleman Co.**, Memphis, Tenn., will cover Tenn., Ala., and western Fla. **Neal Bear Corp.**, W. Richfield, Ohio, will be responsible for Ohio, Ky., W. Va., and western Pa. The **Frank C. Nickerson Co.**, Atlanta, Ga., will travel in N.C., S.C., Ga., and eastern Fla. **Northport Co.**, St. Paul, Minn., has been assigned Minn., Iowa, N. Dak., S. Dak., and Neb.

Rush S. Drake Associates, 1806 Bush Pl., Seattle, Wash., have been appointed to rep Lerco Electronics, Inc., Burbank, Calif., in the sale of electronic hardware in Wash. and Ore.

Stanley Pierce, Norwood, Mass., has been appointed industrial electronics rep in New England for the James Vibrapowr Co., Chicago, Ill.

The Kittleson Co., 418 N. La Brea Ave., Los Angeles, Calif., will rep Librascope, Inc., Glendale, Calif., in Calif., Ariz., New Mex., and Nev.

Mohr Associates, 270 Park Ave., New York City, is now handling both advertising and public relations for Electronic Fabricators, Inc., 682 Broadway, New York City.

The General Ultrasonics Co., Hartford, Conn., has announced the appointment of engineering and sales reps. The **MacDermid Sales and Equipment Corp.**, Bristol, Conn. will be responsible for Conn. **Louis V. Gagnon**, from quarters at Framingham, Mass., will cover Mass., R.I., N.H., Vt., and Me.

Richard B. Pell has been appointed engineering and sales rep on sound systems and intercommunication equipment in the New England terr. for the Special Products Div. of Stromberg-Carlson.

Marvelco Electronics Div. of National Aircraft Corp. has appointed six manufacturer's reps. Named to handle sales of all commercial electronic products are: **John G. Twist Co.**, Chicago, Ill.; **Harrison J. Blind**, Indianapolis, Ind.; **Edwards & Loshe**, Cleveland, Ohio; **Dan Green, Inc.**, Cambridge, Mass.; **William Richter**, Rochester, N.Y.; and the **Wally Shulan & Co.**, Jersey City, N.J.

Harry Halinton of Chicago, Ill., has been appointed exclusive rep in Ill. and Wisc. for the HYSOL lines of epoxy electrical insulating materials and adhesives of Houghton Laboratories, Inc., Olean, N. Y.

R. H. Robinson, 3 Robin Rd., Willimantic, Conn., formerly general sales manager for William Brand & Co. is now representing that company, The Metal Etching Corp., and R C L Manufacturing Co. in the New England Area.

Automatic Switch Co., Orange, N.J., has announced the appointment of **Pierre Lenmark Co.**, 6518 Walker St., Minneapolis, Minn., as authorized ASCO rep. in Iowa in the following counties and all counties east: Winnebago, Hancock, Wright, Hamilton, Marshall, Poweshiek, Mahaska, Monroe, and Appanoose; and in Ill. in Rock Island, Henry and Mercer counties.

Herbert F. Koether and **Robert W. Cox** have merged their respective manufacturer rep firms under the new name of **Koether-Cox Company.** The combined organization, located at 120 W. 13th Ave., Denver 4, Colo., will specialize in electronic components and a limited number of consumer lines.

King Gates Associates, 10623 Puritan Ave., Detroit 38, Mich., have been appointed exclusive rep in Detroit and the surrounding area of Mich. for the decorative glass and metal parts and trim line of Croname, Inc., of Chicago, Ill.

Cinema Engineering Div., Aerovox Corp., Burbank, Calif., has announced changes in factory representation. **Sidney H. Baum**, 70-15 Fleet St., Forest Hills, N.Y., will handle met. N.Y. and also five counties immediately adjacent. **Paul Goley**, 133 Cedar Ave., Woodlyn, N.J., will cover the Phila. area. **Jack Simberkoff**, 68 Hudson St., Hoboken, N.J., will be responsible for eastern Pa., N.J., Md., Del., Wash. D.C., Va., Tenn., and N.C.

