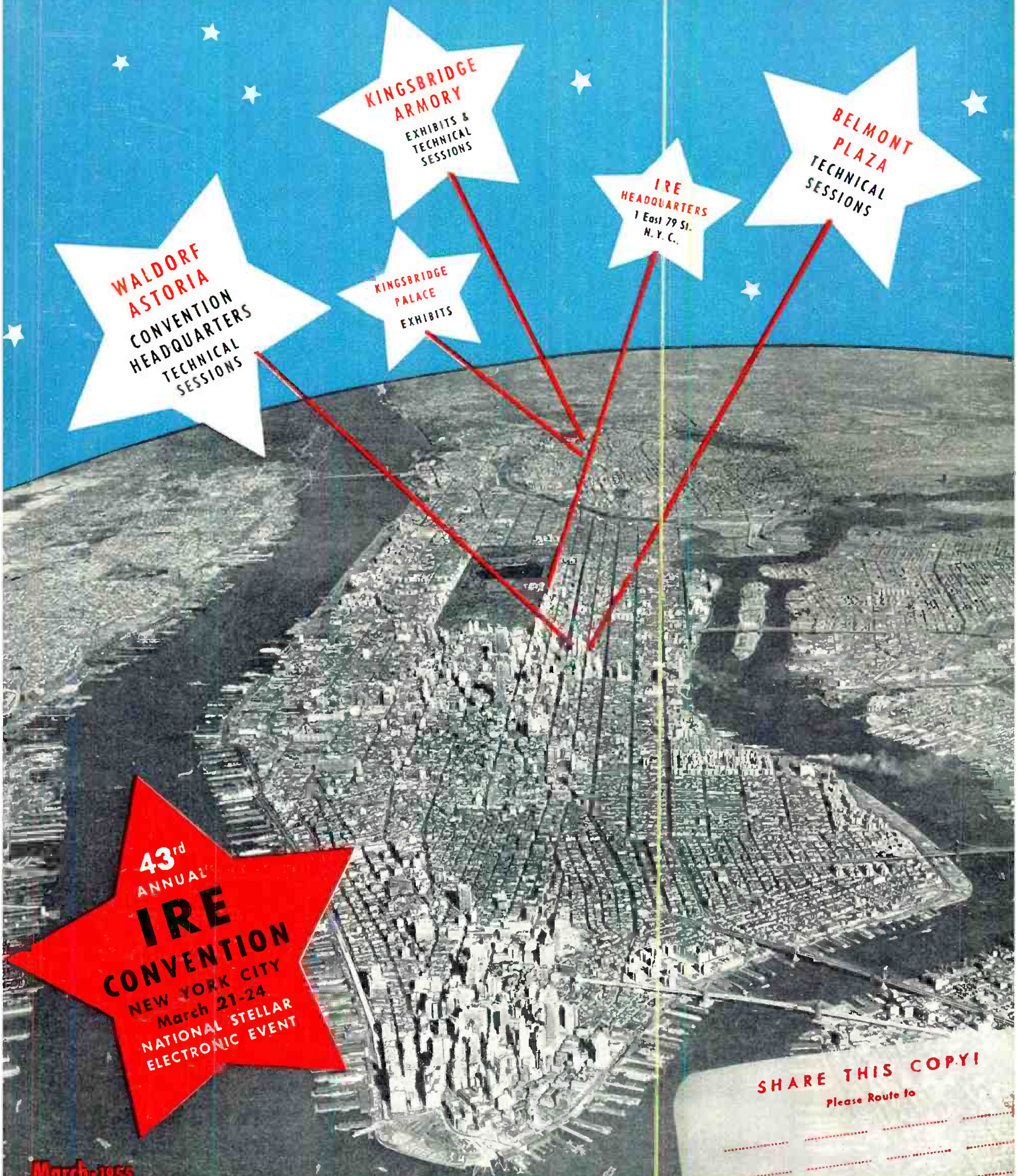
TELE-TECH
& Electronic Industries



March 1955

TELE-TECH

& Electronic Industries

MARCH, 1955

FRONT COVER: 43rd ANNUAL IRE CONVENTION being held in New York City, March 21-24, is once again the focal event of the radio-TV-electronic industries. Aerial photograph looking north from lower Manhattan shows location of Waldorf-Astoria and Belmont Plaza Hotels, where convention headquarters and technical sessions are held, in midtown area. IRE headquarters are a short distance north, bordering Central Park. Kingsbridge Armory and Kingsbridge Palace, scene of exhibits and technical sessions, are located in the Bronx. More than 40,000 are expected to attend. For complete convention information, see page 88.

VISIT TELE-TECH & ELECTRONIC INDUSTRIES AT THE IRE SHOW—EXHIBIT BOOTH 642

DEPARTMENTS

TELE-TECH & ELECTRONIC INDUSTRIES*, Vol. 14, No. 3. Published monthly by Caldwell-Clements, Inc. M. Clements, President; M. H. Newton, Assistant to President; John J. Borghi, Vice President and Treasurer; M. B. Clements, Secretary. Acceptance under section 34.64 Postal Laws and Regulations authorized at Bristol, Conn., June 9, 1954. Additional acceptance at New York, N. Y. 75¢ a copy. Subscription Rates: United States and U. S. Possessions: 1 year, $5.00; 2 years $8.00; 3 years $10.00. Canada: 1 year $7.00; 2 years $11.00; 3 years $14.00. All other countries: 1 year $10.00; 2 years $16.00. Please give title, position and company connections when subscribing.

CALDWELL-CLEMENTS, Inc.

* Reg. U. S. Pat. Off.

Publication Office, Bristol, Conn.

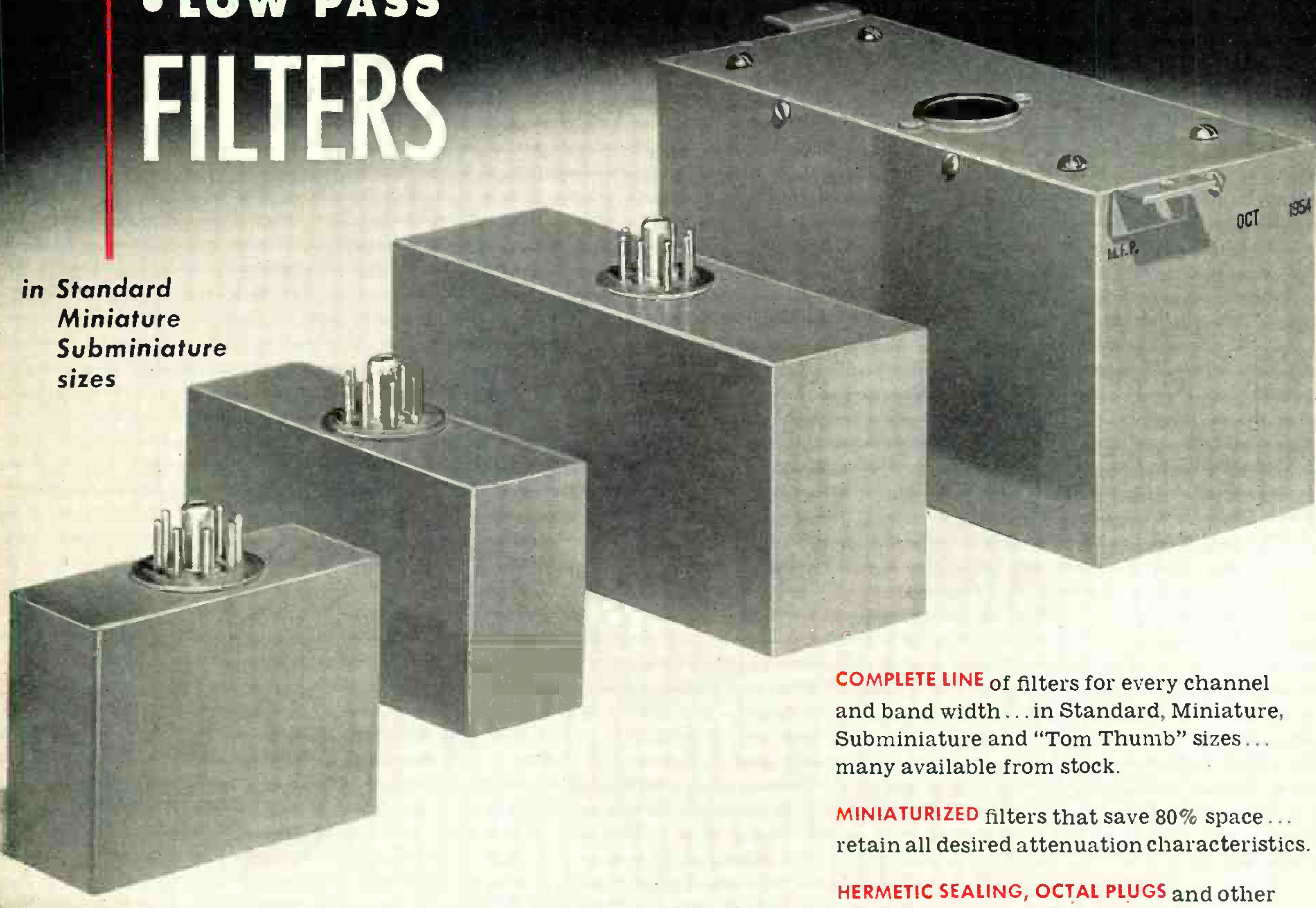
Editorial/Business Offices 480 Lexington Ave., New York 17, N. Y., Tel. Plaza 9-7880

TELEMETERING

• BAND PASS
• LOW PASS

FILTERS

in Standard Miniature Subminiature sizes



COMPLETE LINE of filters for every channel and band width . . . in Standard, Miniature, Subminiature and "Tom Thumb" sizes . . . many available from stock.

MINIATURIZED filters that save 80% space . . . retain all desired attenuation characteristics.

HERMETIC SEALING, OCTAL PLUGS and other new features.

only Burnell offers you . . .

SPECIAL PHASE LINEARITY characteristics to conform to new concepts of high accuracy telemetering practice.

SPECIFICALLY DESIGNED for telemetering, these filters have found great utility in a wide variety of communications and control applications.

APPLICATION ENGINEERING service plus complete technical literature. Write Dept. . . . . , for Catalog 102A.

PARTIAL LISTING OF MINIATURE TELEMETERING BAND PASS FILTERS

Channel Freq.	15% Band Width Type No.	30% Band Width Type No.	Case Size W- L- H-	Approx. Weight	Attenuation 15% B. W.	Attenuation 30% B. W.
400 CPS.	S-15456		2 x 6 x 2¾	3 lbs.	4DB — 15% 20DB — 23% 40DB — 27%	4DB — 30% 20DB — 46% 40DB — 54%
560 "	S-15457	S-15477				
730 "	S-15458	S-15478				
960 "	S-15459					
1300 "	S-15460		1⅜ x 4½ x 2¼	1 lb. 7 oz	3.5DB — 15% 20DB — 23% 40DB — 27%	3.5DB — 30% 20DB — 46% 40DB — 54%
1700 "	S-15461					
2300 "	S-15462					
2570 "	S-15463		1⅜ x 3 x 2¼	9¾ oz.	3DB — 15% 20DB — 23% 40DB — 26%	3DB — 30% 20DB — 46% 40DB — 52%
3000 "	S-15464					
3900 "	S-15465	S-15479				
4500 "	S-15466					
5400 "	S-15467	S-15480				
7350 "	S-15468	S-15481				
10500 "	S-15469	S-15482				
12300 "	S-15470	S-				
14500 "	S-15471	S-15483				
22000 "	S-15472	S-15484				
27000 "		S-15485				
30000 "	S-15473	S-15486				
40000 "	S-15474	S-15487				
52500 "	S-15475					
70000 "	S-15476	S-15488				

OPTIMUM OPERATING IMPEDANCES — SOCKET TERMINAL CONNECTIONS

INPUT		OUTPUT	
Terminals 1 & 2	500 ohms	Terminals 1 & 6	500 ohms
Terminals 1 & 3	10000 ohms	Terminals 1 & 7	50000 ohms

Teletype: Yonkers, N.Y. 3633

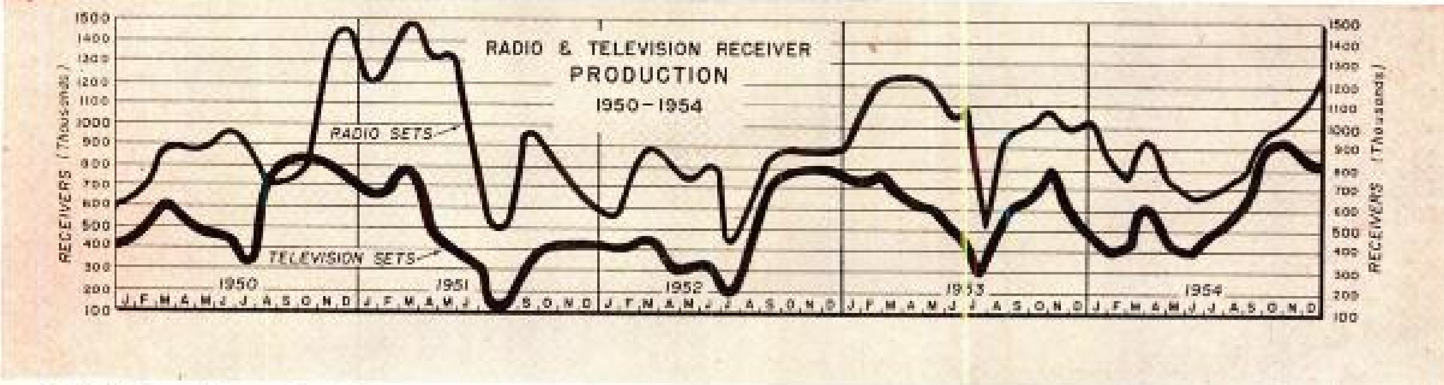
BURNELL & CO., INC.

YONKERS 2, NEW YORK

Pacific Division: 720 Mission St., S. Pasadena, Calif.

First in Toroi and Related Networks

TOTALS



2 Million Auto Radios

E. K. Foster, vice pres. Bendix Aviation Corp., announces that his firm has been awarded continuance of Ford auto radio business to include 1956 models. They have made 2 million sets to date. Here's what was needed for manufacture:

Number of parts	364,000,000
Weight of parts	24,000,000 lbs.
Total continuous work time	3 years
Number of solder joints	176,000,000
Number of connections	280,000,000
Length of hookup wire	3,640 miles
End-to-end distance, all sets	332 miles
Number of rivets	60,000,000
Number of tubes	12,000,000
Number of screws	42,000,000
Length of wire for vibrators and output transformers (two in each receiver)	1,520,000 miles

Germanium Diodes

Approximately 13,250,000 point-contact germanium diodes valued at $9,400,000 were sold in 1954. Of this number approximately 7,000,000 were sold for use in entertainment equipment. It is estimated that 8% were sold for replacement purposes.

Lower Shipping Costs

West Coast manufacturers are looking into consolidated shipping possibilities for small freight shipments weighing between 5 and 72 lbs. Such consolidation avoids high parcel post rates and permits minimum freight rates. Here's how they figure:

SAN FRANCISCO AREA

Weight	Via P P 8th Zone	Via Freight	Via Consol	SAVE At Least
10	1.95	6.00	1.00	.95
20	3.75	6.00	1.80	1.55
30	5.70	6.00	2.60	3.10
40	7.50	6.00	3.40	2.60
50	—	6.00	4.20	1.80
60	—	6.00	5.00	1.00
70	—	6.00	5.80	20

LOS ANGELES AREA

Weight	Via P P 8th Zone	Via Freight	Via Consol	SAVE At Least
10	1.95	6.00	93	1.02
20	3.75	6.00	1.66	2.09
30	5.70	6.00	2.39	1.38
40	7.50	6.00	3.12	2.88
50	—	6.00	3.85	2.15
60	—	6.00	4.58	1.48
70	—	6.00	5.31	69

1955 Resistor Markets (Est.)

Composition 1.5 billion units	$35 million
Deposited Carbon Film 30 million units	$ 4 million
Wirewound (all types) 40 million units	$55 million

Electronic Industry Figures

The Los Angeles Chamber of Commerce, in their "Report on the Electronic Industry" revised to January 1, 1955 have included the following data summarizing the status of the industry in the metropolitan area for 1954:

Number of firms manufacturing electronic equipment, components and material	440
Number of plant locations	502
Number of products manufactured	172
Total square feet of plant facilities	9,750,281
Number of employees	69,637
Annual Industry Payroll	$283,000,000*
Number of firms doing research and development work	203
Number of engineering and design firms	23
Number of service and testing firms	43

INDUSTRY BILLING

Dollar Billing (000 omitted)

1941, 47,000 1943, 95,000
1953, 750,000 1954, 842,000

Estimated 1956—1,000,000,000

* Estimated

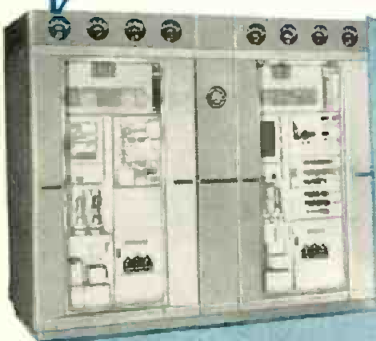
GOVERNMENT ELECTRONIC CONTRACT AWARDS

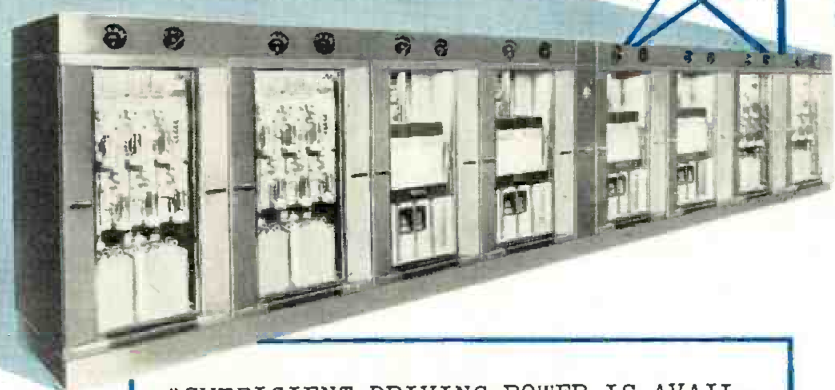
This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in January 1955.

Actuators	1,524,463
Amplifiers	215,362
Amplifiers & Gyros	1,856,111
Amplifiers, trigger	76,580
Antennas	425,732
Antenna Assys	2,418,859
Antenna Controls	236,710
Batteries	3,774,214
Box Relay Resistors	47,527
Boxes, terminal	33,083
Cable	210,776
Cable, power	30,275
Cable, watertight	1,217,864
Capacitors	30,423
Chest Sets, radio	90,570
Comparators, signal	289,421
Computers & Transmitters	563,877
Control Assys	98,637
Controls, frequency	85,575
Countermeasure Sets	175,492
Crystal Units	44,113
Devices, computer	33,464
Diffuser-Mechanism Calibrators	26,982
Drones, target	5,198,558
Electrodes, welding	129,020
Exciters, vibration	91,682
Film, radiographic	29,825
Fluorographic Cameras	85,991
Generators	1,392,165
Generator Sets	6,060,407
Generator Sets, motor	65,757
Generators, signal	317,891
Goniometers	100,406
Headsets	271,999
Kits	479,570
Kits, generator	29,408
Kits, limit-switch	31,268
Kits, modification	35,456
Kits, Parts, etc.	266,274
Indicators	776,596
Inverters	858,408
Machmeters	224,871
Magneto Assys	36,355
Motor Assys	199,731
Motors, Booster	97,483
Motor Generators	1,982,935
Motors, servo	183,380
Multimeters	27,824
Oscillators	218,944
Oscilloscopes	65,498
Parts, control	35,695
Plugs and Receptacles	36,410
Radar Sets	5,927,347
Radio Sets	7,871,225
Radomes	36,851
Recorders, radiosonde	127,422
Rectifiers	27,830
Repair, computer components	160,438
Repair Parts, gyro compass	97,424
Resistors	25,244
Rooms, shielded copper	30,900
Simulators, ground radar, jamming	100,668
Sockets	28,935
Solenoids, remote gun firing	26,193
Stereoplotter Projectors	121,594
Switch Assys	26,969
Switches	29,330
Switchboards, fire control	47,300
Switches, pressure	64,928
Telephone Sets	90,246
Test Equipment, Instrument	128,150
Testers, circuit	156,472
Test Sets	114,897
Thermostatic Assys	46,425
Transformers	60,036
Transmitters, synchro	150,960
Tubes, electron	3,064,856

PROOF OF PERFORMANCE

from 500 WATTS through to 50 KILOWATTS





COMPARE TV TRANSMITTER Proven OPERATING CHARACTERISTICS...

and you will prefer **S-E**

"SUFFICIENT DRIVING POWER IS AVAILABLE SO THAT EACH HALF OF THE FINAL AMPLIFIER IS CAPABLE OF DELIVERING ALMOST 28 KW PEAK."*

The final stage of an S-E 50 KW transmitter consists of two 25 KW diplexed amplifiers.

The above is a direct quote from a "PROOF OF PERFORMANCE" report made by a leading Consulting Engineering firm† on an S-E equipped station — page 4, paragraph 2.

†*Name available upon request.*

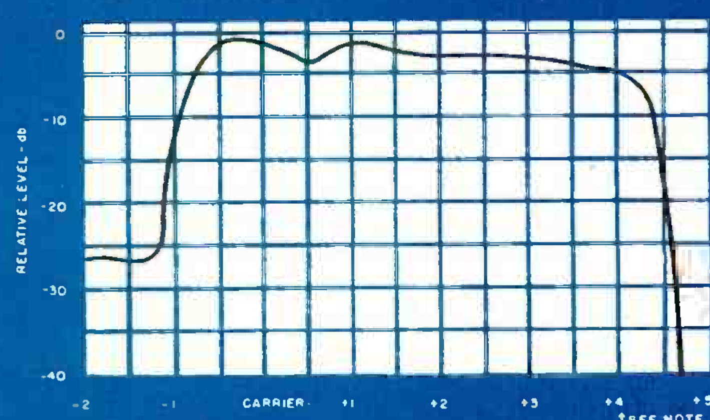
1 50 KW PLUS

With S-E's 50 KW VHF transmitter you get 50 KW PLUS on any channel, including 13. Actual test results quoted from a "PROOF OF PERFORMANCE" test conducted by a leading consulting engineer prove that an S-E 50 KW transmitter will deliver approximately 56 KW peak power. Yet the very same transmitter can be run within specifications at power outputs as low as 30 KW or at whatever power level is needed to conform to your authorized ERP.

2 SUPERLATIVE MONOCHROME QUALITY

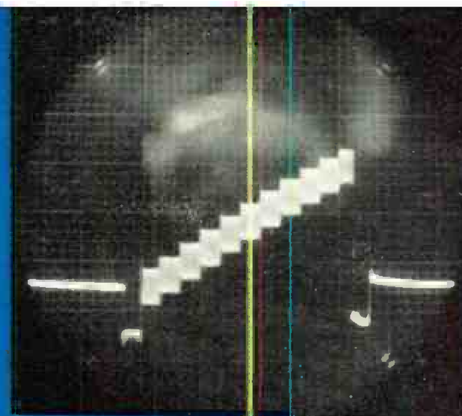
Standard Electronics VHF transmitters and amplifiers assure full compliance with FCC requirements plus a wide margin of safety . . . proof that with S-E transmitters and amplifiers you get the best. Sharp, high-end channel cutoff and conformity to bandwidth specs are shown in the curve to the right, copied from a "PROOF OF PERFORMANCE."

Point-by-point Curve Taken from Actual "PROOF OF PERFORMANCE" as reported by a Leading Consulting Engineer.

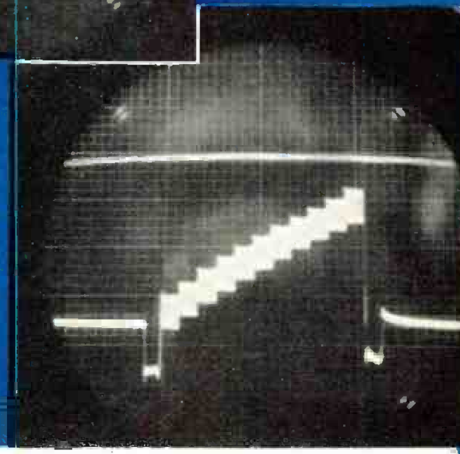


FULL COMPLIANCE WITH FCC COLOR REQUIREMENTS

S-E transmitters and amplifiers have such high monochrome quality because the color quality is also exceptionally good. Designed for color, S-E transmitters have never used the back porch clamping technique. Curve shows excellent band width assuring full response up to 4.2 mc. FCC requirements pertaining to amplitude vs. frequency response for the system can easily be met, as S-E transmitting equipment uses but a very small part of the variation allowed. For proof that S-E transmitters and amplifiers will transmit superlative color signals . . . for proof of essential linearity . . . see stair-step patterns showing input signal and linearity of output signal through the transmitter and broad band amplifier stages, recorded directly from the oscilloscope. No S-E transmitter in service has had to be modified to meet color specifications . . . ability to handle color is engineered into every S-E transmitter.



Pattern Taken Directly from Oscilloscope Showing Input To The Transmitter.



Pattern Taken Directly from Oscilloscope Showing Linearity of Transmitter and Broad Band Amplifier Stages.

4 AURAL TRANSMITTER EXCEEDS REQUIREMENTS

Quoting from "PROOF OF PERFORMANCE" report: — "AM hum and noise level of —53.4 db exceeds the —50 db requirement . . . The FM noise level of the entire system was —56 db and —61db for the transmitter alone — which complies with —55 db Commission requirements."

5 SUMMARY

"The equipment was found to comply with the Commission's requirements."

6 TUBE LIFE

Although not included in the "PROOF OF PERFORMANCE" report or covered by FCC specifications, any discussion of PROOF of S-E transmitter and amplifier PERFORMANCE would be incomplete without mention of a final-tube expectancy of 5000 hours and more! The Chief Engineer of a large S-E equipped station states: "We didn't change our tube budget when we changed from a competitive make 5 KW transmitter to an S-E 50 KW transmitter. At the end of the year, we still had a substantial amount of money left over in our budget." . . . and this in spite of a 10-fold increase in transmitter power!!

7 RELIABLE SERVICE

Although the FCC similarly does not set up standards on service, a valid "PROOF OF PERFORMANCE" must inevitably rest on service to the customer after the equipment is installed. The Chief Engineer of another S-E equipped station is quoted as saying: "In the case of The Standard Electronics Corporation, I would say that their equipment is only exceeded by the splendid cooperation and service we are getting from them."

Compare every make of transmitter before you decide!

Catalog and specification sheets are available, or ask for a personal demonstration of S-E transmitters and amplifiers. Write, wire or phone Standard Electronics.

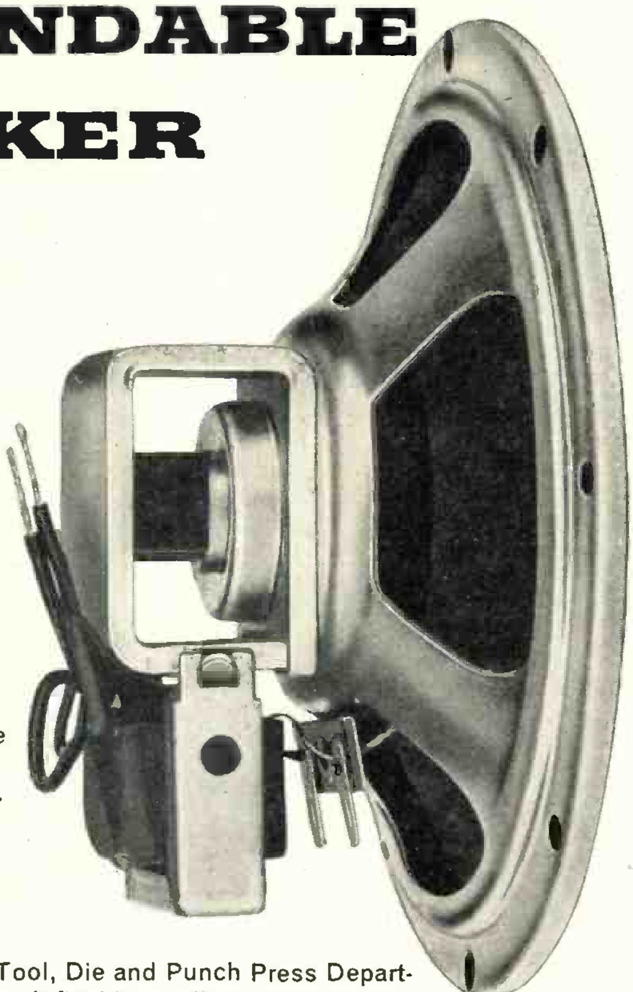
STANDARD SE ELECTRONICS

standard electronics corporation

A SUBSIDIARY OF CLAUDE NEON, INC.

285-289 EMMETT STREET • NEWARK 5, N. J.

BIGELOW 3-5540



TELE-TECH
& Electronic Industries

M. CLEMENTS, *Publisher* — DR. O. H. CALDWELL, *Editorial Consultant*

BERNARD F. OSBAHR, *Editor* — ALBERT J. FORMAN, *Associate Editor*

DR. A. F. MURRAY, *Contributing Editor* — JOHN H. BATTISON, *Contributing Editor*

B. V. SPINETTA, *Directory Editor*
MARTHA USDIN, *Assistant Editor*
CARL THOMAS, *Assistant Editor*
R. C. DAVIES, *Washington News Editor*
CHARLES F. DREYER, *Art Director*
PATRICIA SOUTHWICK, *Editorial Secretary*
STANLEY GERSTIN, *Contributing Editor*

BUSINESS DEPARTMENT

HOWARD A. REED, *Vice President & General Sales Manager*
JAMES S. COLEMAN, *Asst. Sales Manager*
JOSEPH DRUCKER, *District Manager*
PAUL J. CARNESE, *Sales Promotion Manager*
N. McALLISTER, *Asst. Business Manager*
CECILIA KAVANAUGH, *Advg. Records*
A. SHILLIN, *Production Manager*
480 Lexington Ave., New York 17, N.Y.
Telephone PLaza 9-7880

S. M. GASKINS, *Vice President & Western Manager*
JOHN D. LUPTON, *District Manager*
201 N. Wells St., Chicago 6, Ill.
Telephone RAndolph 6-9225

CHRIS DUNKLE & ASSOCIATES
California Representatives
3257 W. 6th Street, Los Angeles 5, Calif.
Telephone DUnkirk 7-6149
1651 Market St., San Francisco 3, Calif.
Telephone UNderhill 3-5282

ELMER DALTON, *Circulation Manager*
A. H. POND, *Controller*

Member
BPA

CIRCULATION NOW 27,000

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

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

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

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

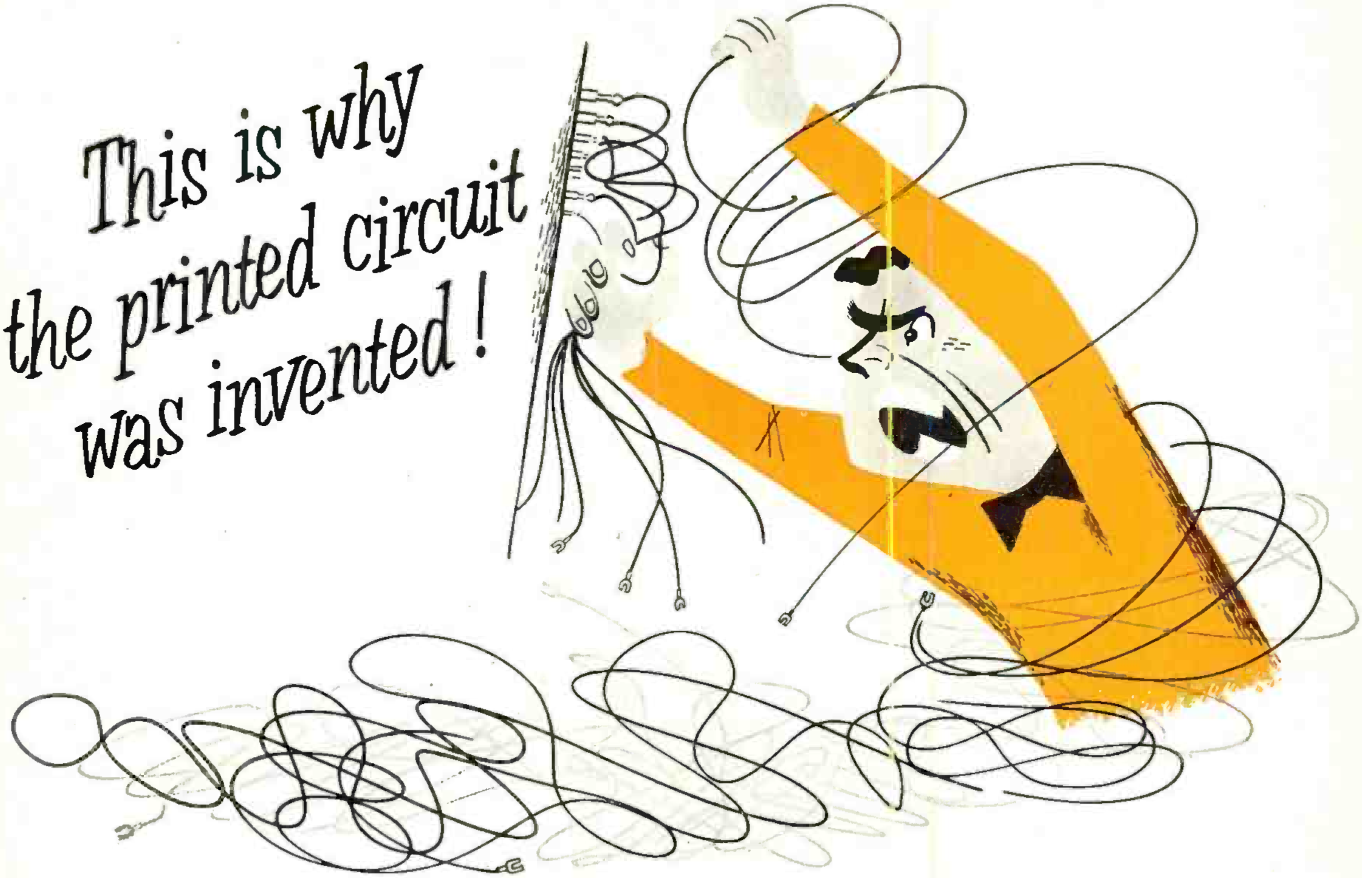
2—Making paid subscriptions available to other engineers in research, design, production, operation and maintenance.

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

THE ELECTRONIC INDUSTRIES DIRECTORY

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

This is why the printed circuit was invented!

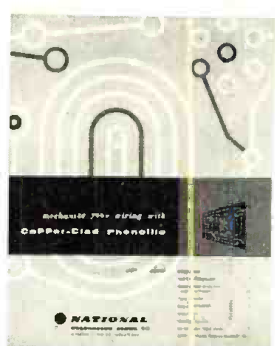


You hold the secret of success in printed circuits if you specify Copper-Clad Phenolite by National.

This is a scientifically compounded laminate possessing *all* the properties and characteristics demanded for the job. Among these are high dielectric and mechanical strength, resistance to heat, moisture, solvents, oils, acids. alkalies. It is light in weight—can be machined, punched, sawed, drilled.

Let us show you how Copper-Clad Phenolite can give you less complex systems at lower cost.

TACKLE YOUR PRINTED CIRCUIT DESIGN JOB WITH THIS HELPFUL GUIDE

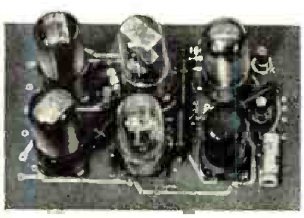


This brochure will definitely help you in your job of achieving miniaturization, automation. Complete coverage of basic technical facts and design data related to applied printed circuitry. Methods of producing printed circuits, and economic aspects of design are treated in detail. Write Dept. K-3 for your free, personal copy. Ask for "Mechanize Your Wiring . . ."

VISIT THE NATIONAL BOOTH—SPACE 777
IRE NATIONAL EXPOSITION, MARCH 21-24 AT NEW YORK

IN CANADA:
National Fibre Company of Canada, Ltd.
Toronto • Montreal

NATIONAL
VULCANIZED FIBRE CO.
WILMINGTON 99, DELAWARE



PRINTED CIRCUIT . . . THE NEW WAY!

(Top) Copper-Clad Phenolite showing the etched conductor pattern for an audio amplifier. (Bottom) Here is the same etched circuit with tubes and other components in place. We have a complete bulletin crammed with ideas and data about our laminated plastics. May we send you a personal copy? Address Dept. K-3.

PHENOLITE
Laminated PLASTIC

Also manufacturers of Vulcanized Fibre, Vul-Cot Waste Baskets, Peerless Insulation, Materials Handling Equipment and Textile Bobbins.

Spotlighting Standardization!

E-I hermetically-sealed terminations and miniature closures*

● **MULTIPLE HEADERS** — Strain-free, vacuum tight headers featuring cushioned glass construction. Silicone treated for maximum dielectric strength and tin dipped for easy soldering.

● **SEALED TERMINALS** — These E-I terminals offer high thermal shock resistance and feature cushioned glass construction. Available in many economical preferred types and special designs.

● **OCTAL HEADERS** — Both plug-in and multiple types feature a new principle of hermetic sealing. Solid metal blanks afford maximum rigidity and mechanical strength.

● **E-I END SEALS** — Completely strain-free. Provide a permanent hermetic seal. For condensers, resistors and other tubular-type components. Available in many standard types.

● **COMPRESSION TYPE HEADERS** — Super rugged, practically indestructible and absolutely rigid. Exclusive E-I process affords increased resistance to shock and vibration.

● **LUG-TYPE, LEAD-THRU INSULATORS** — Compression sealed, super rugged. For applications requiring voltage ratings from 2000 to 4000 (rms.) — transformers, "bath-tub" condensers, etc.

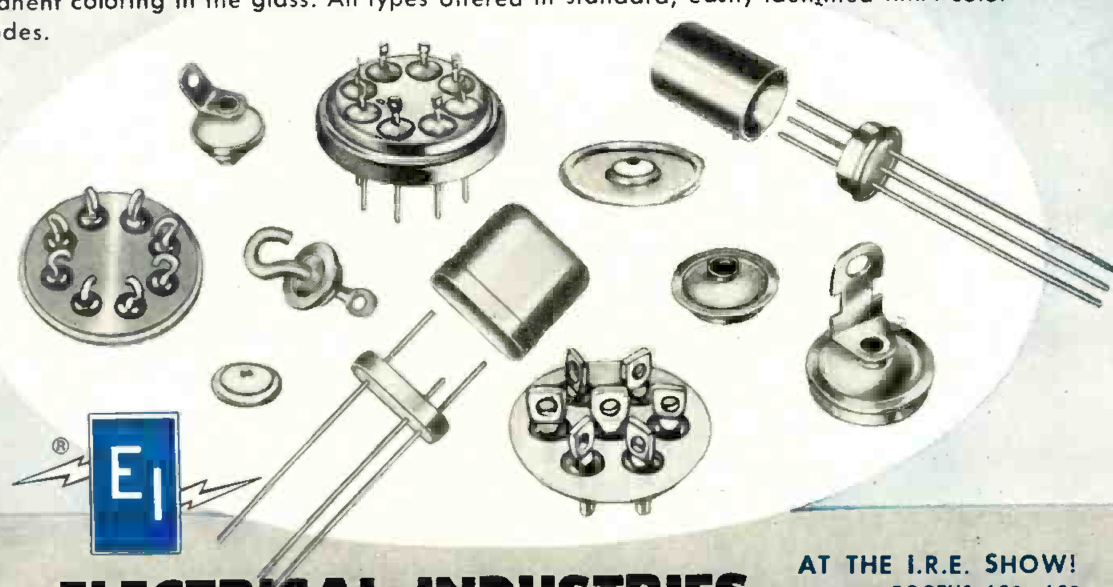
● **MINIATURE CLOSURES** — For transistors and other components requiring hermetic sealing. Square, rectangular and round cases. Supplied in E-I standard types or custom designs to specifications.

● **COLOR-CODED TERMINALS** — Featuring glass inserts with permanent coloring in the glass. All types offered in standard, easily-identified RMA color codes.

*PATENT PENDING
ALL RIGHTS RESERVED

AVAILABLE IN A WIDE RANGE OF STANDARD TYPES TO ECONOMICALLY MEET SPECIAL REQUIREMENTS!

Economical E-I standardized hermetically-sealed terminals and miniature closures are available to meet almost any electronic application. Samples and recommendations on your particular needs will be supplied promptly on receipt of your data. Call or write for complete E-I catalogs, today!



E-I ®

ELECTRICAL INDUSTRIES

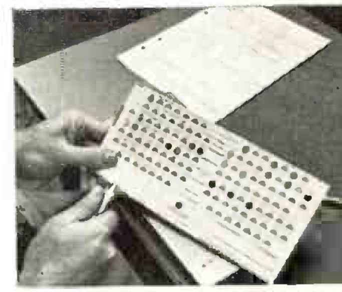
44 SUMMER AVENUE, NEWARK 4, NEW JERSEY

DIVISION OF AMPEREX ELECTRONIC CORP.

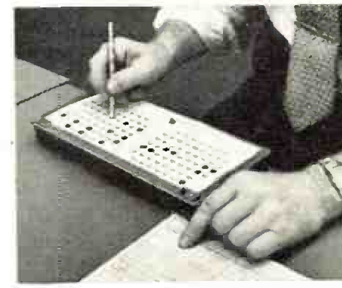
AT THE I.R.E. SHOW!
BOOTHS 650, 652
CIRCUITS AVENUE
Kingsbridge Armory
New York City
March 21-24, 1955

How your telephone call asks directions... and gets quick answers

1



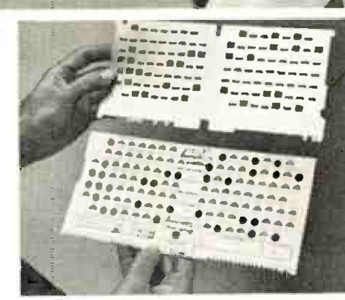
2



Perforated steel cards, which give directions to the Long Distance dial telephone system, are easy to keep up to date. New information is clipped (1) and punched (2) by hand on a cardboard template. This guides the punch-press that perforates a steel card (3), and the two are checked (4). The new card is put into service in the card translator (5).

↓3

4



5

When the Bell System's latest dial equipment receives orders to connect your telephone with another in a distant city, it must find—quickly and automatically—the best route.

Route information is supplied in code—as holes punched on steel cards. When a call comes in, the dial system selects the appropriate card, then reads it by means of light beams and phototransistors. Should the preferred route be in use the system looks up an alternate route.

It is a simple matter to keep thousands of cards up to date when new switching points are added or routing patterns are changed to improve service. New cards are quickly and easily punched with the latest information to replace out-of-date cards.

This efficient, flexible way of keeping your dial system up to the minute was devised by switching engineers of Bell Telephone Laboratories, who are continually searching for ways to improve service and to lower costs. Right now most of the Long Distance dialing is done by operators, but research is hastening the day when you will be able to dial directly to other telephones all over the nation.

BELL TELEPHONE LABORATORIES

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

For product information, use inquiry card on last page.

From Original Engineering...

From Original Engineering . . . and from its half-century of specialized skills and experience, Machlett once again creates new criteria of electron tube performance for high power electronics.

Machlett is first again to offer significant, original design for high power triodes. It was six years ago that Machlett perfected a heavy duty power tube series—the first from any manufacturer. Accepted at once by equipment manufacturers, now universally used, these tubes were also *paid the compliment of imitation.*

With the New Machlett Triodes
COSTS GO DOWN

Because filament power is reduced—
up to 60% (enough, in many cases, to pay for the tube).

Because tube life is longer—
increases of over 100%, compared to conventional types.

Because maintenance is cut—
replacement minimized; cleaning simplified.

Because handling costs are low—
weight down 60 to 70% for air cooled types.

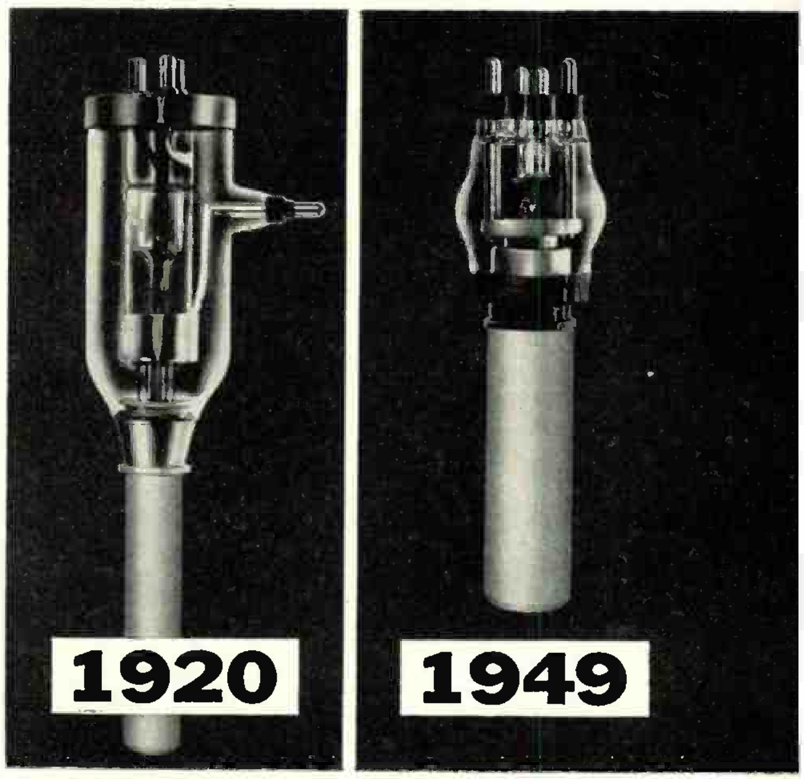
With the New Machlett Triodes
PERFORMANCE GOES UP

Because plate and grid ratings are higher—
broader range of operation is possible.

Because safety margins are usefully increased—
for thermal, mechanical and electrical ratings.

Because lead inductances are very low—
circuit parasitics are reduced by as much as 10-to-1.

Because transconductance is high—
plate efficiency is increased, grid drive reduced, stable performance assured over broadest loading range.



The above tubes portray progressive evolution in electron tube design. Left, Type 892, uses long, high inductance electrode leads and large glass envelope—a design now over 35 years old. Center, Machlett developed, electrical equivalent, industrial ML-5668, has stronger, less inductive internal structures, short glass envelope and sturdier seals, thicker anode with double heat dissipation capacity. Right, most modern tube, Machlett's new ML-6422, uses cylindrical electrode supports for lowest inductance, great stability; large contact area terminals for great seal strength; close-spaced, precisely-aligned electrodes for low drive and high efficiency; thick-wall anode for cool tube operation, high overload capacity; stress-free thoriated-tungsten filament for high load current, low heating power, and longer life.

MACHLETT

And Your First Cost is Only One Postcard—that's all it takes to write Machlett Laboratories for the full story of these premium design, rugged, coaxial triodes. Learn now what to expect of a modern power triode.

MACHLETT LABORATORIES, INC.
1063 Hope Street, Springdale, Connecticut

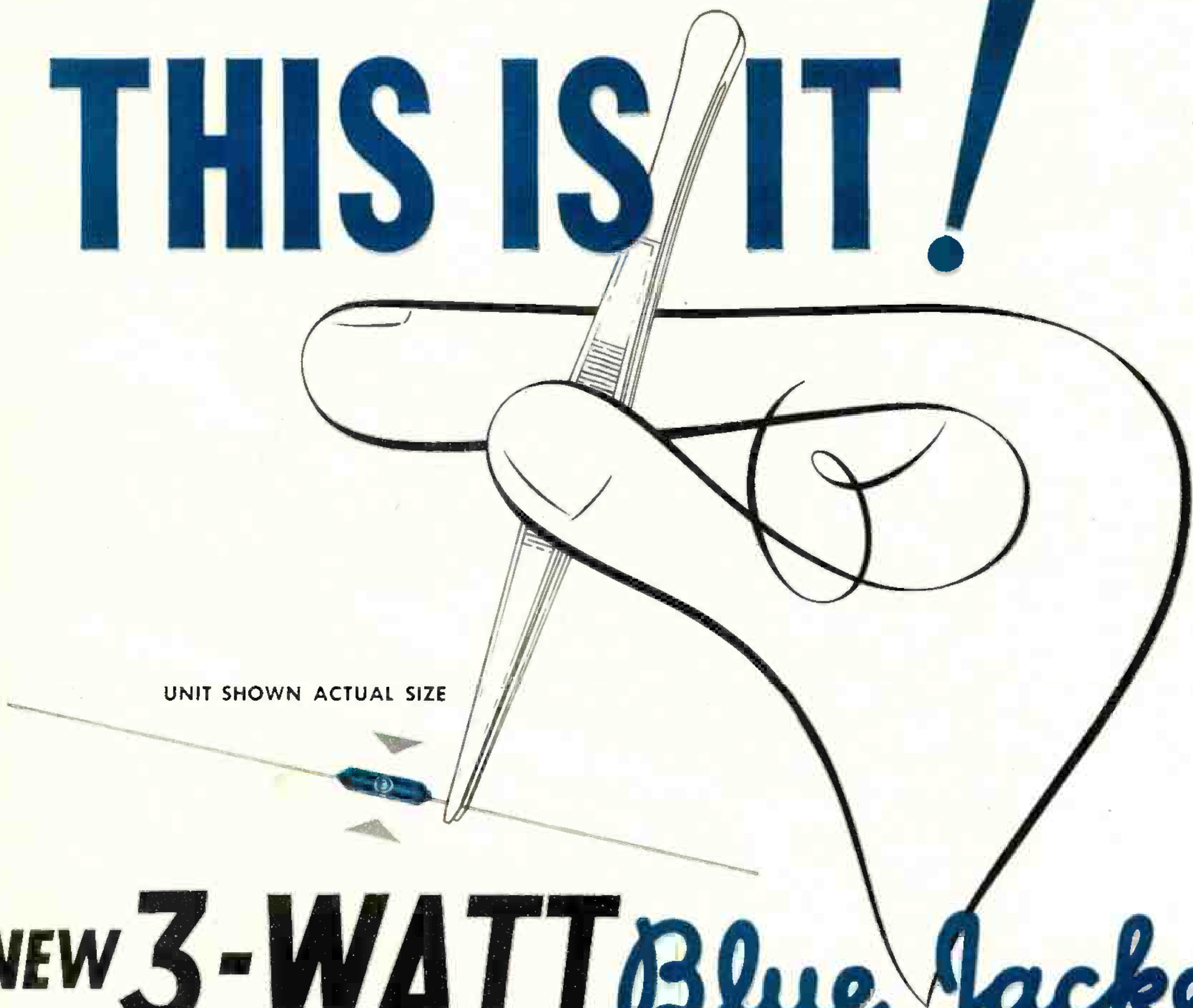
New Performance Criteria

1955

Available only from Machlett Laboratories: Eight new rugged coaxial terminal triodes, with thoriated-tungsten filaments, and incorporating every proven design and production advance made by Machlett in its heavy duty electron tube experience.

Power Output	5-10kW	10-15kW	15-20kW	25-40kW	25-50kW
Water Cooled	ML-6420	ML-6422	ML-6424		ML-6426
Forced-Air Cooled	ML-6421	ML-6423	ML-6425	ML-6427	

THIS IS IT!



NEW 3-WATT Blue Jacket®

miniaturized axial-lead wire wound resistor

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

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

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

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

Standard Resistance Tolerance: ±5%

SPRAGUE

WRITE FOR ENGINEERING BULLETIN NO. 111B

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

As We Go To Press...

Electronic Cooling System In Pioneer Developments

Heralding radically new electronic developments, RCA Chairman of the Board Brig. Gen. David Sarnoff has unveiled several experimental devices expected to have considerable impact on our way of living in the coming years. These include a music synthesizer (technical details on pages 68 and 80) capable of generating any sound, an electronic light amplifier with amplification better than 20-to-1, and an all-electronic cooling system for use in refrigerators and air conditioners.

The cooling system operates noiselessly without any moving parts, motors or compressors. The principle of operation is based on the "Peltier effect" discovered more than 120 years ago, by which passage of an electric current through the junction of two dissimilar materials produces a cooling or heating effect in the region of the junction, depending on the direction of the current. Until recently this has been just a scientific curiosity because materials capable of producing sufficiently low temperatures for practical use were lacking. New knowledge provided by recent studies of solid-state physics have provided some answers.

Nils Lindenblad of RCA Labs. inspects electronic cooling system believed to be first of its kind to achieve practical freezing temperatures. Operation is based on "Peltier effect," described on page 110

In the electronic cooling system, a series of junctions made of alloys of copper and zinc surround a container. For the present a mechanical pump is used to circulate water for removal of heat from the apparatus, but a means is being worked out to pump the water electronically. In one unit 6 oz. of ice froze.

Automatic Tetrode Transistor Production

A machine that can automatically carry out a series of more than 15 steps in making n-p-n tetrode junction transistors has been developed by Bell Labs. The device, familiarly known as Mr. Meticulous will do the following in less than a minute:

Examine a hair-thin bar of germanium or silicon for electrical characteristics; accept or reject it; weld a fine gold wire to a critical point (the 1/10,000 in. thick center p-layer) with an accuracy of 1/20,000 in.; connect this wire to the leads; flip the bar over to repeat the operation; and run a series of tests.

The location of p-layer, and welding the gold wires to it, are extremely important. In hand assembly, improper lead attachment has been a prime cause for rejects. The machine locates the p-layer by attaching a dc source in series with the bar. By shining light on the bar, current is made to flow. The gold wire, with a bias on it, is placed in contact with the bar and moved along it toward the p-layer in 50-microinch steps.