All distribs, reps, and mfrs. planning to attend the 1956 Electronic Parts Distributors Show, May 21-24, at Chicago's Conrad Hilton Hotel, must register in advance by mail for all their personnel attending. *There will be no registration at the show.*

Also, attendance will be policed to discourage badge-passing, and violators will be penalized. This new approach to admission control is designed to make sure that only qualified people are present. Distribs and exhibitors should send their registrations in early. Address: Radio Parts & Electronic Equipment Shows, Inc., Suite 1500, 11 S. La Salle St., Chicago 3, Ill.

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Engineering Dollar

(*Continued from page* 120)

this activity back to the basic responsibilities indicated for Industrial Engineering. However, it is closely related with the utilization of the various factors involved in the definitions originally presented.

Much of the data developed on any detailed cost estimate is eventually used by the processing and standards activity, as well as the tool engineering and the plant engineering activity on business secured through the estimate. The Purchasing Department also utilizes the estimate as a gauge of the performance of their buyers in handling any new product.

Tool Engineering

Organization-wise, the Tool Engineering Section is divided into two broad categories of personnel. The larger group is concerned principally with designing tools, jigs, and fixtures, estimating tooling costs, and to a minor extent are involved in the procurement activity and tool proving activity. The second group in the Tool Engineering Department is principally concerned with trouble shooting production problems related to tools and gauges, procurement of tools, establishment of shop practices and procedures related to tools, etc.

The Tool Engineering Section is generally composed of men who have come up through the ranks and have a practical shop background, particularly in the tool and die makers field. It is regrettable that more mechanical engineers do not enter this field, for it is most lucrative and generally there is a lack of qualified personnel. A major contribution can be made to the production efforts through the design, development, procurement and installation of good tooling.

The Tool Engineering activity obviously has inter-relationship with the Processing group, Cost Estimating, and to some extent the Standards activity.

This group tends to keep processing in line with good practice since they naturally object when incorrect tooling is called for in the process. They are thereby discharging their audit responsibility.

Plant Engineering

It is not common practice to combine Plant Engineering with Industrial Engineering. However, this is beginning to occur in more and more plants.

There are two basic reasons back of this combination.

The first was due to difficulties encountered in effectively coordinating Plant Engineering with Industrial Engineering and these with overall management problems. Labor and material would be wasted by Plant Engineering because change in layout, etc. made by Industrial Engineering often would not be indicated until every question had been answered. The other problems involved proper cost control and planning for the future. The close relationship of these two major functions is easily discerned as they relate to utilization of space, facilities, and equipment. This relationship was our major consideration in combining Plant Engineering with Industrial Engineering.

The combination has worked very effectively. It has achieved a degree of coordination between Industrial Engineering and Plant Engineering not ordinarily found in plants where the two functions are separated.

Peak engineering work loads are more easily handled due to the fact that personnel can be borrowed from the various sections of Industrial Engineering to handle the Plant Engineering problems during the development and installation of major items. This occurs frequently because they are on the same team.

Cost Control has been achieved by applying Industrial Engineering thinking to the Plant Engineering activity. Work order systems, a consolidated tool crib, preventive maintenance programs, appropriation control, etc. have been the result.

Future planning results include a complete relayout of the plant, the installation of which has been accomplished over a two year period. A planned maintenance and facility improvement program was also developed that has been approved by Management and has been in action for two years.

Combining Plant Engineering with the commonly accepted Industrial Engineering activity responsibilities makes possible the utilization of the best features of staff organization specialization and line organization effectiveness in dealing with the actual work problem.

The material presented illustrates the philosophy and approach used to successfully organize a very important function in a medium sized industry. It was the intent of the author to be helpful in furthering Industrial Engineering as a profession and to aid others in accomplishing the task of setting up and successfully operating such a department.

Transfer Functions

(*Continued from page 68*)

puter sections, one of the type shown in Fig. 3 and the other of the type shown in Fig. 6. The circuit of Fig. 6 would form the lower half of the curve and the circuit of Fig. 3 the upper half. Since no diodes from computers A and B are ever conducting simultaneously, the sections may be designed independently except for scale factor. The complete circuit is shown in Fig. 7. In this case R_s and R_o would be common to both sections to effect the same scale factor. Slope m_{ab} in Fig. 10 is the same for both computer sections and would represent the region of no diode conduction in either section. Its magnitude is used in determining the scale factor in Eq. (2). The intercept of m_{ab} is used in determining E_{BO} in Eq. (4).

The typical compound curve of Fig. 9 can also be formed by the circuit of Fig. 7. However, the design is not as simple as for the curve of Fig. 10 because both computer sections are not as independent as before.

In designing such a circuit, this realizability criterion arises:

$$m_{ma} = m_{nb} = m_{ab} > \frac{m_{oa}\, m_{ob}}{m_{oa} + m_{ob}} \qquad (5)$$

If this criterion is not met, one must isolate the two computer sections with a cathode follower, taking into consideration the dc component the cathode follower adds. Even though realizability is indicated, it is sometimes advantageous to use the cathode follower anyhow to obtain a larger overall scale factor.

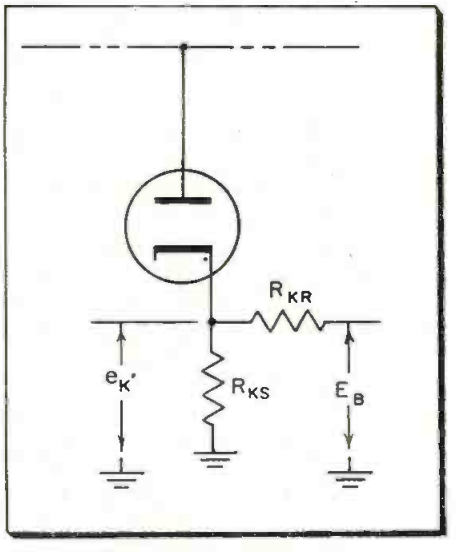

Fig. 12: Bias network effectively includes R_k

If isolation is not required or desired, then the following design procedure must be followed: Assume any arbitrary R_o and R_s. Using these

values, calculate R_{qa} and R_{qb}.

$$R_{qa} = \frac{[(m_{oa} + m_{ob})\, m_{ab} - m_{oa}\, m_{ob}]\, R_o\, R_s}{R_o\, m_{ob}\, (m_{oa} - m_{ab}) + R_s\, m_{oa}\, m_{ab}} \quad (6)$$

$$R_{qb} = \frac{[(m_{oa} + m_{ob})\, m_{ab} - m_{oa}\, m_{ob}]\, R_o\, R_s}{R_o\, m_{oa}\, (m_{ob} - m_{ab}) + R_s\, m_{ob}\, m_{ab}} \quad (7)$$

where

R_{qa} is the parallel combination of R_o and R_{1a} to R_{ma}

R_{qb} is the parallel combination of R_o and R_{1b} to R_{nb}

$$m_{ma} = m_{nb} = m_{ab}$$

The scale factor α introduced is then:

$$\alpha = \frac{[(m_{oa} + m_{ob})\, m_{ab} - m_{oa}\, m_{ob}]\, R_o}{(R_o + R_s)\, m_{oa}\, m_{ob}\, m_{ab}} \quad (8)$$

Then,

$$R_{ka} = \frac{m'_{(k-1)\,a}\, m'_{ka}}{m'_{(k-1)\,a} - m'_{ka}}\, R_s \quad (9)$$

$$R_{kb} = \frac{m'_{(k-1)\,b}\, m'_{kb}}{m'_{(k-1)\,b} - m'_{kb}}\, R_s \quad (10)$$

As a check, after all of the R_k's have been determined, calculate the parallel combination of all R_{ka}'s with R_n, and all R_{kb}'s with R_o, and these values should check with Eqs. (6) and (7) respectively.