When the wire touches the p-layer, the unit acts as a transistor, and the current through the bar falls, indicating the location of the center layer. The wire is moved along the p-layer in 50 microinch steps to determine its width, moved back, and then welded by an electrical surge.

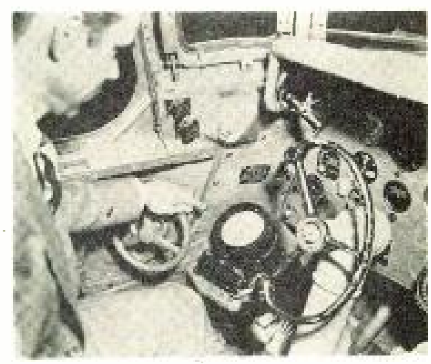
The importance of tetrode transistors lies in the fact that they can operate at very high frequencies. (For technical details, see Nov. 1952 issue of TELE-TECH & ELECTRONIC INDUSTRIES, page 38.)

For more information on the machine, turn to page 140 of this issue.

Compact Aircraft Radar

A compact and highly sensitive airborne radar set which can receive information from distances up to 200 miles is undergoing tests by Braniff International Airways, which has installed the unit aboard one of its DC-6 commercial airliners. The equipment, developed by Allen B. Du Mont Labs., is designed to warn pilots of dangerous terrain, hazardous weather, and for use as a navigation aid. The radar unit, designated Type APS 42 B, has already been successfully used in military transport planes, and the Navy's new Lockheed Constellations are being equipped with the unit.

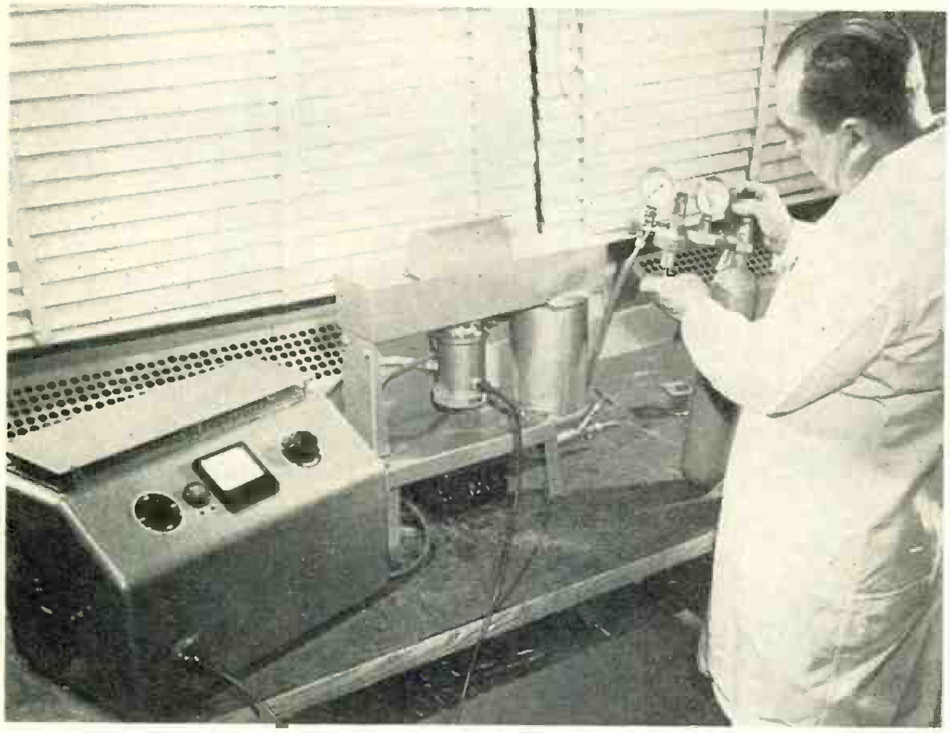
It contains six basic units weighing about 200 lbs. total, including



Azimuth and range indicator of DuMont's new airborne radar installed in pilot's compartment

the antenna, receiver-transmitter, control unit, sync unit, and two azimuth-range indicators. The system meets MIL-I-6181 for r-f interference, operates at X-band (9375 MC) with a nominal power of 40 kw, and has a scan angle of 120° or 240° for nose mounts. Pulse characteristics for search are 800 pps, 0.75 μsec.; for long range and weather, 200 pps, 3.5 μsec.; and for beacon operation, 300 pps, 2.35 μsec.

MORE NEWS on page 14



Curtiss-Wright's new ultrasonic parts washing machine cleans metal objects such as fuze movements and delicate foils. Objects immersed in solvent solution have grime loosened by cavitation and degassing. Power output of 800 kc units range from 200 to 10,000 watts. Either quartz or magnetostrictive transducers are employed. Cost of ultrasonic generator and head is about $1250

Curtiss-Wright Enters Industrial Electronic Field

Curtiss-Wright has demonstrated a new line of commercially available electronic equipment for industrial, medical, laboratory and nuclear applications. Included are:

An 800 KC ultrasonic washing machine;

A combined scaler and ratemeter for use with various counter tubes;

An industrial TV system with a super iconoscope capable of electronic zooming;

A harmonic eliminator for producing pure sine wave 60 CPS power;

An ultrasonic drill for cutting hard materials;

Two non-destructive ultrasonic flaw detectors;

An infra-red night viewing or "black light" system;

A beta gauge for automatic production control;

A 26.8 MC dielectric heater.

Most of the devices are manufactured under license of the German firm, Frieseke & Hoepfner.

Flexible Tubular Waveguide

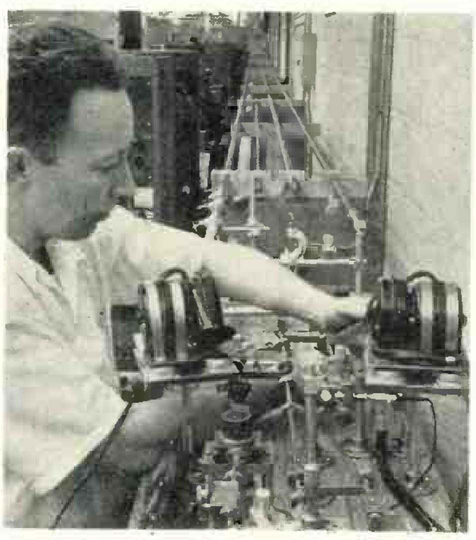
A new and radically different medium for transmitting television and telephone conversations over long distances which has been used successfully in experiments has been announced by Bell Telephone Laboratories. The new medium, a long distance waveguide, is markedly different from modern cable or radio relay systems—it uses hollow metallic tubes roughly two inches in diameter.

Newest look in telephone and TV transmission is experimental long distance waveguide, made of flexible copper, two in. in diameter

Waveguides made of solid metal tubing—roughly like a metal water pipe—have been widely used for some time for short distances. It would be possible to use these solid metal tubes for long distances if they were perfectly straight, but this is impractical. The new long distance waveguide is also a hollow tube, but it is constructed under pressure—and wrapped inside a flexible outer coating which holds the coiled wire in place.

Experiments indicate that both the solid tube type waveguide and the new coiled wire or "helical" type of waveguide can be used together in communications systems, the first for short distances and the latter for long distances.

Although this new form of transmission is still in the experimental stage, a recent long distance test was made at Holmdel in a copper pipe 500 feet long. Engineers bounced signals back and forth in the tube for distances of 40 miles. They calculated that in comparison, the same waves could have traveled only 12 miles in a coaxial cable with the same loss in strength. The carrier frequency for the new waveguide is about 50,000 megacycles.



BTL engineer tests transmission through long distance waveguides of various sizes at Holmdel, N. J. A two-in. diameter was found to be the best size for new flexible hollow tube

New Airliner Radar

New airborne radar, developed especially for airline use, is going into its first regular commercial service aboard a Panagra (Pan American-Grace Airways) DC-6B operating between the United States and South America. The airline announced it had received the first three X-band RDR-1 radar sets built by the Bendix Aviation Corporation for its fleet of new Douglas DC-7B's, and was using one unit to replace the APS-42A radar (a military version) which it had been operating on its South American routes under actual flight and weather conditions since last April. Lighter, more practical and simpler to operate than the APS-42A, the RDR-1 provides the pilot with a clear picture of the weather up to 150 miles ahead when flying at night or on instruments, and spots the exact location of storms.

MORE NEWS on page 16

LIKE THE GREAT ELECTRONICS INDUSTRY

LORAL too has GROWN!

Imprint of Integrity

In the past decade, our organization has developed extensive know-how and experience in the service of the ARMED FORCES, and others, in the DESIGN—DEVELOPMENT—and MANUFACTURE of specialized ELECTRONIC and ELECTRO-MECHANICAL EQUIPMENT in the fields of:

- AIRBORNE NAVIGATIONAL EQUIPMENT
- COMMUNICATIONS SYSTEMS
- RADAR EQUIPMENT
- TEST EQUIPMENT

Our coordinate engineering and manufacturing facilities are at your disposal.

See Us at the
I.R.E. SHOW
Booth 821
Audio Avenue

LORAL has delivered annually many millions of dollars of ELECTRONIC EQUIPMENT

.... *on time!*

Write for Facilities Brochure T-3

LORAL ELECTRONICS CORPORATION

794 EAST 140th STREET • NEW YORK 54, N. Y.

As We Go To Press . . .

Standardized Fuses

For some time Bussmann Mfg. Co., St. Louis, Mo. and Littelfuse Inc., Desplaines, Ill. have worked cooperatively to establish a new standard in fuse clips and fuses for electronic equipment. The complete data on this new fuse series will be published soon. Meanwhile, briefly and in general, the fuse electrical sizes will range up to 10 amperes. Different sized post-type holders and fuses have been assigned to each electrical value, and ear tabs on the fuse metal end-caps are made to act as keys. Thus in practice it will be possible to replace a blown fuse with only one size larger or lower than the prescribed electrical value. The Underwriters Labs. have approved the new standard and it is expected that manufacturers will be able to effect substantial design economies through its use.

RETMA Submits Radiation Report

The Radio-Electronics-Television Manufacturers Association has filed its comments with the FCC on the Commission's consideration of an amendment to Part 15 of the rules governing restricted radiation devices. The comments, submitted by the Association's Director of the Engineering Dept., W. R. G. Baker, contained the reports and recommendations of seven technical task forces. These include: #1, TV receivers; #2, carrier current equipment; #3, fixed and mobile equipment; #4, community antennas; #5, radio receivers; #6, test equipment and miscellaneous; and #7, transmitters.

The TV receiver task force found that RETMA oscillator radiation limits for VHF (50 μv/m for low VHF band, 150 μv/m for high VHF band, with linear interpolation between) have been met by manufacturers without serious added cost to the chassis, and recommends that all sets made after June 30, 1955 meet this limit. At UHF it was found that few, if any, manufacturers were meeting the 500 μv/m oscillator radiation limit, and that difficulties encountered included lack of a suitable antenna isolation circuit, and problems of correlating various measurements. The task force recommended that the 500 μv/m maximum limit be met by all UHF receivers made after Dec. 31, 1956, with linear interpolation between upper VHF band and UHF.

COMING EVENTS

March 1-3—Joint Western Computer Conference and Exhibit, sponsored by IRE, AIEE, and Assn. for Computing Machinery, Statler Hotel, Los Angeles, Calif.

Mar. 9-11—Symposium on Electromagnetic Relays, Oklahoma A&M College, Stillwater, Okla.

Mar. 14-18—ASTE Western Industrial Exposition and Annual Meeting, Shrine Auditorium and Exposition Hall, Los Angeles, Calif.

March 21-24—1955 IRE National Convention, Kingsbridge Armory, New York, N.Y.

Mar. 28-Apr. 1—Soc. for Nondestructive Testing, Technical Sessions, Ambassador Hotel, Los Angeles, Calif.

Apr. 4-5—Atomic Industry Conference, sponsored by Atomic Industrial Forum and Stanford Res. Inst., Mark Hopkins Hotel, San Francisco, Calif.

Apr. 5-7—RTCA Spring Assembly Meeting, sponsored jointly by RTCA and Los Angeles Section of IRE, Los Angeles, Calif.

April 6-10—World Plastics Fair and Trade Exposition, National Guard Armory, Los Angeles, Calif.

Apr. 14-23—International Trade Fair, Hannover, Germany.

Apr. 15-16—9th Annual Spring Technical Conference, sponsored by Cincinnati Section of IRE, Engineering Soc. of Cincinnati Bldg., Cincinnati, Ohio.

Apr. 18-21—24th National Packaging Exposition, sponsored by American Management Association, International Amphitheatre, Chicago, Ill.

Apr. 18-22—National Convention of Dept. of Audio-Visual Instruction of Nat'l. Education Assn., Hotel Biltmore, Los Angeles, Calif.

April 19-21—12th British Radio Components Show, Grosvenor House, London, England.

April 25-27—8th Annual Conference for Protective Relay Engineers, A.&M. College of Texas, College Station, Texas.

Apr. 27-29—7th Regional Conference and Show, sponsored by IRE, Hotel Westward Ho, Phoenix, Ariz.

April 29-30—New England Radio-Electronics Meeting, sponsored by Boston and Connecticut Valley Sections of IRE, Sheraton Plaza Hotel, Boston, Mass.

May 2-5—3rd Annual Semiconductor Symposium of Electrochemical Soc., Cincinnati, Ohio.

May 2-13—British Industries Fair, London and Birmingham, England.

May 4-6—4th Int'l Aviation Trade Show, 69th Regiment Armory, N.Y.

May 6—American Assoc. of Spectrographers 6th Annual Conference, Chicago, Ill.

May 10-12—Metal Powder Show sponsored by Metal Powder Assn., Bellevue-Stratford Hotel, Philadelphia, Pa.

May 16-19—Electronic Parts Distributors Show, Conrad Hilton Hotel, Chicago, Ill.

May 16-20—National Materials Handling Exposition, International Amphitheatre, Chicago, Ill.

May 18-20—Nat'l Telemetering Conference and Exhibit, sponsored by IRE, AIEE, IAS, ISA, Hotel Morrison, Chicago, Ill.

May 19-21—Global Communications Conference, sponsored by Armed Forces Communications Assn., Hotel Commodore, New York, N. Y.

May 24-26—9th Annual Broadcast Engineering Conference, sponsored by NARTB, Shoreham and Sheraton Park Hotels, Washington, D.C.

May 26-27—Electronic Components Conference, Los Angeles, Calif.

May 31-June 3—3rd Basic Materials Exposition, Convention Hall, Philadelphia, Pa.

June 1-11—British Plastics Exhibition, Olympia, London, England.

June 2-5—ARRL Hudson Div. Convention and Amateur Radio Equipment Show, Hotel Adelon, Long Beach, N.Y.

June 20-23—2nd International Powder Metallurgy Congress, Reutte, Tyrol, Austria.

June 20-25—Symposium on Electromagnetic Wave Theory, sponsored by Commission VI of URSI and Univ. of Mich., University of Mich., Ann Arbor, Mich.

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

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

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

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

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

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

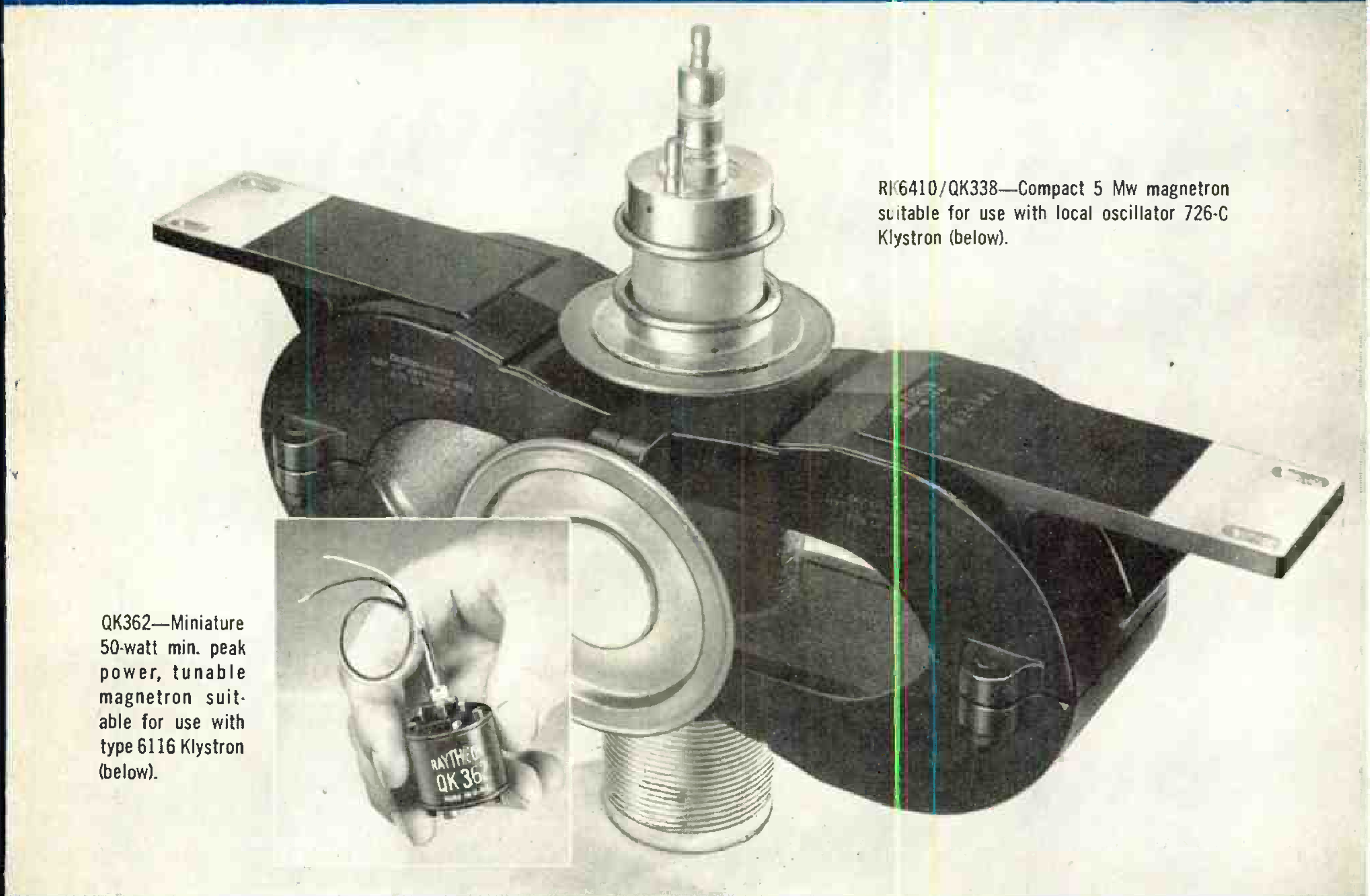
Sept. 14-16—ACM General Meeting, Moore School of Electrical Eng., Univ. of Pa., Philadelphia, Pa.

Sept. 27-Oct. 1—Int'l. Analog Com-

(Continued on page 175)

MORE NEWS on page 23

Raytheon — World's Largest Manufacturer of Magnetrons and Klystrons



RK6410/QK338—Compact 5 Mw magnetron suitable for use with local oscillator 726-C Klystron (below).

QK362—Miniature 50-watt min. peak power, tunable magnetron suitable for use with type 6116 Klystron (below).

Mammoth or midget—and every type between

Raytheon makes high quality tubes for *all* your microwave requirements—over 200 magnetrons and klystrons from L-Band through K-Band in all power ranges—by far the largest, most complete line in the industry.

From the 50-watt minimum peak power, X-Band QK362 for beacon use to the 5 megawatt RK6410/QK338 for long range radar, there are highly efficient Raytheon tube types to supply reliable service in your present or proposed systems—whether in standard or special applications.

Yours for the asking, data booklets on Raytheon Magnetrons, Klystrons and Special Purpose tubes. Write today.

Vibration, long life, rugged dependability are but a few of the factors considered in the design and manufacture of Raytheon Microwave Tubes. Check with Raytheon first for "proved performance pairs" of magnetrons and klystrons.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

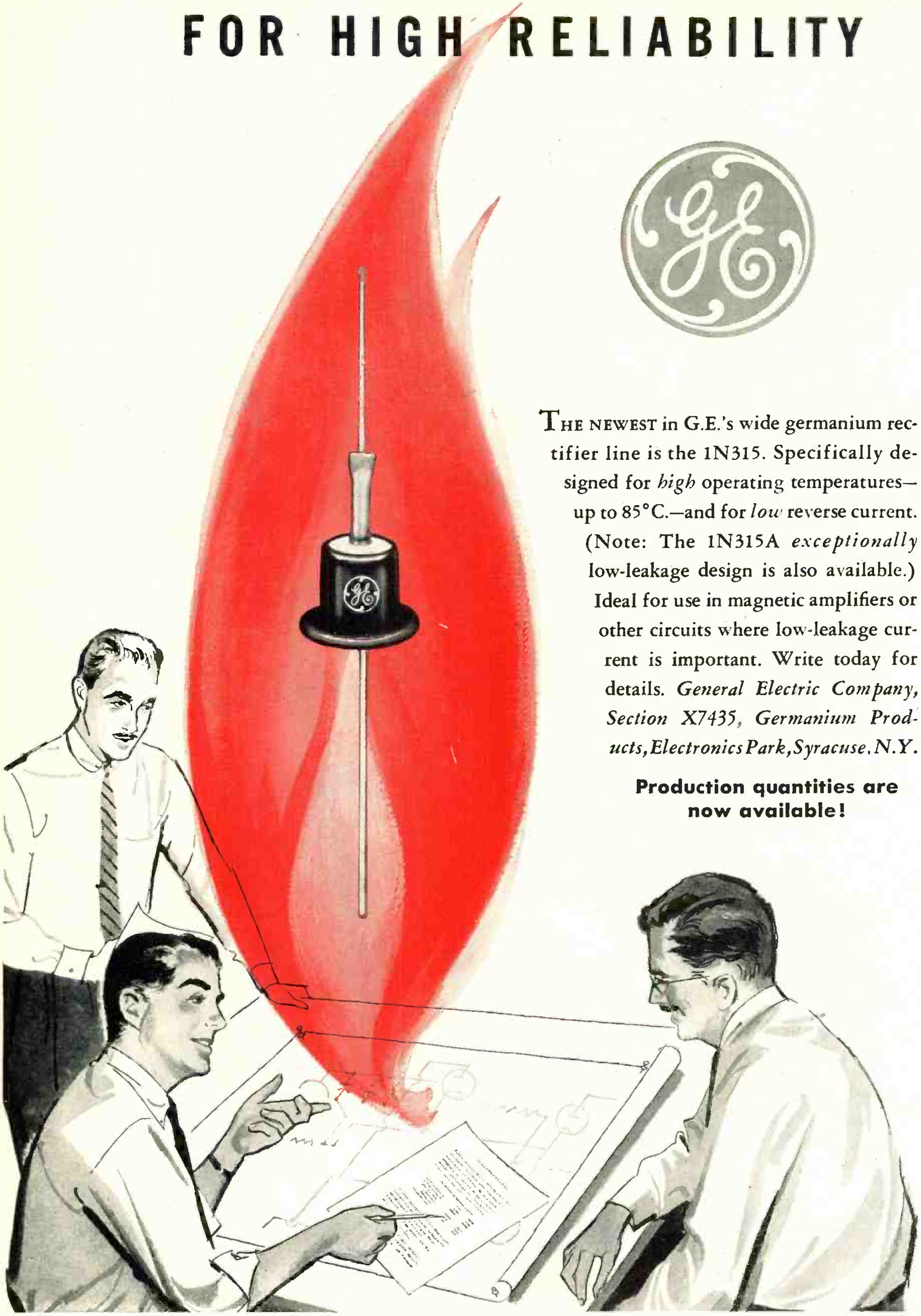
Microwave and Power Tube Operations, Section PL 14, Waltham 54, Mass.,

See the complete Raytheon line at the I. R. E. Show

Kingsbridge Armory—Booths 145, 147, 149 **Kingsbridge Palace—Booths 2, 4**

For product Information, use inquiry card on last page.

FOR HIGH RELIABILITY

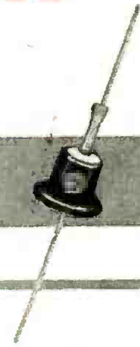


THE NEWEST in G.E.'s wide germanium rectifier line is the 1N315. Specifically designed for *high* operating temperatures—up to 85°C.—and for *low* reverse current. (Note: The 1N315A *exceptionally* low-leakage design is also available.) Ideal for use in magnetic amplifiers or other circuits where low-leakage current is important. Write today for details. *General Electric Company, Section X7435, Germanium Products, Electronics Park, Syracuse, N.Y.*

Production quantities are now available!

AT HIGH TEMPERATURES...

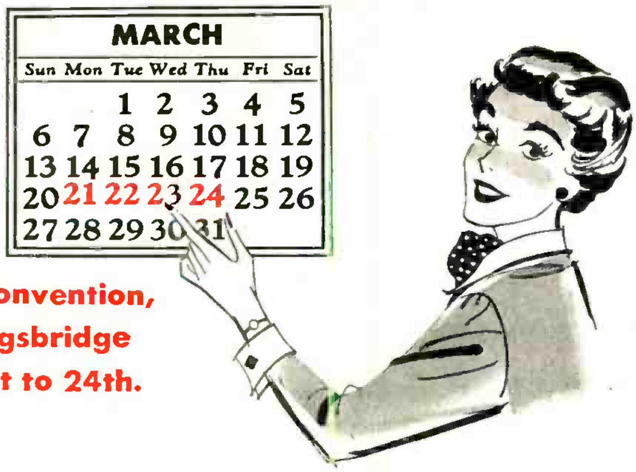
NEW G-E GERMANIUM JUNCTION RECTIFIER



SPECIFICATIONS FOR 1N315A

(Resistive or Inductive Load)

	55°C	71°C	85°C	
Maximum Allowable Peak Inverse Voltage	200	200	100	V
Maximum Allowable D-C Output Current	100	100	100	ma
Maximum Full Load Forward Voltage Drop	.48	.46	.44	V
Continuous Reverse Working Voltage	150	100	50	V
Minimum Forward to Reverse Current Ratio (Average Forward/Average Reverse at Full Load)	2000	800	500	
Maximum Operating Frequency (70% Rectification Efficiency)	50	50	50	KC
Storage Temperature	95	95	95	°C



Tell your secretary to mark the calendar now. See the G-E Germanium Products Exhibit at I.R.E. Convention, Booths 192 and 194 at Kingsbridge Armory, N.Y.C. March 21st to 24th.

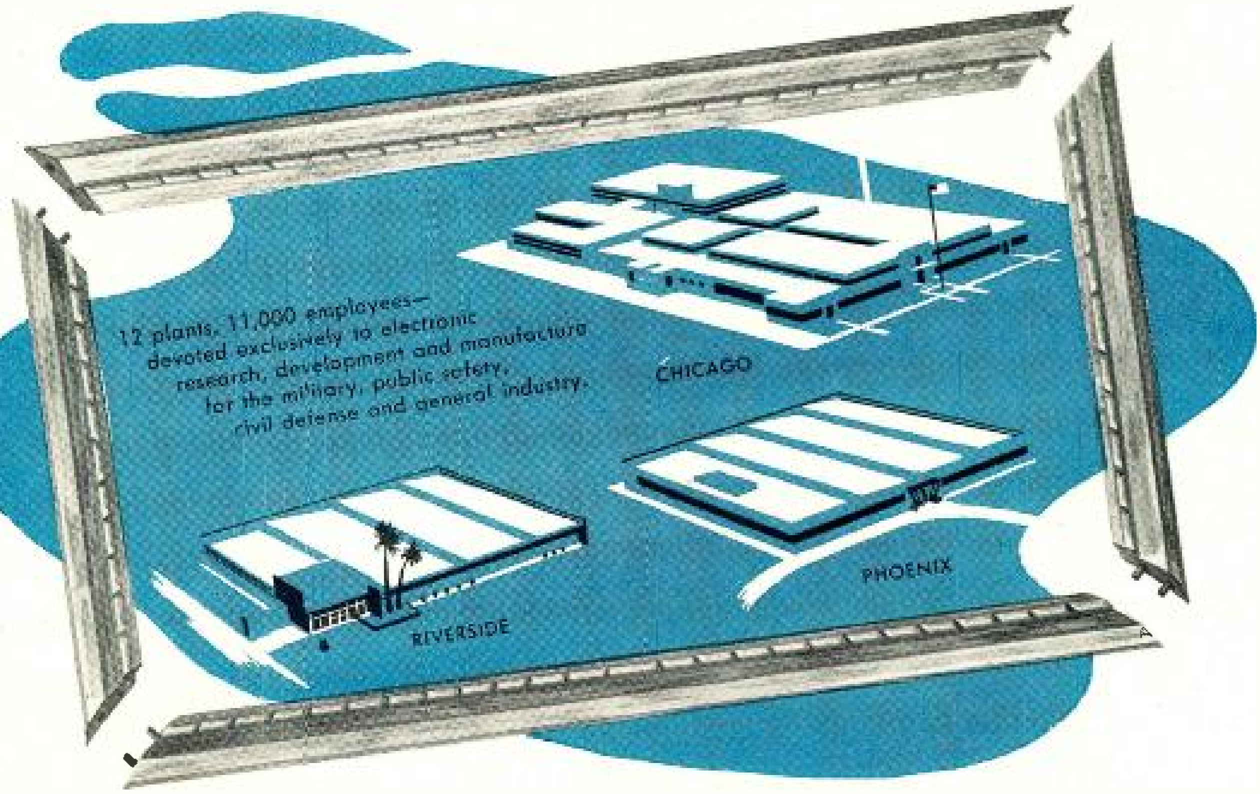
Progress Is Our Most Important Product

GENERAL ELECTRIC

For product information, use inquiry card on last page.

MECHANICAL ENGINEERS • ELECTRONIC ENGINEERS • PHYSICISTS • CHEMISTS* • METALLURGISTS* • MATHEMATICIANS

A JOB FOR YOU WITHIN THIS EXPANDING FRAMEWORK



Your preferred assignment in your preferred location

A place in Military Electronics for YOU . . .

navigational devices
radar
countermeasures
analog computers
communications equipment

carrier	transmitters
VHF	receivers
UHF	multiplexing
microwave	systems

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*

**Phoenix only*

PHOENIX, ARIZONA Motorola Research Laboratories. A staff of 800 enthusiastic scientists and engineers working in a *resort climate*. Special opportunities for experienced men in *transistor* research. (Chemists, Physicists, Metallurgists)

RIVERSIDE, CALIFORNIA Motorola Research Laboratories. Missile systems, guidance and control. Dynamic systems analysis. All electronic military weapons systems. New modern laboratory building surrounded by orange trees.

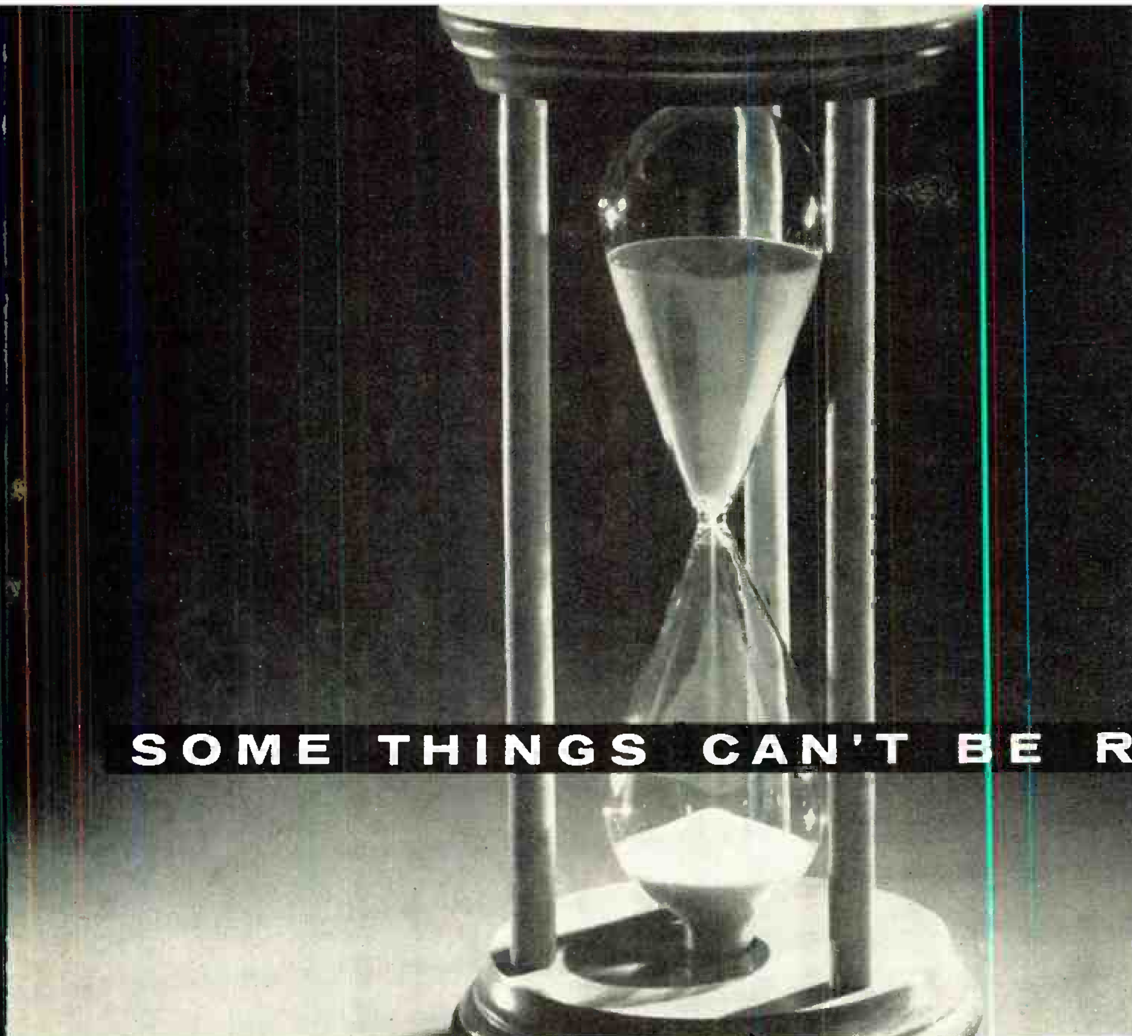
CHICAGO, ILLINOIS Motorola Headquarters. Three laboratories. Grow with Chicago, the communications and transportation center of the country.

Here is your opportunity to become associated with one of America's fastest growing, dynamic organizations . . . where you can set your own challenging course of growth with security, within a broad framework of military and allied industrial projects.

Note the great diversity of Motorola activities. Write us today. Select your preferred area of interest and location. State the important facts of your education, training and professional career. Minimum of 4 years experience required.

Write, Attention: Daniel E. Noble
Vice-President in charge

Motorola COMMUNICATIONS & ELECTRONICS DIVISION
4501 Augusta Blvd., Dept. T.T. • Chicago Ill.



SOME THINGS CAN'T BE RUSHED

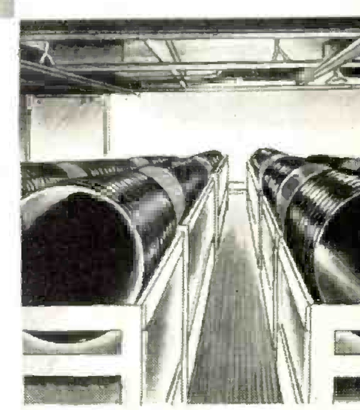
IT TAKES TIME TO SHIFT THE SANDS IN AN HOURGLASS...

...and it takes *time* to make a good recording disc

Not the speed-up...but the slow-down...is the tempo of production in PRESTO's Recording Disc Division. PRESTO's engineers insist on time-consuming operations for the best reason in the world...it's the only way to make the best recording discs in the world!

Surprisingly, PRESTO superior quality discs are competitively priced... offer far more value for the money. See for yourself!

PRESTO Green • Orange • Brown and White label discs are used throughout the world wherever fine recording is done



TIME CONSUMING STEP #3 IN MAKING A PRESTO RECORDING DISC

The secret of clear, high fidelity reproduction is proper "aging" of recording discs. That's why PRESTO devotes so much time to the careful unhurried "curing" of PRESTO discs Each PRESTO disc is fully matured i temperature-controlled and dust-free conditions. No baking or other forc methods are ever used! In time (plenty of time!) the perfect record surface of PRESTO discs is produced

PRESTO RECORDING CORPORATION

PARAMUS, NEW JERSEY

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

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

DERS IN
NIATURIZATION
R OVER
ENTY YEARS...

MINIATURIZED TRANSFORMER COMPONENTS FROM STOCK

Items below and 650 others in our catalog A.

HERMETIC SUB-MINIATURE AUDIO UNITS

These are the smallest hermetic audios made.

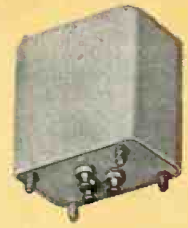
Dimensions . . . 1/2 x 11/16 x 29/32 . . . Weight .8 oz.

TYPICAL ITEMS

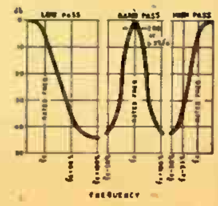
ype No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri MA	Response ±2 db (Cyc.)	Max. level dbm
-30	Input to grid	TF1A10YY	50*	62,500	0	150-10,000	+13
-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
-32	Single plate to line	TF1A13YY	10,000*	200	3	300-10,000	+13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

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

COMPACT HERMETIC AUDIO FILTERS



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

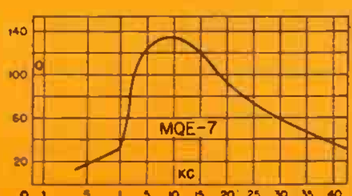


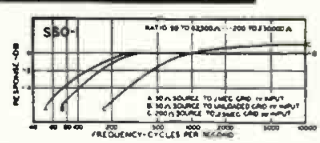
HERMETIC MINIATURE HI-Q TOROIDS

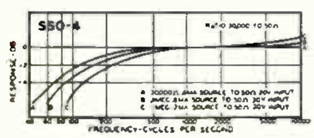
MQE units provide high Q, excellent stability and minimum hum pickup in a case only. 1/2 x 1-1/16 x 17/32 . . . weight 1.5 oz.

TYPICAL ITEMS

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







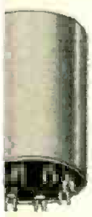
SUB-SUBOUNCER AUDIO UNITS

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

Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.
*SSO-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	3700
SSO-2	Interstage /3:1	+ 4 V.U.	10,000	0-.25	90,000	750	3250
*SSO-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	35
SSO-4	Output	+20 V.U.	30,000	1.0	50	2875	4.6
SSO-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.						
SSO-6	Output	+20 V.U.	100,000	.5	60	4700	3.3
*SSO-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	125

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

OUNCER (WIDE RANGE) AUDIO UNITS



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

TYPICAL ITEMS

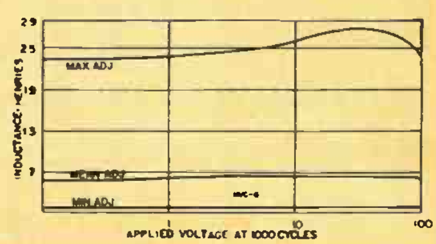
Application	Pri. Imp	Sec. Imp
Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
Single plate to 1 grid	15,000	60,000
Single plate to 2 grids, D.C. in Pri.	15,000	95,000
Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
Push pull plates to line	30,000 ohms plate to plate	50, 200/250,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

HERMETIC VARIABLE INDUCTORS

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

TYPICAL ITEMS

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



ET US MINIATURIZE YOUR GEAR.

DETAILS OF YOUR NEEDS for SIZES and PRICES

UNITED TRANSFORMER CO.

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

Electronic Industries News Briefs

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

ADMIRAL CORP. has licensed **RADIO CORP. OF AMERICA** for five years under patents for radio, TV, and automation equipment and has been licensed by RCA for the same period for patents in TV and radio broadcast receiving sets.

AIR REDUCTION SALES CO., Div. of **AIR REDUCTION CO. INC.**, New York, N. Y. has produced a 20-minute, color-sound movie on tungsten inert-gas arc welding, titled "Nothing But The Best."

AIRTRON, INC., Linden, N. J. has signed a license agreement to manufacture microwave ferrite elements and ferrite-containing microwave devices with **HUGHES AIRCRAFT CO.**, Culver City, Calif.

ALTEC SERVICE CORP. will sell public address systems made by **ALTEC LANSING** to commercial users throughout the U.S. Distribution will be made through **GRAYBAR ELECTRIC**.

AMERICAN STANDARDS ASSOCIATION, New York, N. Y., reports that there are 1440 American standards in use in the U. S. Vice Admiral George F. Hussey, USN (ret.), managing director, states that 200 committees are now working on standards projects.

ARVIN INDUSTRIES, INC., Columbus, Ind., has formed an electronics products division to specialize in subcontract work on military and industrial projects. Glenn W. Thompson, pres., has announced that Leo W. Burns has been named sales manager of the division.

AVION INSTRUMENT CORP. Paramus, N. J. will relocate in Riverdale, Md. as part of the long range expansion plan of its parent company, ACF Industries, Inc. The site is now occupied by the ACF Engineering and Research Div.

BECKMAN INSTRUMENTS, INC., Fullerton, Calif. has acquired **SPECIALIZED INSTRUMENTS CORP.**, and **SPINCO SERVICE CO.**, of Belmont, Calif. The acquired companies will be known as the **SPINCO DIV. of BECKMAN INSTRUMENTS, INC.** with headquarters at Belmont.

ECLIPSE-PIONEER DIV., BENDIX AVIATION CORP., announces that the PB-10A automatic pilots with "flight path control," designed and built by the division, will be installed in the Vickers Viscount airliners to be placed in service in 1955.

BLONDER-TONGUE LABS., INC. of Westfield, N. J., has fully equipped and staffed its second pant near Newark, N. J., to handle additional manufacturing space.

BRUSH ELECTRONICS CO. DIV. OF CLEVITE CORP. has executed, with **ERIE RESISTOR CORP.**, a license agreement with **GULTON MFG. CORP.** and **GLENCO CORP.** under which **GULTON** will make, use and sell barium titanate elements in the phono pickup and accelerometer fields.

BUD RADIO, INC. has purchased a new building in Cleveland, Ohio, which will add 30,000 sq. ft. of space to the present facility.

S. W. CALDWELL LTD. has purchased a building at 443 Jarvis St., Toronto, Ont., Can., to house expanded production and office facilities.

CBS-COLUMBIA DIV. of COLUMBIA BROADCASTING SYSTEM will manufacture closed circuit industrial color TV equipment in addition to making TV and radio receivers, specialized defense items and industrial electronics apparatus.

COLLINS RADIO CO. of Cedar Rapids, Ia., will manufacture 224 VHF receivers and transmitters for use by **UNITED AIR LINES** for installation this summer.

ELECTRODATA CORP. of 717 N. Lake Ave., Pasadena 6, Calif., has delivered three complete "Datatron" high-speed electronic data processing machines to **LAND AIR INC.**, Dayton, Ohio, **ALLSTATE INSURANCE CO.**, Skokie, Ill., and **ARMA CORP.**, Seattle, Wash.

ELECTRO TEC CORP., S. Hackensack, N. J., has been granted a patent covering its process for the manufacture of precision slip ring and commutator assemblies.

GENERAL ELECTRIC CO. has opened a "Systems Center" for its Heavy Military Electronic Equipment Dept. in Syracuse, N. Y.

GENERAL ELECTRIC CO., Syracuse, N. Y. has revealed a radar cathode ray tube that enables ships to "see" 50 miles ahead and 30 miles behind. The tube was installed by GE in navigational radar sets now in use on Navy cargo vessels.

GENERAL INSTRUMENT CORP., Elizabeth, N. J. has added a new $1,500,000 radio-TV-electronics plant to its five factories in the U. S. and Canada. It is adaptable to either civil or military production.

GERMANIUM PRODUCTS CORP., 25 Cornelison Ave., Jersey City 5, N. J., has cut transistor prices up to 40 and 50% on some types.

G. M. GIANNINI & CO., INC. of Pasadena, Calif. and E. Orange, N. J., has established Sales and Field Engineering Offices at 8 S. Michigan Ave., Chicago, Ill.

GUDEMAN CO., electronic components manufacturer has moved its Sunnyvale, Calif., plant to a new building at 190 Commercial St.

GYROMECHANISMS, INC., gyroscope and potentiometer producers, has acquired a building opposite its Halesite, Long Island, plant that will house the design and engineering staffs and increase production facilities 20%.

HAMILTON WATCH CO. has acquired the outstanding shares of the **HATHAWAY INSTRUMENT CO.**, Denver, Colo., producers of electronic electro-mechanical instruments. Mr. Claude M. Hathaway will continue as president.

HEPPNER MFG. CO., Round Lake, Ill., is building a new section to be occupied by the enlarged tool, die and punch press department.

INTERNATIONAL RECTIFIER CORP., El Segundo, Calif., has announced a 5 to 10% price increase on selenium rectifiers made necessary by a 20% increase in selenium cost.

KETAY INSTRUMENT CORP., has merged with **NORDEN LABORATORIES CORP.** The major executives of the combined companies are Morris F. Ketay, pres., Paul W. Adams, exec. vice-pres., Benjamin Gross, board chairman.

KETAY INSTRUMENT CORP. has leased a 20,000 sq. ft. plant in New York City to expand its construction of aircraft instruments.

LINK AVIATION, INC. has purchased a new plant in Binghamton, N. Y., thus adding 2 buildings to its present facilities.

MAGNECRAFT ELECTRIC CO. has moved to its new plant at 3352 W. Grand Ave., Chicago 51, Ill.

MICRO SWITCH DIV. OF MINNEAPOLIS-HONEYWELL REGULATOR CO. has opened a new assembly plant in Independence, Ia., to expand its production of mercury switches and snap-acting switch products.

MICRO SWITCH DIV. OF MINNEAPOLIS-HONEYWELL REGULATOR CO. has established new sales offices in Phoenix, Ariz.; Charlotte, N. C.; and Denver, Colo.

MOTOROLA, INC., Chicago, Ill., is negotiating to acquire an 18-acre tract in Phoenix, Ariz., according to Paul V. Galvin, pres., on which to construct facilities for engineering and light manufacturing that would accommodate 400 to 500 people.

PHILCO CORP., Government & Industrial Div., has been awarded a "Sidewinder" guided missile contract by the Bureau of Ordnance.

PRECISION RADIATION INSTRUMENTS, INC. has removed its facilities to 4223 W. Jefferson Blvd., Los Angeles, Calif. The company's sales offices will remain at 2235 S. La Brea Ave.

RADIO CORP. OF AMERICA has been licensed by **INTERNATIONAL TELEPHONE & TELEGRAPH CORP.** for commercial radio apparatus and tubes.

RADIO CORP. OF AMERICA will merchandise broadcast antenna towers manufactured by **DRESSER-IDECO CO.** of 875 Michigan Ave., Columbus 8, Ohio, to RCA Specifications. Under this arrangement broadcasters will be able to purchase a complete package of TV broadcast equipment.

ENGINEERING PRODUCTS DIV., RADIO CORP. OF AMERICA, Camden, N. J., has completed the 478-mile microwave radio system line linking the key compressor stations of the **EL PASO NATURAL GAS CO.**, El Paso, Texas

THE 1955 NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS has appointed Dr. H. S. Seifert to the subcommittee on rocket engines and Dr. James C. Fletcher to the committee on stability and control. Both scientists are with the senior staff of the **RAMO-WOOLDRIDGE CORP.**, Los Angeles, Calif.

RYAN AERONAUTICAL CO., San Diego, Calif., will build the mid-section of the fuselage of the Air Force's Boeing KC-135 jet tanker-transport, the prototype of which reached 550 miles/hr. on its first flight July 15, 1954.

STANDARD ELECTRONICS CORP., Newark, N. J., subsidiary of **CLAUDE NEON, INC.**, has announced a new unit-engineered kit for converting RCA-TT5A water-cooled TV transmitters to air-cooled operation.

SUPEREX ELECTRONICS CORP. has moved its offices and factory to a larger building at 4-6 Radford Place, Yonkers, N. Y.

SYLVANIA ELECTRIC PRODUCTS INC. plans to establish a company-wide Data Processing Center for which it has contracted to lease a "Univac" electronic computing system from **REMINGTON RAND, INC.**

SYLVANIA ELECTRIC PRODUCTS INC. has established its 9th operating division, the Electronic Systems Div. at 175 Great Arrow Ave., Buffalo, N. Y. Henry Lehne is general manager of the new division.

SYLVANIA ELECTRIC PRODUCTS INC. has begun manufacturing operations in the TV picture tube plant in Hatboro, Pa., formerly owned by **NATIONAL UNION ELECTRIC CORP.** David K. Elwell is plant manager.

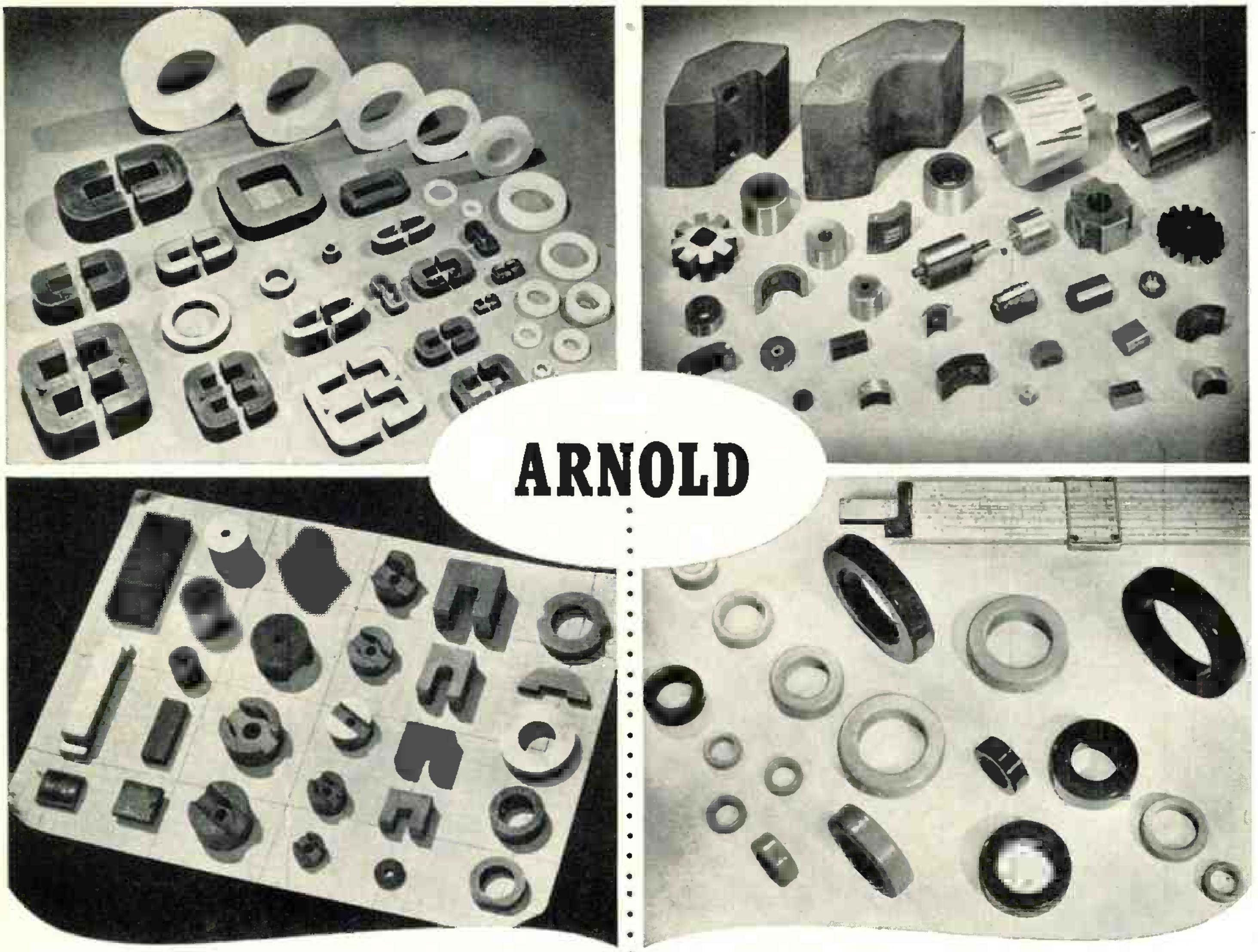
TEKTRONIX, INC., Chicago, Ill., has opened a replacement parts, maintenance information and field engineering office that will be headed by George Edens, formerly of the company's Syracuse field office.

THOMPSON PRODUCTS, INC., makers of aircraft and electronic parts, is planning a $5,000,000 study center east of the Tapco plant, Euclid, Ohio. The first two units will be started by fall, 1955.

TRANS-AMERICAN PRECISION INSTRUMENT CORP. of Flushing, N. Y., has become the **INSTRUMENT DIV. of STERLING PRECISION INSTRUMENT CORP.** No change took place in executive personnel.

YARDNEY ELECTRIC CORP. has organized a new Applications Consultation Dept. offering free engineering advice on battery or portable power source problems. Address inquiries to Applications Consultation Dept., 40-46 Leonard St., New York 13, N. Y.

MORE NEWS on page 26



YOUR ONLY SOURCE

of a Complete Line of MAGNETIC MATERIALS

Arnold products include all grades of Alnico permanent magnets (cast and sintered) . . . tape-wound cores of high-permeability alloys, such as Deltamax, Permalloy and Supermalloy . . . types "C" and "E" cut cores of Silectron in any size or weight range from a fraction of an ounce to hundreds of pounds (50 lbs. max. on 12-mil C cores); also round, square and rectangular Silectron cores . . . powdered Mo-Permalloy cores . . . Cunife, Vicalloy, Permendur and other magnetic materials. Special magnetic components can be produced to meet your specific requirements; and such products as powder cores, tape-wound cores, and C and E cores are carried in stock in a wide range of standard sizes for immediate delivery. Many sizes of cast and sintered Alnico magnets also are stocked.

In other words, Arnold magnetic materials can answer *any* requirement you may have. It is the *only* complete line in the industry; and in addition, Arnold maintains complete control over every production step from raw materials to finished products. Such a source can bring you advantages in long experience and undivided responsibility, and in unequalled facilities for quality production and control. ● *Let us supply your needs.*

W&D 5546

TECHNICAL DATA ON ARNOLD PRODUCTS . . . Write for your copy.

Bulletin GC-106 . . . General information on all Arnold magnetic materials: permanent magnets, tape-wound and powder cores, etc.

Bulletin TC-101 A . . . "Properties of Deltamax, 4-79 Mo-Permalloy and Supermalloy"—28 pages of technical data on Arnold Tape-Wound Cores.

Bulletin PC-104 . . . "Molybdenum Permalloy Powder Cores"—16 pages, complete technical data.

Bulletin SC-107 . . . "Arnold Silectron Cores"—52 pages of valuable data, covering a complete range of core shapes, sizes, tape gauges, etc.

ADDRESS DEPT. T-53

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.

Survey of

New Products of the Month

Capsule summaries of latest electronic developments provide handy reference for engineers in the market for new equipment and components

MAGNETIC RESOLVER, Series 1800, is a fast response unit offered by John Oster Mfg. Co., Avionic Div., Racine, Wis. especially suited for driving circular sweep radar presentations. Rotor and stator inductance values can be supplied held within ±3% (Ask for A-2-31)

AC "VOLTECTOR," produced by Hivolt Ltd., 34a, Pottery Lane, Portland Rd., London, W. 11, can detect the presence of ac current without contact with the conductor. Unaffected by ordinary insulations, but cannot penetrate earthed metal sheathing. (Ask for A-2-32)

K-BAND RF HEADS, made by Vectron, Inc., 408 Main St., Waltham 54, Mass., are complete microwave tuning units that include an r-f assembly and a K-Band mixer. Designed for use with the Vectron SA25 microwave spectrum analyzer. (Ask for A-2-33)

LOW RESISTANCE BRIDGE, Model 604, by Shasta Div., Beckman Instruments, Inc., 1432 Nevin Ave., Richmond, Calif., provides means for checking low resistances (10Ω to 10KΩ) to a high degree of accuracy (0.25%). Three full scale ranges. (Ask for A-2-34)

"VECTORLYZER," made by Advance Electronics, Co., Inc., 451 Highland Ave., Passaic, N.J. measures vector sum or difference of two voltages, imaginary and real components of an unknown voltage in terms of a reference voltage, etc. (Ask for A-2-26)

GUN-BOMB-ROCKET SIGHT TESTER, Model 519, announced by Telectro Industries Corp., 35-18 37th St., Long Island City 1, N.Y. tests gyro computing gun sights and facilitates data compilation to indicate the sight operating characteristics. (Ask for A-2-12)

GAS DETECTOR. A precision electronic unit Model GG/102 produced by Bristol Engineering Corp., Beaver Dam Rd. and Oak Lane, Bristol, Pa. makes quantitative measurements of gas concentrations in certain mixtures of gas and air and some types of combustible gas. (Ask for A-2-13)

RECTIFIER TUBE, NL-616, by National Electronics, Inc., Geneva, Ill., is rated at 2.5 amps dc and 30 amps peak current. Gas and mercury filled for quick starting and long life. Filament voltage 2.5 amps. Filament current, 9 amps. (Ask for A-3-11)

PRESSURE TRANSDUCER. A dual-element air flow differential instrument announced by Technology Instrument Corp., Acton, Mass., has a linear potentiometer resistance ratio vs. pressure within 5%. Wt., 1.3 lbs. (Ask for A-3-12)

SCALER AND RATEMETER made by Electronics Div., Curtiss-Wright Corp., Wood-Ridge, N.J. can be used with Geiger-Muller counter tubes, proportional counters, and scintillation counters. Adjustable from 300 to 3,000 v. Maximum counting speed, 200,000 impulses/second. Counts 3,999,999 pulses. (Ask for A-3-13)

DIPLEXER, Type 5411-A, by Television Transmitter Dept., Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N.J. will handle the total aural and visual power for any TV transmitter from 5 kw to 50 kw. (Ask for A-3-14)

TUBELESS POWER SUPPLY, Model 312, is a dc/ac power supply for life testing racks, computers, experimental equipment, etc., made by Electronic Research Associates, Inc., P.O. Box 29, Caldwell, N.J. Input, 100-125 v. 60 CPS. Output, 0-3/30/300 v dc, or 0-130 v ac variable. (Ask for A-3-15)

ELECTRONIC GENERATOR, Model 1420-B, for development or production testing has frequency range internal oscillator, 50-6,000 CPS, with external oscillator, 25-20 kc. Power output 300 va. Communication Measurements Lab. Inc., 350 Leland Ave., Plainfield, N.J. (Ask for A-3-16)

RADAR PRESSURIZING TEST SET. Model RR-10260-B is a fully-contained, semi-automatic unit made by Lear, Inc., Lear-Romec Div., Elyria, O. Set for 60 in. Hg absolute, a pressure switch controls the low pressure shut-off. (Ask for A-3-17)

MAGNETIC AMPLIFIER, an improved version of the "Moto Mag," by Keystone Products Co., 904 23rd St., Union City 2, N.J. is available in six standard models. Designed for remote control devices, computers, positioning servos, etc. (Ask for A-3-18)

CERAMIC POWER RESISTORS, Types R31, R32, R34, and R36 "Castohm" cast units, expand the line of lightweight, high-temperature resistors made by Shallcross Mfg., Co. Collingdale, Pa., to MIL-R-10566 specifications. (Ask for A-3-25)

COIL IMPREGNANTS. Three new coil impregnants announced by Insl-X Sales Co., 26 Rittenhouse Place, Ardmore, Pa., "Acrylic base A-107," "Insl-X E-67," and "Insl-X Q-101, have a wide range of physical and electrical characteristics. (Ask for A-3-26)

RELAYS. New current and voltage sensing relays of the thermal type announced by G-V Controls, Inc., 28 Hollywood Plaza, East Orange, N.J. are hermetically sealed with outside screw-adjustable operating points. (Ask for A-3-27)

SHOCK MOUNTED CRT. "Edge-Lit" engraved calibration scales in the CRT bezel and rubber shock mount assys by Jan Hardware Mfg., Co., Inc., 75 N. 11th St., Brooklyn 11, N.Y. are lighted by bulbs inside instruments. (Ask for A-3-28)

TAPE CUTTER-SPLICER, Model TS-4DLX, added to the line of Robins Industries Corp., 82-09 251 St., Bellerose 26, N.Y. makes splices in 5 seconds without aid of other equipment. Supplied complete with plastic dust cover (Ask for A-3-29)

THERMOCOUPLE TRANSFER SWITCHES announced by Daven Co., 191 Central Ave., Newark 4, N.J. have a contact resistance of less than 0.004 ohms and will vary not more than±0.0003 ohms for the life of the unit. (Ask for A-3-23)

HIGH TEMPERATURE RECTIFIERS with larger cells to size 5 x 6 in., announced by Semi-Conductor Div., of Radio Receptor Co., 251 West 19th St., New York 11, N.Y. operate without derating at 125°C. Life span 500 hrs. (Ask for A-3-24)

MAGNETIC TAPE RECORDER. New addition to the line of Davies Lab., Inc., 4705 Queensbury Rd., Riverdale, Md., Series 550 for airborne use, is completely self-contained in 2 units 7 in. wide by 7-¾ in. long. (Ask for A-3-30)

MINIATURE VARIABLE INDUCTORS, both shielded and unshielded, made by Levinthal Electronic Products, Inc., 2612 Fair Oaks Ave., Redwood City, Calif., are available as Style A Type 1, in 10 standard values from 56 μh to 1.8 mh. (Ask for A-3-31)

TELEPHONE SYSTEM, P-A-X, by Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill., comprised of standard telephone equipment, is offered for private ownership to control telephone and operating costs. (Ask for A-3-32)

REMOTE CONTROL UNIT, Type MCA-902-A/B, by the Mobile Communications Dept. of Allen B. DuMont Labs., 1500 Main Ave., Clifton, N.J., for two-way mobile radio systems enables the advantageous location of a base station and desk operation. (Ask for A-3-33)

MOTOR. Permanent magnetic dc unit, announced by El Ray Motor Co., North Hollywood, Calif., designed to drive switches, cams, servos., etc., has a 1-⅛ in. diam. Length, 2-$\frac{1}{16}$ in. Gear case diam 1-½ in. Wt., 5-½ oz. (Ask for A-3-35)

BOBBIN WINDER, Model 212-AM, offered by Geo. Stevens Mfg. Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill. has a finger tip, instantaneous wire guide return. Winds all types of random wound bobbin coils, solenoids, repeater coils, etc. (Ask for A-3-21)

IMPEDANCE BRIDGE, Model 250-DA, is an accurate wide range instrument designed for the measurement of resistance, capacitance, inductance, dissipation factors, and storage factors. Made by Electro-Measurements, Inc., 4312 S. E. Stark St., Portland, Ore. (Ask for A-3-22)

LEAD SULPHIDE CELL, CE 705, is a new photo-conductive unit announced by Continental Electric Co., Geneva, Ill. that is being used in the IBM Type 702 electronic data processing machine to detect the beginning and the end of the magnetic tape. (Ask for A-3-19)

VOLTAGE RATIO COMPARATOR, Model 592, made by Telectro Industries Corp., 35-18 37th St., Long Island City 1, N.Y. is used to set accurate voltage ratios, both ac and dc by a calibrated voltage divider network and a zero-center microammeter. (Ask for A-3-20)

FASTENER AND SPACER, a new latch-type "Speed Clip" by Tinnerman Products, Inc., P.O. Box 6688, Cleveland 1, O., provides a positive, vibration-proof attachment of printed circuit boards to radio chassis that can be made by hand. (Ask for A-3-34)

POTENTIOMETERS. Eight models of 970 series wire-wound potentiometers announced by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. have power ratings from 2 to 20 w. at 40 C. and 17 stock resistance values from 2 to 500,000 ohms. (Ask for A-3-36)

GEIGER COUNTER-ASSAYER that enables field assay of radioactive substance has a claimed range up to 12,000 counts/min. Made by Hoffman Laboratories, Inc., 3761 S. Hill St., Los Angeles 7, Calif. (Ask for A-3-37)

MOUNTING CONTROLS, series 47 twisted-tab type, announced by Clarostat Mfg., Co., Dover, N.H. are available with or without power switches. Save time, labor and material. (Ask for A-3-38)

CERAMIC CAPACITORS for color TV receivers, available at Hi-Q Div. Aerovox Corp., Olean, N.Y. are rated at a working voltage of 30 KVDC, or a test voltage of 50 KVDC for 1 min. (Ask for A-3-39)

VACUUM GAUGE. A new single-station thermocouple gauge with printed circuit, Type TG-029, has been announced by Consolidated Vacuum Corp., subsidiary of Consolidated Engineering Corp., 1775 Mt. Read Blvd., Rochester 3, N.Y. (Ask for A-3-42)

WINDER for small toroid coils finished to a ⅛ in. inner diameter has been developed by Electro Devices Co., Inc., 463 Commercial St., Boston, Mass. Measures only 9½ in. in length. No. 30 to No. 40 wire sizes. (Ask for A-3-43)

"VERSTROL," by Assembly Products, Inc., Chesterland, O., detects minute changes of current or voltage while indicating their magnitude and trips relays as a result of these changes. No vacuum tubes. Contact is in meter relay. (Ask for A-3-44)

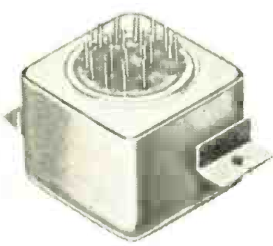
TRANSFORMERS. Line to speaker matching transformers for commercial sound systems using 70 v. distribution techniques have been recently developed by Electronic Communication Equipment Co., 1249 W. Loyola Ave., Chicago 26, Ill. Three sizes available. (Ask for A-3-41)

MORE NEWS on page 28

Airborne Components...

a C.A.C. Specialty

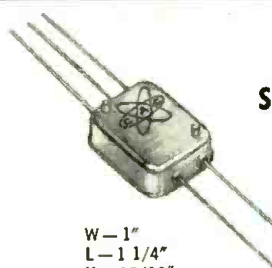
C-A-C®



POWER TRANSFORMERS

Range—400-6000 cps
Efficiency—up to 95%
Wattage—6mw-200 watts
Temperature—-55 to +155° C.

Depicted—6KC 100 Watt Unit
Less than 1.65 cubic inches



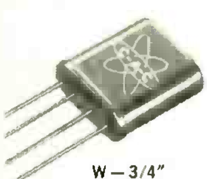
W—1″
L—1 1/4″
H—15/32″

SATURABLE REACTORS

Applications

- Servo Systems
- Data Telemetering
- Remote Frequency Control

Illustrated—High Frequency Reactor Tuned by Varying D. C. Current



W—3/4″
L—3/4″
H—5/16″

PULSE TRANSFORMERS

Pulse Width—.2-50 microseconds
Rise Time—from .03 microseconds

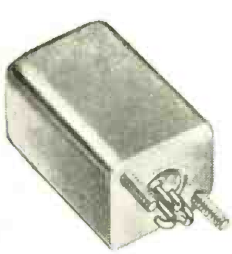
- Blocking oscillator
- Pulse coupling
- Toroidal construction

MAGNETIC AMPLIFIERS

Wattage (output) .5-200 watts
Response—1 cycle up

W—1 1/4″
L—1 3/4″
H—2 5/32″

Illustrated—Auto Pilot Application for Printed Circuit Mounting



W—23/32″
L—23/32″
H—11/16″

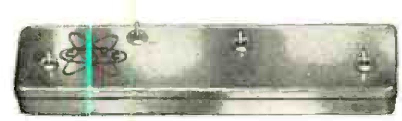
Illustrated
4KC
Band Pass

SUB-MINIATURE FILTERS

For Chassis Mount

Frequency—2.3-35Kc
Impedance in—600-10K Ohms
Impedance out—Grid

- Hermetic Sealed
- Temperature Compensated
- Internal D.C. Isolation
- Balanced or Unbalanced
- Military Specifications



SUB-MINIATURE TUNED CIRCUITS

For Printed Circuit Applications

- Multiple Tuned Transformers
- Delay Lines
- Tuned Circuits

W—1″
L—4 1/4″
H—7/16″

See us at Booth 465 Electronic Avenue, I.R.E. National Convention, Kingsbridge Armory, New York City, March 21-24

FOR ADDITIONAL INFORMATION CONTACT

COMMUNICATION ACCESSORIES COMPANY

HICKMAN MILLS, MISSOURI • PHONE KANSAS CITY, SOUTH 5528

3-55/1.0

I.R.E. National Convention Radio Engineering Show
BOOTH 465

For product information, use inquiry card on last page.

Survey of

New Products of the Month

Capsule summaries of latest electronic developments provide handy reference for engineers in the market for new equipment and components

"MICAPS," a new line of mica capacitors, produced by Micamold Radio Corp., 1087 Flushing Ave., Brooklyn 37, N. Y., are encapsulated and hermetically sealed by dip coating. Smaller than molded types. (Ask for A-3-76)

LUBRICANT. A new silicone fluid, developed by Westinghouse Materials Engineering Dept., E. Pittsburgh, Pa., has passed thermal stability and viscometric tests ranging from −65° to 500°F. (Ask for A-3-77)

RELAY, Type 8AC, developed by Phillips Control Corp., Joliet, Ill., has self-contained rectifier, thereby eliminates exterior wiring and requires less space. (Ask for A-3-78)

RATE GYRO, Model 36128, announced by G. M. Giannini & Co., Inc., 918 E. Green St., Pasadena 1, Calif., weighs less than 1½ lbs. Diam. 2.0 in., 2.68 in. long. Rotor develops 1,500,000 gm cm²/sec. (Ask for A-3-79)

MAGNET WIRE insulated with "Alkanex," a thin-film, polyester-type developed by the G-E Research Lab., is available in round sizes No. 13 Awg. through No. 26 Awg. at Construction Materials Div., General Electric Co., Bridgeport 2, Conn. (Ask for A-3-80)

PANEL METER. A new unit that indicates the ratio of two direct currents is being produced by Thomas A. Edison, Inc., Instrument Div., West Orange, N. J. Handles 50 ma in either coil. (Ask for A-3-81)

TRANSMITTER. A new type of AM radio broadcast unit is a 50-kw maximum power "Ampliphase" type announced by Radio Corp. of America, Engineering Products Div., Camden, N. J. Requires half the space of comparable equipment. (Ask for A-3-82)

SLOTTED LINE, Type 874-LBA, operating over the range from below 300 to 5,000 MC, announced by General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass., is for measuring impedance, standing wave ratio, and attenuation. (Ask for A-3-83)

LONG PLAYING TAPE, called "Irish" LP No. 600 by ORRadio Industries, Inc., Opelika, Ala., because it provides to 6 hrs. playing time at 1⅞ in./sec. Dual track. On 1 mil acetate or 1 mil "Mylar." (Ask for A-3-84)

COPPER CLAD RESISTORS, fixed-composition, Types GM and HM, when mounted on steel panels 4 in. sq., 0.050 in. thick, with ambient temp. of 70°C, have continuous ratings of 3 and 4 w., respectively. By Allen-Bradley Co., 136 Greenfield Ave., Milwaukee 4, Wis. (Ask for A-3-85)

COAXIAL DIALS, the SR series "Duodial" turns counting units, designed for use with the AJ series "Helipot" can be used with any rotating component with a ⅛ in. diam. shaft. Made by Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif. (Ask for A-3-86)

VARIABLE CAPACITOR. A new miniature unit announced by Radio Condenser Co., Camden 3, N. J., for transistorized radio receivers, is the smallest in the company's line. (Ask for A-3-87)

ELAPSED TIME METER, announced by the Instrument Div., Roller-Smith Corp., Bethlehem, Pa., is available in 2½ and 3½ in. sealed and "Bakelite" cases. Dimensions conform with MIL specs. (Ask for A-3-88)

PACKAGING DEVICE, announced by Vitramon, Inc., Box 544, Bridgeport 1, Conn., releases capacitors as required when holder card is bent. Eight cards fit into standard carton without packing. (Ask for A-3-45)

SOLDERING IRON, called "Esico Luger" by The Electric Soldering Iron Co., Inc., Deep River, Conn., has fast-heating tip. Lessens fatigue and speeds spot welding. Actuated by one to three fingers. (Ask for A-3-46)

OHMETER, Model LRO, announced by Industrial Instruments, Inc., Cedar Grove, N. J., has ±1% of full-scale reading accuracy. Ranges, 0.1, 1.0 and 10 ohm full-scale reading. Powered by 1½ v. standard flashlight battery. (Ask for A-3-47)

THYRATRON. A new 3.2 amp dc thyratron has been developed by National Electronics, Inc., Geneva, Ill. Designated NL-730. The gas and mercury vapor unit is rated at 2.5 filament volts, 12 amps filament current. (Ask for A-3-48)

STANDARD SLIP RING and spring-loaded brush contact assys. Available in 10 combinations, 4 micro finish, with 1, 2, 3, 4 silver graphite brush contacts per ring as desired. Ring diam. 1⅜ x 1 in. I.D. Electro-Development Co., 14701 Keswick St., Van Nuys, Calif. (Ask for A-3-49)

SHIELDING BEADS to provide decoupling in circuit wiring have been announced by Ferroxcube Corp. of America, 233 E. Bridge St., Saugerties, N. Y. Made of ferrite material. (Ask for A-3-50)

FREQUENCY STANDARD, 400 and 500 cps., announced by American Time Products, Inc., 580 Fifth Ave., New York 36, N.Y., is in an octal-based 1½ in. diam. x 4½ in. housing. Transistor operated. (Ask for A-3-51)

COIL FORM, made of "Polypenco" Q-200.5 styrene copolymer, supplied by Polymer Corp. of Pa., Reading, Pa., is responsible for accuracy and sensitivity of the new electromagnetic delay lines developed by Helipot Corp., S. Pasadena, Calif. (Ask for A-3-52)

BATWING ANTENNAS for VHF TV broadcasting stations announced by General Electric Co., Syracuse, N. Y., use ⅞ in. "Styroflex" feed lines, and new junction boxes and cable grounding. Thirteen new units conform to new RETMA 50 ohm input impedance standard. (Ask for A-3-53)

RELAY, series 805 dc 32 pole, is now available at Guardian Electric Mfg. Co., 1627 Walnut St., Chicago, Ill. Can connect 32 electrical circuits simultaneously. Weight, less than 5 oz. (Ask for A-3-54)

ROTARY CONVERTER. The analog-digital "Digitometer" has been added to the ultra low torque servo components line of Electro-Mec Laboratory, Inc., 21-09 43rd Ave., Long Island City 1, N. Y. Type 15 has a shaft torque of 0.15 oz. (Ask for A-3-55)

QUARTZ CRYSTALS, CR-38/U and CR-50/U, announced by Cryco, Inc., 1138 Mission St., S. Pasadena, Calif., have frequency ranges of 16-100 kc, load capacities of 20μμf, frequency tolerances of 0.012%. Temperature range, −40° to +70°C. Meet MIL-C-3098A. (Ask for A-3-56)

"TENSOLITE" HOOK-WIRE, announced by Tensolite Insulated Wire Co., Inc., 196 Main St., Tarrytown, N. Y., features an extruded "Teflon" insulation to resist abrasion and wide-range temperature variation from −90° to +250°C. (Ask for A-3-60)

GENERATING PLANT, Model 75 HR a new 75 kw, 93.75 kva gasoline driven unit has been announced by D. W. Onan & Sons, Inc., Minneapolis 14, Minn., for heavy duty and standby service. (Ask for A-3-59)

MORE TECHNICAL INFORMATION

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

SEALED TERMINALS, with compression type threaded end seals, for use on condensers, capacitors, and similar components, supplement the regular line of Electrical Industries, 44 Summer Ave., Newark 4, N. J. (Ask for A-3-58)

TRANSMISSION FILTER, the first made from germanium for infrared application, introduces a series of optical products made from transistor materials to be placed on the market by Baird Associates, Inc., 33 University Rd., Cambridge, Mass. (Ask for A-3-57)

PLUG-IN UNITS, power supplies, load relays, and automatic interrupters, announced by Assembly Products Inc., Chesterland, O., are being redesigned to further simplify the assembly of meter-relay controls. (Ask for A-3-61)

GENERATOR TYPE 240-A, a new multi-purpose precise signal source announced by Boonton Radio Corp., Boonton, N. J., has a frequency range from 4.5 to 120 MC continuously tunable in 5 ranges. Accuracy, ±1%. (Ask for A-3-64)

CATHODE-RAY OSCILLOGRAPH, Type 340, announced by the Instrument Div., Allen B. Du Mont Labs., 760 Bloomfield Ave., Clifton, N. J., features identical X and Y amplifiers with identical frequency response from dc to 30% down at 100 kc. (Ask for A-3-65)

BASIC ANTENNA TOWERS for TV broadcasting stations in 7 basic lattice-type designs were announced as available by the Engineering Products Div., Radio Corp. of America, Camden, N. J. (Ask for A-3-66)

WAVEGUIDE, Type ARA-136, has been developed for use with C-band or X-band commercial airborne weather penetration radar by Airtron, Inc., Linden, N. J. Flexible double ridge type. (Ask for A-3-67)

POLYETHYLENE CONTAINERS, called "Polyvials," for shipping and storing small electronic units and parts, have been announced by Olympic Plastics Co., Inc., 215 E. Washington Blvd., Los Angeles 15, Calif. (Ask for A-3-68)

"TORSYNATOR," a new remote positioning device has a potentiometer for a sender and a low-inertia motor for a receiver. Designed by Air-Marine Motors, Inc., 369 Bayview Ave., Amityville, L. I., N. Y., to replace servo-mechanisms in some applications. (Ask for A-3-69)

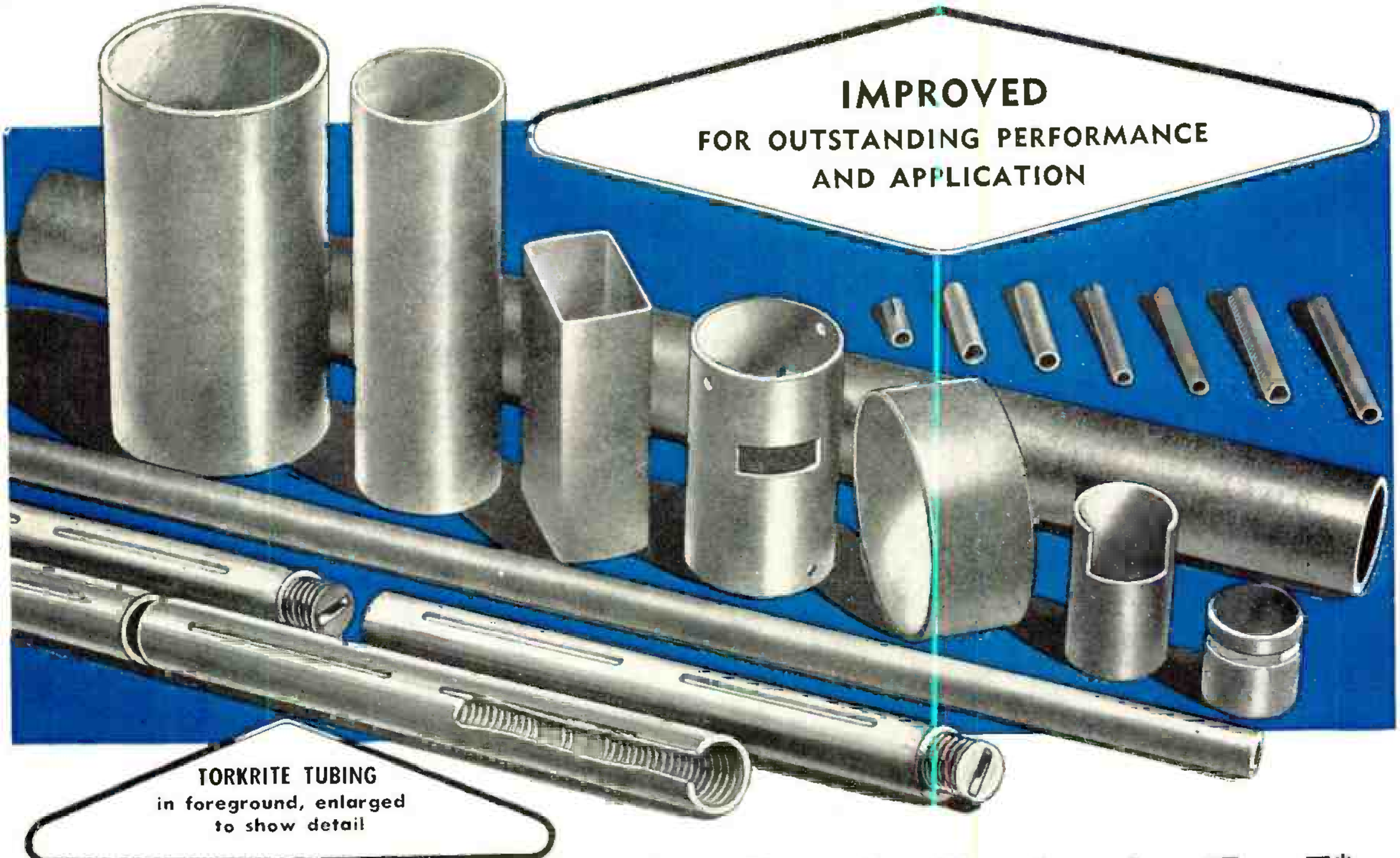
TUNER, developed for noise and field intensity meter, Model NF-105, covers the range from 150 kc to 20 megacycles, announced by Empire Devices Products Corp., 38-15 Bell Blvd., Bayside, L. I., N. Y. (Ask for A-3-70)

TESTER, automatic Hi-Pot Model A., announced by Industrial Test Equipment Co., 55 E. 11th St., New York 3, N. Y., tests in sequence the dielectric strength between any 10 conductors and indicates the locations of breakdowns. (Ask for A-3-71)

NETWORKS, hermetically sealed resistance and resistance-capacitance units, announced by The Daven Co., Dept. RE, 191 Central Ave., Newark 4, N. J., can be supplied with resistance values to ±0.02%. (Ask for A-3-72)

VACUUM RELAY, Type R5-E, designed for pulse network, antenna transfer, and guided missile applications, is the smallest produced by Jennings Radio Mfg. Corp., P.O. Box 1278, San Jose 8, Calif. 3 in. long, 2 in. in diam. (Ask for A-3-73)

MORE NEWS on page 32



C L E V E L I T E*

LAMINATED PAPER BASE PHENOLIC TUBING

In seven specific grades, Clevelite is one of the finest and most complete lines of tubing available to the electronic and electrical industries.

Grade	Application
Grade E	...Improved post-cure fabrication and stapling
Grade EX	...Special grade for TV yoke sleeves
Grade EE	...Improved general purpose
Grade EEX	...Superior electrical and moisture absorption properties
Grade EEE	...Critical electrical and high voltage application
Grade XAX	...Special grade for government phenolic specifications
Grade SLF	...Special for very thin wall tubing having less than .010 wall

High performance factors, uniformity and inherent ability to hold to close tolerances, make Clevelite outstanding for Coil Forms, Collars, Bushings, Spacers and Cores.

Competent Research and Engineering facilities are always available to aid in solving those tough and stubborn design and fabrication problems. May we help you?

Fast, Dependable Delivery at all times.

WHY PAY MORE? For Good Quality . . . call CLEVELAND!

*Reg U. S. Pat. Off.

★ ★ ★

TORKRITE POSSESSES MANY ADVANTAGES

Torkrite affords unmatched recycling ability. After a maximum diameter core has been re-cycled in a given form a reasonable number of times, a minimum diameter core can be inserted and measured at 1" oz. approximately.

Torkrite has no hole or perforation through the tube wall. This eliminates the possibility of cement leakage locking the core or cores.

Torkrite permits use of lower torque as it is completely free of stripping pressure.

With Torkrite, torque does not increase after winding, as the heavier wall acts to prevent collapse and core bind.

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

★ ★ ★

Visit
our Exhibit #519
at the
Radio Engineering Show
in New York City
March 21-24.

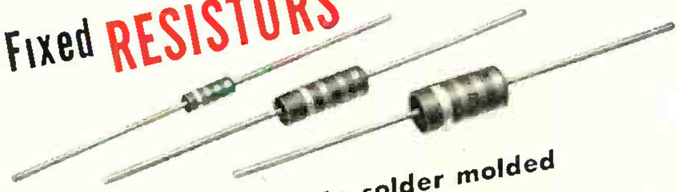
The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO

PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, Ogdensburg, N.Y., Jamesburg, N.J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

NEW YORK AREA R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO

STACKPOLE Fixed RESISTORS

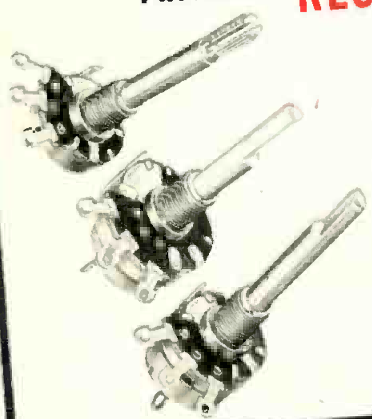


. . . dependable, easy-to-solder molded composition types

Stackpole 1/2-, 1- and 2-watt resistors not only meet exacting performance standards, but save assembly time thanks to their highly-tinned, easily-soldered leads.

MIL-R-11A TYPES—in styles RC20, RC30, RC31, and RC42 available. Write for data on all MIL types.

STACKPOLE Variable RESISTORS



with versatile switching

Single, ganged and concentric shaft dual types in smallest sizes consistent with real dependability offer long, and trouble-free performance for today's requirements. Gold plated "ring spring" contactors assure low noise level. A complete array of unique midget line switches offers practically any desired switching arrangement, with types for both civilian and military use.

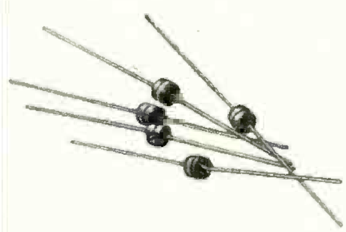
. . . A dependable source of reliable components for over 30 years

New!

Tab-mounting Bakelite shaft control

Just right for rear-of-chassis or concealed front panel controls in TV receivers . . . especially in high voltage circuits. Measures only 0.894" in diameter, yet handles a full .5-watt. Write for data on Stackpole Type LR-6.

STACKPOLE Composition CAPACITORS



Cost-saving, low-value, fixed types

Originated by Stackpole, these tiny units not only represent the simplest, most inexpensive capacitor design yet produced — but likewise have characteristics that make them more desirable than larger, more costly capacitors for many uses. 47 standard types, 0.1 to 10.0 mmf. Write for Stackpole GA Capacitor Bulletin.

STACKPOLE Iron CORES

. . . to match any electrical or mechanical specification

Pioneers in modern iron core development, Stackpole offers practically any desired style and with assured uniformity of both electrical and mechanical characteristics.
Write for Iron Core Bulletin.

New "EE" Engineered Economy Cores

. . . standardized to meet 80% of all requirements at low cost. Write for data on any type.

AVAILABLE THROUGH PARTS DISTRIBUTORS! For name of nearest distributor stocking Stackpole resistors, switches and "EE" iron cores write: Distributors' Division, Stackpole Carbon Co., 26 Rittenhouse Place, Ardmore, Pa.

STACKPOLE *Ceramag*® **CORES**
(Ferromagnetic)

for real uniformity! Wherever ferromagnetic cores are used, Stackpole Ceramag Cores have set the quality standards. But proved superiority in essential characteristics is only part of the story. Even more important is the fact that Stackpole Ceramag core characteristics are maintained with remarkable uniformity regardless of size, shape or production quantity. *The sample matches your specification "on the nose"—and each production unit is exactly like the sample!* Write for Ceramag Bulletin RC-9A including details on available grades and latest characteristic curves.

STACKPOLE
Molded **COIL FORMS**

Cut Assembly Costs!

Reduce coil sizes and cut assembly costs with simplified point-to-point wiring and fewer soldered connections. Over 35 new types available in phenolic, iron, or phenolic with iron center sections. Axial or "hairpin" leads. Write for complete specifications on all types.

STACKPOLE
Slide **SWITCHES**

. . . the economy switches of 1001 uses!

Over 20 types of these inexpensive little Stackpole slide switches cover just about every mechanical and electrical switching requirement for radio and television equipment, small motors, appliances, electrical toys, instruments, etc. For complete details, write for Stackpole Switch Bulletin RC-9B.

Engineering Samples are proof of the pudding!

Engineering samples of standard Stackpole components are available to quantity users. Send details of your requirement for recommendation by Stackpole engineers.

ELECTRONIC COMPONENTS DIVISION
STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

STACKPOLE

NEW TECH DATA for Engineers

Resumes of new catalogs and bulletins offered this month by manufacturers to interested readers

Pulse Generators

A six-page, loose leaf folder, prepared by Burroughs Corp., Electronics Instruments Div., Philadelphia 7, Pa., gives the ABC's of pulse testing and describes three precision pulse generators made by Burroughs. (Ask for B-3-43)

Dynamic Microphones

A 4-page brochure released by Frank L. Capps & Co., Inc., 20 Addison Place, Valley Stream, N.Y. describes the company's line of dynamic and condenser microphones. (Ask for B-3-44)

Terminals and Printed Circuits

"USECO" terminals, terminal boards, and etched and printed circuits are described in a new 8-page bulletin offered by U.S. Engineering Co., 521 Commercial St., Glendale 3, Calif. The bulletins also illustrate production methods and detail quality control. (Ask for B-3-45)

Capacitors

Hi-Q div., Aerovox Corp., New Bedford, Mass. have issued a 24-page catalog that illustrates, and gives performance characteristics and engineering data covering the company's range of ceramic capacitors, plate assemblies, etc. (Ask for B-3-46)

Magnetic Recording Heads

Stancil-Hoffman Corp., 921 North Highland Ave., Los Angeles 38, Calif. have released an informal discussion of magnetic recording heads. Covers considerations of basic design and gives curves and factors in associated electronics. Ten cents in postage. (Ask for B-3-47)

Hysteresis Synchronous Motors

Nineteen models of hysteresis synchronous motors for high fidelity recording and reproducing equipment are described in catalog No 403-2 with specifications, wiring diagrams, mounting details, etc. Issued by Technical Development Corp., 4060 Ince Blvd., Culver City, Calif. (Ask for B-3-31)

Transducers

"Instrument Notes No. 28," released by Statham Laboratories, Inc., 12401 W. Olympic Blvd., Los Angeles 64, Calif. presents an article by Arthur T. Snyder, Boeing Airplane Co., entitled "A New System for Monitoring the Over-all Transduction Ratio for Analog Recording Channels Employing Bridge Type Transducers." Available on request (Ask for B-3-32)

Control Board

The "Handbook on Modern Stage Lighting Control" is available at the Lumi-Tron Div., Metropolitan Electric Mfg., Co., 2250 Steinway St., Long Island City 5, N.Y. (Ask for B-3-33)

Frequency Counter

A new bulletin on the DS-6100 electronic frequency counter, issued by Detectron Corp., 5420 Vineland Ave., North Hollywood, Calif., illustrates the instrument and gives characteristics and technical data. (Ask for B-3-34)

Test Instruments

The Shasta Div., Beckman Instruments, Inc., 1432 Nevin Ave., Richmond, Calif., announces a brochure describing its new line of electronic test instrumentation that includes vacuum tube voltmeters, oscillators, square wave generators, bridges, power supplies, wide band amplifiers, etc. (Ask for B-3-35)

Telemetering System

Bulletin No. EA-8, released by Control Corp., 718 Central Ave., Minneapolis 14, Minn., describes the TM-15 high speed telemetering system which can be operated over microwave, telephone lines, or carrier current to meter volts, amperes, watts, VARS, power factors, pressures and flows, etc. (Ask for B-3-36)

Data Recording Equipment

Bulletin 54-D, released by The Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md., illustrates, describes, and presents technical data covering the Models 530 and 540 magnetic tape recorders. (Ask for B-3-37)

Switchboards

GEA-6168. available at Advertising and Sales Promotion. General Electric Co., Plainville. Conn.. consisting of 24 color pages, describes various types of stage lighting switchboards. Special specification sheets are included in a pocket. (Ask for B-3-38)

Generator

A data sheet released by Decade Instrument Co., Box 153, Caldwell, N.J., describes the "Sweepalator," a combined signal and sweep generator and the "Decalator," Model B., crystal-controlled signal generator. Specifications are given for both instruments. (Ask for B-3-39)

Arbors

Precision Paper Tube Co., 2035 W. Charleston St., Chicago 47, Ill., has issued a listing of over 2,000 coil forms in all shapes, sizes, I.D.'s and O.D.'s with technical data and other engineering information. Write to Dept. TTN. (Ask for B-3-40)

Instruments

Catalog No. 354, prepared by J-B-T Instruments, Inc., 441 Chapel St., New Haven 8, Conn. illustrates and technically describes the variety of meters, testers, switches, indicators, etc., that are produced by the company. Available at D. F. Tobias & Co., 30 Church St., New York 7, N.Y. (Ask for B-3-11)

Components

The 60-page, two-color Catalog 55W presents complete data and outline drawings covering the 3 to 75 KMC waveguide components made by Microwave Associates, 22 Cummington St., Boston, Mass. (Ask for B-3-12)

Electric Plants and Engines

"Power Points Digest," Vol. 10, No. 6, illustrates and interestingly presents electric plants and engines made by D. W. Onan & Sons, Inc., Minneapolis 14, Minn. and their application to Civil Defense. Available without charge. (Ask for B-3-13)

Instruments

A summary released by Kay Electric Co., Maple Ave., Pine Brook, N. J. gives a brief description of each company instrument or accessory with its price and suggests that, for more details and specifications, interested readers write for the complete 1954-55 free catalog. (Ask for B-3-14)

Casting Resin

Technical Bulletin No. 7-2-8, issued by Emerson & Cuming, Inc., 869 Washington St., Canton, Mass. presents the properties of "Stycast" 2340 M, a two-part casting resin that requires no catalyst. (Ask for B-3-15)

Pilot Lights

Form L-157, obtainable by writing to R. E. Greene, Dialight Corp., 60 Stewart Ave., Brooklyn 37, N.Y. describes subminiature pilot lights of the one-terminal type for use on grounded circuits with T-1¾ bulbs having midget flange type bases. (Ask for B-3-16)

TV Information Package

A package that provides technical specifications, prices, and other pertinent information, available at TV Transmitter Dept., Allen B. Du Mont Labs., Inc., 1500 Main Ave., Clifton, N.J. to broadcasters, engineers, and consultants, includes a 36-page book depicting four studio color system layouts, a 20-page brochure describing the operation of Du Mont's color and monochrome multi-scanners, and a separate 10-page color equipment price list. (Ask for B-3-19)

Networks

White Instrument Laboratories, 203 Riverside Dr., Austin 4, Texas, has released Bulletin 500 covering the standard types 501 and 502 twin-T networks. (Ask for B-3-17)

Electronic Gauger System

Application data sheet 102, issued by the Technical Information Service, Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif., describes and illustrates principles of operation, equipment, and circuitry of a telemetering system and use of "Helipot" precision potentiometers. (Ask for B-3-18)

Felt

Ingalls Electronics Co., 30 West Putnam Ave., Greenwich, Conn., have released an interesting 4-page brochure that illustrates and describes the electronic applications of two new products—acoustical felt and latex impregnated felt. (Ask for B-3-26)

Potentiometers

Bulletin D54-1, issued by Markite Corp., 155 Waverly Place, New York 14, N.Y., gives design features, typical performance data, and application advantages of Types 2234 and 2235 rectilinear-motion potentiometers. (Ask for B-3-27)

Transformers

Custom specification of transformers is greatly simplified for the design engineer and the purchaser by the 20-page catalog issued by General Transformer Company, 18240 Harwood Ave., Homewood, Ill. Illustrates "Prototypes" covering the complete range of applications. (Ask for B-3-28)

Mounts

"Barry Product Digest," a 4-page illustrated brochure announced by Barry Corp., Dept. P., 1000 Pleasant St., Watertown, Mass., shows all company standard isolators including miniature shock and vibration mounts. Also, it lists technical articles on shock and vibration. Available to engineers on request. (Ask for B-3-29)

Deflection Yoke Winder

A catalog page by Geo. Stevens Mfg., Co., Inc., Pulaski Rd. at Peterson, Chicago 30, Ill., illustrates and describes the new Model YW series deflection yoke winder. Gives complete technical data on winding motion, coil types, etc. (Ask for B-3-30)

Panel Instruments

"Electrical Measurements," Vol. 21, No. 10, lists and details the complete line of panel instruments with accuracies as high as 0.25 of 1% in dc sensitivities that are made by Sensitive Research Instrument Corp., 9-11 Elm Ave., Mt. Vernon, N.Y. (Ask for B-3-42)

RF Coaxial Cables

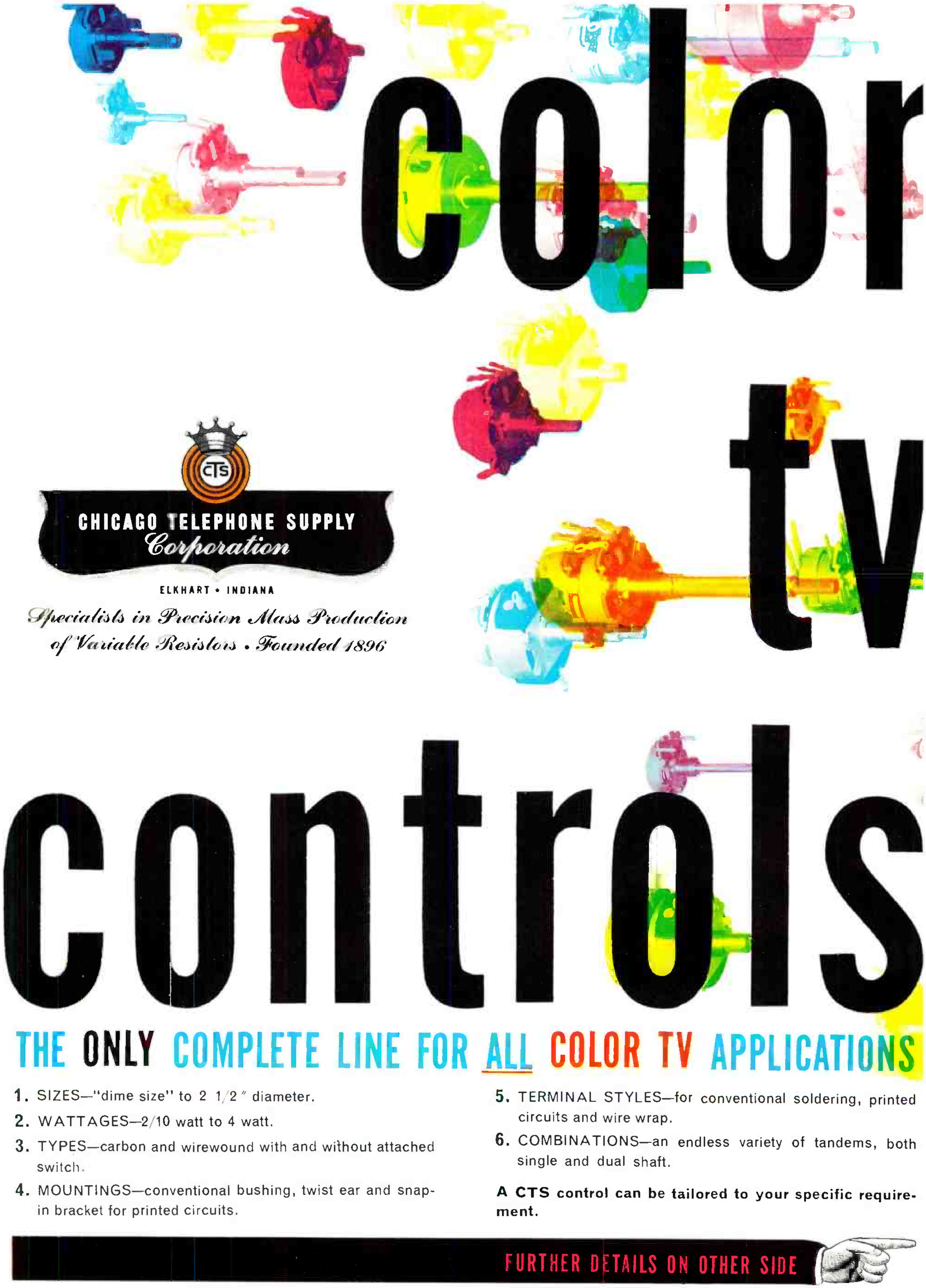
Catalog W1, issued by American Phenolic Corp., 1830 South 54th Ave., Chicago 50, Ill., is a new, separate 34-page publication that illustrates and presents the electrical characteristics of "Amphenol" r-f coaxial cables and transmission lines, and the physical properties of associated jackets, insulations, and conductors. Described, too, are the advantages of the "Amphenol" RF Connector Folders. Catalog R1 illustrates and presents technical data and dimensional drawings covering the company's "Blue Ribbon" connectors. (Ask for B-3-41)

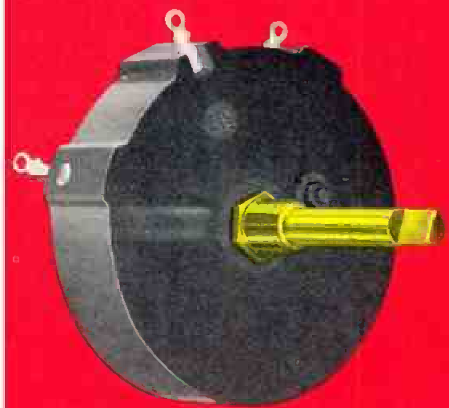
Towers

The numerous variables involved in tower construction are presented in literature issued by Tower Structures, Inc., Gregg St., Lodi, N.J. (Ask for B-3-22)

OBTAIN THESE BULLETINS

described here by writing on company letterhead to Bulletins Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.


color tv controls
CHICAGO TELEPHONE SUPPLY Corporation
ELKHART • INDIANA
Specialists in Precision Mass Production of Variable Resistors • Founded 1896
THE ONLY COMPLETE LINE FOR ALL COLOR TV APPLICATIONS
1. SIZES—"dime size" to 2 1/2" diameter.
2. WATTAGES—2/10 watt to 4 watt.
3. TYPES—carbon and wirewound with and without attached switch.
4. MOUNTINGS—conventional bushing, twist ear and snap-in bracket for printed circuits.
5. TERMINAL STYLES—for conventional soldering, printed circuits and wire wrap.
6. COMBINATIONS—an endless variety of tandems, both single and dual shaft.
A CTS control can be tailored to your specific requirement.
FURTHER DETAILS ON OTHER SIDE

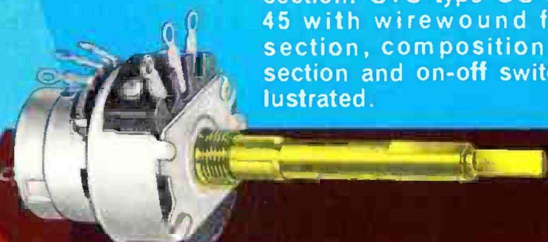


High voltage control for focus applications. Rated up to 5,000 volts DC across end terminals and 2 1/2 watts depending on total resistance. Will operate up to 15,000 volts DC above ground when mounted on insulated panel. CTS type 85.

Miniature 3/4" "dime size composition control. Con serves panel space at pric comparable to larger siz bushing mounted controls CTS type 70.

1 1/8" diameter composition control for applications where ratings up to 3/4 watt required. CTS type 35.

Concentric shaft tandem control with conventional bushing mounting. Designed for front panel dual knob applications, such as contrast and volume. Available in various combinations of composition or wirewound front and rear sections with or without on-off switch attached to rear section. CTS type GC-C252-45 with wirewound front section, composition rear section and on-off switch illustrated.



ar mounted composition ontrol. Simply twist two ars for rigid mounting. iminates bushing and ounting hardware. vailable with shafts for nob operation or for pre-et applications with sulated or metal shaft. TS type P45 with metal haft illustrated.

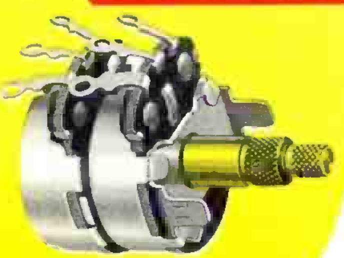
Ear mounted two watt wire wound available with or with out center tap. CTS typ P-254 with tap illustrated.

Four watt wirewound control available with or without center tap. CTS type 27 with tap illustrated.

Higher Wattage Carbo Controls With Exceptiona Stability Available

- **ONE WATT**: Entire 4 series 15/16" diameter lin available with 90 series special one watt military resistance elements.
- **TWO WATT**: Entire 3 series 1 1/8" diameter lin available with 95 series special two watt military resistance elements.

Ear mounted tandem for preset applications. Combines panel space saving features of a concentric tandem with the economy of an ear mounted unit. Available n various combinations of composition or wirewound front and rear sections. CTS type P-C2-45 with composition front and rear sections illustrated.



THE ONLY COMPLETE LINE FOR ALL COLOR TV APPLICATIONS

CTS also makes a complete line of controls for military, black and white TV, radio and other commercial applications. Consultation without obligation available for all your control applications. Write for complete catalog TODAY.

CTS

CHICAGO TELEPHONE SUPPLY Corporation

ELKHART • INDIANA

EAST COAST OFFICE
Henry E. Sanders
130 North Broadway
Camden 2, New Jersey
Phone: Woodlawn 6-1668
TWX No. Camden NJ 380

WEST COAST OFFICE
Robert A. Stackhouse
928 S. Robertson Blvd.
Los Angeles 35, California
Phone: Crestview 4-5931
TWX No. BEV H 7666

SOUTHWESTERN U.S.A.
John A. Green Company
6815 Oriole Drive
P.O. Box 7224
Dallas 9, Texas
Phone: Dixon 9918

CANADIAN DIVISION
C. C. Meredith & Co., Ltd.
Streetsville, Ontario
Phone: 310

SOUTH AMERICA
Jose Luis Pontet
Buenos Aires, Argentina
Montevideo, Uruguay
Rio de Janeiro, Brazil
Sao Paulo, Brazil

OTHER EXPORT
Sylvan Ginsbury
8 West 40th Street
New York 18, New York
Phone: Pennsylvania 6-8239

Specialists in Precision Mass Production of Variable Resistors • Founded 1896

Sylvania "600 ma" Tubes

99.7 proof*

FOR SERIES-STRING TV

* *In a 15-tube series string, analysis proved that 99.7% of all probable combinations of Sylvania types operated within 2% of the heater-current design center. Sylvania's tight heater-current limit is one of the most important contributions to tube performance for series string operation.*

Best for Set Designers In 4 big ways

Sylvania pioneered the development of "600 ma" series string tubes to make possible the cost, space and weight saving features of series-string TV design. And Sylvania gives you these important advantages to insure dependable set performance.

1. Less heater voltage variations—as a result of Sylvania's 99.7 proof tolerances on heater current, fluctuations in line voltage have less harmful effect on heater voltage. Steady-state heater voltage distribution is improved.

2. Less heater burn-outs—Rated heater warm-up time of approximately 11 seconds provides control of thermal characteristics. Voltage surges are alleviated.

3. Less time for normal set operation—Thermal control permits the use of a series resistor instead of a thermistor. Receiver reaches normal operation in less than half the time.

4. More uniformity—Because Sylvania makes everything but the bulb, quality is controlled from raw materials straight through to finished product.