In the previous three cases, E_{BO} had been calculated (for simplicity) from regions of no diode conduction; however, no such region exists here. Bias E_{BO} is then determined from Eq. (11) where e_{oa}, e_{ob}, and e_{oab} are respectively the output voltage axis intercepts of the m_{oa}, m_{ob}, and m_{ab} slopes.

$$E_{BO} = \frac{R_o}{R_s}\left[\frac{e_{oa}}{m_{oa}} + \frac{e_{ob}}{m_{ob}} - \frac{e_{oab}}{m_{ab}}\right] \quad (11)$$

Bias Considerations

All bias voltages of all cases may be taken from a common source if the biases and the source are of the same polarity and suitable magnitudes. Appropriate networks which may or may not perform the additional function of effectively including R_o to R_n may be determined. Considering only the k^{th} branch where the network effectively includes R_k we have in Fig. 12 and Eqs. (12) and (13):

$$R_{kR} = \frac{R_k}{e'_k}\, E_n \quad (12)$$

$$R_{ks} = \frac{R_k}{E_n - e'_k}\, E_n \quad (13)$$

Transfer Functions

(*Continued from page* 127)

Another method of biasing not including R_k in the bias network is shown in Fig. 13 of the k^{th} branch. Here R_k is much larger than the bias network equivalent resistance if this is a dc computer or R_k is much larger than X_{cs} if used in an ac application. Of course:

$$e'_k = \frac{R_{ks}}{R_{ks} + R_{kR}} E_B \qquad (14)$$

The designer may use any type of bias network since the two methods given are merely illustrative.

Other Considerations

Up to now only ideal diodes have been considered; however, practical diodes have certain flaws which often must be allowed for. A very excellent discussion of these flaws is given in reference.[1]

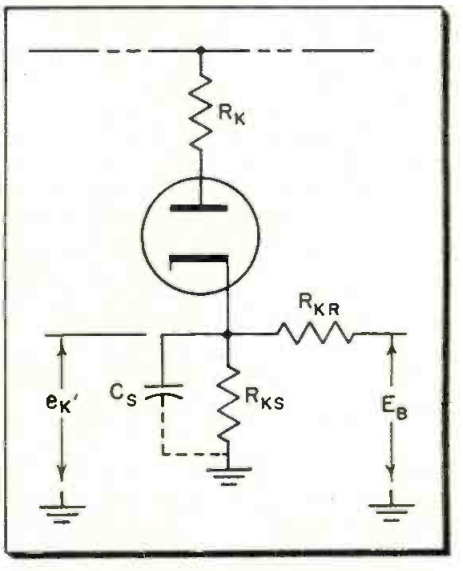

Fig. 13: R_k exceeds bias network resistance

For example, one such flaw is that of a vacuum diode having a forward resistance on the order of 200 ohms and 100 ohms for germanium diodes. These values modify R_k and can be allowed for by subtracting them from R_k to form some R'_k. Since the plate resistance of diodes is unstable or not well defined, it is good practice to make R_k of such a magnitude that it need only be modified in the third significant figure. Actually, all this is dependent on the required accuracy.

Another flaw is that of incurring diode conduction with slight negative plate voltages. For a vacuum diode this can be allowed for by adding about +.5 v. to the breakpoint voltages. This value is somewhat unstable and various methods of compensation are given in the above reference starting on page 333.

At a breakpoint, a diode is in par-

tial conduction producing a large variable forward resistance. This modifies R_k to the extent that the breakpoints are rounded off. Generally this is advantageous in fitting diodes to the curve to be synthesized.