Get the full story on the use of series-string tubes in TV sets by writing for this handy wall-chart brochure on the complete line of Sylvania "600 ma" tubes.

All Sylvania TV PICTURE TUBES now have heaters specially controlled for series string operation!

SYLVANIA

Dept. C40P
Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine St.
Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

See Sylvania in Booths 168-170-172 at the 1955 I.R.E. Show

For product information, use inquiry card on last page.

Better for you

PLUS

PHOTOFACT

Pyramid will now be listed in Photofact folders.

Pyramid has joined the select group of manufacturers who participate in this most valuable of all service aids to make available to you an immediate cross reference between the set manufacturer's part and the part number of the exact Pyramid equivalent.

You will find Pyramid capacitors as original components in sets bearing such famous brand names as

RCA • GE • CBS • Arvin • DuMont • Zenith • Raytheon • Emerson
Motorola • Sylvania • Packard-Bell • Hallicrafters • Westinghouse • Hoffman

and at leading parts distributors everywhere.

PYRAMID ELECTRIC CO., 1445 Hudson Boulevard, North Bergen, N. J.

FXR

4 INSTRUMENTS
1 LOW PRICE

"MICROVAL" PACKAGE

Regulated Klystron Power Supply

Tube Mount and Pad

Slotted Section and Probe

Standing Wave Amplifier

FXR Type Z816A
Regulated Klystron Power Supply
Beam: 300 to 500 V. up to 65 MA.
Reflector: 0 to 600 V.
Metered voltages and beam current.
Modulation: Square wave and sawtooth (sync. and external modulation jacks)

FXR Type X763A Tube Mount
Mounts 2K25 Klystron (Tube incl.)
Built-in 15 DB variable waveguide attenuator
Frequency Range: 8,500 to 9,600 MC/S

FXR Type X105A Slotted Section
Friction Drive
CM vernier scale
Special narrow tapered slot
Precision broached waveguide (1" x ½")
Built-in fixed-tuned probe with radiation suppression
Frequency Range: 8,200 to 12,400 MC/S
1N23B Crystal supplied

FXR Type B810A Standing Wave Amplifier
Standard FXR Precision Component
VSWR Ranges: 1 to 3, 3 to 10, 10 to 30, 30 to 100
Modulation Range: Wide band 300 to 4,000 CPS
Narrow band 1,000 ± 50 CPS
Metered Bolometer Bias: 3.5 to 9 MA.
Separate output jack (from cathode follower)
Calibrated Meter Scale: VSWR, DB, MA.

Other information available upon request.

COMPLETE BASIC EQUIPMENT
For measurements in the "X" band frequency range.

MICROwave VALue is packed into this FXR engineered package of companion instruments . . . made for each other, and priced right for budget minded schools and industry. The versatile Power Supply and Modulator unit drives the Klystron. The variable Buffer Attenuator controls power into the Slotted Section, where a sensitive fixed tuned Crystal Detector supplies the signal to a Standing Wave Amplifier. You get one well-integrated package for all purposes, and all these fine value-packed test instruments for one low price. Individual instruments are also available separately. Be sure to see them at the show. Delivery from stock.

I R E

See the complete line of
FXR PRECISION MICROWAVE TEST EQUIPMENT
at the I.R.E. Show
Kingsbridge Armory, March 21-24
BOOTH No. 375

Write today for Complete Catalog

ELECTRONICS & X-RAY DIVISION · F-R MACHINE WORKS, INC. · FXR ®

Electronics & X-Ray Division
F-R MACHINE WORKS, Inc.
26-12 BOROUGH PLACE, WOODSIDE 77, N. Y. • ASTORIA 8-2800

TELE-TIPS

EXPLOSIVE disconnects for opening as many as 100 circuits without shorting have been developed by Beckman & Whitley, San Carlos, Calif. The primers are fired by a 3-volt, 1-amp, surge, severing two securing screws.

TV-ELECTRONIC service technicians are being honored by a nationally promoted week (March 7-12) sponsored by RCA, and a special month (April 19-May 19) sponsored by GE. It's a wonderful idea. Now how about a special period for the engineers who made the whole business possible in the first place?

EFFICIENCY is the word for a device now on the market which solves two problems for engineers who have the headache of writing necessary reports. It's a pencil with a built-in tube containing a supply of aspirin.

BATTERIES play an often unrecognized vital role in the success of high speed experiments. For example, the Yardney Silvercels in the rocket sled that skidded to a stop from 632 mph in 1.5 seconds had to withstand a 35g force without damage. Similar requirements govern for guided missiles and torpedoes.

FCC authorizations now cover the use of over 700,000 transmitters, and there are about 850,000 commercial radio operators and more than 120,000 amateur radio operators holding permits. The Bell System provides over 5,000,000 telephone circuit-miles by microwave relay, and 54,000 miles of broadband channels for TV.

AUTOMATION receives an extra boost with the publication of a 74-page booklet by Armour Research Foundation under Air Force sponsorship. It's entitled, "A Catalog of Devices Useful in Automatic Data Reduction," and serves as a clearing house for government agencies and industry using automatic devices.

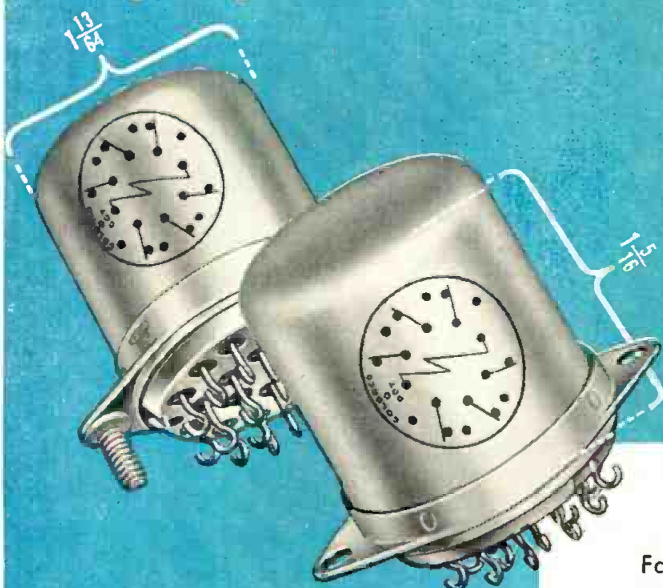
COMPILATION of descriptive data on almost 900 test equipments in 2300 pages constituting three volumes has been announced by Carl L. Frederick & Associates, 4630 Montgomery Ave., Bethesda 14, Md. The

(*Continued on page 44*)

New!

$$-Saver deluxe!

S-D
STRUTHERS-DUNN, INC.



HERMETICALLY-SEALED GENERAL-PURPOSE RELAY

TYPE FC-6 (6 D.T. Contacts)

Withstands 0 to 2,000 cycles vibration to 30G

Withstands up to 60 G shock without contact opening, 2,000 ft.-lbs. without contact transfer or damage.

Designed to exceed MIL-R-5757B and to meet MIL-R-25018 (USAF) and MS24115 (USAF) specifications.

Available for both 85°C and 125°C ambient Nominal coil voltage 26.5 volts DC.

...and priced materially lower than existing relays in its class!

Far superior in performance and durability to previous types, the new Dunco FC-6 hermetically-sealed general-purpose relay is priced materially lower.

Designed from a background of 5 years experience with the Dunco 220XFX100, the FC-6 offers far greater simplicity in its moving parts; easier construction and adjustment; extreme rigidity for high vibration and shock; high contact pressures; low contact bounce; plenty of contact over-travel; and complete absence of internal gaseous materials which might cause contact unreliability.

Vibration resistance of 0 to 2,000 cycles up to 30 G's is attained . . . a heretofore unheard of performance for relays of this class.

Throughout, the Dunco FC-6 incorporates safety factors that make it ideally suited for difficult applications, even in low-energy circuits.

Write, wire or 'phone for Dunco FC-6 Relay Data Bulletin L2406 giving complete specifications.

STRUTHERS-DUNN

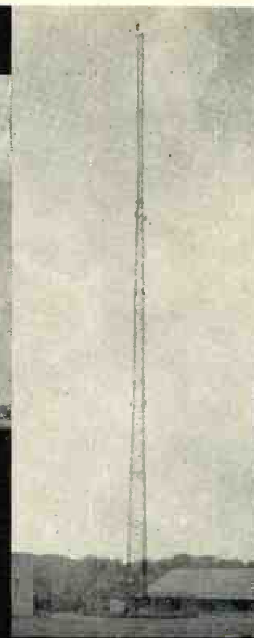
5,348 RELAY TYPES

STRUTHERS-DUNN, INCORPORATED, Pitman, N. J.

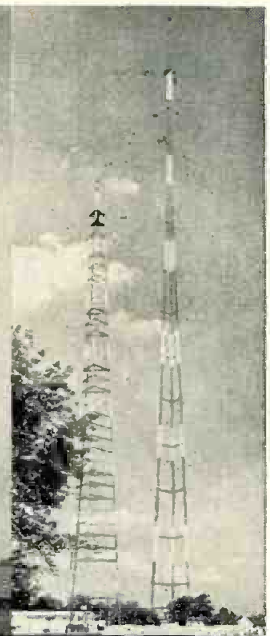
SALES ENGINEERING OFFICES IN: ATLANTA • BALTIMORE • BOSTON • BUFFALO • CHARLOTTE • CHICAGO CINCINNATI • CLEVELAND • DALLAS • DETROIT • KANSAS CITY • LOS ANGELES • MINNEAPOLIS • MONTREAL NEW ORLEANS • NEW YORK • PITTSBURGH • ST. LOUIS • SAN FRANCISCO • SEATTLE • SYRACUSE • TORONTO

WFMJ-FM Truscon Self-Supporting Directional Towers, 400 Feet Tall

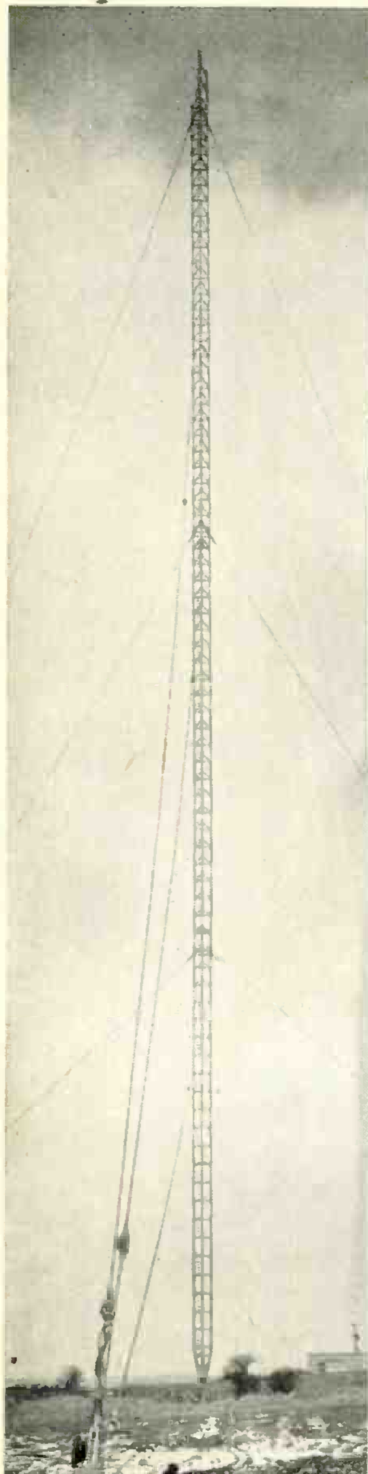
SEE YOUR NEXT TOWER IN OPERATION...NOW!



WBBW Truscon Self-Supporting Tower, 150 Feet Tall



WKBN-TV Truscon Self-Supporting Tower, 539 Feet Tall



WFMJ-TV
Truscon Guyed Tower, 1000 Feet Tall

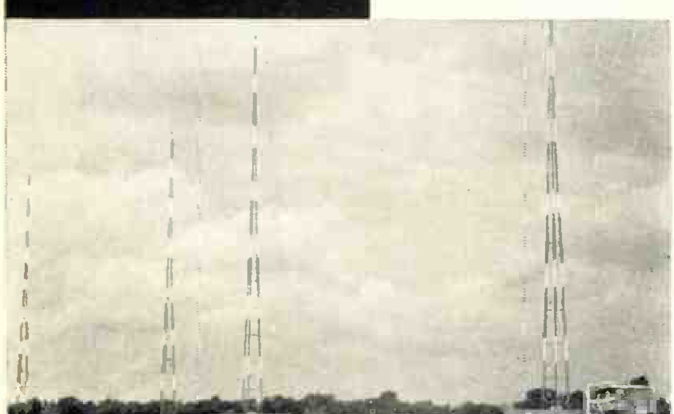
You can see and examine all types of Truscon Towers in full operation in Youngstown.

A tower is one piece of equipment no salesman can bring to you. He can't demonstrate its features in your office. Fortunately, you can get all the advantages of on-the-job demonstration simply by visiting Youngstown. You can get the facts to help you buy on proof. And, you can inspect Truscon's design and fabricating facilities at the same time.

You'll be able to see and examine:

1. A 150-foot self-supporting tower for AM broadcasting.
2. Four 400-foot self-supporting towers in directional array for AM broadcasting.
3. Six 350-foot self-supporting towers in directional array for AM broadcasting with one supporting an FM antenna.
4. A 539-foot self-supporting tower sustaining both an FM and a TV antenna.
5. A 1000-foot guyed tower with TV antenna.

Next time business takes you near Youngstown, make it a point to see all these Truscon Towers. Contact the Radio Tower Sales Department to let us know when you're coming.



WKBN Truscon Self-Supporting Directional Towers, 350 Feet Tall

TRUSCON®

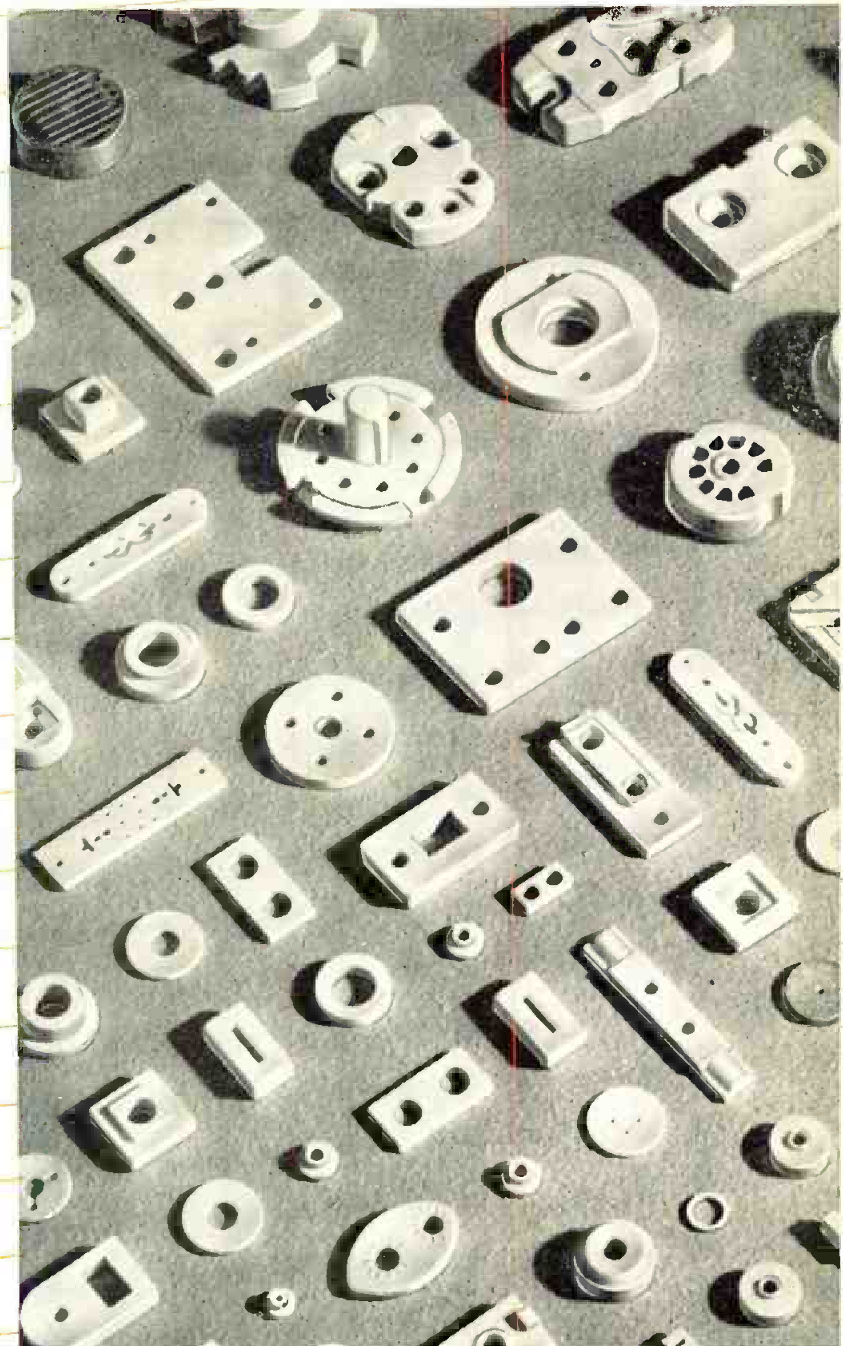
TRUSCON MARK OF MERIT PRODUCTS

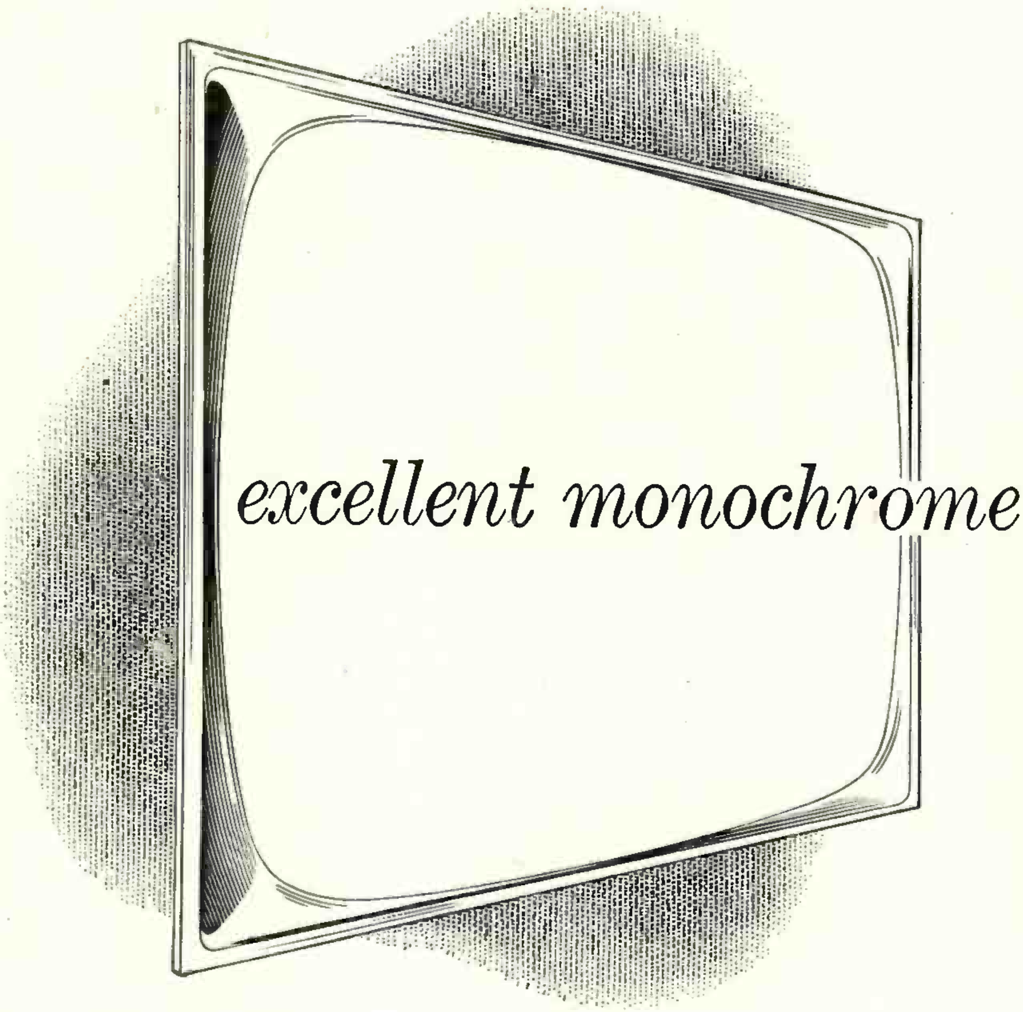
TRUSCON STEEL DIVISION
REPUBLIC STEEL

REPUBLIC STEEL

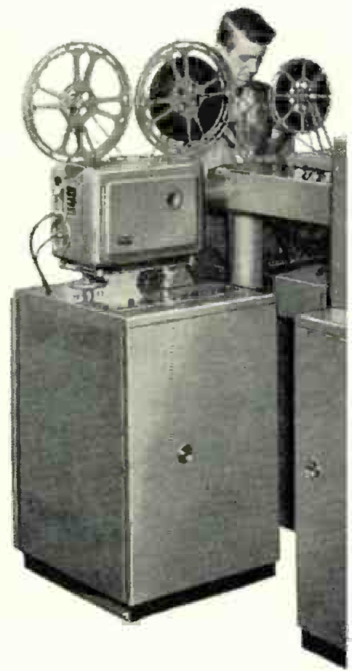
1092 ALBERT STREET • YOUNGSTOWN 1, OHIO
EXPORT DEPT.: CHRYSLER BLDG., NEW YORK 17, N.Y.

A NAME YOU CAN BUILD ON

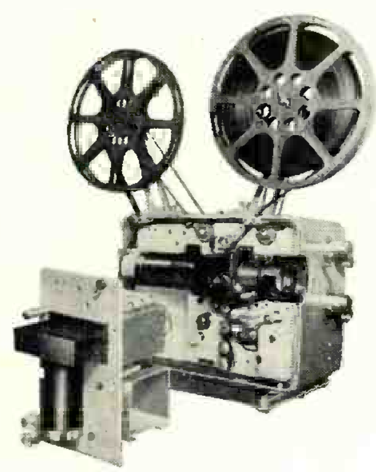




excellent monochrome



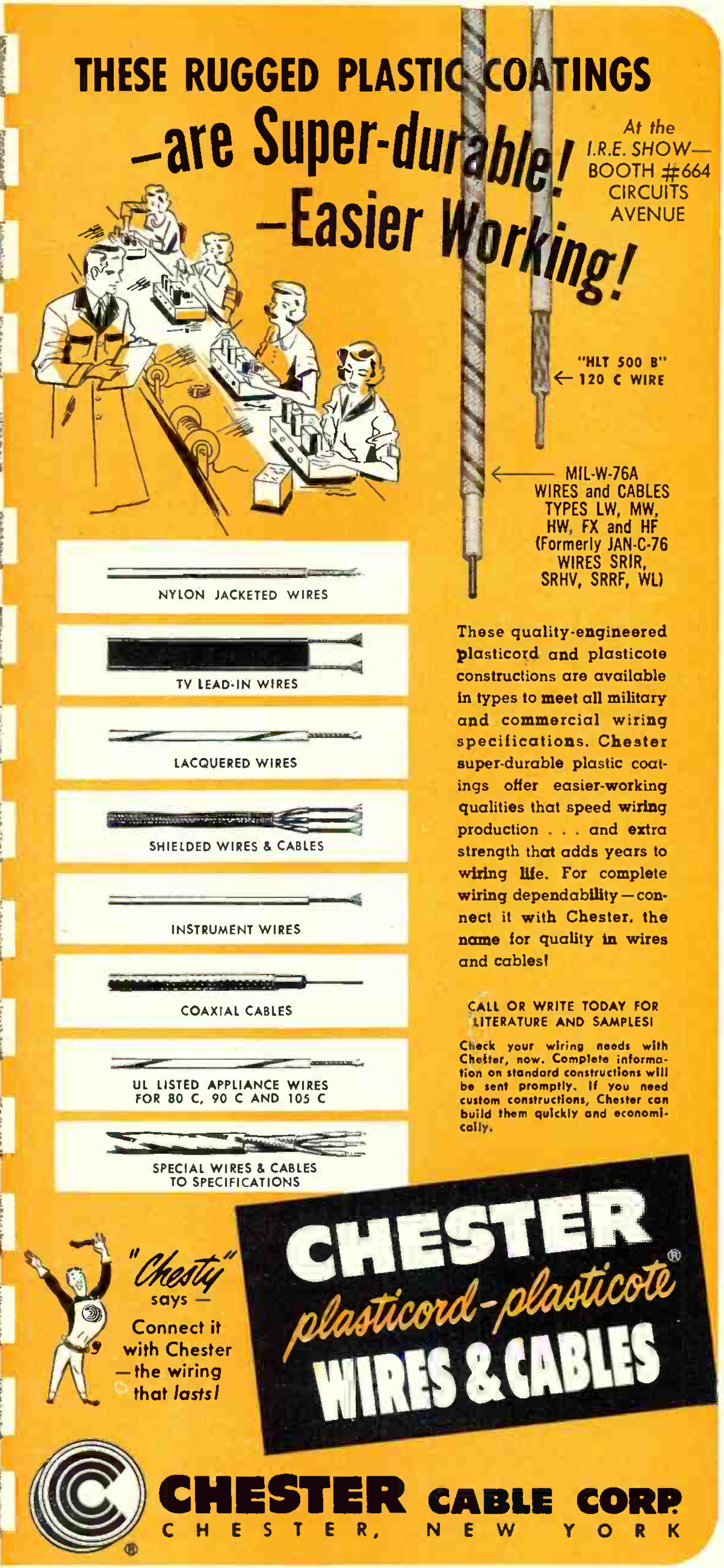
8 hours and



AMAZING CONVERSION WITH DU MONT MULTI-SCANNER

Right now it is possible to have the very finest monochrome reproduction of film, slides, and opaques and still be assured that you will be ready for color whenever you want it—at minimum cost. The Du Mont Multi-Scanner is *the* proved system—proved in over 50 television stations across the nation, many of which have already converted to color without the usual equipment obsolescence and expense.

For product information, use inquiry card on last page.



TELE-TIPS

(*Continued from page* 38)
result of an Air Force research project, "Electronics Test Equipment Data Sheets" is available for $100.00.

2500 KW diesel generating unit made by Worthington Corp. for the Navy's Jim Creek radio station is reportedly the largest single unit yet employed for this class of service.

SPACE SPOTTER TV is one of the latest achievements of industrial television. RCA reports that its "TV Eye" is being used in an Oakland, Calif., parking lot to direct motorists to vacancies on the lot.

"KILOCYCLE KOPS" is the name dubbed on FCC field monitoring crews. In one case they cooperated with Narragansett Park Racetrack officials and local police to scan a crowd and locate the person with a concealed transmitter who was sending the identity of the horse breaking to the front first to bet-placing confederates at the pari-mutuel windows. Convictions were obtained on two counts. In another case, while monitoring for interference in Portland, Ore., a mobile unit observed a strange signal which it traced to an apartment house. It turned out to be a homemade shortwave receiver which had been discarded for two years, but unknown to the owner, he had neglected to disconnect the set or turn off the power switch. The fellow's still wondering about two year's worth of electric bills.

VENTRICULAR FIBRILLATION, or off-rhythm weak heart beats incapable of moving sufficient blood, is often the result of electrical shock, and artificial respiration may not be able to bring the victim around. In hospitals, when fibrillation occurs, it is the practice to induce a spasm by applying 120 volts, 60 cycles, 1.5 amps, with electrodes directly to the heart to shock it back into normal rhythm. A similar technique is being developed for field use, using engine, battery-motor or propellant-turbo driven generators, or a transformer, to supply a current applied to the skin of the chest and flowing to an electrode near one foot. Instantaneous generator starting is one of the key problems since even a few minutes deprivation of blood flow can be fatal.

"OUR BEST PORTABLE RECORDER YET"

says Richard Parks, Asst. Chief Engineer, ABC, San Francisco

"This new Ampex 600 really fills a need. We like it. It's compact. And its fidelity and timing accuracy leave nothing to be desired. Now no matter how important the program material, we can send the 600 out after it. The results that come back are as good as we could have recorded inside our studio on Ampex 350s. For program protection the 600's third head is an excellent feature. The engineer monitors as he records. There's no guesswork. The recording is always right."

"The photo shows Bill Adams, our farm reporter. He has made extensive use of the 600 for farm interviews."

Model 600

NOW THERE'S AN AMPEX FOR EVERY BROADCAST NEED

The new 600 completes the Ampex line. In any station it's an ideal portable, and for many it's an all purpose machine. The Ampex 600 fits limited space and limited budgets, but does an unlimited job. Base price is $498. In portable case it's $545. The Ampex 620, a portable amplifier-speaker unit in matching case is a superb quality monitoring unit, usable inside or out; price is $149.50.

The Ampex 350 is the versatile broadcast studio machine. It has a remote control plug-in, two speeds, 10½-inch reels, easy editing and quick accessibility for service. Its durability defies time and hard usage.

Model 350

Bulletins on the low cost Ampex 600, the versatile 350, the 450 eight-hour reproducer and the Ampex Tape Duplicator are available on request. Write today to Dept. U-1881

AMPEX
CORPORATION

Signature of Perfection in Sound

934 CHARTER STREET • REDWOOD CITY, CALIFORNIA

Distributors in principal U. S. cities; Canadian distribution by the Canadian General Electric Company.

For product information, use inquiry card on last page.

Letters . . .

Tape Stickage

Editors, TELE-TECH:

In the November 1954 issue of TELE-TECH & ELECTRONIC INDUSTRIES, there appears an item by Talmadge R. England entitled "Tape Stickage" which states in effect that "Squeal on playback often results after the heads have had 100 or so tapes run across them becoming so smooth that the intermolecular forces between the head and tape material is actually sufficient to stop the machine or break the tape," and as a remedy: "Lightly burnish the heads with crocus cloth and follow with a thorough cleaning with carbon tetrachloride."

Such treatment of magnetic heads will almost certainly result in damage, possibly irreparable, certainly expensive. Tape squeal on playback is, in most instances, due to lack of lubricant on the tape itself. Many valuable tapes were prepared, in the earlier days of magnetic recording, on tape without lubricant, and some more recent tape has appeared to lose its lubricant with a great deal of use. The remedy adopted by many recording companies is to transfer the material from old to new tape, and to discard the unlubricated tape. Under no circumstances should heads be polished with any abrasive, and we recommend that carbon tetrachloride be avoided for cleaning purposes, preferring alcohol or Audio Devices' head cleaning solvent.

Walter T. Selsted
Chief Engineer
Ampex Corporation
Redwood City, Calif.

Tube Selection

Editors, TELE-TECH:

I was pleased to read in your January issue all the thoughtful comments on my article, "Tube Selection Increases Signal Capacity of TV Receivers," published in the October, 1954 issue.

First, let me state that I agree in principle with Mr. A. K. Wright of Tung-Sol Electric when he succinctly says of tube selection, "I'm agin it."

I, too, am against making tube selection a crutch for poor design, but let us just as succinctly review the facts of the case. The title and content of my article indicates that a tube selection process will increase the signal capacity of a receiver; but if the replacement tube is not selected, then normal variations are obtained in signal capacity. The operation of the set does not depend on selection.

Tube selection as a partial answer to the signal handling problem is not new. Many of our better known manufacturers have employed selection at one time or another. It is not uncommon to find an RF or (gain-controlled) IF tube in a TV receiver that is color-coded, indicating that the tube has been selected. The recent appearance of two tube types, the 6CF6 and the 6DC6 (which are simply selected 6CB6's) is an admission of the problem.

Due to increased station power, TV receivers are required to handle a greater range of signal; but with the substantial variations in gain-control in available IF and RF tubes, all TV circuit designers are plagued by the problem of designing receivers to handle the greater signal strength variations without increasing receiver cost.

Some of those commenting on my article related experiences with tube selection where the yield was extremely small or where specially-stabilized tubes were used. Their experiences are very interesting but are not relative to this selection process.

But lo and behold! The answer to the problem of reliable gain-control tubes in TV receivers is indicated by several of the correspondents: That is, the development of a new tube type that will be more suitable for gain-control and will be more uniform than the tubes now available to TV set designers.

Robert G. Horner,
Project Engineer
TV Engineering Department
CBS—Columbia
Long Island City, N. Y.

Editors, TELE-TECH:

The correspondence on "Tube Selection" published in your January issue is most interesting and expresses very clearly the many objections to the practice. Let me say at the very outset that I too am strongly opposed to tube selection, but at the same time I feel that this may be an opportune moment to restate some of the reasons why it sometimes becomes necessary.

In the early days of radio, the fact that a receiver performed at all was ample justification for its existence and measurements of any kind were the exception. As the art progressed however, performance measurements became more common until nowa-

(*Continued on page* 136)

Now Fairchild is able to miniaturize potentiometers and still give you the accuracy and reliability you need.

This advance is made possible by Fairchild's continuous and extensive research on new materials such as epoxy-resin and halogenated polyethylene insulating materials, and precious metal alloy resistance wire, and by thorough evaluation of these materials in our own environmental testing facilities. These advances are maintained by our rigid quality control program on materials, processes, and manufacturing.

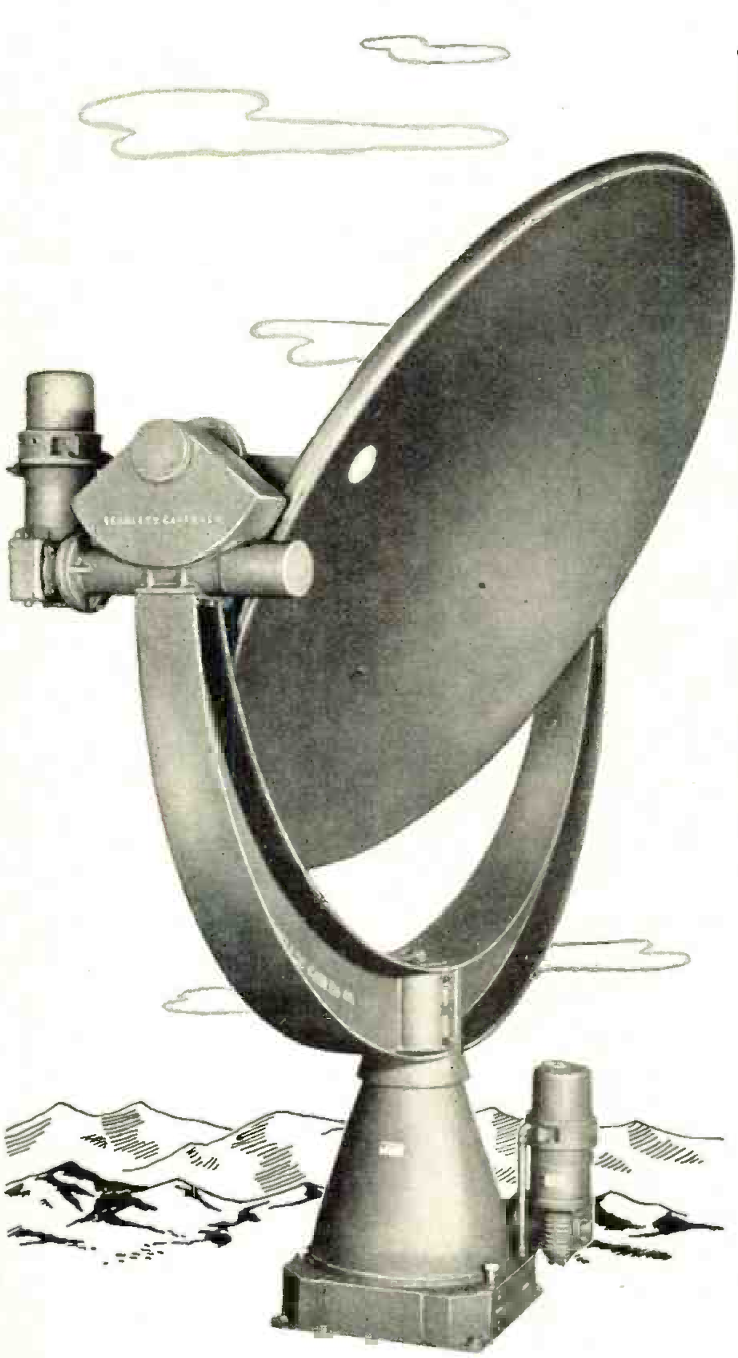
MINIATURIZATION
without sacrificing performance

Fairchild miniature precision potentiometers meet applicable portions of MIL-E-5272A for humidity, vibration, temperature cycling, fungus resistance and salt spray. These units, in ⅞" and 1⅛" diameters, meet the same requirements for accuracy and reliability as most standard precision units up to 2" in diameter.

No matter what factors govern your choice of precision potentiometers, you'll find the answer in Fairchild's complete line. Write Dept. 140-59E1, Fairchild Camera and Instrument Corporation, Potentiometer Division, 225 Park Avenue, Hicksville, Long Island, New York.

FAIRCHILD
PRECISION POTENTIOMETERS

HIGH ATOP A TOWER OR A MOUNTAIN IN WIND, RAIN, SNOW AND ICE



...this new Houston-Fearless

MICROWAVE PARABOLA

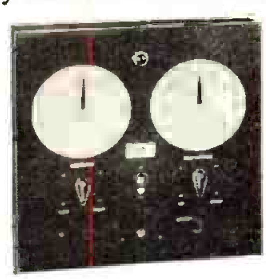
operates completely by

REMOTE CONTROL!

There's no need to climb an icy tower in zero weather, wind or rain to position this new Houston-Fearless Remote Control Microwave Parabola. It's all done from the remote control panel (shown below) right in the station.

This Houston-Fearless Parabola can be mounted anywhere within 1500 ft. (or more, if required) of the transmitter. It rotates 370° in azimuth and tilts 15° up and 30° down. Large dials on the remote control panel, calibrated in degrees, show the exact position. It is driven by 1/6 HP motors producing a torque of 10,500 inch pounds @ 1 RPM, sufficient to operate under severe icing conditions. Magnetic brakes prevent overide when Parabola is stopped at any exact position.

Designed to operate in the open without protection, it will withstand a wind velocity of 120 mph. Motors and rotating shafts run on sealed, anti-friction bearings and require no lubrication during the life of the unit. Here is complete dependability and freedom from servicing where it really counts. Send for catalog and complete information.



Write for information on specially-built equipment for your specific needs.

The HOUSTON FEARLESS Corporation

• DEVELOPING MACHINES • COLOR PRINTERS • FRICTION HEADS
• COLOR DEVELOPERS • DOLLIES • TRIPODS • PRINTERS • CRANES

11805 W. OLYMPIC BLVD • LOS ANGELES 64, CALIF.

"WORLD'S LARGEST MANUFACTURER OF MOTION PICTURE PROCESSING EQUIPMENT"

For product information, use inquiry card on last page.

. . . here's new might for miniatures

Dur-Mica DM15

World's Smallest Mica Capacitor

The First Miniature Dipped Mica Capacitors with Parallel Leads.

NOW! Also available . . .

El Menco Dur-Mica DM20

1 to 3900 mmf. at 500vDCw

1 to 5100 mmf. at 300vDCw

El-Menco *Dur-Mica*

IDEAL FOR PRINTED CIRCUITS. Meets all Humidity, Temperature and Electrical Requirements of MIL-C-5 Specifications. El Menco's Dur-Mica DM15 establishes a *"new dimension"* in capacitor performance with ranges from 1 to 390 mmf. at 500vDCw and 1 to 510 mmf. at 300vDCw. A new, tougher phenolic casing provides temperature co-efficient and stability equal to or better than characteristic F in all but the lowest capacity values . . . efficient operation at temperatures as high as 125°C. El Menco's Dur-Mica DM15 can be used in a variety of transistor circuits and other miniature electronic equipment in military and civilian applications.

Sells for Less than the famous El Menco CM-15 — Provides Economy of Size with Maximum Performance and Widest Application.

test El Menco "Dur-Micas" for yourself!

Write for free samples and catalog on your firm's letterhead.

El-Menco *Capacitors*

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC CONNECTICUT

molded mica · mica trimmer

tubular paper · ceramic

Jobbers and distributors write to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.

going...

going...

gone!

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

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

KESTER SOLDER

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

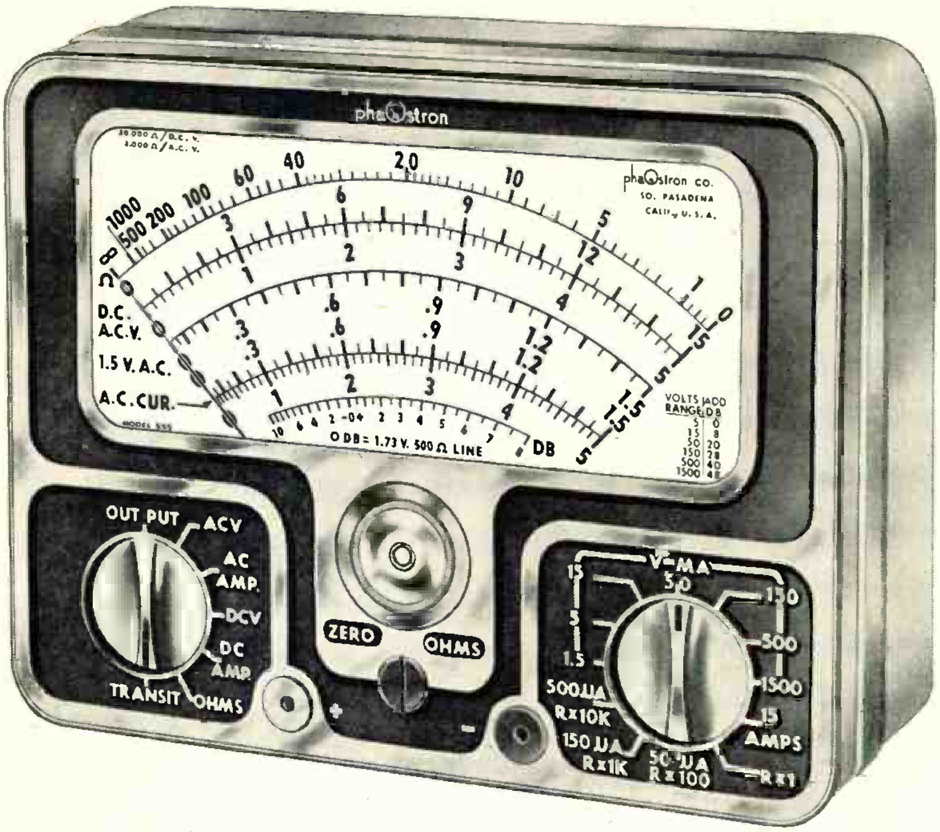
For product information, use inquiry card on last page.

the KEY
to your problem

phaostron

the NEW LOOK in

"555" metal-cased MULTIMETERS



POCKET SIZE WITH A 4 7/8" LENGTH SCALE

WE LEAVE IT TO YOU

WOULD YOU BUY A PLASTIC-CASED WRIST WATCH . . .

if you *could* buy the finest movement in a magnetically shielded metal case?

Phaostron, world famous manufacturer of ENVIRONMENT FREE PRECISION AIRCRAFT EQUIPMENT for Military and Industrial uses introduces a new concept in Multimeters. This magnetically shielded, metal-cased "555" compares with plastic-cased multimeters as a fine watch in a precious metal case would compare with a plastic wrist watch.

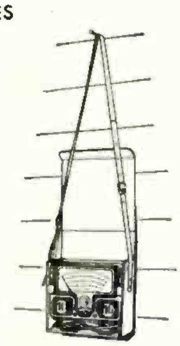
The shielded, shatterproof and anti-magnetic case insures continued accuracy and integrity of this instrument for years to come.

Phaostron "555" Multimeter incorporates more ranges, including AC current, greater visibility, simplified and functional controls and the greatest value offered to date.

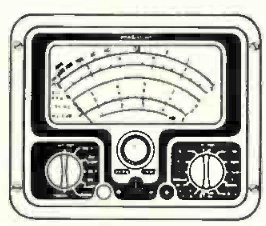
See the Phaostron "555", note its many outstanding features, its beautiful satin chrome case, its compactness and light weight, and you will know why

"YOU CANNOT BUY BETTER"

AC CURRENT RANGES
SEPARATE RANGE & FUNCTION SWITCHES
ONLY 2 JACKS

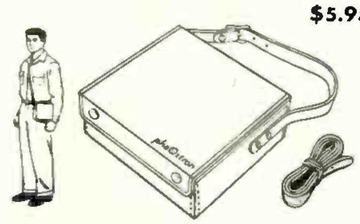


COLOR CODED SCALES ARE RED, GREEN, BLUE & BLACK
ACCURACY 3% DC, 4% AC



PANEL MOUNTING ADAPTER $1.50

GENUINE LEATHER CARRYING CASE
$5.95



"555" MULTIMETER

$39.95 *complete with probes and batteries*
at your PARTS DISTRIBUTOR

Manufactured by PHAOSTRON COMPANY • 151 Pasadena Avenue • South Pasadena, Calif., U.S.A.

BELL SYSTEM'S NEWEST TELEPHONE DEVELOPMENTS

use RAYTHEON filamentary subminiature tubes

TELEPHONE ANSWERING. When you aren't there, the automatic telephone answering set takes over, delivers previously dictated message in your voice, records caller's reply and plays it back to you at your convenience.

"HANDS-FREE" TALKING. Telephone set base has a built-in microphone — you talk *without* picking up handset. Tiny desk speaker amplifies the distant voice so that several persons in a group can listen to the conversation. For privacy, you lift the receiver, automatically shutting off the microphone and speaker. Small amplifier, not visible in the picture, furnishes power.

The Bell System's new telephone answering set and new telephone for "hands-free" and conference use naturally require tubes of the utmost reliability. Raytheon Filamentary Subminiature Tubes qualified only after undergoing a long series of exacting tests by both Bell and Raytheon.

Low microphonics, low power requirements, high efficiency, long life and, above all, supreme reliability characterize the Raytheon Tubes in these newest telephone developments.

It will pay you to find out what Raytheon Filamentary Subminiatures can do to better the performance, convenience and economy of *your* electronic equipment.

RAYTHEON *FLAT PRESS* Subminiature Tubes are the tubes with the *SEAL OF RELIABILITY* — the longer glass to metal seal that gives you these important advantages:

- Glass heated only once — no button, low glass strain, no lead burning
- Reentrant seal eliminates breakage from short bends
- Leads completely tinned right to glass
- Flat press with in-line leads for easier socketing, easier wiring, adaptability to printed circuits

FLAT PRESS SUBMINIATURE TUBES • RAYTHEON • THE SEAL OF RELIABILITY

Reliable, long-lived Raytheon Subminiature Tubes in these Bell equipments, illustrated above, were tested for dependable, trouble-free service over long periods.

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — Home Office: 55 Chapel St., Newton 58, Mass. Bigelow 4-7500

For application information write or call the Home Office or: 4935 West Fullerton Avenue, Chicago 39, Illinois, NAtional 2-2770

589 Fifth Avenue, New York 17, New York, PLaza 9-3900 • 622 South La Brea Ave., Los Angeles 36, California, WEbster 8-2851

RAYTHEON MAKES ALL THESE:

RELIABLE SUBMINIATURE AND MINIATURE TUBES • SEMICONDUCTOR DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

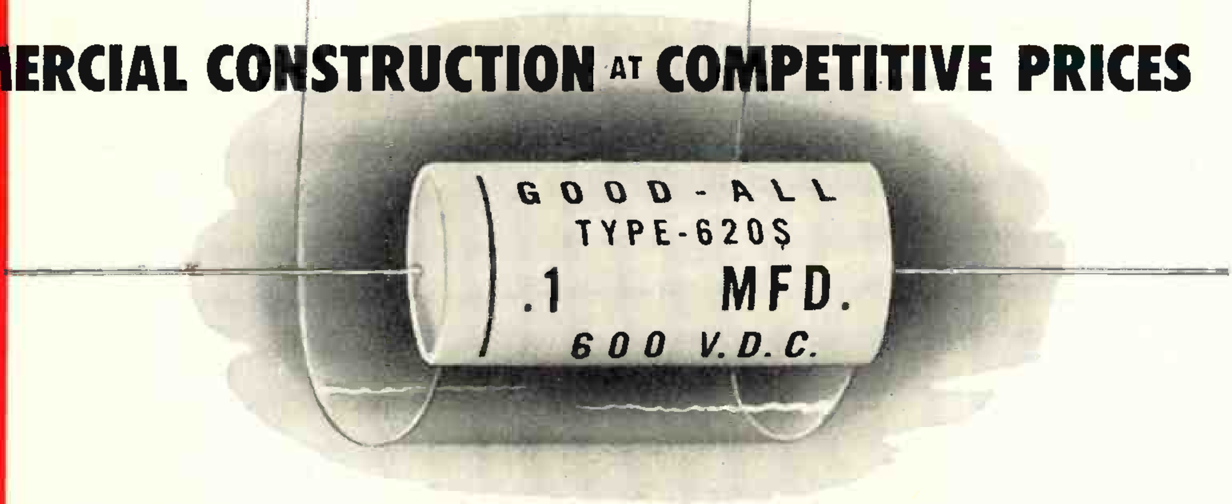
COME IN AND TALK OVER THESE TUBES WITH US AT THE I.R.E. SHOW

Good-All capacitors

MYLAR* DIELECTRIC

*Du Ponts Trade Mark for its Polyester Film

COMMERCIAL CONSTRUCTION AT COMPETITIVE PRICES



Good-All SERAMELITE Capacitors

MODELS 620S and 621S

. . . combine the excellent electric characteristics of "MYLAR" with the superior humidity resistance properties of "Seramelites" to produce a completely new capacitor for exacting applications at reasonable prices.

These competitively priced new miniature capacitors closely approximate the performance of expensive hermetically sealed units. They are designed to cover the entire capacitance and voltage range.

CHARACTERISTICS:

- Insulation resistance 20,000 megohm-microfarads
- Power Factor is Less than 1%
- Operating Temperature −55° C to +125° C
- Generally smaller than RETMA Standards
- Tolerances as close as ½ of 1%

CONSTRUCTION FEATURES:

- Tubular Ceramic Enclosure
- New Plastic End Seal
- Inserted Tab or Extended Foil
- Miracle X Impregnated

OTHER GOOD-ALL "MYLAR" CAPACITORS

FILM-X (Hermetically Sealed) • MARBELITE (Plastic Impregnated Paper Tube)

Available for printed circuit or other applications in all mounting styles. Built to your specifications.

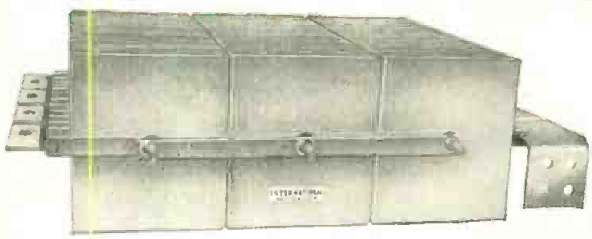
We will have our complete line of Capacitors at the **I.R.E. SHOW, Booth 75** at Kingsbridge Palace.

GOOD-ALL ELECTRIC MFG. CO. 120 FIRST ST • OGALLALA, NEBRASKA

Good-All capacitors

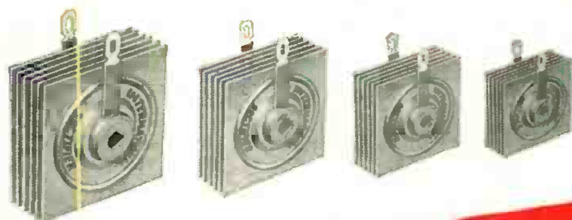
INTERNATIONAL *Selenium Rectifiers*

the WIDEST RANGE in the INDUSTRY



INTERNATIONAL
industrial power rectifiers

Ratings to 250 KW, 50 ma. to 2,300 amperes and up. From 6 volts to 30,000 volts and up. Efficiency to 87%. Power factor to 95%. Cell sizes from 1 sq. in. to 42 sq. in. Ambient temperature range to 125 C without derating. **Write for Bulletin C-349.**



INTERNATIONAL
tv and radio miniature rectifiers

Input ratings from 25 to 195 volts AC and up. DC output current from 10 to 1,000 ma. Available in half wave and voltage multiplier units. Bridge units available to 1200 ma. **Write for Bulletin ER-178A**

INTERNATIONAL
high voltage cartridge rectifiers

DC output voltages from 20 volts to 20,000 volts and up. DC output current, half wave, from .2 to 195 ma. Cell diameters: 1/16" to 1". Overall length: 1/2" to 12". Available with pigtail, stud, or ferrule terminals. Hermetically-sealed types also available. **Write for Bulletin H-2**

INTERNATIONAL
RECTIFIER CORPORATION

EL SEGUNDO, CALIFORNIA • ORegon 8-6281
NEW YORK: 501 MADISON AVENUE • PLaza 3-4942
CHICAGO: 205 W. WACKER DR. • FRanklin 2-3889

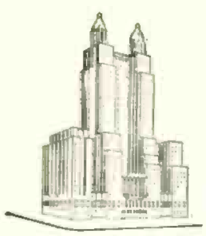
World's Largest Supplier of Quality Industrial Rectifiers

March 21-24

The Radio-Electronic SPECTACULAR of 1955!

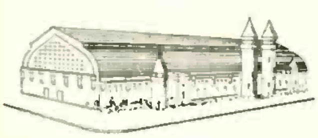
See! Hear!

IRE National Convention



At both the Waldorf-Astoria (convention headquarters) and Kingsbridge Armory, you'll attend what actually amounts to 22 conventions fused into one. Hundreds of scientific and engineering papers will be presented during the many technical sessions, a large number of which are organized by I R E professional groups. You'll meet with the industry's leaders—enjoy the finest meeting and recreational facilities in New York.

and Radio Engineering Show



At the Kingsbridge Armory and Kingsbridge Palace, you'll walk through a vast panorama of over 700 exhibits, displaying the latest and the newest in radio-electronics. You'll talk shop with the industry's top manufacturers—enjoy the conveniences provided for you in the world's finest exhibition halls, easily reached by subway and special bus service.