Logarithmic Computer

As mentioned in the introduction, it was desired to make a db meter with a linear scale. To accomplish this the audio signal was first rectified and filtered so that only positive average signal levels were inserted into the computer. The network then was designed to take the logarithm of this time function using 10 v. input arbitrarily as zero db. In the design of the network, the diodes were assumed to cut off at a plate potential of —.5 v. This assumption was slightly in error, but the results were adequate for the intended application. The circuit diagram is shown in Fig. 11. This circuit was tested using a VTVM with 5% accuracy. A plot of this data on semi-log co-ordinates is shown in Fig. 8, indicating acceptability between 1.5 v. to 100 v. input, since the curve approximates a straight line in this region.

Reference

1. *Waveforms* (*Rad. Lab. Series*, Vol. 19) McGraw-Hill Book Co., Inc. page 58.

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dition, with near zero generator resistance, is again higher than in the hushed condition, (by approximately 2 db).

A really drastic difference between hushed and unhushed operating condition does not occur until the generator resistance is increased. The top curves on the left and right side are drawn for hushed and unhushed condition with an external generator resistance of 3.9K, that is approx. 3½ times the measured input impedance, in either condition.

In the hushed condition, we still maintain a section in which noise voltage is nearly constant, although of course, now higher due to the larger generator resistance. This is the region above 3 kc. Relative noise voltage here is approx. 6 db.

Below 3 kc we have again an increase of noise voltage at a rate of approximately 2.2 db per octave, in other words, a manifestation of our 1/f component.

Turning now to the unhushed condition on the right side of Fig. 12, we cannot detect any region in which noise voltage is nearly con-

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stant, although it is obvious that if our investigation had been carried beyond the 15 KC frequency limit, the top curve would eventually have leveled off, perhaps somewhere between 25 and 40 KC. The whole length of the curve shown here is the typical picture of a transistor being dominated by the 1/f noise component, a picture which is only too well known to those who are currently designing or using transistor amplifiers. The rise of noise voltage with decreasing frequency, incidentally, also follows the familiar pattern. It is approximately 3 db per octave, which is an often found figure in general transistor noise measurements.

We would like to point out one mild surprise into which we ran when making the measurements which you see here plotted as relative noise voltage curves.

Although when operating with very low generator resistance our unhushed transistor shows a noise voltage which is approx. 2 db higher than the hushed transistor, its 1/f behavior is almost identical with the behavior of the hushed transistor. In both cases 1/f does not manifest itself until our frequency drops below 750 cycles. This may raise the question: "Why should we go to the trouble of hushing a transistor at all, if our only improvement is 2 db?"

The answer is that, in the first place, we set out in our tests by selecting an unhushed condition which markedly resembled the hushed condition, as has already been outlined in detail (to be as fair as possible to the unhushed transistor and to establish comparable testing conditions, i.e. comparable testing conditions regarding input impedance and frequency response. In the second place, we are seldom dealing with generator resistances as low as 10 ohms. Matched or nearly matched impedance operation is more likely to occur. In that case, as the middle curves on the left and right side of the illustration show, the difference between hushed and the unhushed condition is enormous. These middle curves were drawn for a generator resistance of 1K where it is nearly matched with the measured transistor input impedance (1.2K).

If we compare individual operating points, with a given frequency and given generator resistance, the hushed transistor compares particularly favorably with the unhushed

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transistor in the low frequency region. For instance, at 300 cycles, and with a nearly matched generator resistance of 1K, we find a noise voltage of 9 db in the hushed and 17 db in the unhushed condition. This difference in noise figure or improvement in the same transistor by changing over from unhushed to hushed condition, should be of particular interest to the designers of audio equipment.