Admission by registration only. $1.00 for I R E members, $3.00 for non-members. Social events priced extra.

The Institute of Radio Engineers
1 East 79 Street, New York

7 out of 704*

good reasons why you should attend the Radio Engineering Show

Hear...

vital research and engineering papers on computers, transistors, color TV, etc., subject-organized in 55 sessions.

Watch...

a computer balance a cane, making 20 corrective moves a second—at the IRE Show.

See...

the exhibits of 69 components vital to successful Automation. Or compare 21 different types of Transistors—and other subminiature components.

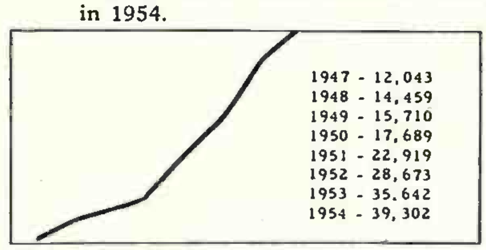
Check-up on...

"1955 Instrumentation" shown on Instruments Avenue. Exhibit grouping helps you see more on the Avenues named.

Audio • Broadcast • Radar
Transistor • Television
Radio • Components • Microwave
Airborne • Production
Circuits • Computer • Electronics

Meet...

all your friends. 39,302 attended IRE in 1954.



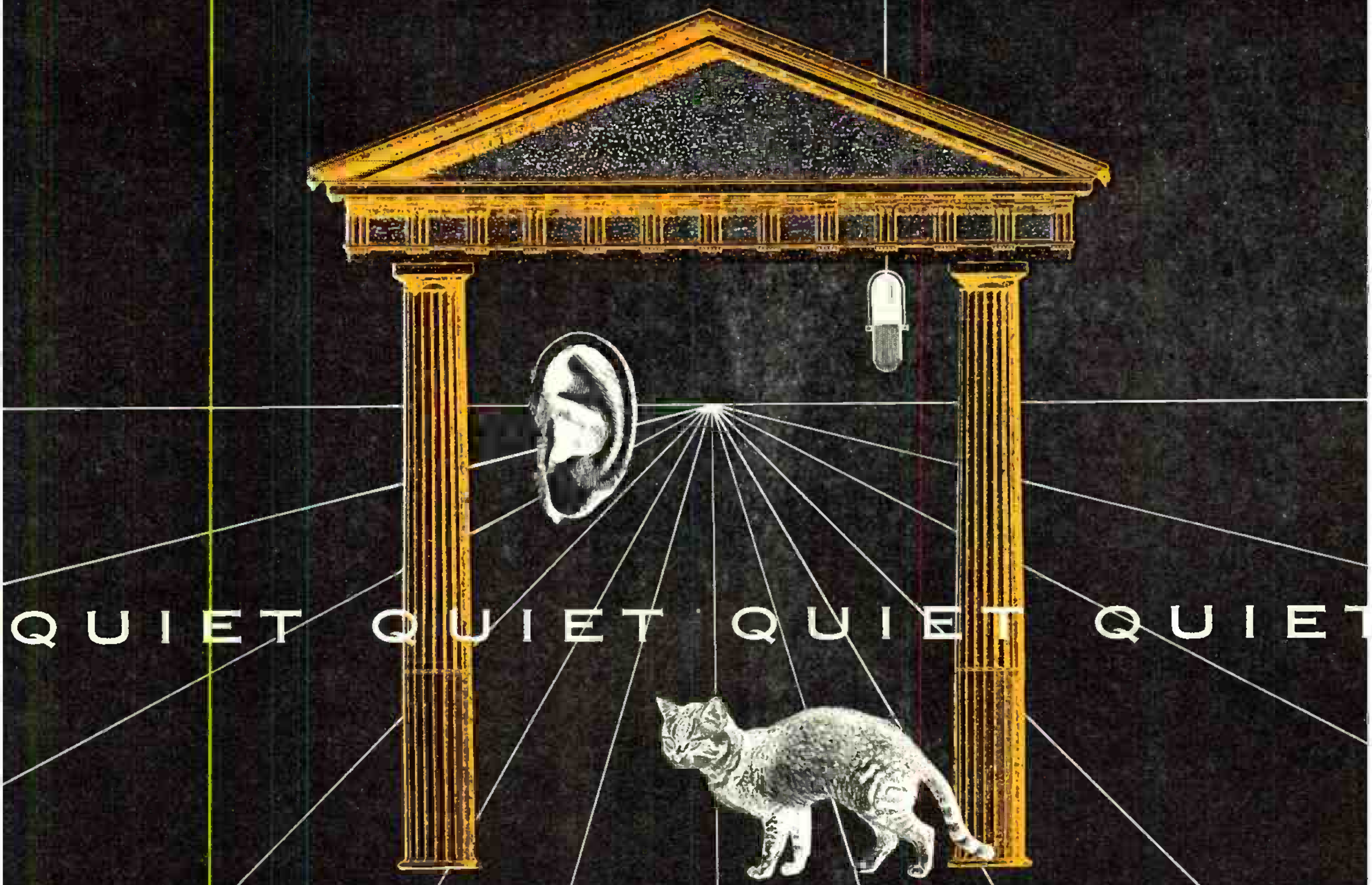
Enjoy...

The Convention's Social Events. It is good to mingle with your industry friends at IRE.

Get the facts...

faster and easier at exhibits and sessions than you could from weeks of your own "digging."

**Send for the 1954 Directory of 604 Exhibitors and list of 100 new exhibitors.*

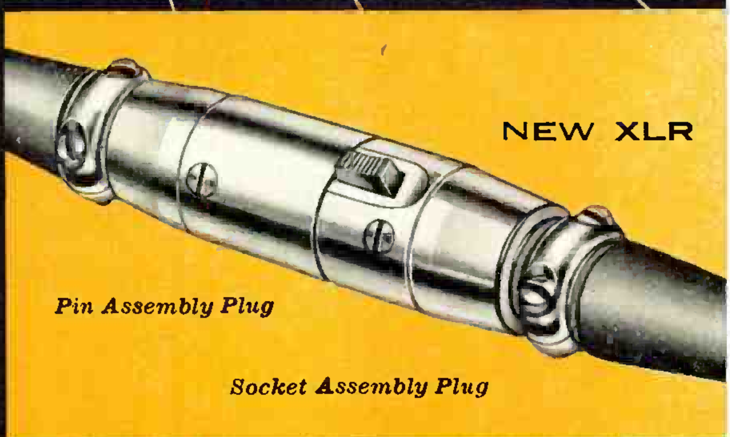


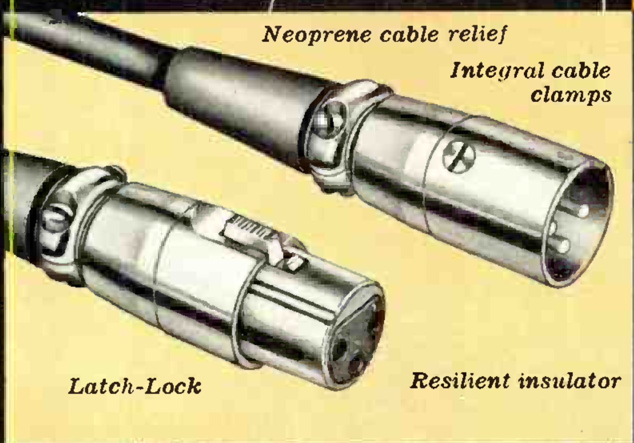
XLR is the designation of Cannon's all new audio cord connector . . . the most modern addition to the long line of distinguished Cannon Connectors featured on all top-quality microphones. It's really **quiet**, too!

New resilient insulator and specialized construction of socket contact assembly protects against disagreeable mechanical interference . . . noise problems encountered with many other type connectors when their cables are moved, pulled or subjected to shock.

Features streamline design, bright nickel finish, integral cable clamp, neoprene cable relief, and the time-tested Latch-Lock that Cannon pioneered on the first audio connectors. Available with three 15-amp. or four 10-amp. contacts. Available in panel receptacle type, providing same continuous characteristics.

Available from distributors everywhere, or from the factory in production quantities.





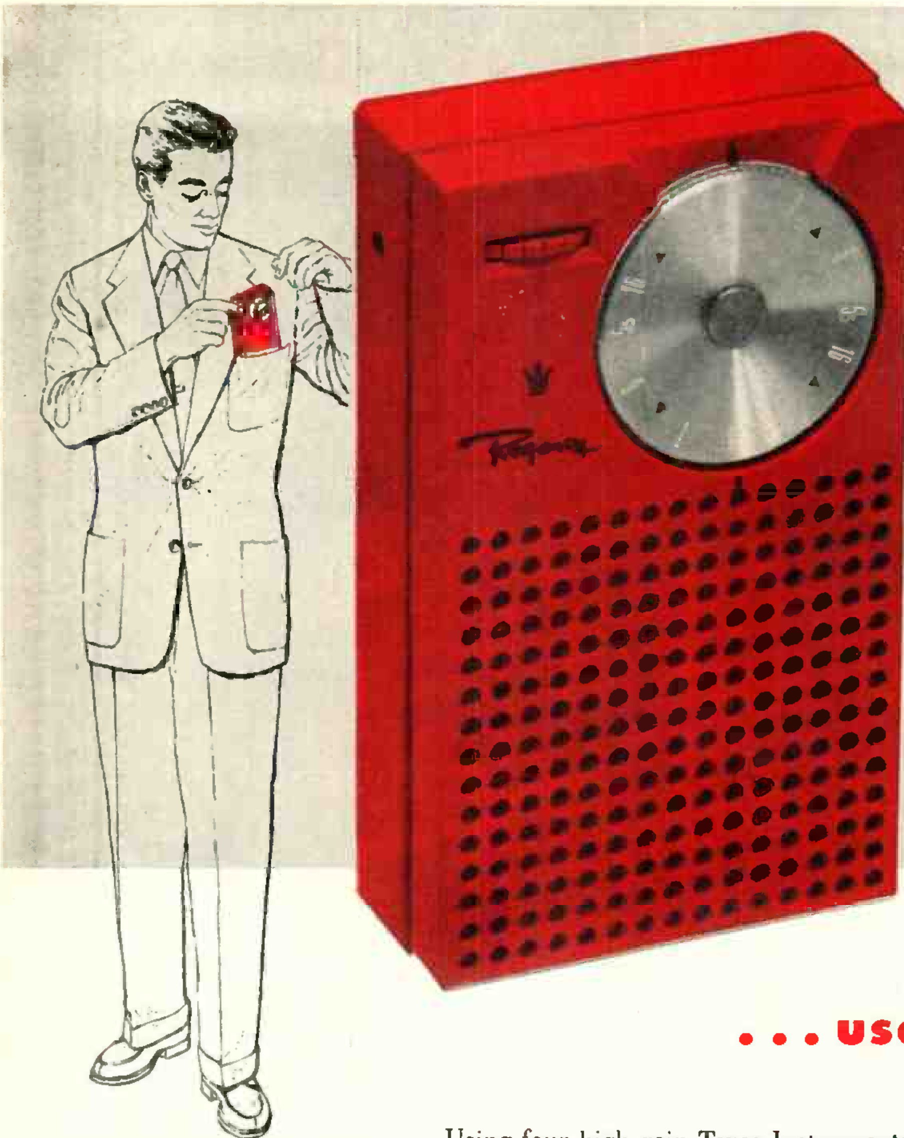
first in connectors

CANNON PLUGS

CANNON ELECTRIC COMPANY
3209 Humboldt St.,
Los Angeles 31, California

Please refer to Dept. 201

Factories in Los Angeles; East Haven; Toronto, Canada; London, England. Representatives in all principal cities. Distributors everywhere.



the *First* transistorized consumer product

. . . uses TI transistors!

* *With four Texas Instruments grown junction n-p-n germanium low cost, high gain transistors,* the Regency radio achieves power gains of 32 decibels in each intermediate-frequency stage and 37 decibels in the audio stage. One transistor is used as a combination mixer-oscillator, two as intermediate-frequency amplifiers, and one as an audio amplifier. Output transformer also TI manufactured.

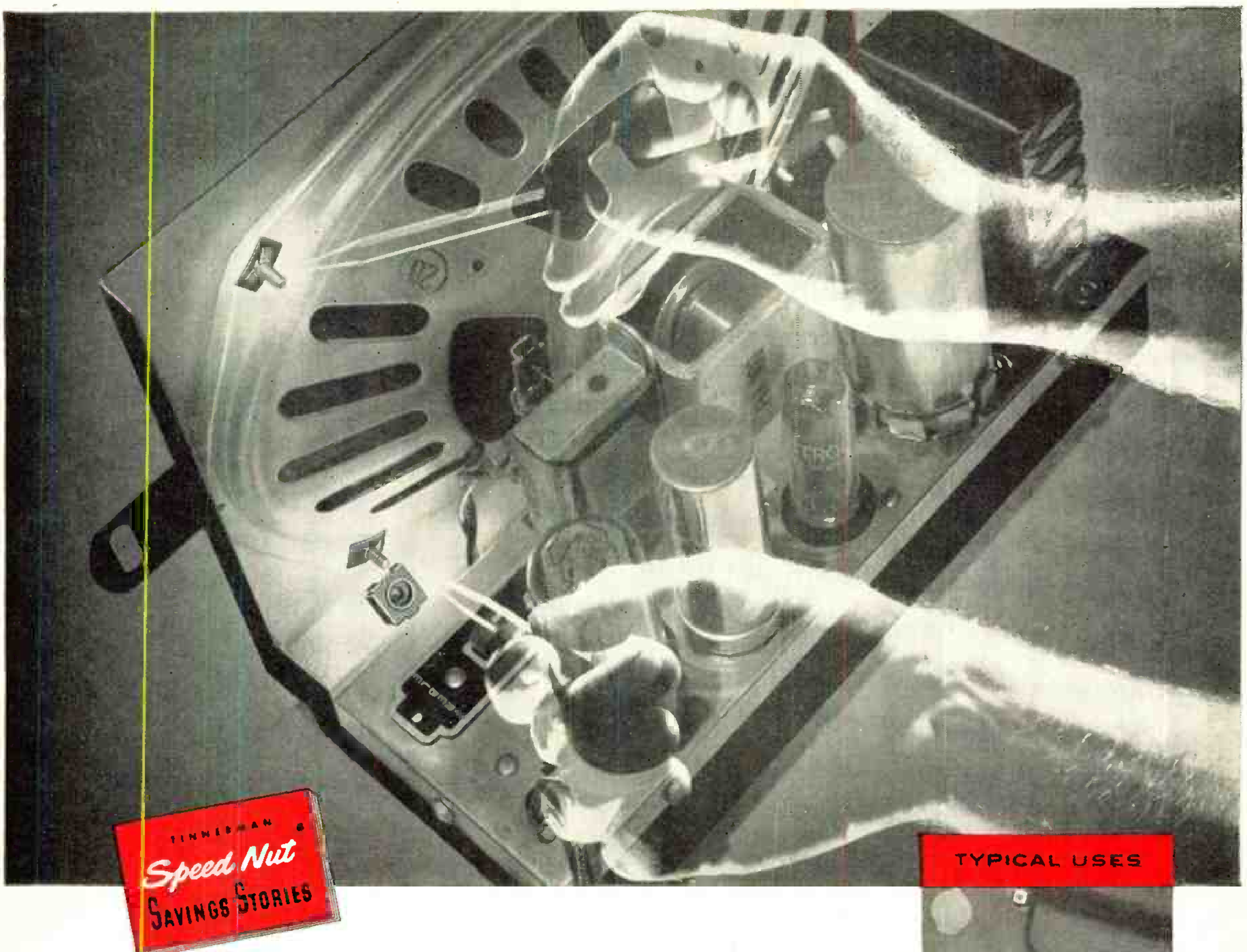
Using four high gain Texas Instruments transistors, the world's first transistorized consumer product — a high performance pocket size radio — is now available on the retail market! Priced under $50, the world's smallest commercial radio receiver (manufactured by Regency of Indianapolis) achieves better performance than many much larger conventional sets. To produce the specially designed transistors used in this superb little instrument, TI has developed advanced manufacturing techniques that assure uniformly high product quality as well as mass production quantities.

With the transistor radio already a reality, the multi-million dollar consumer market is ready and waiting for still more transistorized products. Don't delay your own product development for lack of suitable low cost, high performance transistors. In designing transistorized products, depend on transistors from Texas Instruments, a leading supplier of transistors for a variety of commercial and military applications. Producing the industry's widest range of semiconductor devices — silicon or germanium; diodes or transistors — Texas Instruments is your most *experienced* source of supply for dependable semiconductor products.

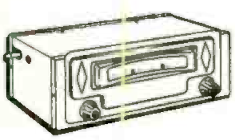
See the industry's widest line of semiconductor products—Booth 796—Radio Engineering Show

TWENTY-FIFTH YEAR OF PLANNED GROWTH

TEXAS INSTRUMENTS
INCORPORATED
6000 LEMMON AVENUE DALLAS 9. TEXAS



How to Cut Costs 75%... with Tinnerman SPEED GRIPS®!



Assembly and material costs cut from 12 cents to less than 3 cents—a saving of 75% on just one fastening application! That's the Tinnerman SPEED NUT Savings Story for the Automatic Radio Manufacturing Company, Boston, on its CUSTOM-BUILT AUTO RADIO LINE.

SPEED GRIP Nut Retainers replaced hard-to-fabricate tapped holes and weld-type nuts as the mounting fasteners on each set. SPEED GRIPS are quickly and easily snapped into square punched holes. No special tools or skills needed! Flat Type SPEED NUTS also provide a vibration-proof attachment of speaker to baffle.

And here's a "temper-saver" for the man who installs the radio in his car. SPEED GRIPS have "mechanical hands" that hold the nut in bolt-receiving position for blind location attachments. What's more, they "float" to compensate for any misalignment in mounting holes.

There are more than 8,000 shapes and sizes of SPEED NUT brand fasteners to help you save assembly time, material costs and handling. Write today for your "SPEED NUT Savings Stories" booklet of typical Tinnerman savings to industry.

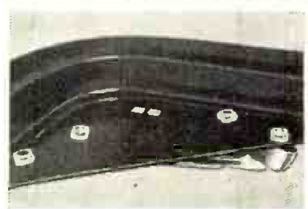
TINNERMAN PRODUCTS, INC. • BOX 6688, DEPT. 12, CLEVELAND 1, OHIO

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.

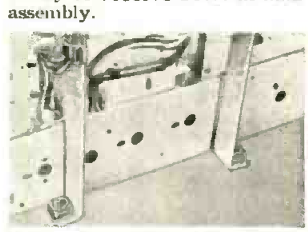
TINNERMAN Speed Nuts®
FASTEST THING IN FASTENINGS®

TYPICAL USES

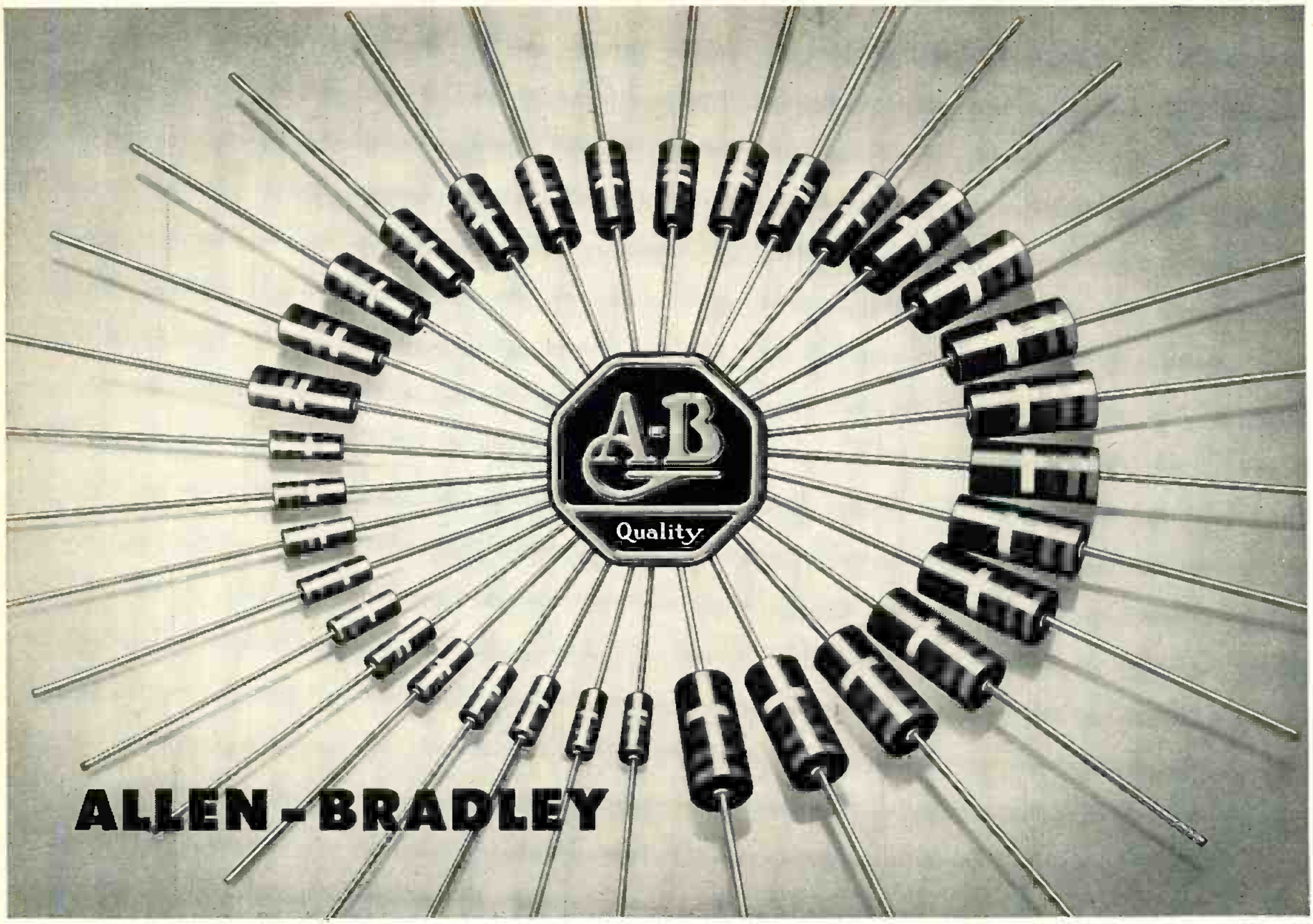
SPEED GRIPS are applied by hand on this automobile floor pan.



Front seat grab handle of car is ready to receive bolts in final assembly.



SPEED GRIPS furnish a firm, sturdy attachment for television chassis mounting.



THE NAME THAT GUARANTEES *Quality* IN MOLDED RESISTORS

When you specify Bradleyunits for your radio, electronic, or television circuits you are "playing safe" with your reputation as an electronic engineer . . . because Bradleyunits are ultra-conservatively rated.

All Bradleyunits are rated at 70C ambient temperature . . . not at the usual 40C. They do not exhibit erratic resistance changes nor do they open circuit. They will operate at full rating for 1,000 hours with less than 6 per cent resistance change. Bradleyunits require no wax impregnation to pass salt water immersion tests. Their differentially tempered leads prevent sharp bends near the body of the Bradleyunit. In every way, Bradleyunits are a QUALITY product . . . trouble free, accurate, and always dependable.

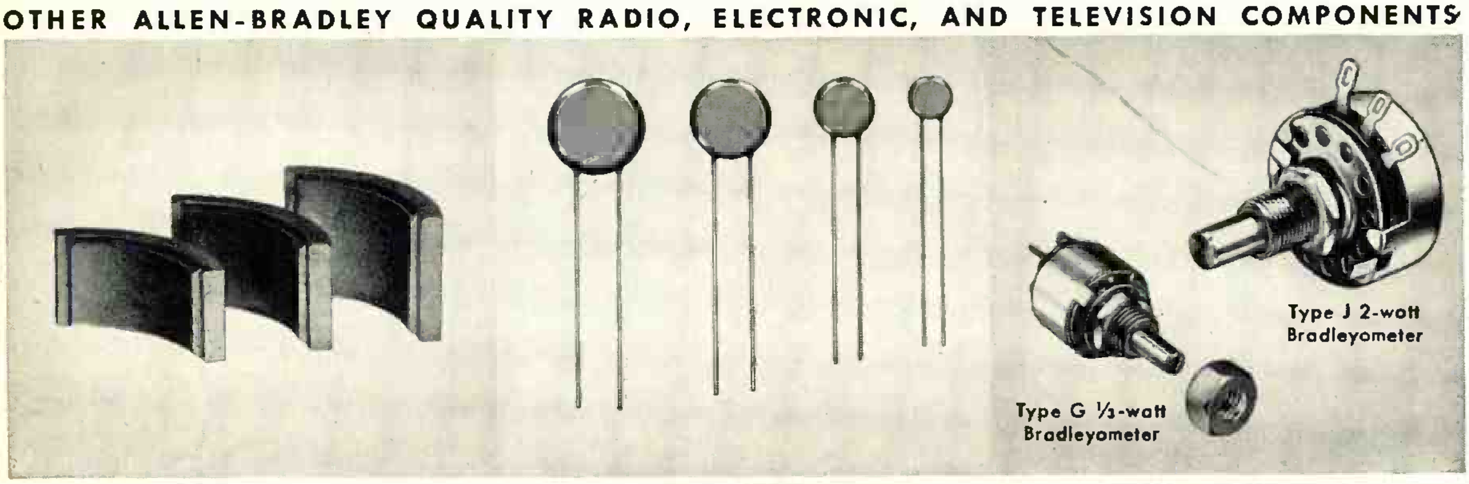
Let us send you our latest technical data sheets.

Allen-Bradley Co.
1342 S. Second St., Milwaukee 4, Wis.

In Canada
Allen-Bradley Canada Limited, Galt, Ont.

See Allen-Bradley exhibit at IRE Engineering Show—Booth 794

OTHER ALLEN-BRADLEY QUALITY RADIO, ELECTRONIC, AND TELEVISION COMPONENTS



FERRITE CORES **CERAMIC CAPACITORS** **ADJUSTABLE RESISTORS**

12,800 TO 50,000 MC

integrated equipment for
Extremely
High
Frequencies

SIGNAL GENERATORS

SIGNAL SOURCES

SPECTRUM ANALYZERS

Now, Polarad has applied its advanced engineering techniques to produce **fully** self-contained microwave test equipment for use in the Extremely High Frequency region—12,800 to 50,000 MC.

This new line of Signal Generators, Signal Sources, and Spectrum Analyzers is designed to save engineering manhours in the laboratory and on production lines—obviating experimental test set-ups.

The Extremely High Frequency Polarad Signal Generator, for example, furnishes monitored power output as well as measures external signal strength and frequency.

Highest accuracy and reliability of operation are assured by careful engineering and the use of highest quality components. For complete information write to your nearest Polarad representative or directly to the factory.

	SIGNAL GENERATORS		SIGNAL SOURCES		SPECTRUM ANALYZERS		
Frequency Range	Model Number	Output Power	Model Number	Power Output (Average)	Model Number	Sensitivity (Signal=Noise)	Dispersion (Average)
12.8 to 17.5 KMC	SG 1218	−10 DBM	SS 1218	15 mw	SA 1218	−70 DBM	30 MC
15.75 to 16 25 KMC	SG 1516*	−6 DBM	SS 1516	5 mw	SA 1516	−70 DBM	45 MC
16.25 to 16.75 KMC	SG 1617*	−6 DBM	SS 1617	5 mw	SA 1617	−70 DBM	45 MC
18.0 to 22.0 KMC	SG 1822	−10 DBM	SS 1822	10 mw	SA 1822	−60 DBM	40 MC
22.0 to 25.0 KMC	SG 2225	−10 DBM	SS 2225	10 mw	SA 2225	−60 DBM	40 MC
24.7 to 27.5 KMC	SG 2427	−10 DBM	SS 2427	10 mw	SA 2427	−60 DBM	40 MC
27.27 to 30.0 KMC	SG 2730	−10 DBM	SS 2730	10 mw	SA 2730	−60 DBM	45 MC
29.7 to 33.52 KMC	SG 3033	−10 DBM	SS 3033	10 mw	SA 3033	−60 DBM	45 MC
33.52 to 36.25 KMC	SG 3336	−10 DBM	SS 3336	9 mw	SA 3336	−50 DBM	45 MC
35.1 to 39.7 KMC	SG 3540	−10 DBM	SS 3540	5 mw	SA 3540	−50 DBM	45 MC
37.1 to 42.6 KMC	External Source Power Measurement Range: +6 to +30 DBM Accuracy with Correction: ±2 DB		SS 3742	Approx. 3 mw	I.F. Gain Control: 0 to 40 DB I.F. Band Width: 50 KC Sweep Frequency: 5 to 40 CPS		
41.7 to 50.0 KMC			SS 4150	Approx. 3 mw			

Modulation: All units except the SG 1516* and SG 1617* can be modulated as follows:
1. Internal
   1000 CPS Square Wave
2. External
   a. Pulse
      Pulse Width: 0.5 to 10 Microseconds
      PRF: 100 to 10,000 CPS
      Pulse Amplitude: 10 volts Pk to Pk Min.
      Polarity: Positive
   b. Sawtooth or Sinusoidal
      Frequency: 100 to 10,000 CPS
      Amplitude: 15 Volts RMS Min.

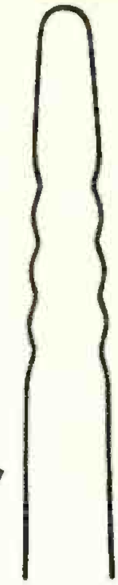
*Internal variable pulse and FM modulation

Polarad ELECTRONICS CORPORATION
43-20 34th St., Long Island City 1, New York

AVAILABLE ON EQUIPMENT LEASE PLAN
FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

REPRESENTATIVES • Albuquerque • Atlanta • Baltimore • Boston • Chicago • Cleveland • Fort Worth • Kansas City • Los Angeles • New York
Philadelphia • San Francisco • Seattle • St. Paul • Syracuse • Washington, D. C. • Canada, Arnprior—Export: Rocke International Corporation

For product information, use inquiry card on last page.



Something in Common

No single tool...
not even
a hairpin...
works best
for all applications.
This is
true of
diodes, too.

The Hughes line of semiconductor devices is multiplying swiftly. It comprises several different categories and numbers more than two hundred separate RETMA, JAN, and special diode types. This means that you can now spell out requirements for a diode in terms of your particular circuit application. And it means that one or more types in the extensive Hughes line will most probably match those requirements with *just the right* characteristics.

Greater selectivity is one of the results of the vigorous and continuing Hughes program of research and development—a program aimed directly at satisfying anticipated industrial and military requirements. At the same time, your assurance of better quality and thorough dependability in *all* Hughes semiconductors is maintained. So, when you need diodes with High Temperature . . . High Forward Conductance . . . Computer Type . . . High Back Resistance . . . JAN-Approved . . . General Purpose, or other special characteristics, be sure to ask about Hughes Diodes. The chances are that you will find just the one you want.

At the IRE Show

We will be displaying samples of our famous GERMANIUM POINT-CONTACT DIODES, *as well as the new* GOLD JUNCTION *and* SILICON JUNCTION *series. You will want to inspect the operating demonstration of light beam voice transmission system, with circuitry featuring our latest types of* NPN *fused junction transistors and photocells. So come in to Booths 753-5-7 and pay us a visit. You will be most cordially welcome.*

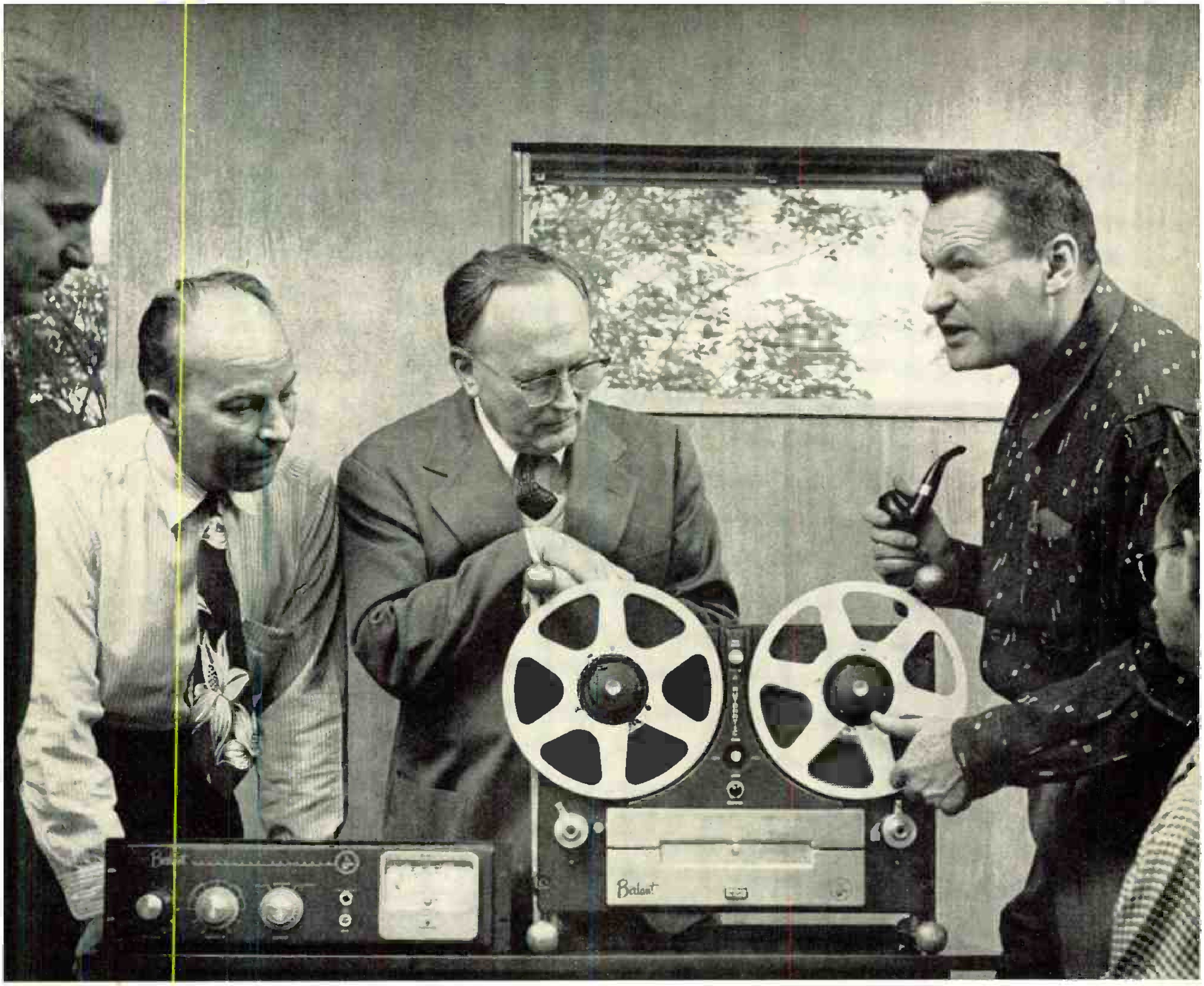
Hughes

SEMICONDUCTOR SALES DEPARTMENT

Aircraft Company, Culver City, Calif.

New York · Syracuse · Philadelphia · Chicago

ALL SUBMINIATURE DIODES MADE BY HUGHES ARE FUSION-SEALED IN A ONE-PIECE MOISTURE-PROOF GLASS BODY. ACTUAL DIMENSIONS, DIODE GLASS BODY: 0.265-INCH LONG, BY 0.105-INCH DIAMETER, MAXIMUM.



"Better than pushing buttons..."

A quick flick of the thumb . . . it's on "RUN." At any speed, another flick stops the tape. Fast forward and reverse are just as simple. What's more, it can be fully operated from a remote position with the same easy *"joy stick control."*

In a final test session, the engineering team responsible for the design and production of the new Berlant Automatic Recorder BAR-1 was highly gratified with the final analysis and performance of the new machine. Meeting with Bert Berlant, president of Berlant Associates, they put the new recorder through a series of rigorous tests. They found the new automatic control fool-proof.

Tested under actual working conditions, the new *"joy stick control"* marks a new advance in the art of magnetic recording. It is an exclusive feature which has been added to all the outstanding advantages of the Berlant Broadcast Recorder BR-1.

The new Berlant Automatic meets every requirement of the recording studio, radio station or industrial application. Its provision for five heads (three are standard) permits both single and dual track operation. The BAR-1 also includes an A-B test fader which allows metering between incoming signal and playback without transients or clicks.

And these additional requested features: Hysteresis synchronous direct drive with 99.8% timing accuracy. Instantaneous *Reeloks*. Automatic cut-off. Tape tension arms. Adjustable bias. Simplified cueing and editing.

All of the above are what 382 different engineers asked for in a questionnaire before work was started. We considered the man in the figure department, too. He wants dependability and low maintenance cost . . . at the right price! We've given it to him.

$695 IS THE PROFESSIONAL USERS NET FAIR TRADED PRICE

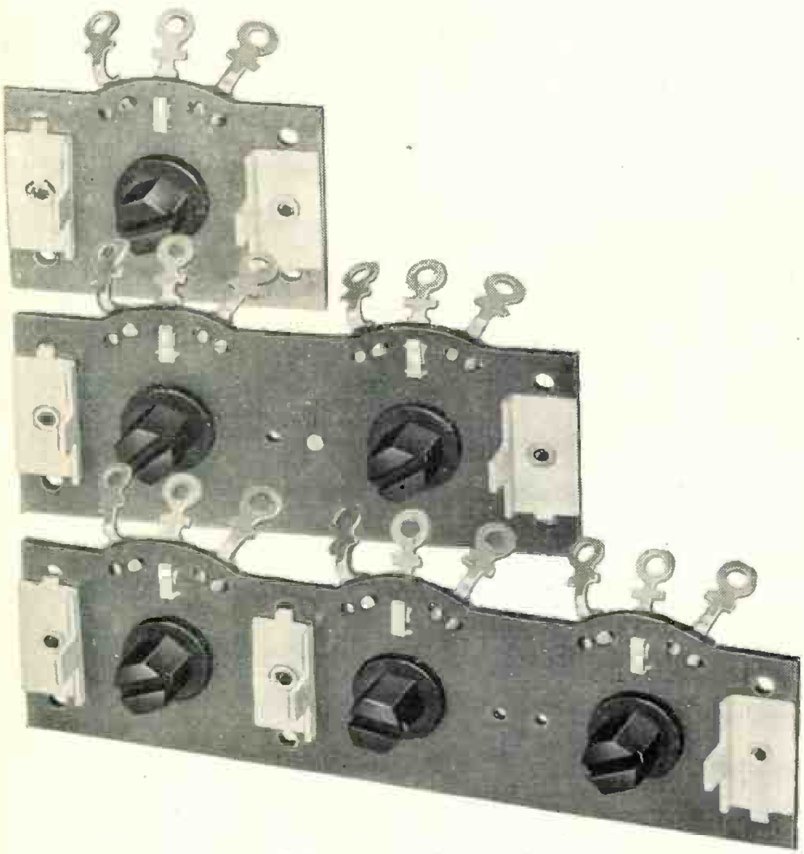
You'll want to test it yourself, we know. For a distributor close to you, for more complete technical brochure, write: Berlant-Concertone,

4917 West Jefferson Boulevard,
Dept. M13, Los Angeles 16, California

THIS IS REPORT NO. 3 IN A SERIES OF FIELD TESTS.

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

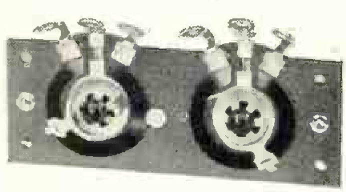
Multiple Unit Carbon Controls —in *New* Cost-Saving Design



Resistance values: *250 ohms to 10 megohms, in a variety of tapers.*

Shaft: *Hex phenolic, with slotted end; lengths — zero up to 7/8" FMS in 1/8" increments.*

Rear view shows simple, rugged design, with resistance wafer attached directly to phenolic panel.



A COMPLETELY new type of carbon control just developed by Mallory offers opportunities for important savings in your production. Available in single, dual and triple units, this model features a unique strip-type phenolic panel construction that is particularly applicable to TV alignment controls.

SAVES PRODUCTION TIME . . .
A dual or triple unit can be mounted in no more time than your assemblers now need for a single control.

REDUCES COMPONENT COST . . .
The new simplified design makes it possible for Mallory to produce multiple units at costs materially lower than that for a corresponding number of conventional single controls.

FLEXIBLE DESIGN . . .
This unique design offers many adaptations . . . at low cost. Phenolic hex shaft with screw driver slot makes for ready adjustability and is supplied in 1/8" increments of zero to 7/8" FMS. Terminals can be solder lugs or wire wrap solderless type. Mounting arrangement can be holes for riveting or twist tabs. Resistances cover the range from 250 ohms to 10 megohms, with rotational stop provision.

Minimum spacing of shafts . . . 1 5/32" between centers . . . is identical with that required for single controls. You can install the new units as direct replacements in many existing chassis and mounting plate designs. Special center spacings can, of course, be supplied.

Plan to take advantage of these new economies in the equipment you are now designing . . . and investigate the possibilities for using them in the products you are now manufacturing. For technical details, and for engineering assistance by Mallory specialists, write or call Mallory today.

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

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

Expect more . . . Get more from

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

NEW

Type 1218-A
UHF Unit Oscillator
complete with patch cord and connectors, **$465.00**

900 to 2000 Mc Oscillator

The latest addition to the line of G-R Unit Instruments is the Type 1218-A UHF Unit Oscillator . . . a well designed, well-engineered signal source which provides high power at ultra-high frequencies, and costs much less than existing u-h-f generators.

This instrument is remarkably versatile. It can be modulated with either square waves or pulses. Its frequency can be adjusted accurately in slight increments at any point over its wide range. It is a general-purpose, thoroughly shielded source of power for use in laboratory or field. It is useful not only for driving slotted lines and the Admittance Meter but also for exciting antennas for field-strength measurements, and for high-frequency research and development work on pulse-type equipment of all kinds.

The Oscillator is designed to work with the many other G-R Unit Instruments — Oscillators, Amplifiers, Null Detectors, Pulse Generators, High-Frequency Detectors, Crystal-Controlled Oscillators, Power Supplies — to form a wide variety of flexible, economical measuring systems. These "building blocks" provide, without frills, the most in performance at lowest cost.

CIRCUIT: Grid-separation triode oscillator uses Type 5675 UHF Pencil Tube. Line sections with sliding contacts used to tune plate and cathode.

FREQUENCY RANGE: 900-2000 Mc.

HIGH UHF OUTPUT POWER: Continuously adjustable from low values to minimum of 200 milliwatts into 50-ohm load.

FREQUENCY CALIBRATION: Direct reading to 1% with slow-motion drive.

INCREMENTAL FREQUENCY CONTROL: (cannot be seen in photo).

FREQUENCY DRIFT: Not over 0.1% per day.

MODULATION: Many kinds of external modulation can be applied: Sinusoidal amplitude modulation, pulse modulation and square-wave modulation from about 100 to 5000 cps.

AUTOMATIC CONTROL: Voltages can be inserted in series with the plate to hold the amplitude constant as frequency is varied. Voltages also can be inserted in series with the grid for electronic control of frequency.

LOW NOISE: f-m noise due to vibration and microphonics is unusually low. Rectifier and filter for the heater voltage are built in to reduce modulation by the power-line frequency.

POWER SUPPLY REQUIRED: Type 1203-A Unit Power Supply ($40) for operation from 115-volt, 50-60 cycle power. The Type 1202-A Unit Vibrator Power Supply ($125) for operation in the field from 6 or 12-volt storage battery.

ACCESSORIES: Type 1217-A Unit Pulser for direct pulse modulation.

Type 1000-P7 Balanced Modulator for amplitude modulation up to 100% with negligible fm and pulsing with fast rise time and short duration.

Type 874 Coaxial Elements such as adaptors, attenuators, filters, voltmeters, mixers.

Type 1750-A and 1263-A Sweep Drive and Amplitude-Regulated Power Supply for automatic sweeping over the oscillator frequency range.

Type 480-P7UI Panel for mounting Type 1218-A UHF Oscillator in standard laboratory relay rack.

Types 1217-A $225, 1000-P7 $225, 480-P7UI $14, and 874 Coaxial Elements are available from stock for immediate shipment. Types 1750-A and 1263-A will be available shortly.

WE SELL DIRECT — Prices are net, FOB Cambridge or West Concord, Mass.

GENERAL RADIO Company

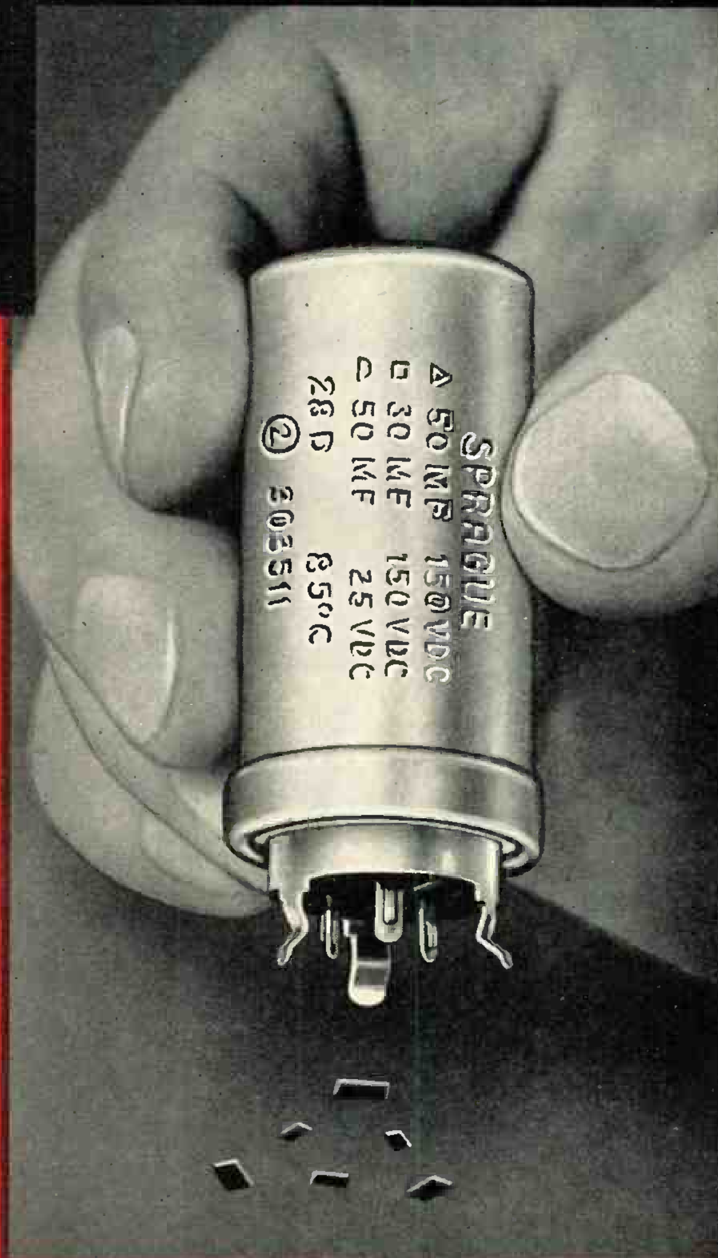
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

1915-1955
40 Years of Pioneering in Electronics

90 West Street NEW YORK 6
8055 13th St., Silver Spring, Md. WASHINGTON, D. C.
920 S. Michigan Avenue CHICAGO 5

A SNAP FOR WIRING BOARD ASSEMBLIES

NEW Sprague Type 28D Push-Lok* Electrolytic Capacitors Give Fast, Fool-Proof Mounting



HERE'S THE BEST APPROACH yet to electrolytic capacitors for printed wiring board assemblies.

It's Sprague's new Type 28D Push-Lok Electrolytic. Just insert the connecting lugs through the slots in the wiring board, and the capacitor is held securely in place until the chassis is ready for dip soldering . . . so securely that solder gaps are eliminated. Spring action of the Push-Lok lugs is strong enough to hold relatively heavy capacitors in place, even when the board is carried sideways, or upside-down on a conveyor. Tab connections are always in close contact with the printed conductors. Yet, unlike other designs, no secondary operations are required for this fast and secure mounting.

Other advantages include:

Fool-Proof Positioning—A Push-Lok can only be inserted the right way. A wide index terminal is provided in the mounting ring to index the assembly on the chassis or other surface if desired.

The Ability to Print Wiring Boards on Both Sides—Shoulders on the Push-Lok lugs plus additional prongs keep the capacitors clear of the chassis.

Safety—Circular shield conforms with suggestions of Underwriters' Laboratories, Inc. Tools cannot be inserted easily between the bottom of the capacitor and the chassis.

FOR COMPLETE INFORMATION on these new Type 28D Push-Lok electrolytic capacitors, write for Engineering Bulletin to Sprague Electric Co., 233 Marshall Street, North Adams, Massachusetts.

**Push-Lok is a Trademark of the Sprague Electric Company*

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

SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

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

SEE US AT THE I.R.E. SHOW—247-249 Instruments Avenue

TELE-TECH
& Electronic Industries

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

Bonus For Inefficiency

Estimating the cost of an electronic research or production job is not easy. In commercial operations, when a company finds a better means for executing a project, it usually results in a well deserved increase in profits. In other words, there is a strong incentive for efficiency.

Unfortunately, this is often not the case with government contracts. As a matter of fact, the amount of profit may increase in direct proportion to a firm's inefficiency!

Take the cost-plus-fixed-percentage contract for example. At times this might be necessary when a new development is being pioneered and no satisfactory criteria exist for cost determination. But in the case where some dollar yardstick does exist, the company which spends the most can come up with the highest total bill—and consequently the greatest profit.

Now take the more common situation of the fixed-cost government contract with redetermination clause. In this case it is to the company's benefit to spend as much money on the project as it can—up to the contract ceiling—to keep its profits up. There is no incentive for increasing efficiency, as there is in commercial operations, because the manufacturer does not share in the saving of a reduced contract cost.

The whole problem of finding the best procurement means is rather intricate, complicated by such factors as renegotiation clauses which limit profits. It should be noted that an incentive-type contract does exist, but it is infrequently employed.

No matter how you slice it, government contracts generally do not offer any incentive to improve efficiency and reduce costs. This is unfair to the producer with know-how and to the taxpayer.

Consequently we urge the broader utilization of incentive arrangements which provide for a sliding profit scale—profits going up as the contracting company reduces cost through greater efficiencies. Let's get rid of the bonus for inefficiency!

Allocation Sniping

In recent weeks two incidents of what we call "Allocation Sniping" have come into the news. The first, which involved the desire of the military to acquire the use of television channels 2 to 6, fortunately turned out to be only a rumor. The second, however, is factual and has been formally presented to the FCC. This involves a petition by the National Association of Manufacturers to be permitted to operate on unused portions of the FM broadcasting band. (See page 174 for additional details.) We make no comment on the pros or cons of either of these issues at this time. The important thing to note however is that apparently there is no vehicle in the existing frequency allocation procedures which enables allocations to keep pace with the times.

Fifteen years ago, VHF-TV frequencies were of very little interest to the Navy because the equipment available was not particularly efficient due to the state of the art at the time. Commercial TV of course changed all this and the VHF frequencies are now highly prized for long range ship-to-ship or ship-to-shore communication. FM sound broadcasting failed to make strong inroads into AM-served areas and so today we have relatively idle frequencies in FM allocations while mobile industries and special industrial services desperately seek more frequencies to operate on.

It would seem that with the electronic industries still expanding we can expect more allocation sniping from time to time unless measures are taken to increase allocation efficiency. Such measures might be: a) services which have been allocated frequencies being required to make consistent use of those bands (this means military as well as civilian), b) making frequencies allocated to services subject to periodic function reviews. Where the service rendered could be better accomplished with different frequencies and more modern equipment, the initiation of planned obsolescence program to retire old equipment and recover frequencies would benefit.

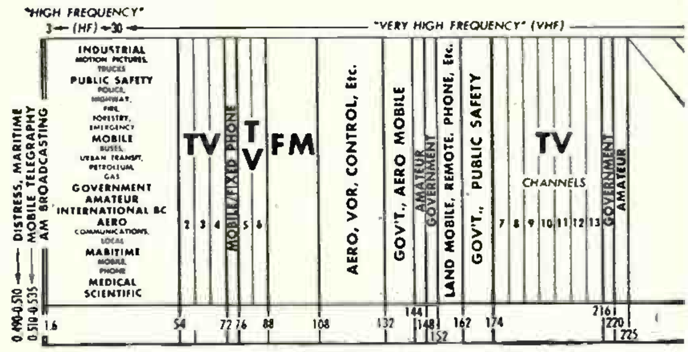
Electronic Press Days

The Los Angeles Chamber of Commerce, through its Electronics Committee headed by Les Hoffman, recently held its first "Electronic Press Day." Purpose of the meeting was to inform members of the local and national consumer and trade publications as to the type and scope of electronic manufacturing in the Southern California area. (See page 160 for more detailed information.)

We believe that meetings of this type are good for all concerned and that other cities with substantial numbers of electronic manufacturers might well follow suit. Such meetings give the press an "awareness" of important electronic activities in their locality and provide a substantial reference point on which to evaluate either national news or news from other localities. The personal contacts arising out of such meetings can become important "two-way" information streets. Finally, through municipal sponsorship, such meetings also tie industry and government closer together and act to promote the civic pride of local citizens.

RADARSCOPE

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

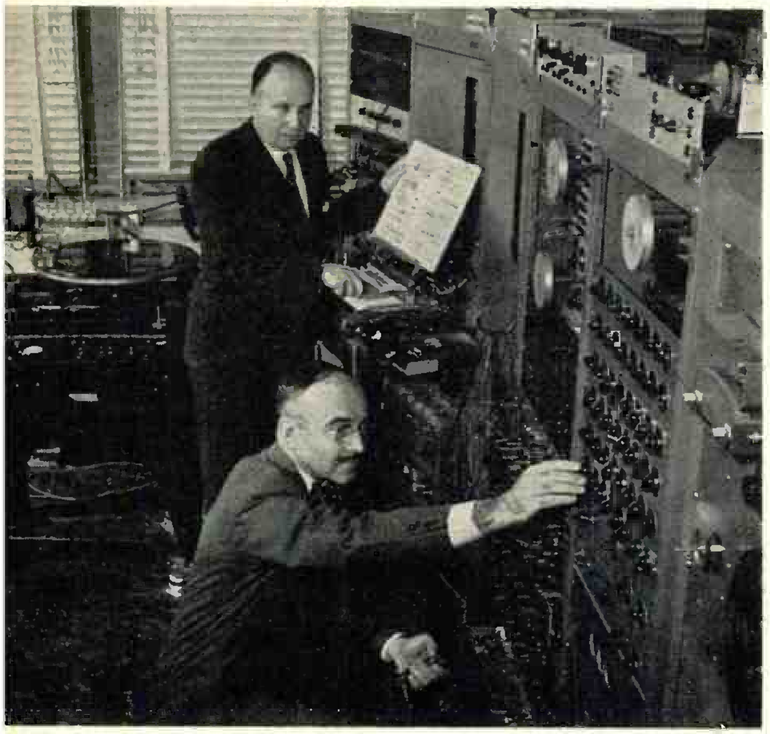


MULTI-COLOR RADAR, mentioned in these pages last May has been demonstrated for the U. S. Navy by Chromatic TV Labs. Utilizing a modified version of the single-gun Chromatron color TV picture tube, the new radar indicator offers a number of advantages for safety aids and military tactical operations. This includes easy information identification of stationary and moving targets by differentiating separate color displays.

HOUSEHOLD ELECTRONIC CLOCKS will be placed on the market by General Electric, probably late this year. The new timekeeper is of the synchronous type, and does not require any cord connection to an electrical outlet. Operational details have not been revealed, but it is believed that electromagnetically induced signals are amplified in the clock to drive the hands.

TOP AIR FORCE officers smile wryly at the difficulty of obtaining technically qualified personnel to enlist. Said one, "It's ironic. Industry offers better pay to attract these men away from us. And it's Air Force contract money that enables them to do it."

ELECTRONIC MUSIC SYNTHESIZER



Dr. Harry F. Olson at the keyboard and Herbert Belar at the control panel of the new electronic music synthesizer developed at the David Sarnoff Research Center of RCA. The machine, capable of duplicating or originating any sound, receives its instructions from a keyboard with the following control functions: four keys for frequency, three for multiplying and dividing frequencies, four for harmonics, three for attack and decay, and four for amplitude. A duplicate channel of 17 keys provides for portamento and other musical variations. See details on page 80

AC-DC TELEVISION receivers show excellent promise. Emerson has already announced a 17-inch model for $149.95.

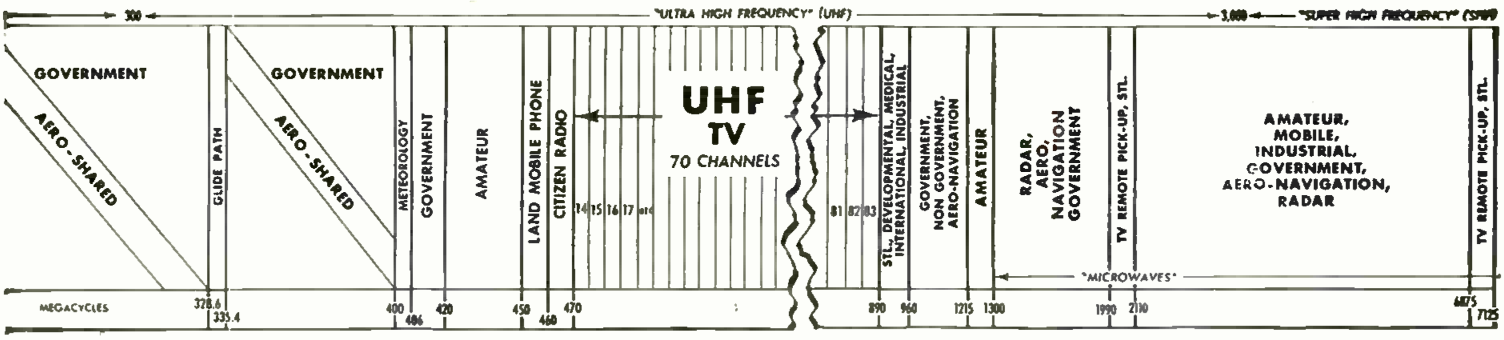
BIG MICA STRIKE in North Carolina by Minerals Processing Co. points up increasing attention being focused on this critical material. Depending on quality, the sheeted mica sells for about $18 to $70 per pound. Over 90% of the 15,000,000 pounds of the high quality grade used for electronic and electrical equipment in the U. S. is imported, mostly from India, Brazil and Canada. The government is attempting to further synthetic mica production. Mica substitutions, such as special glass, are undergoing intensive development.

IMPORTERS of foreign made radio sets have received stern warning from FCC that such units had better conform to radiation requirements expected to be adopted. Compliance will probably make these receivers considerably more expensive.

COLOR TV broadcast technique described by GE engineer is reported to assure sharp monochrome pictures on home b-w receivers when program is telecast in color. It also simplifies color registration for the studio engineer. The new method makes possible the studio pickup of a separate black-and-white image, to which the color picture is added, instead of previous methods of superimposing red, green and blue pictures to form the b-w picture. A sequential color camera is employed.

ELECTROENCEPHALOGRAPHY

BRAIN WAVE measurements employed in encephalography (EEG) have proven quite valuable in diagnosing neurological ills. Since the first recordings were made in 1924, the characteristic electrical behavior of normal and abnormal brains has been extensively catalogued. According to Arthur D. Little's *Industrial Bulletin,* there are several hundred laboratories in the U. S. specializing in this technique. By attaching electrodes to the scalp, the electrical impulses traveling around the brain's nerve loops may be recorded on a strip chart or examined with a multi-cathode-ray tube wave analyzer. Although many frequencies appear, the major types are alpha waves (8 through 13 CPS) which occur in 85% of normal adults, and beta waves (18 through 30 CPS) which are less regular than alpha. The EEG for normal adolescents is about the same as for normal adults, but there is less constancy of pattern, and it is more adaptable to change under stimulus. The EEG for the newborn is formless, developing into slow delta rhythms during the first year. Normal alpha frequencies and voltages are developed by age 14, and beta rhythms by



16. Improved equipment and techniques promise a growing understanding of brain workings during the coming years.

COLOR-TV

EMPHASIZING the growing application of color TV for medical and industrial uses, Dr. Alfred N. Goldsmith described techniques for remote diagnosis at a recent meeting of the Armed Forces Institute of Pathology. At this meeting RCA demonstrated in a closed circuit hookup how a doctor in Philadelphia had human tissue examined through a microscope by pathologists in Baltimore and Washington. At about the same time, Peter Goldmark, President of CBS Labs., demonstrated a microscope-color-TV system which projects pictures on a 6-ft. screen with magnifications of 15,000. Both for medical practice and medical education, electronic devices are slated to play an increasingly vital role.

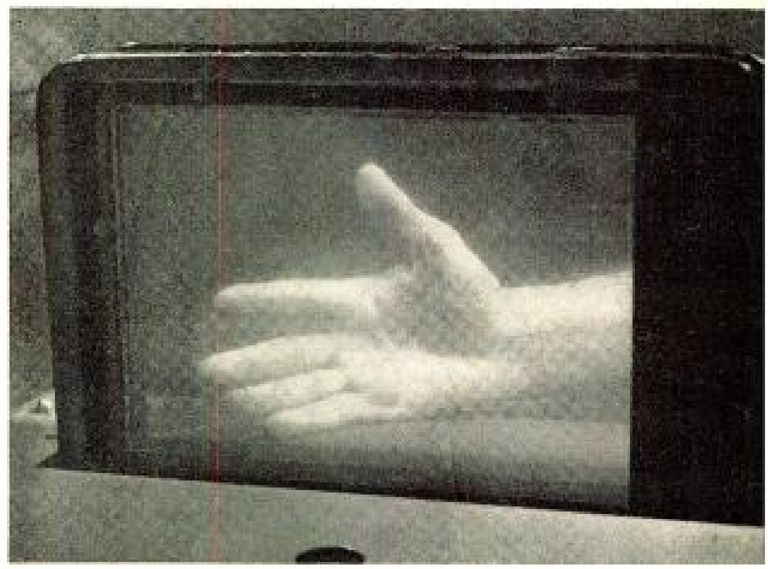
AUDIO

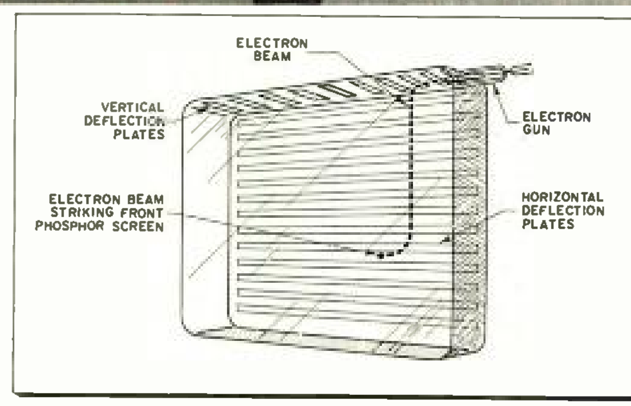
RADICALLY NEW development in audio—the electronic music synthesizer—has been demonstrated by RCA. Although not yet ready for mass production, the synthesizer has very clearly opened fabulous new horizons in sound production techniques. The function of the instrument is basically two-fold: to synthesize familiar sounds, and to create an unlimited range of tone variations. It has a capacity for originating endless varieties of rhythms, including the duplication of any sound and the origination of sounds never before heard. A year was required to build the machine, at a cost of about $25,000, and another year for developing means for using it. In operation, pressing the keys produces perforations in a paper roll, which feeds its message to the synthesizer. The machine sends the desired sound to a stylus which makes the recording on a disc. At present the machine can produce the tones of one musical instrument at a time, so separate recordings are made and then combined to form a complete orchestral selection. The synthesizer's ability to duplicate a person's voice offers possibilities for psychological warfare. Among many other applications are the rejuvenation of old recordings.

COMPONENTS & DESIGN

LARGE REDUCTION in engineering time and costs of selecting proper components for electronic equipment are claimed for a mechanized system for storing and searching engineering data. Details of this system, entitled the Electronic Component Information Center (ECIC), are contained in a research report (PB111548) recently made available to industry by the U. S. Department of Commerce's Office of Technical Services, Washington 25, D. C., for $4.25. This report of research by Battelle Memorial Institute under Air Force contract describes the elements of a machine-sorted punched-card system for recording, searching, and tabulating data on any electronic component. Its importance is pointed up by the fact that proper selection of the most reliable and effective components is often the most costly and difficult step in the development of complex electronic systems.

FLAT TV TUBE FOR AIRCRAFT





TV picture tube, consisting of a transparent phosphor screen sandwiched between flat plates, has been developed by the West Coast Electronics Div. of Willys Motors. It is only 3 in. thick and is capable of operating with 2000 line definition. An electron beam is injected in a field-free region along a horizontal edge, bent vertically at a desired point by the voltage on one of the transverse vertical deflection plates, and then bent again to the charged phosphor screen by one of the transparent horizontal deflection plates. The tube, using only electrostatic principles, is expected to be used in Navy aircraft instrument panels in 1958, and will enable pilots to see geographical features, altitude, speed and similar data right in front of them without interfering with vision

Evaluation of Radar Sea Clutter

Understanding of statistical properties of disturbed ocean surface sheds light on design requirements for military search radar

By ***ALLEN H. SCHOOLEY***
Superintendent
Electronics Div.
Naval Research Lab.
Washington 20, D.C.

ABSTRACT. Sea echo, or sea clutter, is a term used to denote radar reflection and scattering associated with the wind-disturbed surface of the sea. To date the precise relationship between the clutter and the sea surface is not completely understood. This lack of understanding is, at least in part, due to the lack of a satisfactory statistical model of the sea surface. This paper will emphasize recent work on the statistical properties of a wind-disturbed water surface with the view of helping electronic engineers better understand the sea clutter problem.

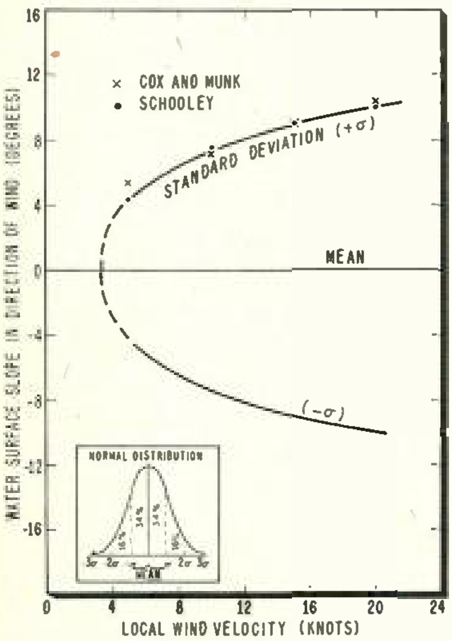


Fig. 1: Mean slope and standard deviation curves for wind-disturbed water surface

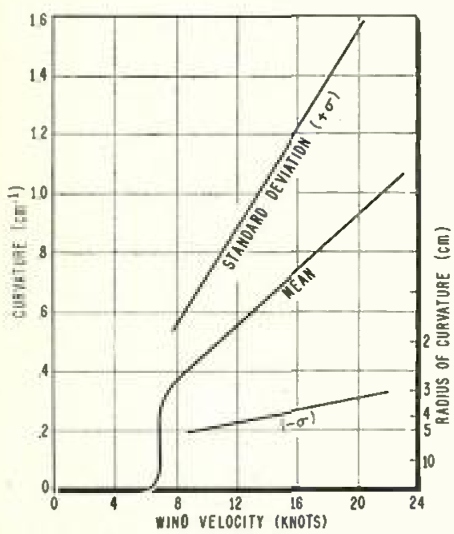


Fig. 3: Mean curvature and standard deviation curves for a wind-disturbed water surface

THE surface of a large body of water is seldom calm. Wind, rain, earthquakes, fish, ships, currents, and tides are all elements that cause the surface of the sea to be rough and undulating. For most purposes, however, only the wind need be considered as the surface disturbing element.

The state of the wind-swept sea surface is important in radar operation. A radar operator looking for a target sometimes finds that energy scattered back from a rough sea surface (sea clutter) overrides and obliterates echoes from the desired target. In other words, it is often sea clutter, rather than system noise, that determines the maximum radar detection range for a particular target. It is evident, therefore, that the relationship between sea state and sea clutter is of considerable practical importance. It is also an interesting scientific riddle that has not yet been satisfactorily solved.

The following two phenomenological radar equations are introduced to serve as the basis for further discussion.[1, 2]

$$\overline{P}_r = \frac{P_t G^2 \lambda^2 \Phi \tau c \sec \Theta}{2(4\pi)^3 R^3} \sigma^\circ \ (\Theta \text{ small}) \qquad (1)$$

$$\overline{P}_r = \frac{P_t G^2 \lambda^2 Ⓗ \Phi}{(4\pi)^3 R^2 \sin \Theta} \sigma^\circ \ (\Theta \text{ large}) \qquad (2)$$

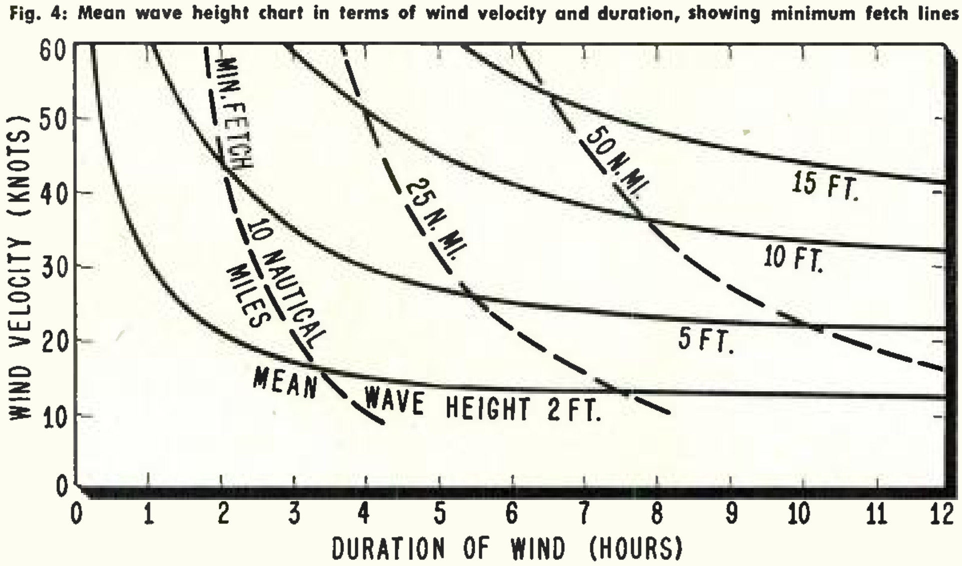
where $\overline{P}_r$ = Received sea echo power averaged over many pulse periods

- P_t = Transmitted peak power
- G = Power gain of the antenna
- λ = Wavelength
- R = Range to target
- Φ = Azimuthal antenna beamwidth which is approximately equal to angle subtended by the one way half-power points of the antenna pattern
- Ⓗ = Vertical antenna beamwidth
- τ = Pulse length
- Θ = The depression angle of the axis of the beam with respect to the horizontal
- c = Velocity of radio propagation
- σ^0 = The average radar cross section of sea clutter per unit area of the sea surface

Eq. (1) is valid for $\Theta < \tan^{-1} 2$ Ⓗ $R/\tau c$ and Eq. (2) is valid for $\Theta > \tan^{-1} 2$ Ⓗ $R/\tau c$.

All of the factors in Eqs. (1) and (2) except σ°, can be controlled and measured for a particular radar under particular conditions. If this is done σ° can be calculated for the conditions considered. This has been done in a very preliminary way by several investigators and this work is summarized in reference 2. It turns

Fig. 4: Mean wave height chart in terms of wind velocity and duration, showing minimum fetch lines



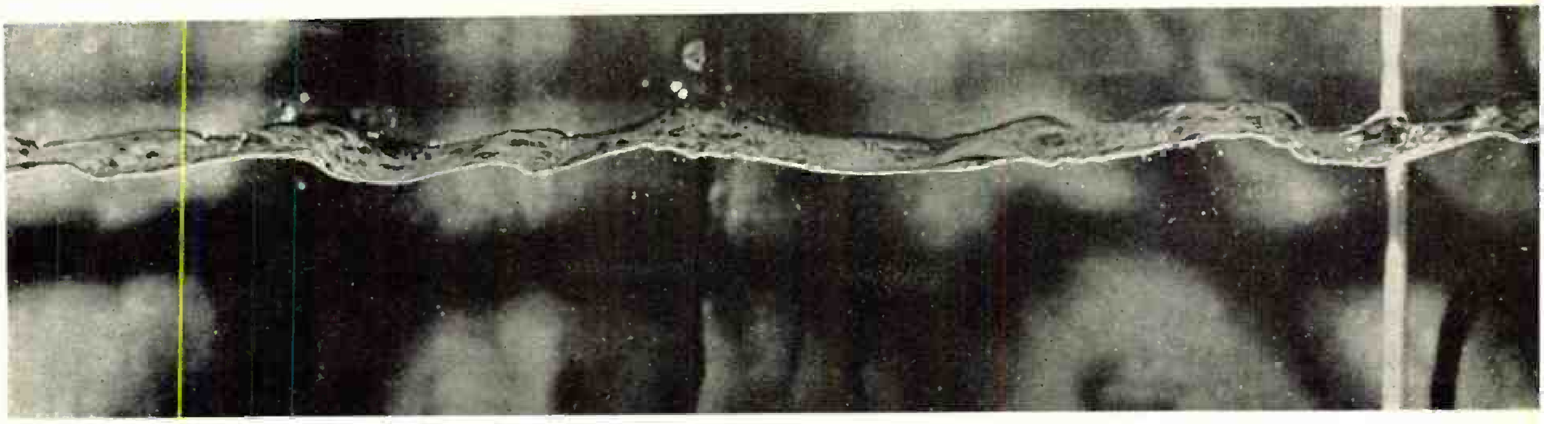


Fig. 2: Profile of a water wave created by a 16-knot wind in a small water windtunnel

out that σ° is a complicated function of so many variables that it is probably impractical to make enough field measurements to establish its complete quantitative nature experimentally. This is made more evident by noting the principal variables upon which σ° depends. It has been found that

$$\sigma^{\circ} = f_1(\Theta, \lambda, P, S) \qquad (3)$$

where σ°, Θ, and λ have been defined previously and where

f_1 = An unknown function
P = The angle of polarization
S = The sea state

All of the variables of Eq. (3), except S, can be measured in a reasonably straightforward manner. Thus, the nature of S must be important in unlocking the secret of radar sea-clutter.

Wind-Disturbed Water Surface

In the past it has been customary to give descriptive terms to various sea states such as calm, smooth, slight, moderate, rough, very rough, high, and to associate significant wave heights and lengths with each sea state. It is the heights of the large waves that become important to the designers, crews and passengers of ships, and the builders of breakwaters and docks. Radar sea clutter, on the other hand, is quite sensitive to the smaller waves. It has been observed that sea clutter is more severe under conditions of a sharp choppy sea caused by local winds than when the sea is glassy with a heavy swell caused by a distant storm. Thus, a quite sophisticated description of the sea state or sea surface is needed in order to relate it to sea clutter.

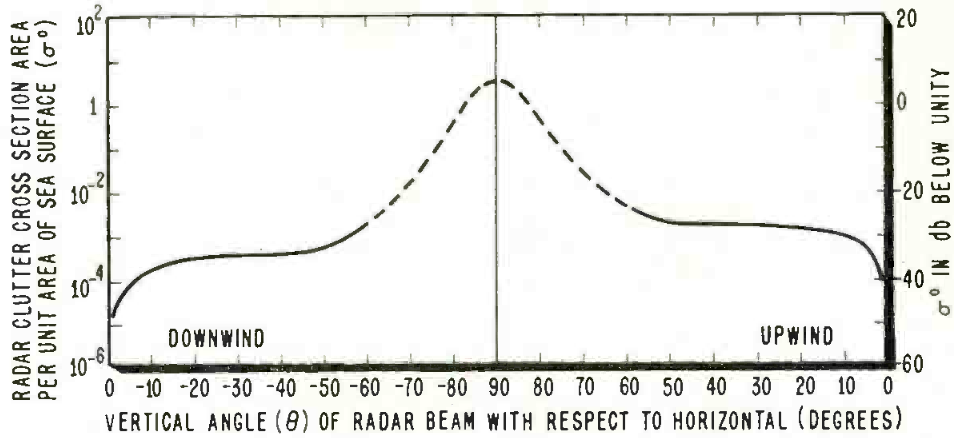
Unlike electromagnetic waves in free space the velocity of propagation of water waves is not a constant. For isolated deep water waves where the ratio of height to wavelength is less than 1/100, the wave form is sinusoidal and the velocity of propagation varies with wavelength.[3] Waves of moderate height (ratio of height to wavelength of between 1/100 and 1/25), have a nearly trochoidal shape. For large waves (ratio of height to wavelength of greater than 1/25), the troughs are wider and flatter and the crests narrower and steeper than the trochoidal shape. Instability and breaking of the tops of the waves occur at height-to-length ratios in the region of 1/10 to 1/7. The velocity of water wave propagation increases slightly as the ratio of length to height becomes a larger number. Actually a wind-disturbed water surface is usually a more or less random composite of waves coming from various directions with various heights, shapes, and wavelengths depending upon the action of local and distant winds. Any satisfactory description of the surface therefore must be given in statistical form. It may be assumed that the target causing radar sea clutter is made up of a large number of individual scatterers that are facets of the sea surface having random slopes, sizes, and heights. It is the sum of the noncoherent scattering back to the radar from these facets that produces sea clutter. Thus, perhaps one needs to be able to describe the surface of the sea in terms of the statistical distribution of scatterer slope, size, and height. Once having such a statistical description of the sea surface it may be possible, with sufficient mathematical ingenuity, to relate the gross effect of the sea surface to the production of radar sea clutter.

Maximum Slopes

Hulburt[4] used pictures of sunlight reflected from the facets of the water surface to estimate the maximum slopes of these facets. Cox and Munk,[5] and Schooley[6] have made studies relating the distribution of water surface slopes to local wind velocity. Cox and Munk analyzed pictures taken from aircraft of the sun's reflection from the surface of the Pacific Ocean. Schooley's data were derived from flash pictures of the surface of the Anacostia River. Fig. 1 shows smoothed data taken from both of these references. As a first approximation it is assumed that the distribution of water surface slopes is a normal distribution with a mean value of zero. The dispersion around this mean value increases as the local wind velocity increases beyond a certain thresh-

(*Continued on page* 118)

Fig. 5: Approximate radar clutter cross section per unit sea surface area as a function of depression angle with respect to the horizontal for a sharp radar beam



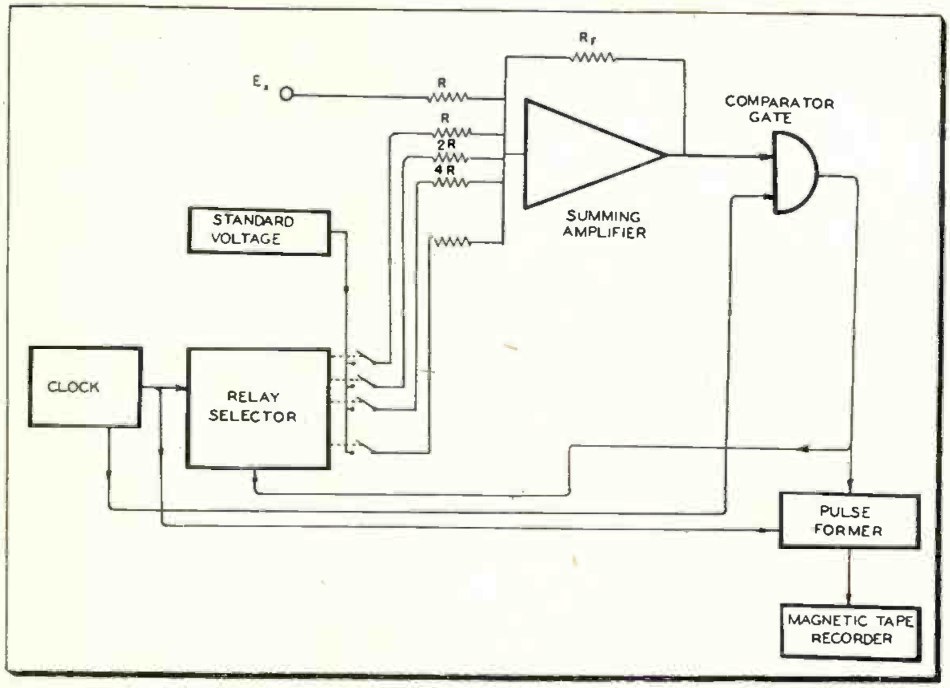


Fig. 1: Block diagram showing system operation of single-channel encoder

Data

By
J. R. ZWEIZIG
Jet Propulsion Lab.
California Institute of Technology
Pasadena 3, Calif.

Analog transducer output is converted to digital form for subsequent automatic computation

IN recording engineering data for subsequent automatic computation, it is advantageous to have these data recorded in digital form. Accuracies of approximately 0.1% may be easily achieved through the use of digital methods. This encoder was designed for recording digitally the output of analog transducers used in rocket-motor tests.

The major characteristics of the encoder are as follows: There are two input channels, each with a sampling rate of 40 complete measurements per second and an input range of 0—1 v. Accuracy of the encoder is ±0.1% as output is described by 10 binary digits. Through the use of contact-modulated amplifiers, the input range may be lowered to 0 to 10 mv. This sensitivity is required for use with most input transducers.

Digitized data at the encoder output are recorded on a single-channel magnetic tape and are later transferred to printed tabular form or punched cards by the transcriber unit of the data-handling system.

The transcriber unit reads the tape at a rate slow enough to allow printout operations and card punching and tabulates separately the information from the two input channels.[1]

Analog-To-Digital

Several methods for converting continuously varying voltages from the analog to the digital form are in common use.[2,3] Certain elements are essential in analog-to-digital converters. One such element is a reference voltage with which the input signal may be compared. Another is a comparator device which is capable of detecting coincidence between the magnitude of the input voltage and the reference voltage to the degree of accuracy desired.

Two general methods of varying reference voltage are frequently used. In one—the linear-sweep method—the reference voltage is varied continuously and smoothly as a linear function of time. In the other, incremental changes in standard voltage are made permitting successive comparisons between the standard and the unknown. When this method is used, the standard is held constant during each comparison period.

Encoding Method

Any point in the interval 0 to 1 may be described by a binary number

$$a_1a_2a_3 \ldots a_n = a_1 \frac{1}{2} + a_2 \frac{1}{2^2} + a_3 \frac{1}{2^3} + \ldots a_n \frac{1}{2^n}$$

The *a* values are limited to either 0 or 1. In the relay encoder the binary coefficients refer also to the position of the relay contacts in the encoder, 1 representing a closed relay and 0 an open relay. As *n* becomes large, the sum of the terms on the right approaches 1, when a_n equals 1. The series shown may be extended to include any number of terms; however, in a physical situation the limit of significant terms is imposed by the accuracy of measurement required or the noise level of the comparator. A point within the interval 0—1 v. may be described uniquely through the following sequence of operations: The binary coefficient a_1 is assumed to have the value 1, and the first term is subtracted from the unknown voltage. If the difference is positive, the value 1 is retained for a_1, whereas if the difference is negative, the a_1 is made equal to 0. Next the value of the coefficient a_2 is assumed to be 1, and the second term is subtracted from the residue of the preceding operation. The value of a_2 is determined as either 0 or 1 as before, depending on the sign of the new difference. In a similar manner, the unknown is compared with the sum of all terms of the series. The subtraction operation is realized by adding negative increments of voltage to the positive input voltages.

As these operations are performed, the binary-number equivalent of the unknown voltage is generated serially by the comparison operation. This same binary number may also be obtained in parallel form by noting the position of the relay contacts at the end of the sampling period. This parallel output provides a convenient way of displaying the binary-number output visually.

Operation Of Encoder

In describing the operation of the encoder, it is convenient to follow the block diagram in Fig. 1, which shows the functional units for one channel. Trigger pulses from the clock close relays which introduce voltages into the comparator. The first relay to be closed (which cor-

Encoder for General Instrumentation

responds to the most significant digit) adds a voltage at the comparator input which requires a positive analog input signal greater than +0.5 volt to prevent release of the relay. Likewise, the second relay adds an increment requiring greater than +0.25 volt to prevent its release. All the other digits are evaluated using the same scheme. It is assumed that input voltage does not change during the sampling period.

This discrimination between positive and negative sums of the series is the function of the comparator gate. Output of the comparator gate consists of reset pulses indicating 0 and blank spaces which represent 1. The complement of the reset pulses is formed and made ready for recording in the pulse-former circuit. The serial binary numbers are recorded on the tape, and the occurrence of a pulse of either polarity provides timing information for the transcriber.

Timing Pulses

Since the time scale on the digitized record depends on a knowledge of the sampling rate of the encoder, an electromechanical tuning fork is used to control the frequency of the timing pulses. These timing pulses determine the closing time of the relays which introduce standard voltage increments into the summing amplifier. A second pulse which is displaced by one-half of a comparison period serves as a reset pulse when passed by the comparison gate. Thus the comparison operation is delayed until after the relay is fully closed.

The timing scheme for operation of the two-channel encoder is shown in Fig. 2. Output digits from the two channels of the encoder are inter-

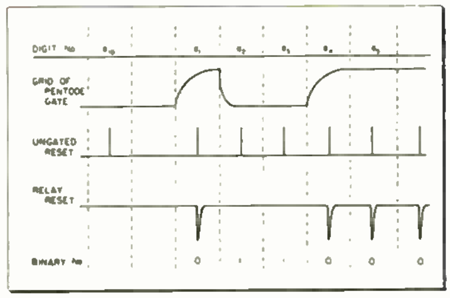


Fig. 4: Timing scheme for comparator gate

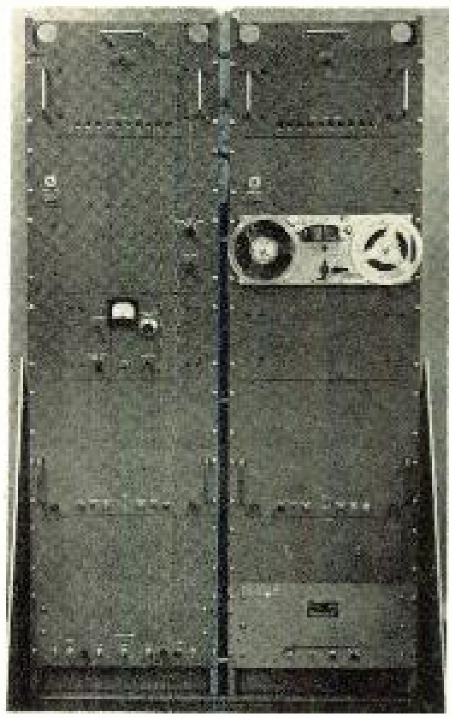


Fig. 5: Two-channel prototype encoder

laced in recording them on the magnetic tape. Thus the respective measurements on the two channels coincide in time. Additional pulses are interlaced with those of the two information channels and identify the group. At the end of a group of 30 pulses, a blank space equal to one digit period is left to separate the pulse groups representing complete samples.

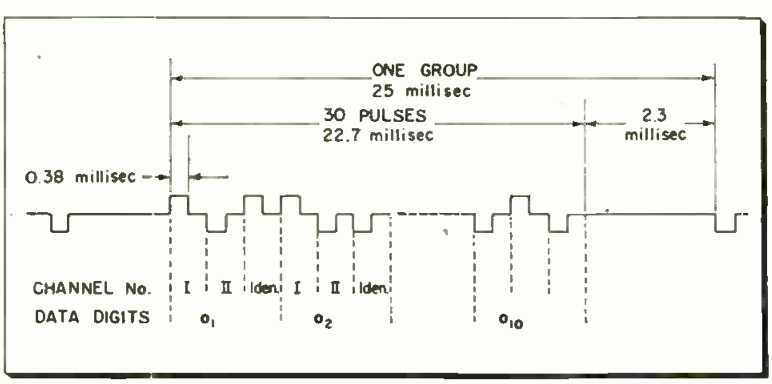
Single-Track Advantage

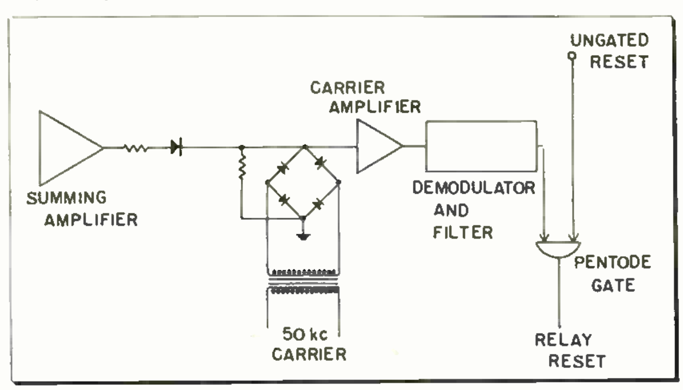
For a two-channel instrument, the single-track tape recorder could have been replaced by a dual-track recorder with simplification of the transcriber circuitry. However, the single-track recorder has the advantage that the number of input channels may be increased with a minimum change in circuitry. To be useful in field recording an encoder should accept a large number of inputs and should have a simple method of data storage. For this reason a single-channel magnetic tape was used, and recordings may be made at tape speeds of 15 or 20 in./sec. Approximately 90 pulses/in. are recorded at a tape speed of 15 in./sec. This density of pulse recording is easily realized and utilizes well-known, pulse-recording techniques.[4]

Time division between channels is accomplished by a three-tube thyratron ring[5] which distributes pulses between two information channels and the identification numbers which are interspersed. All of these timing pulses for the two-channel encoder are generated by the clock circuitry. The cathode-coupled thyratron ring which acts as channel commutator operates at a rate of 1320 pulses/sec. Ring trigger pulses for the various channels are formed from the leading edge of signals at the plates of the thyratron ring. Plates of the thyratrons are connected to diode "and" gates[6] so that a reset pulse is passed to the comparator gate of the proper channel. After each 10 digits, an interval equal to the duration of 1 digit is left for readout and reset-

(*Continued on page* 142)

Fig. 2: (l) Output timing arrangement for two-channel encoder. Fig. 3: (r) Comparator circuit with offset and drift under 0.1%





Stabilizing Transistors

By employing direct-coupled feedback methods of stabilization, usable temperature operating ranges of transistors are extended as much as 40° C. ambient

By ***SOL SHERR*** *and* ***THEODORE KWAP***

General Precision Laboratory Inc., Pleasantville, N. Y.

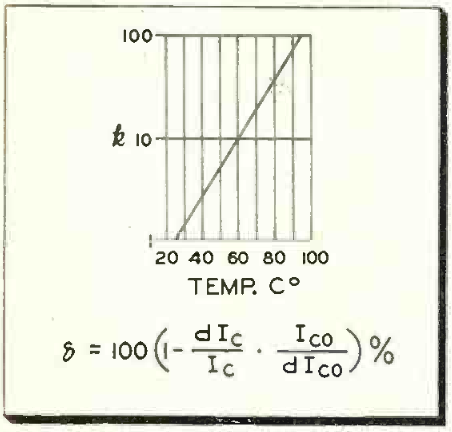


Fig. 1: Increase with temperature is linear

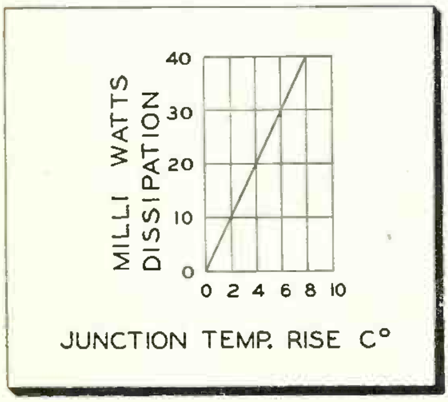


Fig. 2: Junction temperature rises with I_c

A MAJOR problem of transistor circuit design is stabilization of transistor characteristics and operating points against temperature variation. This problem has been given a good deal of attention, and several methods have been proposed as possible solutions.[1,2,3,4,5,6,7] The two basic approaches are, first, immersion of the device in a temperature controlled system and, second, application of direct coupled feedback to control the runaway action of the transistor collector current. The temperature control method is usually costly as to size and weight, and may also put electrical limitations on the design. This paper will limit itself to direct-coupled feedback methods as applied to the stabilization problem.

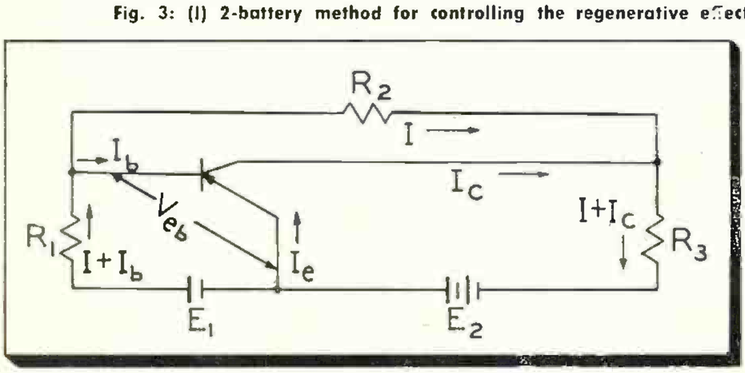
The feedback method has been treated to some extent in other articles.[1,2,3] However, in the writers' opinion, insufficient emphasis has been placed on the improvements in temperature range and stability of operation to be achieved by stabilization; nor has it been adequately stressed that lack of stabilization severely limits the utility of transistor circuits and increases the danger of failure. Thus, schemes for achieving stability by this means have been described and analyzed,[1,2,3] but this combination of insufficient emphasis on the significant advantages, and lack of convincing experimental data has tended to restrict general appreciation of the values of stabilization. This article attempts to help correct this situation. It presents two relatively unpublicized methods for stabilizing operating points, independently developed by the authors as well as several other workers in this field. By utilizing these methods, the temperature operating range of transistors normally rated at a maximum of 40°C to 50°C ambient can be extended to at least 80°C ambient, while some types rated at 75°C have been operated over 115°C in stabilized circuits. The methods are usable in many different circuit configurations, and appear to offer reasonable life expectancy even at elevated temperatures. Circuits embodying these methods have been subjected to a complete analysis, and design equations have been derived.

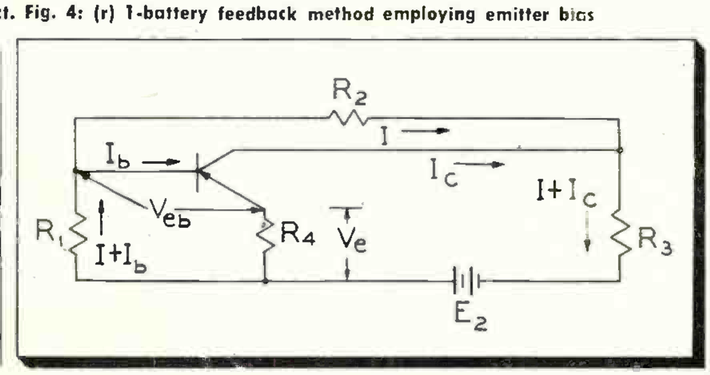
A major cause of temperature instability in transistor operation is the change in collector saturation current, I_{co}, with temperature. A commonly quoted rule for diffused junction transistors is that I_{co} will double for approximately every 11°C of junction temperature change. Fig. 1 is a graph of this variation. This I_{co} variation produces a regenerative bias voltage from base to emitter, which causes I_e and I_c to increase. As I_c increases, the junction temperature increases. Fig. 2 shows the increase in junction temperature due to the dissipation at this point. This change causes a further increase in I_{co} until at some comparatively low temperature the action becomes runaway and destroys the transistor. Previous to complete failure, there is a drastic change in parameter characteristics due to the change in I_e, and an extreme shift in operating points as a result of this action. Eqs. 8 and 9 are in the same form as Eqs. 4 and 5 for the previous circuit, and may similarly be used as design equations for this circuit.

Typical Application

As a special form of the general case described in Eq. 8, if R_1 = infinity, $R_3 = R_L$ and $R_4 = 0$, stabilization may be achieved by the use of only one additional resistor, namely R_2, where R_L is the load resistor. When this choice is possible, the method of stabilization described here is most attractive as to simplicity and minimum power dissipation.

Fig. 3: (l) 2-battery method for controlling the regenerative effect. Fig. 4: (r) 1-battery feedback method employing emitter bias





Against Temperature Variations

A sample design will be done to show the general method in designing a stabilization circuit. The design will be done on the circuit configuration shown in Fig. 4. The data given is:

Transistor type—Raytheon CK 721
B voltage—45 v.
A. C. gain required — G = 70
Max. input signal (peak to peak) = .06 v.
Max. temperature (ambient) = 75°C

The first step is to choose an operating point. In this case the operating point will be $I_c = 2$ ma, $V_c = -6$ v. The manufacturers curves will give the values of r_e, r_b and r_c knowing the value of I_c. For 2 ma Raytheon specifies $r_b = 350$ ohms, $r_e = 20$ ohms, $r_c = 0.7$ megohms, $\alpha = .975$. The value of I_{co} should be measured on the transistor to be used. $I_{co} = 12$ μa.

$$\therefore R_L = G\,[r_e + r_b\,(1 - \alpha)] = \frac{70\,[20 + 8.75]}{.975}$$

$$R_L = 2K$$

Knowing the operating point and the R_L it is now possible to draw the load line as shown in Fig. 8.

$$\frac{I_{c1}}{V_c} = \frac{1}{R_L}$$

$$I_{c1} = \frac{V_c}{R_L} = \frac{6}{2 \times 10^3} = 3 \text{ ma}$$

$$\therefore \text{ When } V_c = 0,\ I_c = 2 + 3 = 5 \text{ ma}$$

$$\text{or } V_c + I_c R_L = 6 + 4 = 10 \text{ v.}$$

After drawing the load line on the collector characteristic curve the maximum collector swing is marked off. For this design 2.1 v. above and below the operating point are marked. Since I_c will increase with temperature, the amount that I_c may be permitted to increase without distorting the output signal is noted. In this case the allowable increase in I_c is 1 ma.

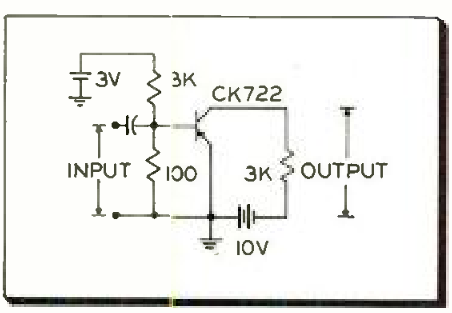


Fig. 5: 2-battery temperature stabilized ckt

The next step is to calculate the value of ΔI_{co} which will occur. The transistor dissipation must also be calculated since this heat will add to the ambient temperature and give the true junction temperature. In this design the dissipation is

$$3 \times 10^{-3} \times 4.0 = 12 \text{ mw.}$$

The junction temperature rise curve is shown in Fig. 2.

The junction temperature therefore is $75° + T_R = 75° + 2.5° = 77.5°$C.

Using Fig. 3 with the new junction temperature gives ΔI_{co}.

$$\Delta I_{co} = I_{coT°} - I_{co25°}$$

$$I_{co} = 349 - 12 = 337 \ \mu a.$$

$$\therefore \rho = \frac{\Delta I_c}{\Delta I_{co}} = \frac{1 \times 10^{-3}}{.337 \times 10^{-3}} = 2.96$$

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

solving for R_2

$$R_2 = \frac{E\,(\rho - 1)}{(I_c - I_{co}\rho)} = \frac{45\,(2.96 - 1)}{.975\,(2 \times 10^{-3} - 12 \times 10^{-6} \times 2.96)}$$

$$R_2 = 47K$$

I flowing t rough R_2 is

$$I = \frac{V_c + I_c R_L}{R_2} = \frac{6 + 4}{47 \times 10^3} = .212 \text{ ma}$$

$$I_T = I_c + I = 2.212 \text{ ma}$$

$$I_T R_3 + I_e R_4 = E - V_c - I_c R_L = 35 \text{ v.}$$

$$I_T R_3 = 35 - I_e R_4$$

Choose a value for R_4 and calculate R_3.

$$\text{Let } R_4 = 1500 \text{ ohms}$$

$$\therefore R_3 = \frac{35 - 3}{2.2 \times 10^{-3}} = 17.6K$$

$$R_1 \approx \frac{I_e R_4}{I + I_b} = \frac{2.2 \times 10^{-3} \times 1.5 \times 10^3}{(.2 + .25)\,10^{-3}} = \frac{3.3}{.45} = 7.3K$$

The resultant stability percentage, is 98.2 and the dissipation in the stabilization circuit components is .088 watts. Increases in the stability percentage can be achieved at the cost of greater component dissipation and higher battery voltage. The requirements of the individual circuit will determine whether stability or dissipation is of most importance.

TABLE 1

	FIG. 3 70° C	FIG. 4 75° C	FIG. 5 45° C
I_C MA	1.5	1.95	2
$I_{CO25°}$ μ A	8	9	22.5
$I_{CO25°}$ μ A Calculated at T° C	164	252	88
ΔI_C MA Theoretical	0.36	0.464	—
ΔI_C MA Measured	0.37	0.45	1.4
δ Calculated	98.7%	99.1%	82.1%
α	0.875	0.918	0.91

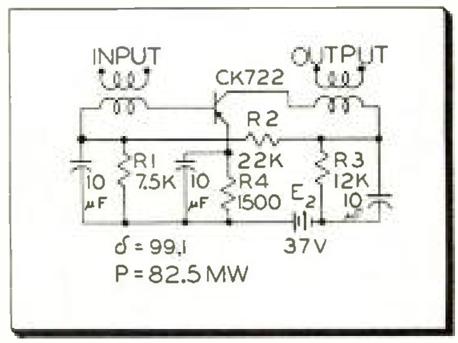


Fig. 6: Recommended operation set ckt values

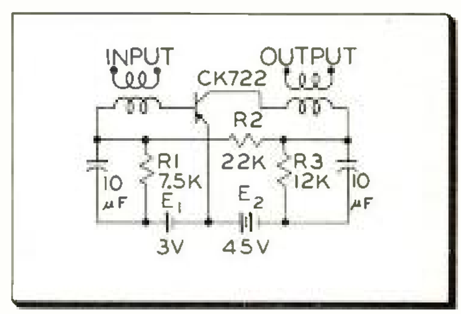
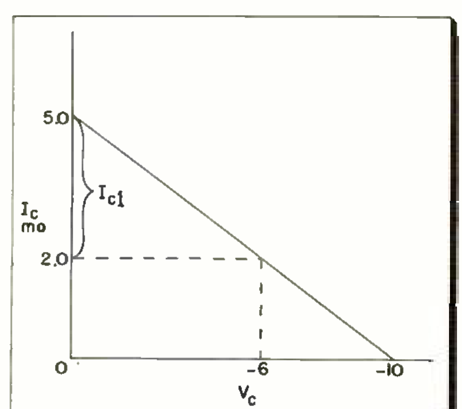


Fig. 7: Control circuit minimum stabilization

Fig. 8: Load line for transistor operation



Stabilizing Transistors (Continued)

TABLE 2

MANUFACT'R	TYPE	#UNITS TESTED	AVERAGE TEMP. OPERATION AS AMPLIFIER: FIG. 4 NO. STAB.	FIG. 3 STAB.		r_e 1*	r_e 2*	r_b 1*	r_b 2*	$r_c \times 10^6$ 1*	$r_c \times 10^6$ 2*	α 1*	α 2*	$I_{co} \times 10^{-6}$ 1*	$I_{co} \times 10^{-6}$ 2*
A	1 PNP	12	37°C	80°C	MAX.	24	24	575	575	2.0	1.0	.927	.91	15	18
					MIN.	10	10	132	132	.62	.4	.895	.85	2	6
					AVG.	18	18	245	245	1.28	.7	.92	.88	7.6	12
A	2 PNP	5	37°C	85°C	MAX.	19	19	500	600	3.12	2.5	.969	.969	10	25
					MIN.	14	14	314	300	2.27	.7	.961	.96	3	2
					AVG.	16	16	412	450	2.62	1.7	.963	.964	5.2	5
B	1 PNP	2		82°C	MAX.	21	21	625	625	1.56	1.56	.973	.973	9	9
					MIN.	17	17	270	270	1.04	1.04	.968	.968	4	4
					AVG.	19	19	448	448	1.25	1.25	.97	.97	6.5	6.5
B	2 PNP	2		80°C	MAX.	39	39	558	500	2.33	1.0	.959	.95	14	14
					MIN.	14	14	25	25	.27	.2	.952	.94	7	7
					AVG.	27	27	291	263	1.3	.6	.955	.945	10.5	10.5
C	1 NPN	10	40°C	70°C	MAX.	28	28	500	500	2.78	2.7	.972	.972	9	16
					MIN.	14	14	52	52	.71	.7	.959	.959	3	2
					AVG.	21	21	251	251	1.95	2.	.966	.966	6.3	7.
D	1 PNP	3		73°C	MAX.	27	27	870	810	1.86	1.4	.983	.983	11	19
					MIN.	22	22	470	470	1.25	.8	.975	.975	8	8
					AVG.	25	25	722	700	1.51	1.1	.979	.979	9	12
E	1 PNP	3		85°C	MAX.	23	23	600	600	2.56	2.1	.966	.95	16	16
					MIN.	2	10	240	240	1.0	1.	.949	.93	2	2
					AVG.	19	16	476	476	1.61	1.55	.956	.94	7	7
E	2 PNP	2		80°C	MAX.	14	14	418	400	2.78	2.6	.965	.95	5	6
					MIN.	10	10	334	340	1.39	1.2	.944	.93	4	4
					AVG.	12	12	376	370	2.08	1.9	.954	.94	4.5	5
F	1 PNP	2		73°C	MAX.	26	26	833	800	1.67	1.6	.982	.982	15	20
					MIN.	19	16	341	350	.253	.2	.975	.975	5	6
					AVG.	22.5	21	587	575	.96	.9	.978	.978	10	13
F	2 PNP	2		85°C	MAX.	20	20	425	400	1.85	1.8	.952	.952	6	6
					MIN.	16	16	276	250	1.11	1.	.938	.93	6	6
					AVG.	18	18	300	325	1.48	1.4	.945	.941	6	6
G	1 PNP	2		88°C	MAX.	32	32	210	210	4.15	4.15	.99	.99	4	4
					MIN.	30	30	187	187	3	3	.992	.992	5	5
					AVG.	31	31	198	198	3.57	3.57	.991	.991	4.5	4.5
H	1 NPN	12	41° C	110°C	MAX.	66	47	306	290	10.9	9.1	.932	.945	2.5	3
					MIN.	16	18	24	24	3.	1.	.828	.835	.2	.1
					AVG.	26	28	106	97	6.25	5.35	.91	.9	1.1	1.83
I	1 PNP	2		76°C	MAX.	17	17	520	520	2.5	2.4	.975	.974	4.5	3.5
					MIN.	17	17	500	500	2.	1.93	.973	.971	3	3
					AVG.	17	17	510	510	2.25	2.16	.974	.972	3.75	3.25
C	1 SIL.	2	95°C	130°C	MAX.	146	146	390	390	.83	.83	.953	.953	< .5	< .5
					MIN.	143	143	360	360	.625	.625	.952	.952	< .5	< .5
					AVG.	145	145	375	375	.727	.727	.952	.952	< .5	< .5
C	2 SIL.	12	95°C	148°C	MAX.	164	164	780	780	2.32	2.32	.975	.975	< .5	< .5
					MIN.	21	21	300	300	.77	.77	.92	.92	< .5	< .5
					AVG.	47	47	430	430	1.05	1.05	.943	.943	< .5	< .5

1 * BEFORE HEAT TEST
2 * AFTER HEAT TEST

The actual circuits on which measurements were made are shown in Fig. 5, 6, and 7. The values were chosen to permit operation at recommended operating points with reasonable values of battery-voltage and dissipation in the stabilizing resistors. The circuit of Fig. 7 was used as a control circuit since the minimum of stabilization exists in this circuit. This can be shown by substituting $R_3 = R_4 = 0$ in Eq. 8, resulting in

$$\rho = \frac{R_2 (R_1 + b) + R_1 b}{R_2 [R_1 (1 - \alpha) + b] + R_1 b}$$

If $R_1 (1 - \alpha) \gg b$ and $R_2 R_1 \gg R_1 b$, this reduces to $\rho = \frac{1}{1 - \alpha}$ which is the inherent stabilization of the transistors.