Noise Figure vs. Frequency

The noise figure curves in Fig. 12C for the hushed condition and 12D for the unhushed condition were obtained in accordance with formula (8) given above. That is, the actual noise voltage referred to the input was compared with the thermal voltage drop created by the generator resistance across the non-thermal input impedance. In comparing the shape of the 3 noise figure curves in Fig. 12C for 10 ohms, 1 K, and 3.9 K generator resistance with the 3 corresponding noise voltage curves in Fig. 12A, it will be noted that the curvatures and slopes in both diagrams are identical, only their relative elevations being different. The same is true of the voltage and noise figure curves in Fig. 12B and 12D on the right side. In the hushed condition in Fig. 12C, for reasons explained above, the noise figure curve for 1 K generator resistance lies below the curve for 3.9 K generator resistance, while the 10 ohm generator resistance curve is well above both. This is not surprising since both zero generator resistance and infinite generator resistance, according to equation (8), produce an infinite noise figure; in either of these two conditions the external thermal generator resistance does not create a noise voltage drop across the internal input impedance which is assumed to be non-thermal.

The best noise figure readings in hushed condition (Fig. 12C) are in the order of 1 DB. They occur with 1 K generator resistance at frequencies above 3 KC. In unhushed condition (Fig. 12D) all noise figure readings are higher and curves steeper due to a larger 1/f component. Fig. 12D also contains an interesting cross-over between the 10 ohm generator resistance noise figure curve and the 3.9 K curve. It occurs at approximately 600 CPS. Below this frequency, noise figure with 10 ohm generator resistance is actually better than with 3.9 K generator re-

sistance. The physical explanation of this seeming paradox is that, as proven by voltage Fig. 12B, the low generator resistance of 10 ohms "ties down" the 1/f component while with 3.9 K generator resistance it is fully rampant.

Thermal Vs. 1/f Noise

Fig. 13 pertains to a special investigation in which the departure from the 1/f to the thermal noise power spectrum is clearly revealed. The solid lines represent the calculated familiar 1/f noise power, as plotted against the ratio of upper to lower frequency of the passband. If the lower frequency f_1 is held constant and f_2 only is varied, we may also draw continuous curves representing thermal noise power as a function of f_2/f_1. In this case, f_1 was held at 23 CPS. In the measurements, the Millivac MV 19A noise voltmeter was used as a variable high pass filter and indicating meter. The band pass curves were plotted for each measurement and the bandpass accurately determined. Also, the curves furnished normalization data for the noise power measurements. It may be seen that the experimental points follow the F_0 equals 9 db 1/f curve and enter the thermal region at F equals 4 or 5 db.

Generator resistance was matched to input impedance.

Optimum Collector Current

There have been published and unpublished attempts to reduce the noise in transistors by drastically reducing either collector current or collector junction power. From our foregoing description of the hushed transistor amplifier you have seen that we consider current and power somewhat less important in connection with noise reduction efforts than voltage, in particular collector junction voltage.

However, it would be wrong to ignore entirely collector current and collector junction power in our attempts to find the best operating conditions for a hushed transistor.

In Fig. 14 is seen the change of noise voltage referred to the input terminals, the latter being shorted or nearly shorted by a low generator resistance, as collector current is being varied. It goes without saying that the gain of our hushed transistor also varies, so do our collector voltage and base voltage. Again we assume grounded emitter operation. However, these changes are not drastic and have, therefore, not been plotted here in order to keep the presentation simple.

The input noise voltages shown

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(*Continued from page* 133)

are given in mμV, as measured with our 223 cps filter amplifier at 1 kc. We see that noise voltage changes quite substantially with collector current, its optimum being at approximately 390 μa. This happens to be a value quite close to our operating condition, under which the measurements previously reported were made.

Low Noise Performance Without Hushing

Recently, there have become available considerably improved transistors which, without strictly following our concept of hushed operation, show surprisingly low input noise voltages. We have tested such transistors and have found that even if the noise in them, in conventional circuitry and with conventional operating parameters, is low, it can always be improved by applying the principle of hushing.