Tests were performed on a number of transistors from nine manufacturers. Representative results are shown on Table 1. Measured results are in good conformance with theory and the resultant stabilization factors gave excellent performance over the temperature range.

This is the design equation which permits us to predict the amount of stabilization which may be achieved for various combinations of circuit components.

Emitter Current

It is also of interest to know to what extent variability in I_e is controlled by this circuit. For this case differentiate Eq. 3 giving

$$\frac{dI_c}{dI_e} = \frac{R_1 R_2 + R_1 R_3 - b (R_1 + R_2 + R_3)}{R_1 R_3} \qquad (5)$$

This equation may be used to determine the stabilization against changes in I_e which may exist from transistor to transistor.

Another form of this circuit which permits operation with only one battery is shown in Fig. 4. The circuit equations are

$$I_c = \frac{I_{co} [R_1 R_2 + R_1 R_3 + (R_4 + b)(R_1 + R_2 + R_3)] + R_1 E_2}{(1 - \alpha) R_1 R_2 + R_1 R_3 + (R_4 + b)(R_1 + R_2 + R_3)} \qquad (6)$$

$$I_c = \frac{I_e [R_1 R_2 + R_1 R_3 + (R_4 + b)(R_1 + R_2 + R_3)] - R_1 E_2}{R_1 R_2} \qquad (7)$$

The dependence of I_c on I_{co} is again found by differentiating Eq. 6 giving as the first stabilization equation

$$\frac{dI_c}{dI_{co}} = \frac{R_1 R_2 + R_1 R_3 + (R_4 + b)(R_1 + R_2 + R_3)}{(1 - \alpha) R_1 R_2 + R_1 R_3 + (R_4 + b)(R_1 + R_2 + R_3)} \qquad (8)$$

In addition the second stabilization equation is found by differentiating Eq. 7, giving

$$\frac{dI_c}{dI_e} = \frac{R_1 R_2 + R_1 R_3 + (R_4 + b)(R_1 + R_2 + R_3)}{R_1 R_2} \qquad (9)$$

To assist in assessing the extent of this effect, we define the percentage stability as

$$S = 100 \left(1 - \frac{dI_c}{dI_{co}} \times \frac{I_c}{I_{co}} \right) \% \qquad (1)$$

This expresses the stability in terms of the ratio of the fractional change in I_c to the fractional change in I_{co}. It is similar in form to the equation for power supply regulation which utilizes the ratio of the fractional change in output voltage to the fractional change in input voltage as a criterion of performance. The particular form used in Eq. 1 is convenient because if both fractional changes are equal, S = 0%, and if the fractional change in I_c is 0, S = 100%. Both these results are in logical conformance with what we require the stabilization equation to express.

Circuit Analysis

A circuit for controlling the regenerative effect described above is shown in Fig. 3. The circuit equations are

$$I_c = \frac{I_{co} [R_1 R_2 + R_1 R_3 - b (R_1 + R_2 + R_3)] - \alpha [E_2 R_1 - E_1 (R_1 + R_3)]}{(1 - \alpha) R_1 R_2 + R_1 R_3 - b (R_1 + R_2 + R_3)} \qquad (2)$$

$$I_c = \frac{I_e [R_1 R_2 + R_1 R_3 - b (R_1 + R_2 + R_3)] + R_1 E_2 - E_1 (R_2 + R_3)}{R_1 R_2} \qquad (3)$$

where $b = \frac{V_{eb}}{I_e} = r_e - \frac{I_b r_b}{I_e}$

(*Continued on page 145*)

Parabolic Reflector for Sound Recording

An inexpensive parabolic, of the type in use for UHF transmission, provides the directivity necessary for recording under field conditions

Fig. 1: Author recording jungle bird sounds

By F. ALTON EVEREST
Associate Director
Moody Institute of Science,
11428 Santa Monica Blvd.,
W. Los Angeles 25, Calif.

THE first attempt to record bird songs with the family tape recorder and a non-directional microphone is usually a sad disappointment. Through such experiments we come to appreciate that the ear is actually a highly directional transducer when attention is focused on the desired sound and mental discrimination against the background noise is brought into play. This attention factor in hearing achieves directive results that can be duplicated electronically or acoustically only with very elaborate gear. However, as we will see here, acceptable results can be obtained with a standard tape recorder, an inexpensive pre-amplifier, and a simple parabolic reflector. (See Fig. 1.)

The equipment to be described has been put to good use in recording of bird songs, animal sounds, and miscellaneous sound effects for use with scientific motion pictures.

Design Considerations

As portability was an important factor, planning pivoted around the use of a light-weight tape recorder—a Stancil-Hoffman Minitape. To take advantage of the extra sensitivity possible due to the directivity of the parabolic, a pre-amplifier was needed. And, as constant headphone monitoring was desired, to determine when the recorder should be started and stopped, a simple two-stage monitoring amplifier was also incorporated.

The key to the extra efficiency is, of course, the parabolic reflector. The types presently in use for UHF radio transmitting and receiving are admirably suited to this work.

Dimensions are important. The diameter must be of the order of a wavelength or greater to be effective. In the parabolic shown in the photographs, the diameter is 44 in. This means that the diameter is $\lambda/2$ at 300 CPS and for higher frequencies the situation improves. Sound pressure at the microphone diaphragm is increased by the fact that all parallel rays of sound approaching the parabolic are brought together at the focal point. (See Fig. 4) These various components add in phase and drive the pressure-operated microphone harder than would be the case without the reflector. The greater the diameter, the greater this effect, as long as the sound arrives in parallel rays.

The depth of the parabolic influ-

(*Continued on page* 122)

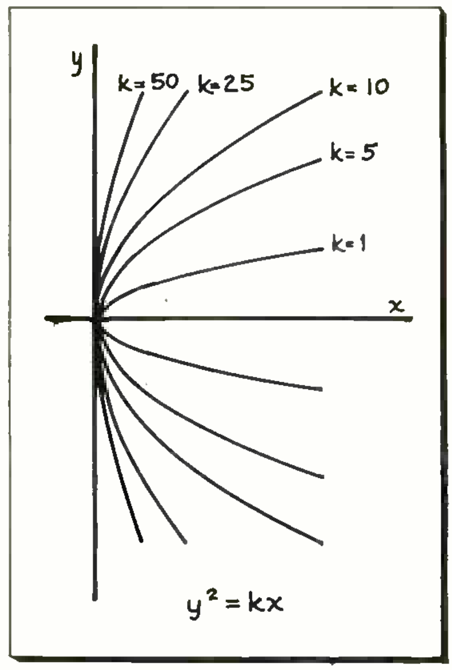
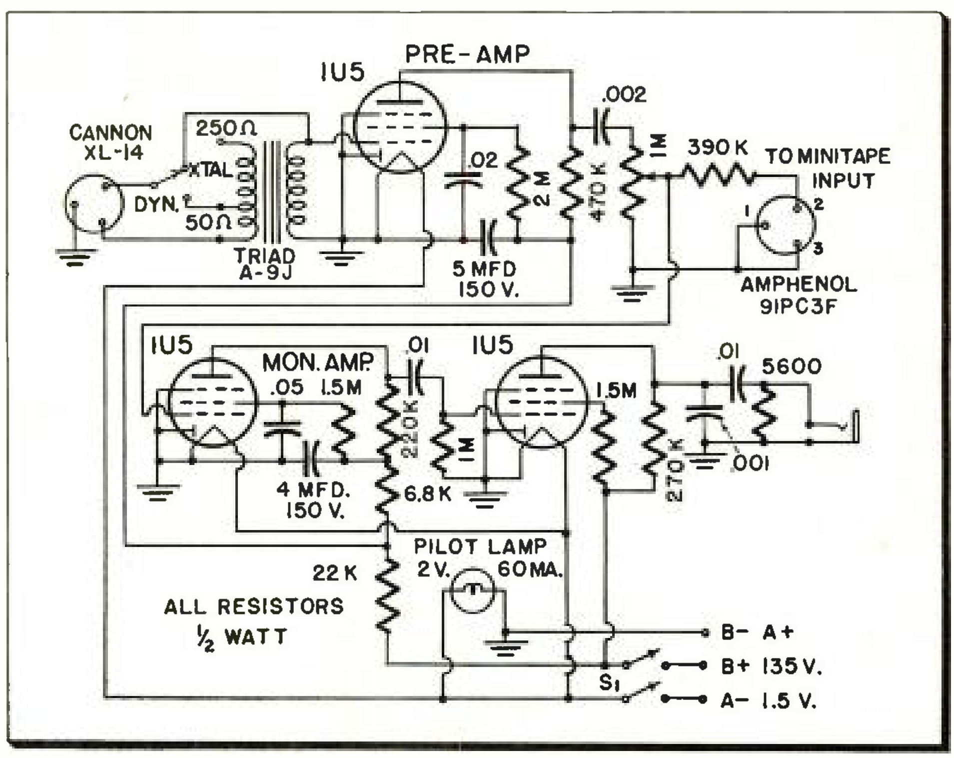


Fig. 2: Parabolas drawn for various values of k

Fig. 3: Pre-amp and monitoring amplifier



Design of Twin Tee

How to derive optimum circuit for amplifier utilized in feedback control and similar systems

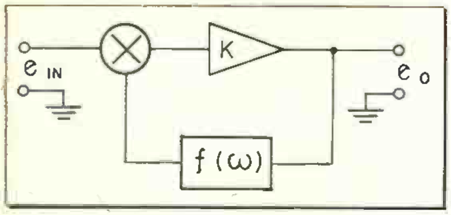


Fig. 1: Feedback amplifier block diagram

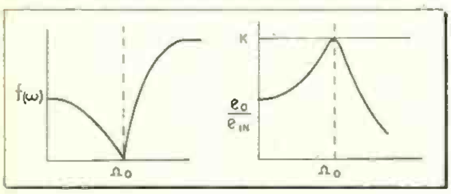


Fig. 2: (a-l, b-r) Twin tee amplitude response

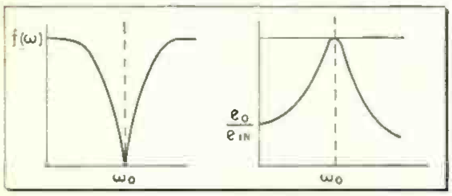


Fig. 3: (a-l, b-r) Response and gain characteristics of practical tuned amplifier circuits

C. J. Savant

C. A. Savant

R. F. Destabelle

By DR. C. J. SAVANT, Jr.
C. A. SAVANT &
R. F. DESTABELLE
North American Aviation, Inc.
12214 Lakewood Blvd.
Downey, Calif.

In feedback control system design, the need often arises for a low frequency tuned amplifier. In the interests of weight and size reduction, considerable effort has been directed toward resistor-capacitor methods of tuning amplifiers. A number of recent papers[1,2] have demonstrated rapid methods of design of R-C parallel Tee Notch networks. This article presents the results of an effort to determine an optimum tuned amplifier using parallel tee networks.

In order to understand the operation, consider the familiar block diagram shown in Fig. 1. The error voltage at the input of the amplifier is given by

$$\varepsilon = e_{in} - f(\omega)\, e_o \qquad (1)$$

where $f(\omega)$ is the transfer function (e_o/e_{in} ratio as a function of frequency) of the feedback path. In the case considered here $f(\omega)$ is the transfer function of the parallel tee network as a function of frequency. The overall gain of the system is easily calculated to be

$$e_o/e_{in} = k/(1 + k\, f(\omega)) \qquad (2)$$

For the condition that K is large compared to unity, Eq. 2 can be simplified to the following:

$$e_o/e_{in} = 1/f(\omega) \qquad (3)$$

The function $f(\omega)$ for a twin tee network is shown in the sketch of Fig. 2a. The transfer function of the amplifier with a twin tee in the feedback loop, given by Eq. 3, is the reciprocal of 2a, which when plotted resembles the sketch of Fig. 2b. Notice that although the response of Fig. 2a drops to zero at ω_o, the response of e_o/e_{in} rises only to a finite value, since near $f(\omega) = 0$ the unity in the denomination of Eq. 2 cannot be neglected, and hence at $f(\omega) = 0$.

$$e_o/e_{in} = K \qquad (4)$$

Hence the amplifier has now been made frequency sensitive having the selection properties of an LC tuned amplifier.

Limiting Factors

The above derivation is somewhat oversimplified because it was assumed that K, the gain of the amplifier, is frequency independent. Actually, there are three factors which must be considered:

1) The frequency response of the amplifier with no twin tee.
2) Loading of last stage of the amplifier by the input imped-

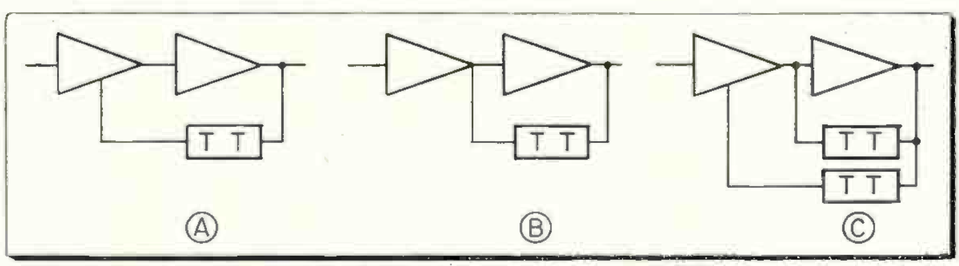
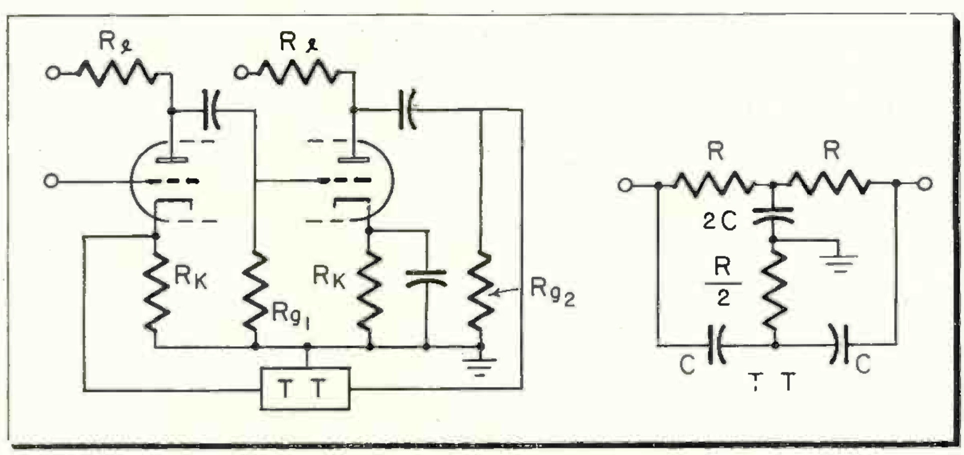


Fig. 4: Comparisons of three basic circuit types. See Figs. 5-7, and Tables 1-2

Fig. 5: Practical circuits A_1, A_2 and A_3. Latter two variations use high-mu triodes



Tuned Amplifiers

ance of the twin tee.

3) The loading of the output of the twin tee by the cathode resistor of the first stage.

Item 1 is significant because it implies that the amplifier must have good gain at the "tuned" frequency. The fact that the amplifier itself will drop off at a higher and lower frequency will only further improve the system when a twin tee is used for tuning.

Statement 2 indicates the possibility of amplifier loading at frequencies above ω_o of the twin tee. Consider circuit A, where the twin tee is connected from the plate of the output tube to the cathode resistor of the input tube. At high frequencies the load impedance of the output tube is approximately $R_k + 2/j\omega c$. Compared to the plate load of the output tube, R_k is small and for frequencies several octaves above the tuned frequency, the reactive portion of the impedance becomes small. Hence at higher frequencies the amplifier becomes more heavily loaded, and the gain is reduced. Here again, the tuning is only improved by this situation.

The impedance level of the twin tee should be selected so that the output tube is not loaded for frequencies less than ω_o.

Output Loading

The effect of output loading of a twin tee (Item 3) can be derived analytically.[1,2] Practically, when the cathode resistor is small compared to the impedance of the network, the circuit no longer exhibits the same symmetric response, (Fig. 3a.) Hence the resulting overall gain of the tuned amplifier is distorted as shown in Fig. 3b. At frequencies ω_o, the twin tee with output load resembles a voltage divider. For example in the limit, at dc, the impedance is simply the series resistance, 2R.

The three circuit variations shown in Fig. 4 were considered. Although one circuit proved superior to the others, the results of all circuits are tabulated for comparison purposes with additional data supplied for the optimum circuit.

The physical circuit features for the systems of Fig. 4 can be summarized by the circuit diagrams of Figs. 5, 6 and 7. The values are given in Table I. Circuit A_1, uses a medium μ twin triode (2C51). Circuit A_2 uses a high μ twin triode (12AX7). Cir-

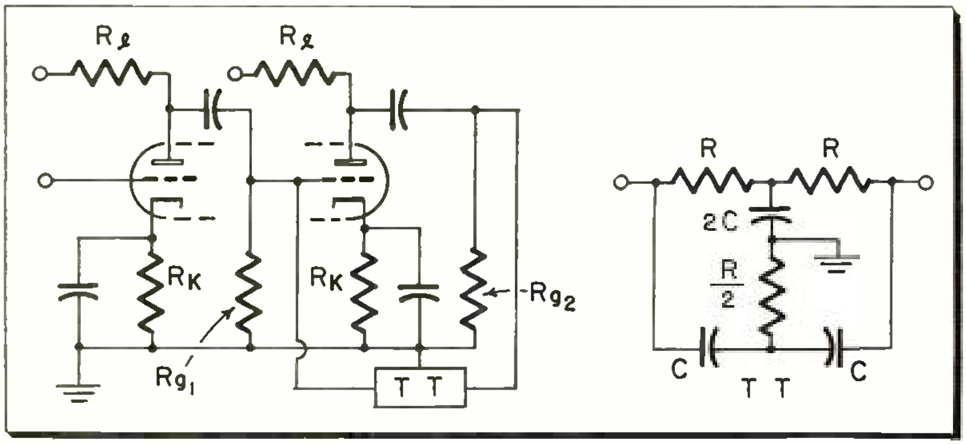


Fig. 6: Practical circuit B. Note component values and gain in Tables 1-2

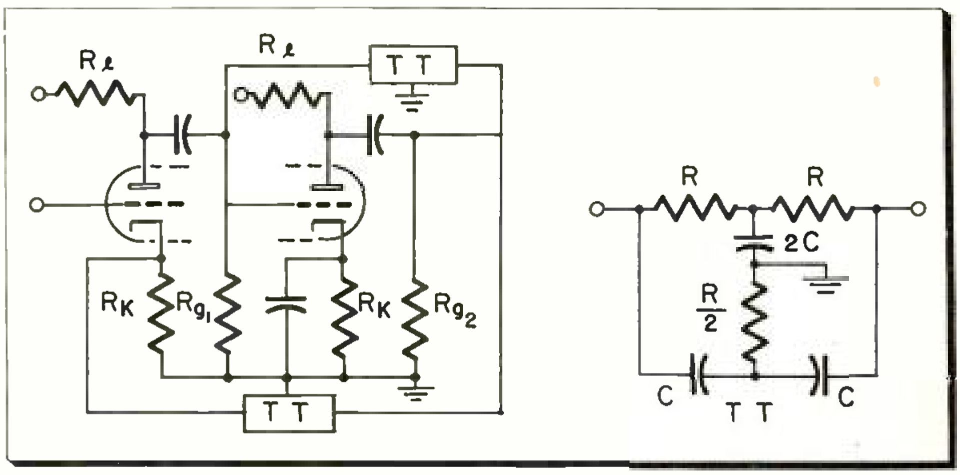


Fig. 7: Practical circuit C. Note component values and gain in Tables 1-2

Table 1—Circuit Constants

Circuit	Tube	R_1	R_k	Rg_1	Rg_2	R	C
A_1	2C51	39K	1.5K	100K	100K	10K	3300μμf
A_2	12AX7	330K	2K	470K	100K	10K	3300μμf
A_3	12AX7	330K	2K	470K	100K	100K	330μμf
B	12AX7	330K	2K	470K	100K	100K	330μμf
C	12AX7	330K	2K	470K	100K	10K / 100K	3300μμf / 330μμf

Table 2—Normalized Gain (Referred to 5 kc Gain)

Circuit	Gain at 5 kc.	Frequency 400 c.p.s.	2.5 kc	5 kc	10 kc
A_1	94	—	19.7%	100%	11.7%
A_2	225	2.02%	12.85%	100%	3.72%
A_3	1200	6.92%	10.82%	100%	5.25%
B	1200	17.9%	26.6%	100%	13.3%
C	182	4.72%	7.67%	100%	3.80%

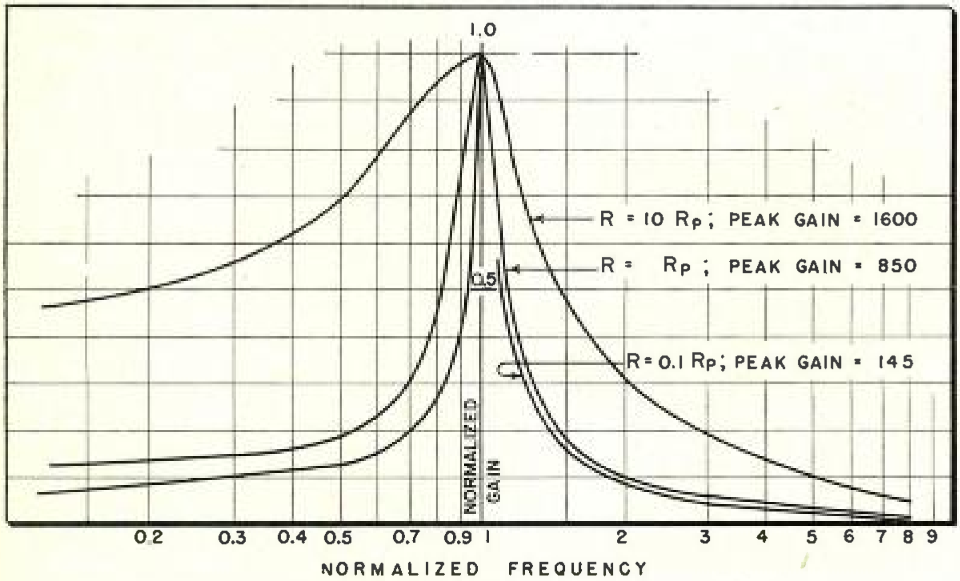


Fig. 8: Normalized response for high-mu triodes

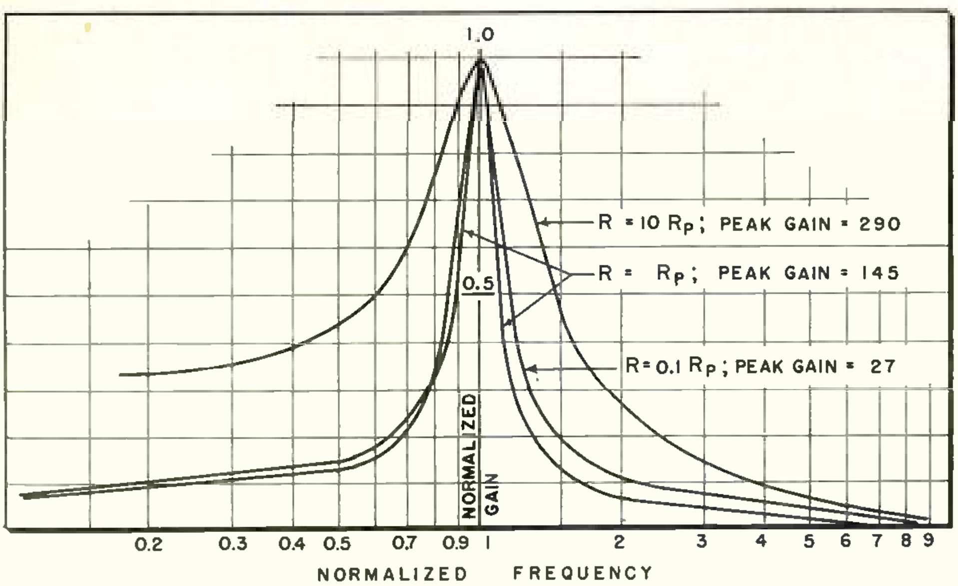


Fig. 9: Normalized response for low-mu triodes

cuits A_2 and A_3 are equivalent except for the network resistance.

In the interest of obtaining a wide spread of design information, the optimum circuit (A_3) was plotted for both high and low μ twin triodes, and with impedance levels of 0.1 and 1.0 and 10 times the plate resistance of the tube. The amplitude response for the cases considered is shown on Figs. 8 and 9.

Conclusions

Referring to Figs. 8 and 9, it is seen that although the peak gain is sacrificed, higher Q is obtained with the lower impedance twin tees. The main factors involved are the loading of the last stage by the input impedance of the twin tee and the loading of the twin tee by the input impedance of the first stage.

The 10 R_p curve has poor tuning at frequencies less than ω_0 because very little voltage is fed back, since the parallel tee impedance is large compared to the cathode resistor of the first stage. At frequencies above ω_0, the tuning is normal. The lower impedance twin tees have a higher Q. This is principally due to amplifier loading for frequencies above ω_0. Below ω_0 the lower impedance twin tees provide good tuning because there is sufficient voltage fed back to lessen the amplifier gain.

In order to operate with only a reasonable loss of gain, and yet to provide good tuning, it is apparent that the impedance level equal to the plate resistance (r_p) of the tube is an optimum.

The circuit of Fig. 5 demonstrates the optimum twin tee tuned amplifier, with the design parameters given in Table I and the response shown on Fig. 8 and 9. On the basis

(*Continued on page* 114)

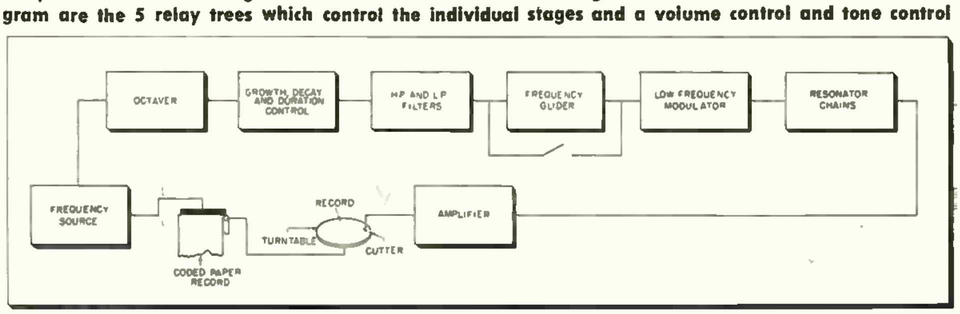
A New Music Synthesizer

An engineering description of RCA's new electronic music synthesizer was delivered to the recent 1955 AIEE Winter Meeting in New York by Dr. Harry F. Olson, head of RCA's Acoustical Lab. Dr. Olson is codesigner of this new unit along with Herbert Belar, also of RCA's Princeton Research Laboratories.

Dr. Olson prefaced his description of the equipment with an analysis of sound waves and their technical characteristics. The properties of sound he itemized as frequency, intensity, growth, duration, decay, portamento, timbre and vibrato. (See Fig. 1.) In order to faithfully reproduce a given tone, all of these characteristics must be known. The synthesizer, through its electronic circuitry, can vary the combination of these values in such a way as to reproduce any known musical sound. It can also produce sounds which

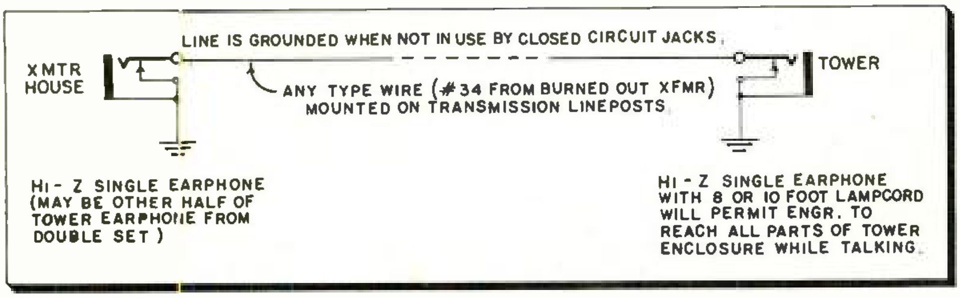
(*Continued on page* 112)

Fig. 1: Essential parts of the electronic music synthesizer. Complete system consists of 2 such channels; while one feeds a signal to the cutter the other is forming the next tone. Not shown in the diagram are the 5 relay trees which control the individual stages and a volume control and tone control



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency



Simple transmitter house-to-tower telephone line aids maintenance work

Taped Announcer

D. W. COLTRANE, Chief Engineer, KCOL, Fort Collins, Colo.

HERE, at KCOL, we use what we call an "Automatic tape" to provide a second voice for the spots on the early morning shift. It is done by means of the switch shown in the diagram. Whenever the announcer is ready for the spot, he presses a "momentary make" switch which is located beside his mike switch, starting the Magnecorder. After the spot is through the machine runs 4 seconds and stops, automatically. It is then cued for the next spot.

The night announcer recorded the spots the same way. He pressed the start button, read the spot, then waited 4 seconds till the machine stopped. He pushed the start button again and read the next spot. We have a meter in the audio input line so that the morning operator can maintain the audio level on playback the same as the evening operator maintained it while recording. This assures the proper voltage being applied to the 2050 grid both times to maintain the proper cues. The 10,000 ohm pot across the secondary of the input transformer will do the same thing and marks may be made on the dial to note the correct positions.

Connection is made to the forward motor of the Magnecorder only. The machine is loaded and turned on, then to start it the start switch is pushed. A disabling switch is provided to permit normal operation of the recorder. Whenever the "Automatic" is not operating, bias for the 2050 is obtained by rectifying voltage from the 6.3 volt transformer. When it is in operation the bias is obtained by rectifying the audio. When the audio ceases the 0.1 mfd condenser discharges through the 9.4 megohm resistor. After 4 seconds the bias is low enough, the 2050 fires and activates the plate relay, breaking the 6.3 volt relay circuit, in turn stopping the recorder.

Polarity of the line voltage must be observed because one side of the line is grounded to the unit.

The audio is obtained from the 16 ohm output of the amplifier. If the input level is maintained properly, no difficulty should be experienced. Since the amplifier is across the program line continuously, the tubes should be checked often for noise, hum and distortion.

$$$ FOR YOUR IDEAS

Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, double-spaced text is requested. Our usual rates will be paid for material used.

Transmitter House Tower Telephone

LAWRENCE L. PRADO, JR., Chief Engineer, WPEP, Taunton, Mass.

MEMORIES of younger days and the tin can and string type of telephone deserve credit for this idea!

Those needing a telephone between the transmitter house and tower enclosure for assistance in balancing diode rectifier units or other maintenance and repair work may find the following diagram very helpful.

Random Pulse Noise Generator

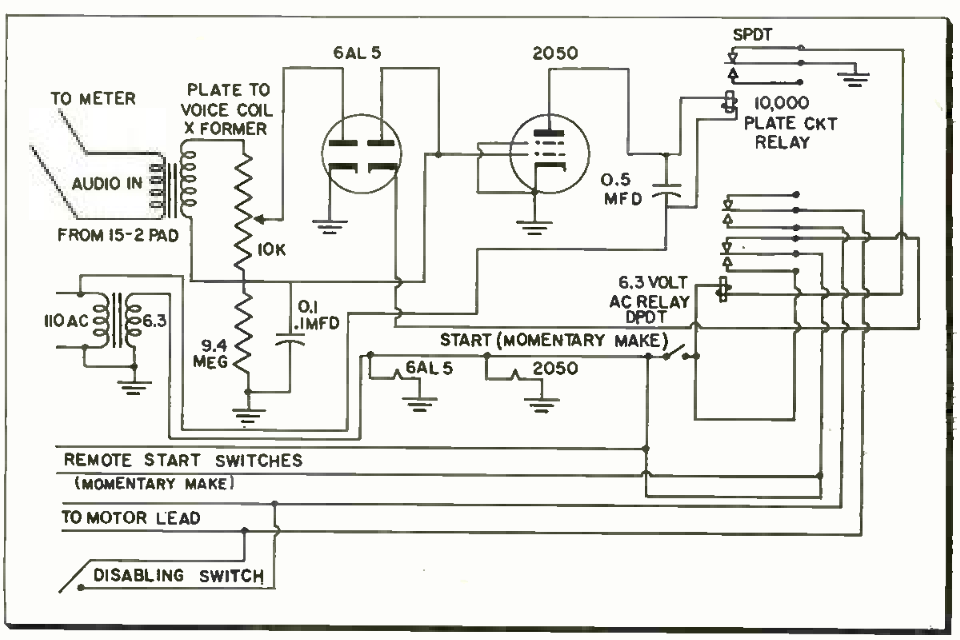
C. FRANK CORDARO, Chief Engineer, WKAP, Allentown, Pa.

OCCASIONALLY the need for a random non-uniform noise generator is necessary as a test instrument for special purposes. The included schematic details an inexpensive noise generator, which we have found more than adequate for its purpose, and in use for many years.

The diagram consists basically of five neon relaxation oscillator circuits in parallel. The ouput of the oscillators are fed thru Ro, the output load resistor.

Although the components of each oscillator are labeled the same, no (Continued on page 114)

Automatic "taped announcer" circuit provides second voice for spots



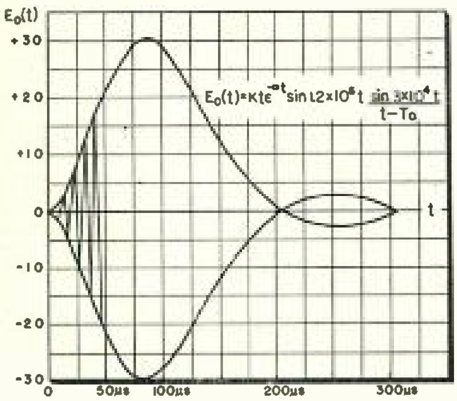


Fig. 1: Transient response to unit impulse

Transient Response

Effects of attenuation and cascading in narrowband frequency-modulation systems studied. Results shed light on communications "ring" picture

By STANLEY P. LAPIN
and
JEROME J. SURAN*
Communications & Electronics Div.
Motorola, Inc.
4545 Augusta Blvd.
Chicago 51, Ill.

IMPULSE noise in radio receivers, such as that produced by automobile ignition systems, is related to the transient response of the selective networks in the receiver. The transient response of the band-pass circuits usually encountered is quite complex, and most attempts at theoretical evaluation of such networks meet with little success, particularly in the case of relatively narrow-band FM communication receivers.

The transient response of complex band pass networks is commonly referred to as a "ring" picture. This is due to the general appearance of the response, which may be described as a decaying, amplitude-modulated, sine wave. A general equation for such a response may be approximated by:[1]

$$(1)\ e(t) = Kt^{n}\epsilon^{-\alpha t}\frac{\sin^{m}(\beta t+\theta)}{(t-\delta)^{m}}\sin(\omega t)$$

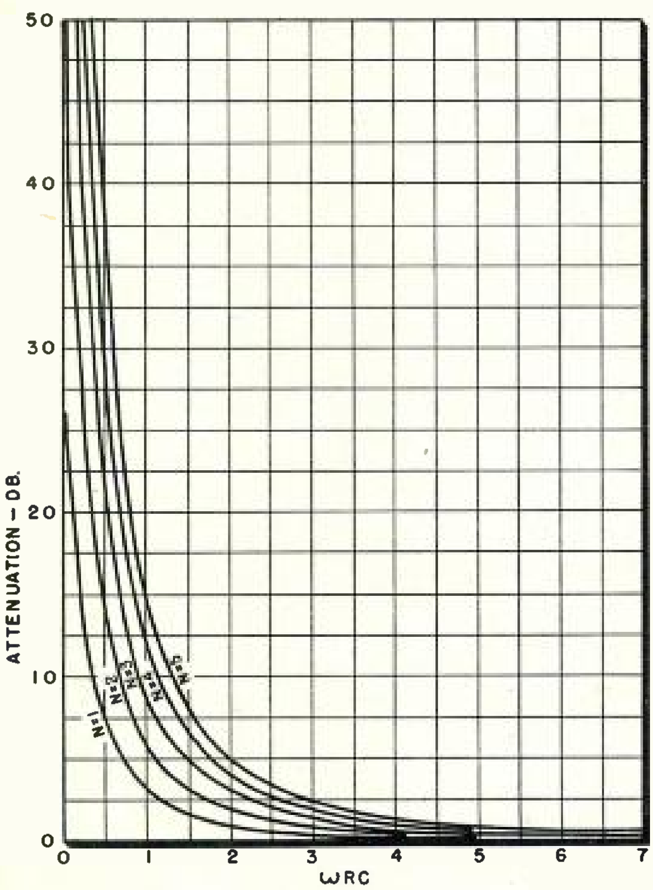
where e(t) is the instantaneous voltage of the response at time t, β is approximately 2π times the bandwidth of the selective circuits, ω is the center frequency of the band pass, ε is the base of the natural logarithm, and K, n, α, m, θ, and δ are all constants determined by the circuit. A typical curve calculated from equation (1), is given in Fig 1.

Narrow-band superheterodyne receivers generally achieve their i-f selectivity in one of two ways. The most prevalent method has been the use of multiple L-C sections which are isolated from each other by means of unilateral vacuum tube amplifiers (in a distributed filter-amplifier circuit). The second method is through the use of cascaded L-C sections in a lumped-circuit filter, such as the Permakey filter (see Fig. 2) used in Motorola two-way radio equipment. A question exists as to the effect of the unilateral property of the amplifier tubes in the distributed filter on the transient response of the entire selective network. Most attempts to answer this question on a theoretical, analytical basis, using the actual selective circuitry as the object of analysis, result in expressions which are too complex for easy solution.

Transfer Function

In general theoretical terms, however, the transfer function of any linear four terminal network can be represented by some function of fre-

* *Mr. Suran is presently with General Electric Co., Syracuse, N.Y.*



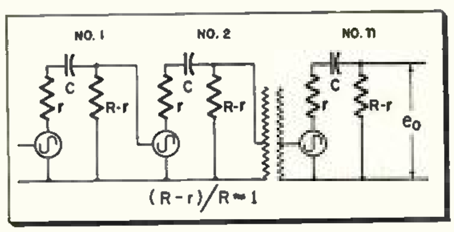
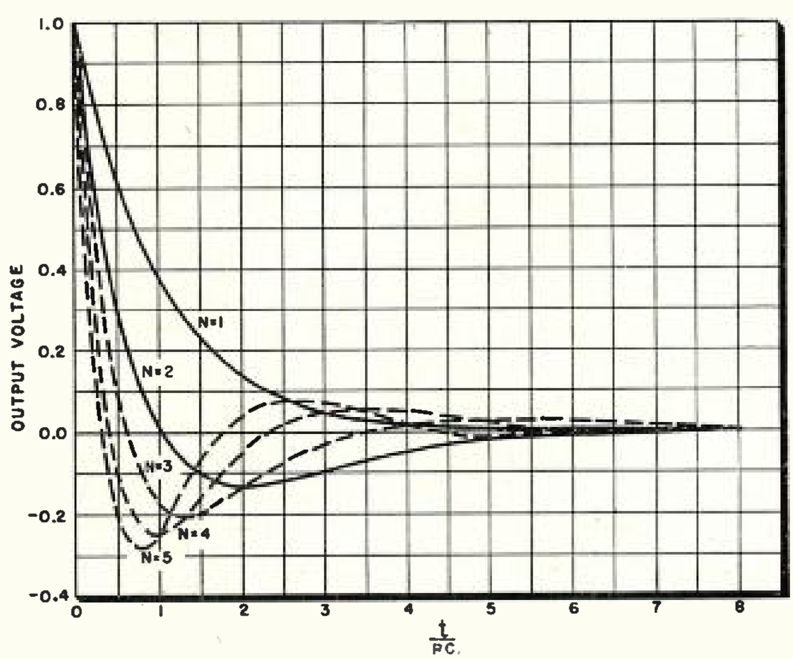


Fig. 3: (I) R-C high-pass filter.

Fig. 4: (Far left) R-C high-pass filter frequency response.

Fig. 5: (below) R-C high-pass filter transient response



in NBFM Receivers

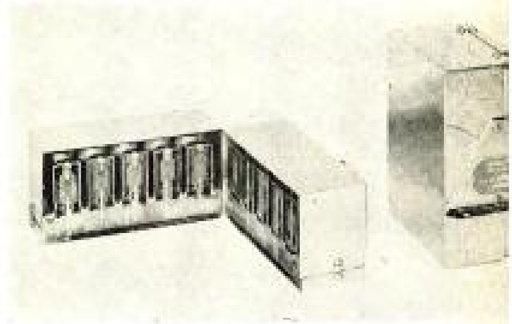


Fig. 2: "Permakay" lumped circuit filter

quency, H(ω). Once this function is known, the output response of the network to any desired input signal can be determined. In particular, the transient response to a pulse can be determined. There is *only* one attenuation and phase shift curve for any given H(ω), and also *only* one transient output for a given input.

In addition, for the types of networks usually encountered in practice, which may be defined as minimum-phase shift networks, there exists *only* one phase shift curve for a given attenuation curve.

Therefore, any two linear, minimum phase-shift networks, which have the same H(ω), will have the same attenuation and phase shift curves and also the same transient response for a given input, regardless of the interior of the network. Conversely, any two networks having the same attenuation curves will have the same H(ω), and therefore, the same transient responses.

Actual transient responses can be calculated for the simpler networks easily. Fig. 3 shows the circuit of an n-section, cascaded, isolated, R-C high pass filter, and Fig. 4 shows the frequency response of one, two, three, and four sections of this filter. The calculated transient response of this circuit to a unit step is given as:[2]

$$(2)\, e(t) = \epsilon^{-\frac{t}{RC}} \sum_{K=0}^{n-1} \frac{(-1)^k\,(n-1)\,!}{(n-1-K)\,!\,(k\,!)^2} \cdot \left(\frac{t}{RC}\right)^k$$

where e(t) is the instantaneous output voltage at time t, R and C are the values of the components in the circuit, and n is the number of sections. Equation (2) is plotted for n=1, 2, 3, and 4 in Fig. 5. It can be noted that:

a) as n increases, the time for the first zero crossing to occur decreases,

b) as n increases, the maximum amplitude of the waves between the first and second zero crossings (and between successive zero crossings) increases.

c) The number of zero crossings is equal to n-1.

d) As n is increased, successive waveforms look approximately more and more alike.

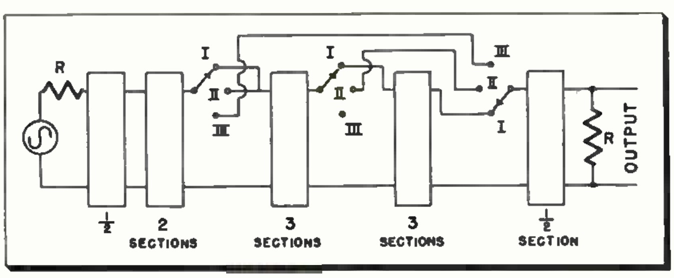
If the circuit had been of the band-pass type, the type of response shown in Fig. 5 could be considered as half the envelope of an amplitude-modulated sine wave whose frequency would be at the energy center of the pass band, and the familiar ring pattern would result. It would be noted that the isolating tubes of Fig. 2 did not prevent the ringing.

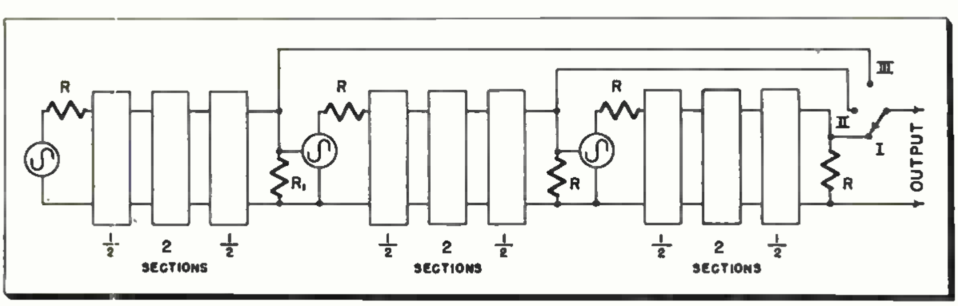
Network Function

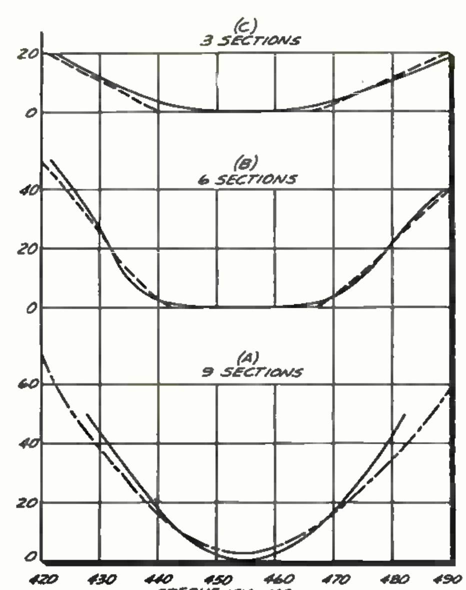
In the calculation of the response of cascaded, isolated circuits, the network function, $H_1(\omega)$, of one such circuit, is raised to the nth power, where n is the number of circuits. In a properly designed and properly matched lumped filter, the same procedure is followed—that is, if $H_1(\omega)$ is the response of one section, $H_1(\omega)^n$ is the response of n identical sections. Proper termination consists of matching the filter to its image impedance at all frequencies. In practice, filters are usually terminated in a resistor having a value equal to the image impedance at the center frequency. This results in a mismatch at the ends of the filters at other frequencies. However, in a long filter (i.e.—n large), the effects of this mismatch become very small, due to the insertion losses of the large number of sections. This becomes evident upon comparison, for a long filter, of a measured attenuation curve with a calculated curve based on perfect matching. Therefore, the same results can be expected, approximately, when the number of filter sections is increased, as when the number of cascaded isolated circuits is increased.

To experimentally investigate the problem of "ringing" in lumped selective networks, two filters were constructed, using derived sections calculated from classical filter theory. The first of these is a nine section filter, constructed with a three gang switch such that: in posi-

Fig. 6a: (l) Nine-section filter. Fig. 6b: (below) Similar filter with isolating amplifier tubes. Fig. 7: (far right) Filter attenuation curves







tion I, the full nine section filter is measured; in position II, a six section filter is measured; in position III, a three section filter is measured. This arrangement is shown in Fig. 6(A). The second filter is similar to the first, except that isolating, amplifier tubes are placed after three full sections and after six full sections (see Fig. 6B), with three measurement positions provided: position I, after nine sections; position II, after six sections; and position III, after three sections.

Relative attenuation curves of the two filters for the three switch positions are given in Fig. 7.

It can be noticed that the attenuation curves of both types of filters are almost identical.

The various filters were each excited with two different pulses, oscilloscopic photographs of which are shown in Figures 8 and 9. The outputs of the filters are shown in the succeeding figures, all having a sweep base with 10 divisions equal to 500 microseconds. In each case, the top picture shows the response to the shorter pulse of Fig. 8, and the bottom picture shows the response to the longer pulse of Fig. 9.

Figs. 10 and 11 show the outputs of the filters in position I (nine-section filters). It should be noted that the responses from both filters are very similar, even though one of these filters contains isolating amplifiers. The slight difference in transient responses may be attributed to the slight difference in attenuation curves, as shown in Fig. 7A.

Figs. 12 and 13 show the outputs of the filters in position II (six-section filters). It again should be noted that the two responses are similar, and, in addition, only minor differences exist between these six section responses and the full nine section responses (Figs. 10 and 11).

Conclusions

Figs. 14 and 15 show the outputs of the filters in position III (three-section filters). Here again, the two responses are similar to each other. However, although there is some similarity between these three-section responses and the six-section responses (Figs. 12 and 13) the change is much greater than the difference between the six and nine section filters.

From the theoretical considerations and the experimental results, the following conclusions may be drawn:

a) Transient or ring response is purely a function of the attenuation curve in a linear minimum-phase network, and if one of these curves is known, the other can be derived. This is independent of what makes up the circuit.

b) The use of cascaded circuits separated by amplifier tubes does not substantially change the transient response from that of directly cascaded circuits, assuming the two attenuation curves are approximately the same.

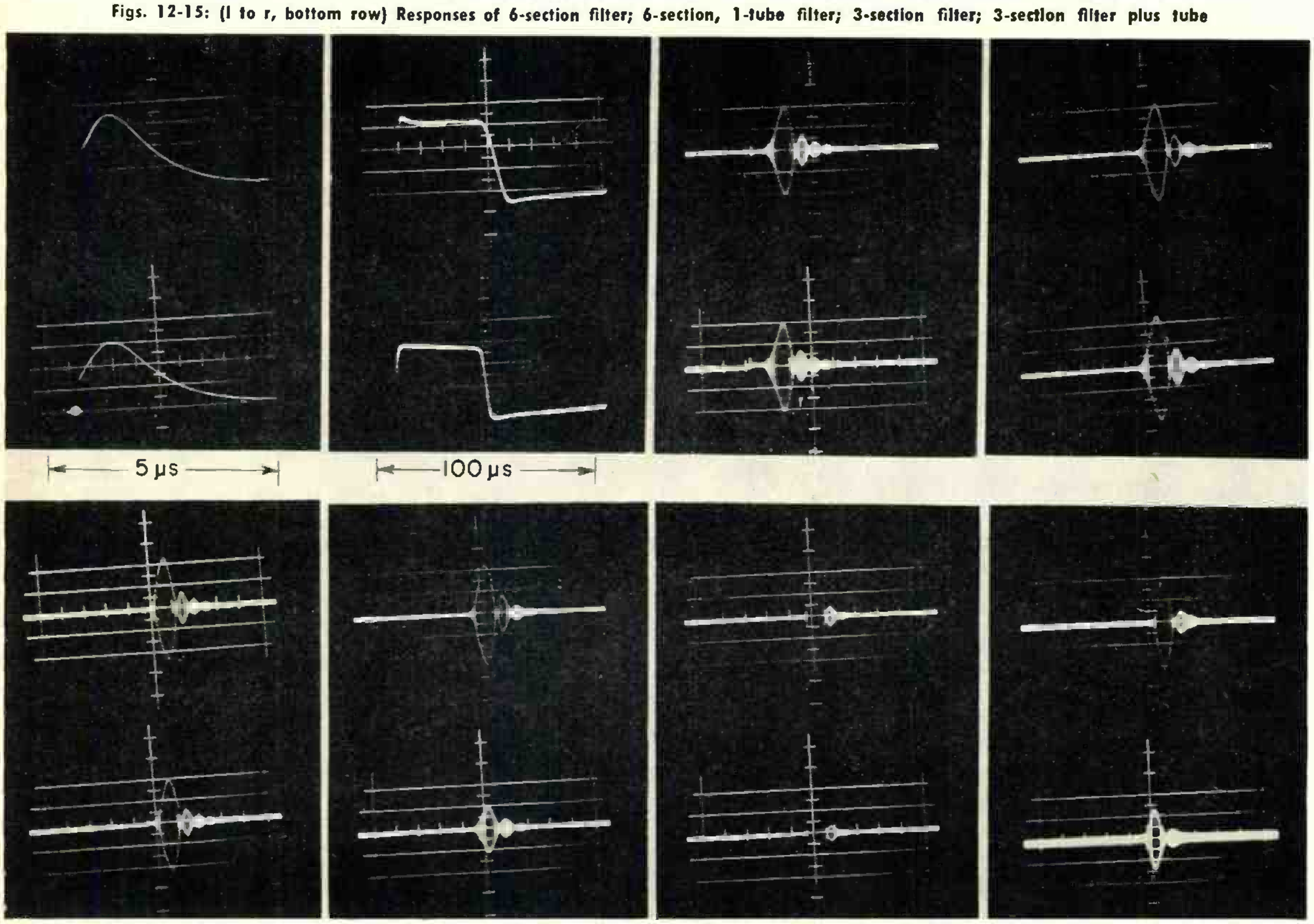
c) Increasing the number of sections in a selective circuit has less and less effect on the transient response as the number gets larger and larger.

REFERENCES

(1) S. P. Lapin and J. J. Suran, "Impulse Noise in FM Receivers," *I.R.E. Convention Record*, March, 1954.

(2) M. F. Garder and J. L. Barnes, *Transients in Linear Networks*, Wiley and Sons, New York, 1942. (See transform tables.)