Furthermore, if such transistors are operated with fairly low supply voltages such as 1.5 v. or 1 v. we found that even if they are not hushed in accordance with our conception of low noise operation, they follow our hushed circuitry in one important aspect: an increase of noise with decreasing collector current, that is a decrease below a certain optimum current value which is relatively "husky." Some transistors will display minimum noise when being operated at 1 ma, others at .5 ma and still others at .25 ma. Yet, amplifier designers will have a natural desire to run their input transistors at collector currents as small as possible because a smaller collector current increases the input impedance. This is another opportunity for transistor hushing to compensate for an undesirable feature (higher noise) created by a desirable feature (high input impedance due to lower collector current).

We should also not forget that what seems to us to be low noise today may not be considered as such at all tomorrow. We believe that transistor hushing will always be a powerful weapon in the running battle against amplifier noise because it will always improve the noise behavior of transistors even if without its use they show fairly good noise figures. Today we are pleased with our hushed transistor amplifiers which have substantially less than 500 mμV noise referred to the input, with the input shorted, and equivalent noise resistances in

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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.

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the order of a hundred or less ohms. We also feel that noise figures in the order of 5, 3, 2 and 1 db are great improvements over earlier transistor performance. Yet the day may not be far off when we will require and expect these same low noise figures and equivalent noise resistances in conjunction with very much higher input impedances. We feel confident that transistor hushing will then again offer valuable help in solving these problems in much the same manner in which negative feedback is an indispensable tool for achievement of ultimate amplifier linearity, regardless of the gradual perfection of amplifier tubes and their linearity characteristics.

Acknowledgments

A word should be said with regard to earlier research workers who have been successful in reducing transistor noise. In the new world of transistors we all feel more or less like offsprings of Dr. Shockley who expressed hope as early as 1950 that "noise will be reduced toward the minima set by Johnson and shot noise." We admire this foresight of a pioneer whose prediction has come true. Actually, it is even exceeded in the hushed transistor, because the effect of shot noise is nearly gone too, Johnson noise remaining as the dominant and, of course, unavoidable noise source.

A. C. Montgomery and M. A. Clark in 1953 (Jour. App. Phys., letter to editor, pp. 1337 and 1338), published the results of noise figure measurements, made on "a recent p-n-p alloy transistor," approaching a 3 db limit; they showed frequency regions similar to ours, in which thermal-noise was dominant. The main difference between their earlier work and ours seems to be that we are reducing noise in *normally noisy* transistors rather than looking for premium transistors giving choice noise performance.

Acknowledgments also go to Dr. K. Mortonson of R.P.I., Donald Desjardin of the Sperry Gyroscope Co., Jeanne Pedersen of R.P.I. and Donald Morey of Volkers and Schaffer Manufacturing Corp.

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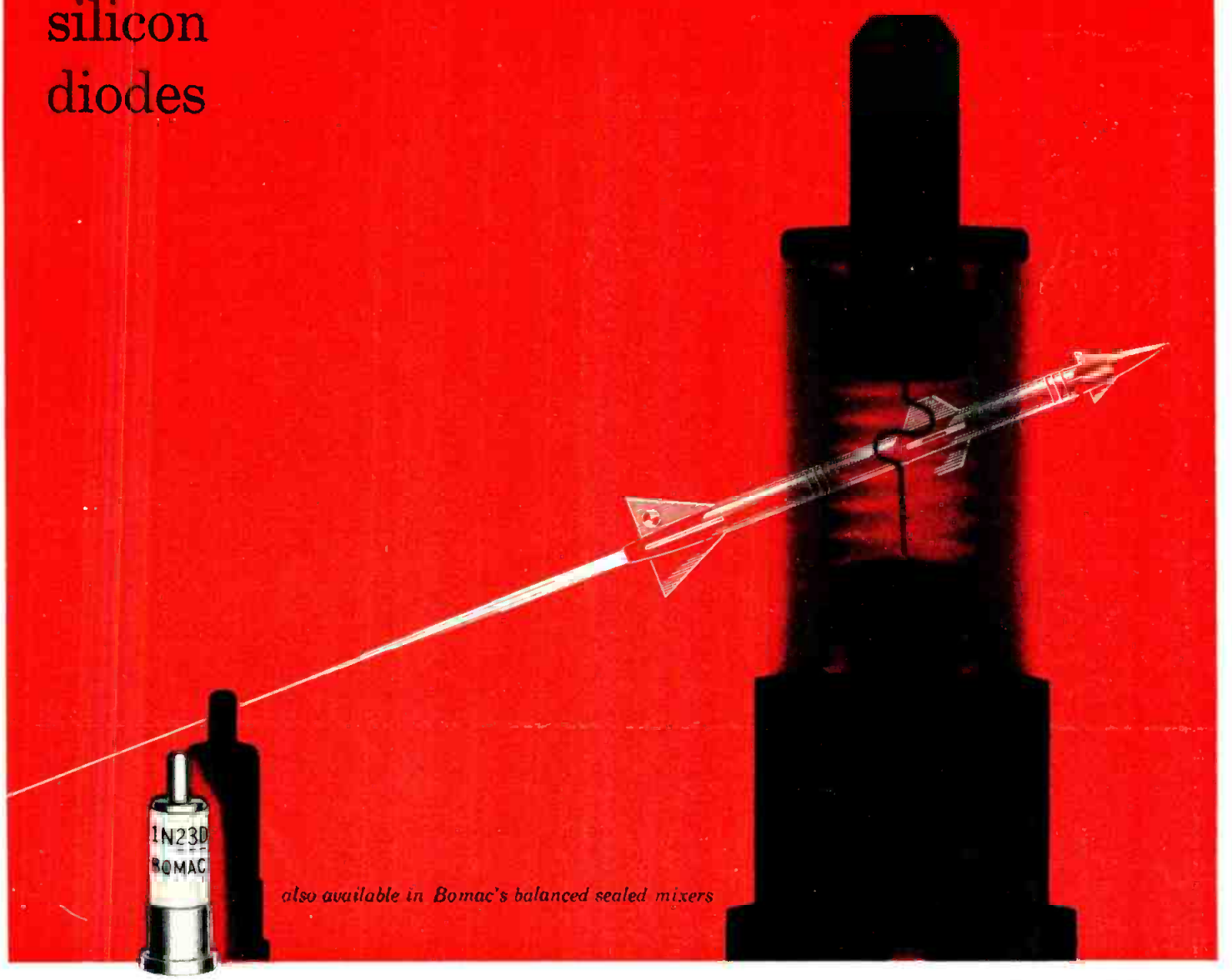

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TRANSISTOR DATA	RCA-2N109	RCA-2N139	RCA-2N140
MAXIMUM RATINGS (Absolute Values):			
Collector Volts	−25	−16	−16
Collector Ma	−70	−15	−15
Collector Dissip. (mw)	50	35	35
Operating Temperature (°C)	50	70	70
Typical Operation†:	**Class B Amp.**	**455-Kc IF Amp.**	**Converter**
DC Collector Volts	−9	−9	−9
DC Emitter Ma	−2††	1	0.4
Useful Power Gain (Approx. db)	33	30	—
Useful Conversion Power Gain (Approx. db)	—	—	27
Typical Noise Factor (Approx. db)	—	4.5	—
Power Output (mw)	160*	—	—
Parameters and Characteristics:			
Feedback Capacitance (uuf)‡	—	9.5	9.5
Feedback Conductance (umhos)‡	—	0.25	0.2
Base Resistance (ohms)‡	—	75	90
Current Amplification Ratio†	70**	48	45
Figure of Merit for High-Frequency Performance (Mc)‡	—	14	16
Cutoff Frequency (Mc)	—	4.7	7

†In common-emitter circuit at ambient temperature of 25°C.
*For 2 transistors in class B af circuit, and maximum distortion at 10%
‡Based on one-generator, small-signal, hybrid-π equivalent circuit for the common-emitter connection.
††Zero-signal condition. **For large signal.

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