Figs. 8-11: (l to r, top row) Short input pulse; long input pulse, response of 9-section filter; response of 9-section, 2-tube filter.
Figs. 12-15: (l to r, bottom row) Responses of 6-section filter; 6-section, 1-tube filter; 3-section filter; 3-section filter plus tube



Noise Measurements on Telephone Circuits

Comparison made of instruments and terms employed. Utilization of transmission measuring set outlined

By
H. C. FRANKE
Bell Telephone Labs., 463 West St., New York 14, N.Y.

THE evaluation of telephone circuit performance for speech transmission involves many parameters which have a direct relation to the transmission quality. One of the more important factors generally considered is the transmission impairment caused by the amplitude-frequency characteristic of the noise existing on the telephone circuit. Over the years the engineering profession has devised various methods by which this noise can be measured. These methods, although yielding comparable results, are difficult to interpret in many cases. Hence, in this discussion, it is proposed to show a comparison of noise quantities and terms which are currently used. No attempt is made to analyze the underlying principles upon which these quantities are based. However, it is expected that the comparisons given will result in a better understanding of this subject among engineers.

Measuring Instruments

Two types of instruments are in general use for noise measurements. One of these instruments is known as the Western Electric 2B Noise Measuring Set; this is used for noise measurements of voice-frequency circuits. Although this instrument is capable of single frequency measurements, it is generally not used for this purpose. The other instrument is a type of noise meter commonly referred to as a transmission measuring set; this has some characteristics comparable to those of the 2B set but it is calibrated to an entirely different reference. Such a test set can be used for either noise or single frequency power measurements as well as for the measurement of harmonic distortion. An instrument of this type found in many laboratories is known as the 12A Transmission Measuring Set manufactured by the Daven Company.

Initially in this article a comparison will be made of the quantities measured with the two types of instruments, where a test power, sometimes referred to as test tone, of 1000 CPS is applied to the input of each set. The magnitude of the test signal is expressed in dbm-db with reference to 1 mw. Table I shows the relations between this test power at various magnitudes expressed in dbm and the corresponding values obtained on the 2B set and on the TMS. It is assumed that the instruments were calibrated properly in accordance with the instruction books.

The values in the table refer to the "corrected" reading of the 2B set after a calibration constant referred to in the instruction book has been added to the combined attenuator and meter readings.

The terms 144 weighting and F1A weighting take into account the relative interfering effects of different noise frequencies on a telephone line when a telephone set using the 144 type or the HA-1 type telephone receiver, respectively, is employed. Weighting is the artificial adjustment of measurements in order to account for factors which, in normal use of the device, would otherwise be different from conditions during measurement. For example, background noise measurements may be weighted by applying factors or by introducing networks to reduce measured values in inverse ratio to their interfering effect.

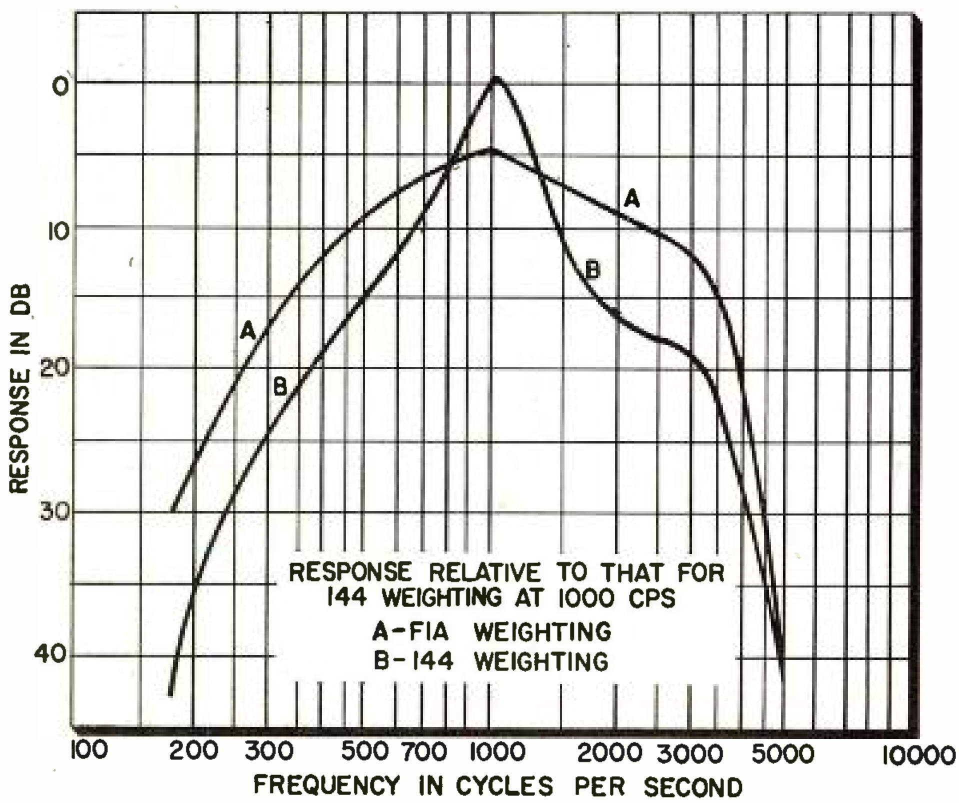


Fig. 1: Line weightings for telephone message circuit noise. Response curves are based on corrected values (using instruction book calibration constant) for WE 2B set

The reference power for readings in dbRN (db above reference noise) is a 100 CPS calibrating power of one micro-microwatt (10^{-12} watt or 90 db below 1 mw). The reference point for readings in dba (db adjusted) is obtained by making an adjustment to the 10^{-12} watt reference for equal transmission impairment due to noise for the two different types of telephone sets.[2] The results of listening tests made on a number of common kinds of noise to determine the transmission impairment have indicated that the zero calibration point for noise measured in dba should be a 1000 CPS power 5 db above 10^{-12} watts or —85 dbm. Fig. 1 shows the 144 weighting characteristics and the F1A weighting characteristics in these relative positions.

It will be noted from Table I that on 1000 CPS power the 2B set reads 5 db less with F1A weighting expressed in dba than with 144 weighting expressed in dbRN.

A transmission measuring set (TMS) calibrated at 1000 CPS will read power correctly when used to measure a 1000 CPS test power regardless of the weighting characteristic. However, if the TMS has a frequency characteristic deliberately introduced by weighting other than flat and is calibrated at 1000 CPS, then readings at other frequencies will not be correct readings of power in terms of dbm.

A transmission measuring set equipped with 144 frequency weighting can be used to measure any single frequency or other steady noise in terms of dbRN. With the set calibrated to read 0 dbm for 1 mw of 1000 CPS power, the noise expressed in dbRN is 90 added to the TMS reading. For example, a reading of —40 dbm on the TMS is equivalent to 90—40 or 50 dbRN.

Similarly when a transmission measuring set which has F1A frequency weighting and has been calibrated to read 0 dmb for 1 mw of 1000 CPS power, is used to measure any single-frequency or other steady noise, the reading can be expressed in dba by adding 85. For example, if the TMS reading is —40 dbm, the noise is 85—40 or 45 dba.

Thus, when the "noise" referred to in the preceding two paragraphs is 1000-cycle "noise" or a 1000 CPS test power, its value in terms of dbRN (144 weighting) is 90 db greater than its value in dbm; and its value in dba (F1A weighting) is 85 db greater than its value in terms of dbm. These relationships are shown in Table 1.

TABLE 1:
1000 CPS Test Power

1000 CPS dbm	2B Set dba (F1A wtg)	2B Set dbRN (144 wtg)	TMS dbm**
0	85	90	0
—10	75	80	—10
—20	65	70	—20
—30	55	60	—30
—40	45	50	—40
—50	35	40	—50
—60	25	30	—60
—70	15	20	—70
—80	5	10	—80
—90	—5	0	—90

With 1000 CPS test power applied to the input of the test set, this table shows the relation between corrected* values in dba or dbRN measured with a 2B Noise Measuring Set and values measured in dbm with a Transmission Measuring Set.

*The corrected value refers to the reading on the instrument (attenuator and meter reading) and the calibration constant as shown in the 2B set instruction book.

**This relation will hold at 1000 CPS for any weighting if the TMS is calibrated at 1000 CPS.

TABLE 2:
Thermal Type Noise In a 3 KC Band

(1) Noise dbm	(2) 2B Set dba	(3) 2B Set dbRN	(4) TMS dbm (F1A wtg)	(5) TMS dbm (144 wtg)	(6) TMS dbm (Flat wtg)	(7) **Signal-to-Noise Ratio-db 2B Set or TMS (F1A wtg)	(8) (144 wtg)	(9) (Flat wtg)
0	82	82	— 3	— 8	0	3	8	0
—10	72	72	—13	—18	—10	13	18	10
—20	62	62	—23	—28	—20	23	28	20
—30	52	52	—33	—38	—30	33	38	30
—40	42	42	—43	—48	—40	43	48	40
—50	32	32	—53	—58	—50	53	58	50
—60	22	22	—63	—68	—60	63	68	60
—70	12	12	—73	—78	—70	73	78	70
—80	2	2	—83	—88	—80	83	88	80

With thermal type noise uniformly distributed in a 3 KC band applied to the input of the test set, this table shows the relation between corrected* values in dba or dbRN measured with a 2B Noise Measuring Set and values in dbm measured with a Transmission Measuring Set. Values of Signal-to-Noise Ratio are also indicated.

*The corrected value refers to the calibration constant in the 2B set instruction book.

**It is understood that the test signal and noise are both measured at the same point in the circuit and in this table it is assumed that at the point of measurement the signal is 1 mw or 0 dbm at 1000 CPS.

Thermal Noise

Table 2 shows a comparison of measurements made when thermal noise, flat over a 3 KC band, is applied to the several weightings of the two types of measuring sets. Column 1 gives the magnitude of the noise power expressed in dbm as would be measured on a reference instrument, such as a thermocouple type meter. The corresponding noise values expressed in dba and dbRN obtained with the 2B set are indicated in columns 2 and 3 for noise inputs from 0 to —80 dbm. The noise values measured on a transmission measuring set calibrated in dbm with F1A, 144 and flat weighting are shown in columns 4, 5 and 6.

With noises of types other than a 1000-CPS sine-wave or a 3 KC band of thermal noise, the relations between readings with different weightings would necessarily be different from those shown in Table 1 or 2. For example, a pure 200-CPS noise would read about 37 db greater on flat weighting than it would on 144 weighting. This would be true, whether the measuring means was a 2B set or a TMS. A pure 200-CPS noise would read about 27 db greater on flat weighting than it would on F1A weighting. The reason for these differences is because of the difference in the interfering effects of the noise in different types of telephone sets.[2]

Signal-to-Noise

The last three columns in Table 2 indicate the signal-to-noise ratio which is the ratio of the magnitude of the signal to that of the noise expressed in db. In the table, the signal is taken as a 1 mw test power of 1000 CPS and the noise consists of thermal noise measured in the absence of the signal power. Both measurements are made at the same point in the circuit and with the same type of instrument.

As seen in Table 2, the numerical value of the signal-to-noise ratio, for a given signal and a given noise, depends on the frequency weighting with which the signal and the noise are measured. For example, the table shows that with a signal of 1mw at 1000 cps and a fluctuation noise of —50 dbm, the signal-to-noise ratio is 50 db with flat weighting, or 53 db with F1A weighting, or 58 db with 144 weighting. The table also shows that with a given weighting, the signal-to-noise ratio is the same whether the measuring instrument is a 2B set or a transmission measuring set.

The signal-to-noise ratio is obtained from two measurements, one of signal and the other of noise. (If the magnitude of the signal is partially masked by noise, its value is obtained as described later). The point at which these two measurements are made need not be a point where the test power is 1mw. For example, assume that the magnitude of the test power obtained with the 2B set with F1A weighting is 76 dba (equivalent to —9 dbm from Table 1) and the magnitude of the noise at the same point is 29 dba; the signal-to-noise ratio is 47 db (76—29) with F1A weighting. If this noise is thermal noise as has been assumed, it will also read 29 dbRN with 144 weighting (Table 2), but the 1000 cps test power will read 81 dbRN with 144 weighting (Table 1); so that with 144 weighting the signal-to-noise ratic is 52 db (81—29).

Similarly with a TMS using the values assumed above, the test power would read —9 dbm, and the noise with F1A weighting would

(Continued on page 152)

TABLE 3:

Correction for determining signal in the presence of noise

(1) Difference in db between combined signal and noise measured alone.	(2) Correction in db to be applied to the combined signal and noise reading to obtain signal alone.
0	Signal cannot be computed.
1	—6.9
2	—4.3
3	—3.0
4	—2.2
5	—1.7
6	—1.3
7	—1.0
8	—0.8
9	—0.6

Reliable Connections

By ***R. GEORGE ROESCH, President***
The Eraser Co.
Syracuse, N.Y.

UNFORTUNATELY, there is no satisfactory definition of the term "quality" with regard to wire stripping and wire preparation. However, there are several precautions which may be exercised during production to insure high reliability of electrical connections.

A prime point to keep in mind is that cut or nicked strands of wire resulting from careless removal of insulation cause poor connections, and possibly major damage when subjected to vibration.

In the case of coaxial cable, the proper amount of braid wire must be stripped from the cable for the correct fit and/or impedance match to the connector. If too little is stripped, then the contact may not seat in the connector. If too much, then an adequate contact to the braid may not occur. Likewise, if loose ends are present in the connector, there is a possibility of one of these causing a short. Even though one may not damage strands of wire, it has been found that should some strands of insulation remain on the wire, they will vaporize, and thus prevent a satisfactory soldered connection or even a good tinning job, if the wires are tinned prior to soldering.

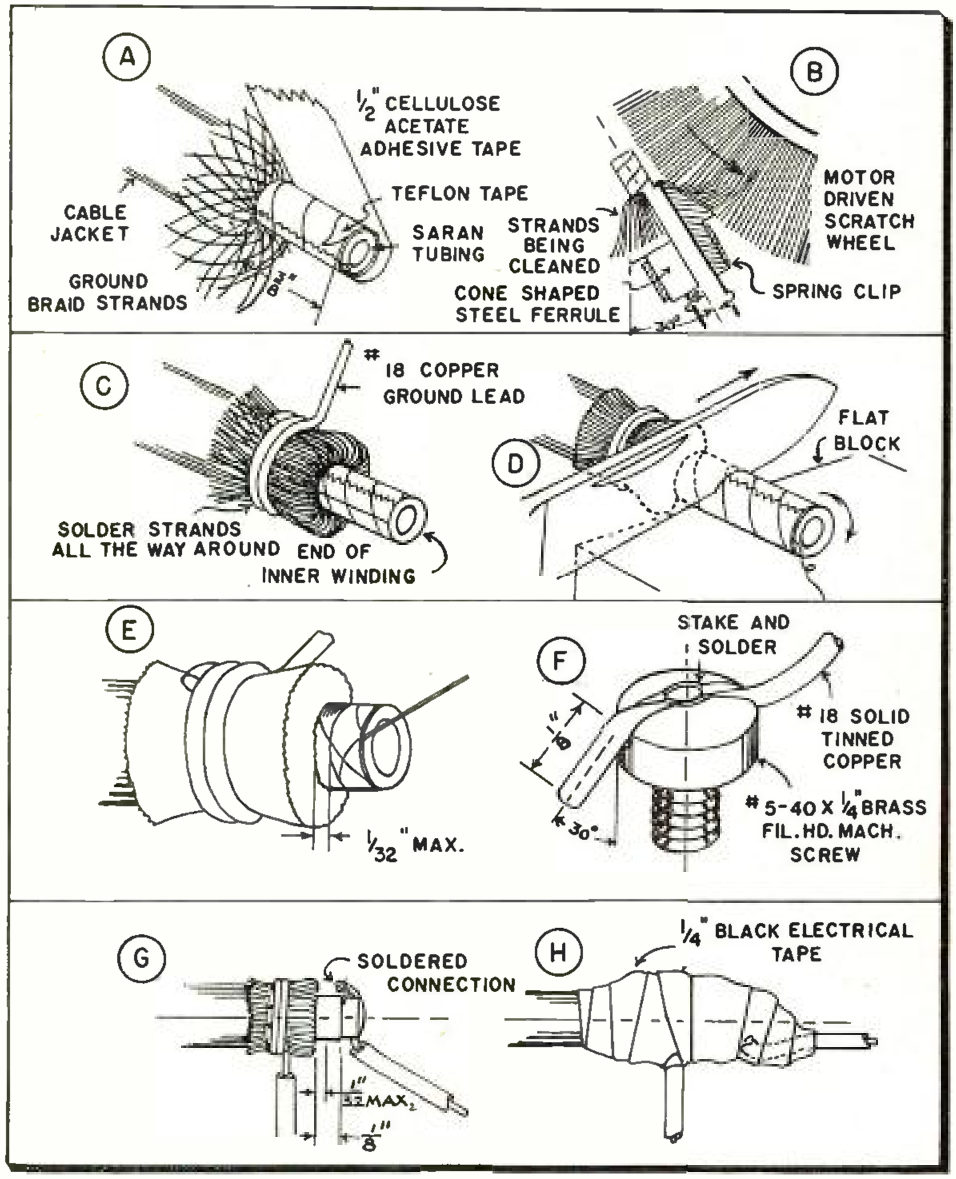
To illustrate the practical aspects of making reliable connections, consider the following example of operator instructions for fabricating the input and output ends of a delay line.

Input-End Fabrication

1. Without nicking or otherwise damaging the underlying ground

(Continued on page 157)

Sequence of stages for producing a reliable electrical connection on a delay line



View of exhibits at Kingsbridge Armory during last year's convention

Preview of

Latest electronic engineering developments to be covered by 251 technical papers in 55 sessions. 704 manufacturers exhibit products

MARCH 21 will mark the beginning of another record-breaking four-day IRE National Convention. New York City's Waldorf-Astoria and Belmont-Plaza hotels will provide eight session halls this year for the presentation of the majority of the 251 scheduled technical papers. Additional facilities for the presentation of two simultaneous technical sessions will be provided at the Kingsbridge Armory in the Bronx. A total of 55 sessions, topping last year's figure of 51, will be held in the eight meeting halls between March 21 and 24.

Exhibits of the Radio Engineering Show, formerly located at Grand Central Palace, will be housed at the Kingsbridge Armory and the nearby Kingsbridge Palace. Attendance is expected to surpass 1954's record of 39,302 and it is reported that 704 exhibits, better than a 13% increase over last year, will be erected on the four-acre floor of the armory.

The convention's social program will be initiated by a "get-together" cocktail party on March 21 in the Grand Ballroom of the Waldorf-Astoria. Two evenings later, the Grand Ballroom will be the scene of the Annual Banquet, at which Gen. Matthew Ridgway, Chief of Staff, U. S. Army, will deliver the major address.

Dr. John R. Pierce, of the Bell Telephone Laboratories, has been renamed Editor of the Proceedings of IRE for 1955. John D. Ryder will formally assume the presidency of the Institute at the Convention's opening meeting on March 21st at 10:30 A.M., also to be held in the Waldorf's Grand Ballroom. Arthur V. Loughren will be the principal speaker at this meeting.

The technical program includes the following papers:

Monday, March 21, P.M.

INSTRUMENTATION—I

Chairman: P. S. Christaldi, Allen B. DuMont Labs., Inc., Instrumentation Division, 760 Bloomfield Ave., Clifton, N. J.

Direct-Reading Instrument for the Measurement of RMS Pulse Jitter, Jesse J. Taub, and Charles I. Smith, Material Lab., New York Naval Shipyard, Brooklyn 1, N. Y.

An Automatic Sonic Spectrum Analyzer and Curve Tracer, Edward F. Feldman, Panoramic Radio Prods. Inc., 10 S. Second Ave., Mt. Vernon, N. Y.

A Simplified Method for the Measurement of Highly Linear Sawtooth Waveforms, Sherwood King, University of Tennessee, Knoxville, Tenn.

The Diagraph, a Direct-Reading Instrument for Graphic Presentation of Complex Impedances and Admittances, Richard C. Hess, Federal Telephone and Radio Co., 100 Kingsland Ave., Clifton, N. J.

Measurement of Parameters that Determine Front Edge Response of Pulse Transformers, Isidore Bady, Signal Corps Engineering Lab., Ft. Montmouth, N. J.

ANTENNAS & PROPAGATION—I—ANTENNAS

Chairman: John V. N. Granger, Head, Radio Systems Lab., Stanford Research Institute, Stanford, Calif.

Efficiency of Surface Wave Excitation, Alan F. Kay, Technical Research Group, 56 West 45 St., New York, N. Y. and Francis J. Zucker, Air Force Cambridge Research Center, 230 Albany St., Cambridge 39, Mass.

Serrated Waveguide: Theory and Experiment, R. S. Elliott and K. C. Kelly, Hughes Research & Development Labs., Hughes Aircraft Co., Culver City, Calif.

Properties of a Radiating Discontinuity on a Corrugated Surface Transmission Line, M. J. Ehrlich and I. K. Williams, Microwave Radiation Co., Inc., 3312 Pacific Ave., Venice, Calif.

Symmetrical Microwave Lenses, C. Goatley and C. F. Parker, Melpar, Inc., 452 Swann Ave., Alexandria, Va.

Lens and Feed System for Volumetric Scanning GCA Antenna, G. D. M. Peeler and W. F. Gabriel, Microwave Antennas & Components Branch, Electronics Div., Naval Research Lab., Washington 25, D. C.

MOBILE COMMUNICATIONS

Chairman: Daniel E. Noble, Vice President, Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Illinois

An Experimental Mobile Dispatching System, R. W. Collins and V. A. Douglas, Bell Telephone Labs., 463 West St., New York 14, N. Y.

450 Megacycle Mobile Equipment Employing Direct Frequency Modulation, W. Ornstein, Canadian Marconi Co., 2442 Trenton Ave., Montreal, Quebec, Can.

Design Problems of V.H.F. Repeater Stations, J. R. Neubauer, Radio Corp. of America, Camden 2, N. J.

Evaluation of Sideband Noise and Modulation Splatter of V.H.F. Transmitters, W. Firestone, Motorola, Inc., 4501 W. Augusta Blvd., Chicago 51, Ill.

A Miniature Reflectometer for Portable and Mobile Transmitters, Edwin M. Stryker, Jr., Collins Radio Co., Cedar Rapids, Ia.

COMMUNICATIONS SYSTEMS—I

Chairman: F. M. Ryan, American Telephone and Telegraph Co., 195 Broadway, New York 7, N. Y.

See page 100 for new electronic products to be displayed at this year's national convention in Kingsbridge Armory and at Kingsbridge Palace

A New Horizon in Communication Theory—The Polyphase Concept, Allan A. Kunze and John G. Schermerhorn, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

A Theorem Concerning Noise Figures, A. G. Bose, Research Laboratory of Electronics, M.I.T., Cambridge, Mass. and S. D. Pezaris, Dept. of Electrical Engineering, M.I.T., Cambridge 39, Mass.

Automatic Operation of a High Power Amplifier, V. R. DeLong, Collins Radio Co., Cedar Rapids, Ia.

The Use of Reflex Techniques in a VHF-UHF Communication System, Paul G. Wulfsberg, Engineering Div., Collins Radio Co., Cedar Rapids, Ia.

A New Teletypewriter Using the Integration Method of Detection, Henning F. Harmuth, Signal Corps Engineering Labs., Ft. Monmouth, N. J.

INDUSTRIAL ELECTRONICS

Chairmen: Conan A. Priest, Onondaga Pottery Co., 1858 W. Fayette St., Syracuse 1, N. Y., and Wilfred L. Atwood, Consulting Engineer, 528 Adelaide Ave., S.E., Warren, Ohio

An Instrument to Count and Size Particles Suspended in a Gas, Ernest S. Gordon, Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill.

Design Considerations of Microwave Ovens, Robert A. Rapuano and Robert V. Smith, Raytheon Manufacturing Co., Equipment Engineering Div., 150 California St., Newton 58, Mass.

High-Speed Electronic Fault Protection for Power Tubes & Their Circuitry, W. N. Parker and M. V. Hoover, Tube Div., Radio Corp. of America, Lancaster, Pa.

A Magnetic Thyratron Grid Control Circuit, James H. Burnett, Electrons, Inc., 127 Sussex Ave., Newark, N. J.

A Static Frequency Detector, Magnetic Type, Henry W. Patton, Engineering Dept., Collins Radio Co., Cedar Rapids, Ia.

TELEMETRY & REMOTE CONTROL—I SYMPOSIUM: SOME PROBLEMS ASSOCIATED WITH TELEMETERING AND REMOTE CONTROL OF A SPACE STATION

Chairman: J. Gordon Vaeth, Office of Naval

1955 IRE National Convention

Research, Port Washington, N. Y.

The Use of Piloted Balloons as Space Laboratories, M. D. Ross, Office of Naval Research, Air Branch, Washington, D. C.

Ionic and Nuclear Problems of Rocket Propulsion, F. J. Murray, Columbia University, New York, N. Y.

Instrumentation of a Minimum Satelite for Astro-Physical Research, S. F. Singer, University of Maryland, Baltimore, Md.

Telemetering and Control of a Space Station, Wernher Von Braun, Redstone Arsenal, Huntsville, Ala.

Telemetering in the Development of Space Flight, C. E. Ruckstuhl, Jr., Bendix Pacific Division, Bendix Aviation Corp., North Hollywood, Calif.

Synthetic Training for Space Flight, G. V. Amico, Special Devices Center, Office of Naval Research, Port Washington, N. Y.

CIRCUIT THEORY—I
SYMPOSIUM: NETWORK DESIGN

Chairman: Chester H. Page, National Bureau of Standards, Connecticut Avenue, Washington 25, D. C.

The Use of Potential Analogs in Network Synthesis, Ronald E. Scott, M.I.T., Cambridge, Mass.

Iterative Network Synthesis, Howard B. Demuth, Stanford Research Institute, Stanford, Calif., and George A. Caryotakis and A. Donald Moore, Stanford University, Electrical Engineering Dept., Stanford, Calif.

The Use of Least Squares in Network Design, M. Robert Aaron, Bell Telephone Labs., Murray Hill, N. J.

Influence of Computing Machines on Network Design Methods, John T. Bangert, Bell Telephone Labs., Murray Hill, N. J.

Summation and Outlook, Ernest A. Guillemin, M.I.T., Cambridge 39, Mass.

J. D. Ryder, IRE President 1955-56

W. Hewlett, IRE President 1954-55

AUTOMATIC CONTROL—I

Chairman: John E. Ward, Servomechanisms Laboratory, M.I.T., Cambridge 39, Mass.

Analysis of Combined Sampled-and Continuous-Data Systems on an Electronic Analog Computer, Louis B. Wadel, Chance Vought Aircraft, Inc., P.O. Box 5907, Dallas, Tex.

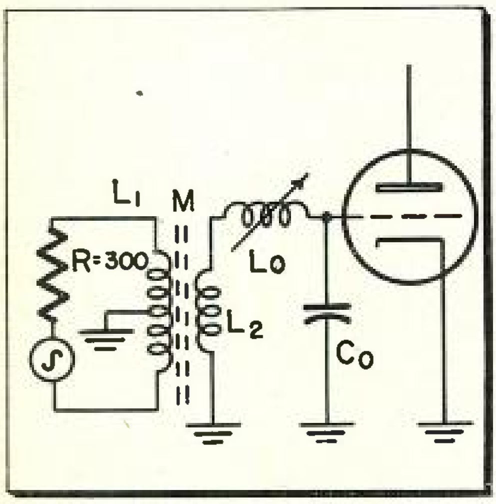
An Adaptive Servo System, A. H. Benner and R. F. Drenick, Radio Corp. of America, RCA Victor Div., Camden, N. J.

(*Continued on page* 162)

TECHNICAL PAPERS TOPICS, SYMPOSIA, and their LOCATIONS for 1955 IRE CONVENTION

	BELMONT-PLAZA	WALDORF-ASTORIA HOTEL					KINGSBRIDGE ARMORY	
	Moderne Room	Starlight Roof	Astor Gallery	Jade Room	Sert Room	Grand Ballroom	Marconi Hall	Faraday Hall
Monday, March 21 2:30 - 5:00 P.M.	Session 1 INSTRUMENTATION - I	Session 2 ANTENNAS AND PROPAGATION - I Antennas	Session 3 MOBILE COMMUNICATIONS	Session 4 COMMUNICATIONS SYSTEMS	Session 5 INDUSTRIAL ELECTRONICS	Session 6 TELEMETRY & REMOTE CONTROL - I Symposium: Some problems associated with telemetering and remote control of a space station.	Session 7 CIRCUIT THEORY - I Symposium: Network Design	Session 8 AUTOMATIC CONTROL - I
Tuesday, March 22 10:00 A.M. - 12:30 P.M.	Session 9 TELEMETRY AND REMOTE CONTROL - II Remote Control	Session 10 ANTENNAS AND PROPAGATION - II Antennas	Session 11 AERONAUTICAL AND NAVIGATIONAL ELECTRONICS - I Airborne Devices and Environment	Session 12 BROADCAST TRANSMISSION SYSTEMS - I TV Broadcasting	Session 13 AUDIO - I General	Session 14 • INFORMATION THEORY - I	Session 15 (Joint) INSTRUMENTATION and TELEMETRY AND REMOTE CONTROL	Session 16 ELECTRON DEVICES - I Tubes
Tuesday, March 22 2:30 - 5:00 P.M.	Session 17 INSTRUMENTATION - II	Session 18 ENGINEERING MANAGEMENT - I Panel Discussion: Operations Research - a Tool of Engineering Management	Session 19 AERONAUTICAL AND NAVIGATIONAL ELECTRONICS - II Radar and Aircraft Landing Aids	Session 20 BROADCAST TRANSMISSION SYSTEMS - II Color Television	Session 21 AUDIO - II Symposium: Music, High Fidelity, and the Listener		Session 22 TELEMETRY AND REMOTE CONTROL - III Recent telemetering developments	Session 23 ELECTRON DEVICES - II Microwave Tubes
Tuesday, March 22 8:00 - 10:30 P.M.		Session 24 AUTOMATIC CONTROL - II Trends in Automatization of Procedures and Processes in Business and Industry					Session 25 AUDIO - III Seminar: Magnetic Recording for the Engineer	
Wednesday, March 23 10:00 A.M.-12:30 P.M.	Session 26 ULTRASONICS - I	Session 27 ELECTRONIC COMPUTERS - I	Session 28 MICROWAVE THEORY AND TECHNIQUES - I Microwave Components	Session 29 PRODUCTION TECHNIQUES Electronic Equipment Assembly Methods	Session 30 (Joint) INSTRUMENTATION and NUCLEAR SCIENCE	Session 31 • (Joint) SYMPOSIUM ON SPURIOUS RADIATION	Session 32 CIRCUIT THEORY - II General Theory	Session 33 ANTENNAS AND PROPAGATION - III Panel Discussion: Extended Range VHF and UHF Propagation
Wednesday, March 23 2:30 - 5:00 P.M.	Session 34 ULTRASONICS - II	Session 35 ELECTRONIC COMPUTERS - II Symposium: The Design of Machines to Simulate the Behavior of the Human Brain	Session 36 MICROWAVE THEORY AND TECHNIQUES - II Microwave Techniques	Session 37 QUALITY CONTROL AND RELIABILITY STUDIES OF ELECTRONIC TUBES AND SYSTEMS	Session 38 BROADCAST AND TV RECEIVERS		Session 39 CIRCUIT THEORY - III Filters and Lines	Session 40 ANTENNAS AND PROPAGATION - IV Propagation
Thursday, March 24 10:00 A.M. -12:30 P.M.	Session 41 MEDICAL ELECTRONICS I Panel Discussion	Session 42 INFORMATION THEORY - II	Session 43 ELECTRON DEVICES III Cathode Ray Type Tubes	Session 44 COMPONENT PARTS - I Electro-Magnetic Devices	Session 45 NUCLEAR SCIENCE - I	Session 46 • ENGINEERING MANAGEMENT - II General	Session 47 MICROWAVE THEORY AND TECHNIQUES - III Ferrites	Session 48 ELECTRONIC COMPUTERS - III
Thursday, March 24 2:30 - 5:00 P.M.	Session 49 MEDICAL ELECTRONICS II General	Session 50 ENGINEERING MANAGEMENT - III Symposium: Management Selection as viewed by Psychologists and Engineering Executives	Session 51 ELECTRON DEVICES IV Transistors	Session 52 COMPONENT PARTS - II General	Session 53 INFORMATION THEORY - III		Session 54 (Joint) MICROWAVE COMMUNICATIONS AND SYSTEMS	Session 55 AERONAUTICAL AND NAVIGATIONAL ELECTRONICS - III Navigation

Designing



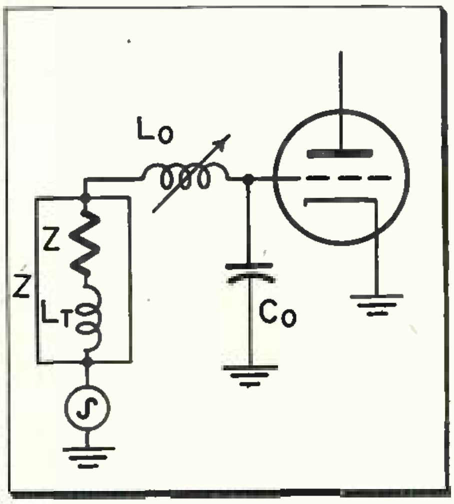


Fig. 1: (l) Series transformer-oscillator feed. Fig. 2: (r) Equivalent circuit

By
JURI SOKOLOV
Oak Mfg. Co.
4300 N. Kilpatrick Ave.
Chicago, Ill.

Extremely low-loss transformer assures high rejection of unbalanced signal while changing antenna impedance for optimum noise figure

ONE of the most important parts of a VHF tuner is the input circuit which consists of either a balun or of an r-f transformer followed by a resonant circuit.

The input circuit must provide 1) the proper transformation of the antenna impedance for the optimum Noise Factor, 2) selectivity, 3) must assure as high a rejection as possible of unbalanced signal and 4) must transform the symmetrical signal received from the antenna twin line into the asymmetrical signal needed for the excitation of the grid of the amplifier tube.

At the same time it must be as lossless as possible because any loss in the input circuit deteriorates the NF of the tuner.

The main disadvantage of baluns is their relatively high price. Transformers are much cheaper.

Transformers may be used in parallel or in series with the input oscillating circuit. In the first case, a high impedance level secondary is required. Many difficulties are connected with such a secondary because of the distributed capacity and self-resonance of the winding. It is much easier to design a transformer for series connection, because in this case the secondary winding consists of only a few (2-5) turns so that its self-resonance lies far above the VHF frequency range.

If the transformer feeds the oscillating circuit in series, as represented in Fig. 1, the equivalent circuit is that shown in Fig. 2. Z is the impedance looking into the secondary of the transformer when the primary is loaded with the resistance R = 300 ohms

Thus:

$$Z = R + jX = j\omega L_2 + \frac{\omega^2 M^2}{R + j\omega L_1} =$$

$$j\omega L_2 + \frac{\omega^2 M^2 R}{R^2 + \omega^2 L_1^2} - \frac{\omega^2 M^2 j\omega L_1}{R^2 + \omega^2 L_1^2}$$

where: L_2 is the inductance of the secondary winding.

L_1 is the inductance of the primary winding.

M is the mutual inductance between the primary and secondary windings.

$\omega = 2\pi f$ where f is the frequency

R is the signal generator's internal resistance.

Hence: $$R = \frac{\omega^2 M^2 R}{R^2 + \omega^2 L_1^2} \qquad (1)$$

and $$X = \omega L_2 - \frac{\omega L_1 \omega^2 M^2}{R^2 + \omega^2 L_1^2} \qquad (2)$$

Y is the series damping resistance of the equivalent input resonant circuit. The equivalent parallel damping resistance (see Fig. 3) R_g is:

$$R_g = \frac{1}{\omega^2 C_o^2 R} \qquad (3)$$

where C_o is the tuning capacity plus all stray capacities.

For best NF R_g must satisfy the relation:

$$R_{g_{opt}} = \sqrt{R_{eq} R_T \beta} = \frac{1}{\omega}\sqrt{\frac{A}{g_m}} \qquad (4)$$

where R_{eq} is the equivalent noise resistance $R_{eq} = \frac{2.5}{g_m}$

R_T is the transit time damping resistance $R_T = A_1/\omega^2$

$\beta = 5$ is a constant

A and A_1 are constants with respect to ω

For zero VSWR in the antenna line or for constant VSWR on all channels it must be:

$$R_g = A_2 R_t = \frac{A_3}{\omega^2} \qquad (5)$$

where A_2 and A_3 are constants.

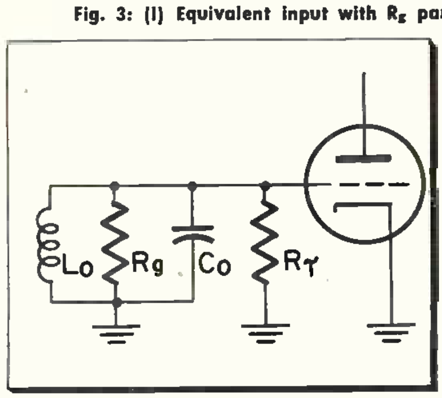
If the condition (4) is satisfied on all channels, then:

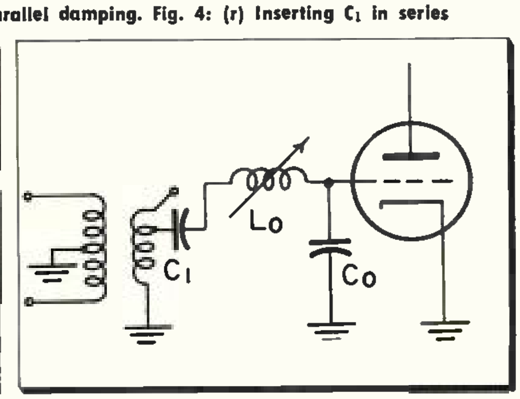
$$VSWR = \frac{R_T}{R_{g_{opt}}} = \frac{A_1}{\omega^2} \frac{\omega}{\sqrt{\frac{A}{g_m}}} = \frac{A_4}{\omega}$$

Since $R_T > R_{g_{opt}}$

for the VHF channels and type of tubes, this relation shows that if the optimum NF condition is satisfied, the match improves with increasing of the channel frequency.

Fig. 3: (l) Equivalent input with R_g parallel damping. Fig. 4: (r) Inserting C_1 in series





Low-Noise TV Tuner Inputs

The bandwidth of the input circuit is:

$$\Delta\omega = \frac{\omega_o}{Q} = \frac{\omega_o\,(1/R_g + 1/R_t)}{\omega_o\,C_o} = \frac{\frac{1}{R_g} + \frac{1}{R_t}}{C_o}$$

If the condition (4) for optimum NF is satisfied

$$\Delta\omega = \frac{1}{C_o}\left(\omega\sqrt{\frac{g_m}{A}} + \frac{\omega^2}{A_1}\right)$$

Thus $\Delta\omega$ increases faster than linearly with the frequency.

Returning to the expression (1), two cases have to be considered:

$$R > \omega L_1 \text{ and } R < \omega L_1 \qquad (6)$$

The first condition $R > \omega L_1$ can easily be realized because the smaller L_1 is, the fewer are the troubles due to the self-resonance of the coil. In this case R becomes:

$$R = \frac{\omega^2 M^2 R}{R^2} = \frac{\omega^2 M^2}{R} \text{ and}$$

$$R_g = \frac{R}{\omega^4 C_o^2 M^2} \qquad (7)$$

Thus R_g varies with the fourth degree of ω so that the transformer cannot cover more than one channel. Such a transformer can be, and is, used in the turret tuners where each channel has its own transformer. In this case (of the turret tuner with the wire wound coils) there is no necessity for the iron core. The mutual inductance

$$M = K\sqrt{L_1 L_2}$$

can be made sufficiently large by coupling the primary of the input transformer to the entire tuning inductance L_o

If

$$R < \omega L_1$$

$$R = \frac{\omega^2 M^2 R}{\omega^2 L_1^2} = K^2 \frac{L_2}{L_1} R \qquad (8)$$

and

$$R_g = \frac{L_1}{\omega^2 C_o^2 K^2 R} = \frac{A_5}{\omega^2}$$

As one can see, R_g satisfies condition 5 for constant VSWR but not condition 4. If we are going to employ the series feeding transformer, the only way of approaching condition (4), which is that necessary for the optimum NF, is to use two secondary windings or a taped secondary. In this case the low frequency channels (2 to 6) are fed by the secondary having more turns, while for the high frequency channels (7 to 13), we physically switch in another secondary which has fewer turns.

On the lowest channel (Ch. 2) where ωL_1 is usually equal to or even smaller than R_g, rapidly decreases, thus undercoupling the antenna.

Finally, Eq. 2 in the case of $R < \omega L_o$ becomes:

$$X = \omega L_2 - \omega K^2 L_2 = \omega L_2 (L - K^2)$$

On the high frequency channels this equivalent inductance, together with the stray inductance of the leads, can become so high as to prohibit the use of any additional coil necessary for the tuning.

In order to reduce the inductance L_2 $(1-K^2)$ the coupling K has to be kept as tight as possible (therefore the necessity to use the powdered iron core) and the inductance L_2 as low as possible. Having the turns ratio determined by Eqs. 3, 4 and 8, which must be satisfied in order to obtain the best NF, the only way of reducing L_2 is to reduce L_1. That is why L_1 is usually too small on Ch. 2. In actual cases, however, both of these measures (increasing of K and keeping L_2 as low as possible) are usually insufficient. The designer therefore is compelled to insert in series with the high channels secondary winding, a capacitor C_1 as shown in Fig. 4. This capacitor reduces the effective capacity of the circuit.

It should be noted that the capacity C_1 does not change the condition of optimum NF, i.e., it does not change the antenna transformed impedance seen from the grid. In fact, if the equivalent parallel damping resistor across the entire circuit is R_{gT}, then the equivalent parallel damping resistor R_g across the capacity C_o is:

$$R_g = R_{gT}\left(\frac{C_1}{C_1 + C_o}\right)^2$$

and since

$$R_{gT} = \frac{1}{R\left(\frac{C_1 C_o}{C_1 + C_o}\right)^2 \omega^2}$$

we have

$$R_g = \frac{1}{R\omega^2 C_o^2}, \text{ as in Eq. 3}$$

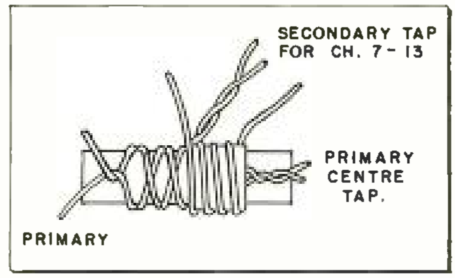


Fig. 5: Crosswound primary increases rejection

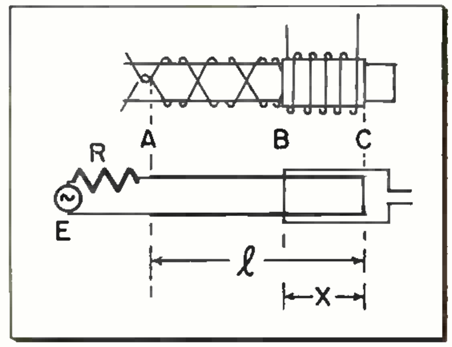


Fig. 6: Transmission line equivalence

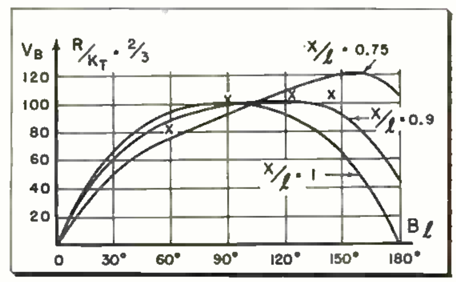


Fig. 7: Graphic presentation of Eq. 10

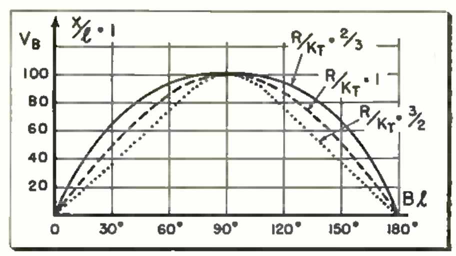


Fig. 8: Graphic presentation of Eq. 10

In other words, a transformer designed to satisfy condition 4 without the series capacitor C_1, still satisfies the optimum noise condition if C_1 of any value is used. The use of the series capacitor however, has the desirable effect of increasing the selectivity of the input circuit. Thus, the main considerations in the antenna transformer design are:

It must be wound on a powdered iron core and the inductance of the primary winding must satisfy, on Ch. 2, the relation

$$\omega L_1 \cong R \qquad (9)$$

From the point of view of the performance on Ch. 2, it were better to have $\omega L_1 > R$, but the necessity to

(*Continued on page 153*)

Photoetched Microwave Transmission

Design and fabrication techniques for strip type lines, transitions and test equipment open new horizons for light weight construction. Relative merits of parallel and tri-plate types evaluated

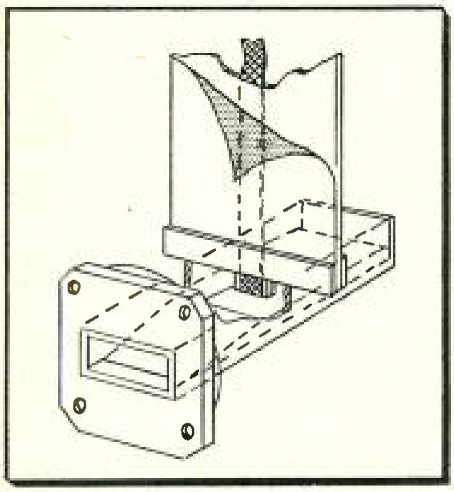


Fig. 12: Tri-plate transition

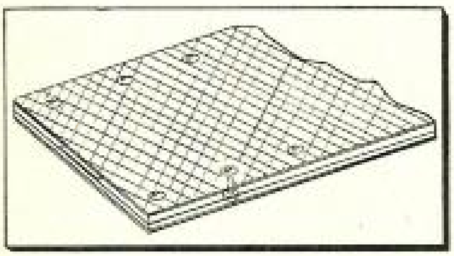


Fig. 13: Early tri-plate fabrication of line

by NORMAN R. WILD
Sanders Associates
Nashua, N.H.

Part One of this two-part article, published in the Feb. 1955 issue, describes the basic characteristics and construction of tri-plate lines.

Before components could be readily designed in photoetched Tri-plate transmission line, it was apparent that a reliable slotted line, free from all leakage and modes other than the Tri-plate mode, would have to be designed. Such an equipment was made by constructing a long section of Tri-plate slotted line and etching one of the outer conductors completely away in the central portion, as is shown in Fig. 7.

This line was then encased in a machined metal housing with a tapered slot in its top surface, the top surface then serving as the missing outer conductor of the Tri-plate line. With the line completely encased in the housing, parallel plate mode is entirely suppressed. The housing, containing the Tri-plate line, is then bolted to a Hewlett Packard type 809B carriage with probe. In use, smooth reliable standing wave patterns were obtained with this slotted line up to frequencies of about 7000 MC. Above this frequency erratic results were obtained because of the unwelcome introduction of the waveguide $TE_{1\text{-}0}$ mode. This problem was solved by moving the side walls of the slotted line casing closer in toward the center conductor until they were below cutoff for dielectric filled waveguide propagation at the highest operating frequency desired.

Matched Loads and Attenuators

Matched loads and fixed pad type attenuators were constructed using resistor tape. To make a load, the tape was cut with a pair of scissors to give the desired taper for a good match and then sandwiched between the dielectric sheets so that its resistive surface was in contact with the center strip of the Tri-plate transmission line. Loads consisting of 3 in. length of 100 ohm/square tape have been constructed which have a VSWR under 1.05 over a 10% band centered at 4200 MC. Such a load, assembled and unassembled, is shown in Fig. 8. Note the use of rivets.

Fixed attenuators were made simply by selecting a length of tape with the appropriate resistance value to give the attenuation desired and tapering both of its ends to obtain a good match. Variable attenuators were also constructed using resistive cards cut in the shape of a cam to give the desired attenuation taper. These cards were fastened to a shaft, and as the shaft rotated, a varying amount of the resistive cam was superimposed over the center strip of the Tri-plate line in a slightly hollowed out area in one of the dielectric slabs which form a part of the Tri-plate sandwich.

The resistor tape used for making loads and attenuators in Tri-plate is most convenient for use with strip microwave transmission lines. It can, for example, be cut with scissors, has a thickness of only 4 or 5 mils which makes it convenient for sandwiching between dielectric sheets, and is relatively inexpensive.

Directional Couplers

Directional couplers have been designed to give various coupling values. A typical directional coupler consisting of two stubs spaced ¼λ apart, capacitively coupled to the main line and directly coupled to the mixing line, is shown in Fig. 9.

This particular coupler has a 20 db coupling and 18 db directivity at 4200 MC for very small gap spacings, once again illustrating the extremely rapid

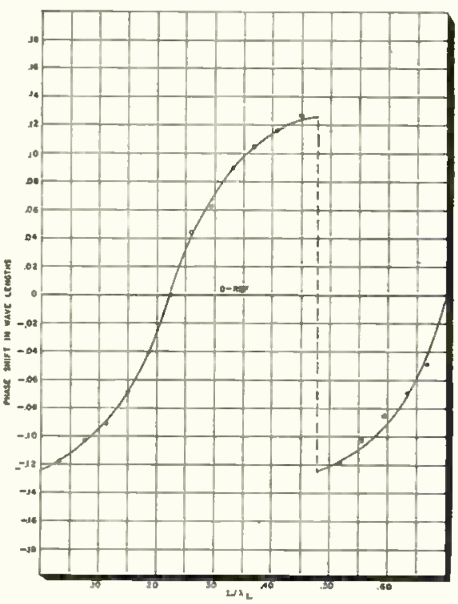
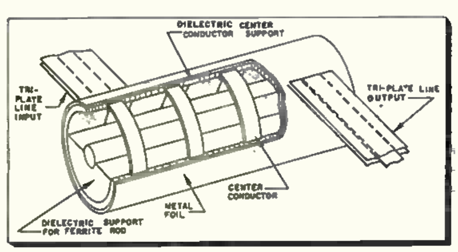
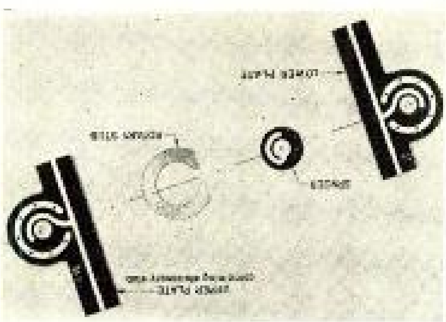


Fig. 14: Phase shift of L/λ_L for open stub

Fig. 18: Construction of tri-plate gyrator



Lines



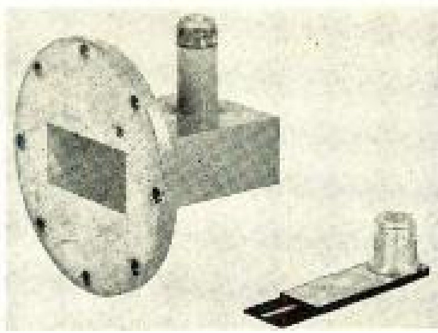


Fig. 15: (l) Single-stub tuner, exploded view

Fig. 16: (center) Adapter devices for coaxial cable. Waveguide at left, tri-plate unit is at right

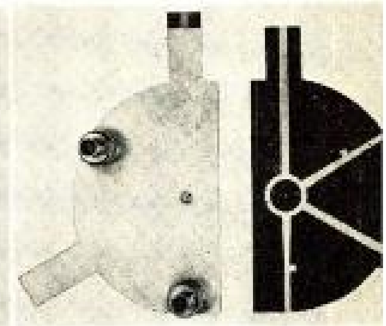


Fig. 17: (r) Tri-plate hybrid ring with crystal holders. (a) Assembled and (b) Internal view

field decay obtained with Tri-plate line.

Fig. 10 illustrates a series stub used as an impedance matching device, and shows the change in Z/Z_0 plotted in VSWR as a/λ is increased from 0 to 0.64 for various values of b/λ. Note that as "a" approaches $\lambda/2$, all of the curves exhibit the properties of a series resonant circuit. This illustrates the compatibility of this line's performance with theory, and also demonstrates the capabilities of the slotted line previously discussed.

Measurements taken on an open circuited shunt stub are recorded in Fig. 11. The stub has the same characteristic impedance as the main transmission line. The curves illustrate the change in VSWR as the stub length is varied over 0.7λ. The dotted curve is corrected for line attenuation. Fig. 14 depicts phase shift variations with changes in the normalized stub length.

A Smith Chart plot of admittance as the stub length increases from 0 to 0.48λ would demonstrate that the open circuited shunt stub is indeed a pure susceptance.

A single shunt stub tuner consisting of an upper plate containing a stationary stub, a spacer, a rotary stub and a lower plate was constructed, and from this evolved the double shunt stub tuner. The double shunt stub is essentially the same as the single unit except that its elements are in duplicate. Fig. 15 is an exploded view of a single shunt stub tuner.

While these stub tuners operate on the principle of a continuous short circuit, it is obvious that the same design can be adapted to an open circuited stub tuner. Successful phase shifters have also been built utilizing the same operating principles as the single and double shunt stub tuners.

A Type N coax to Tri-plate adaptor constructed from a standard UG58A/U panel plug is shown in Fig. 16. The mounting flange of the plug is fastened to one of the outer plates of the Tri-plate line by means of screws which also serve as short-

(*Continued on page* 148)

Ultrasonics for Sandpaper Production

By PAUL W. JOY
The Carborundum Co.
Niagara Falls, N. Y.

SANDPAPER and abrasive cloth are fast becoming the most versatile and skillful tools of industry. There is one machine, for example, employing abrasive belts that can be positioned to within such accurate limits that a sheet of newspaper passing through it will have the newsprint erased and still emerge as an undamaged sheet of paper!

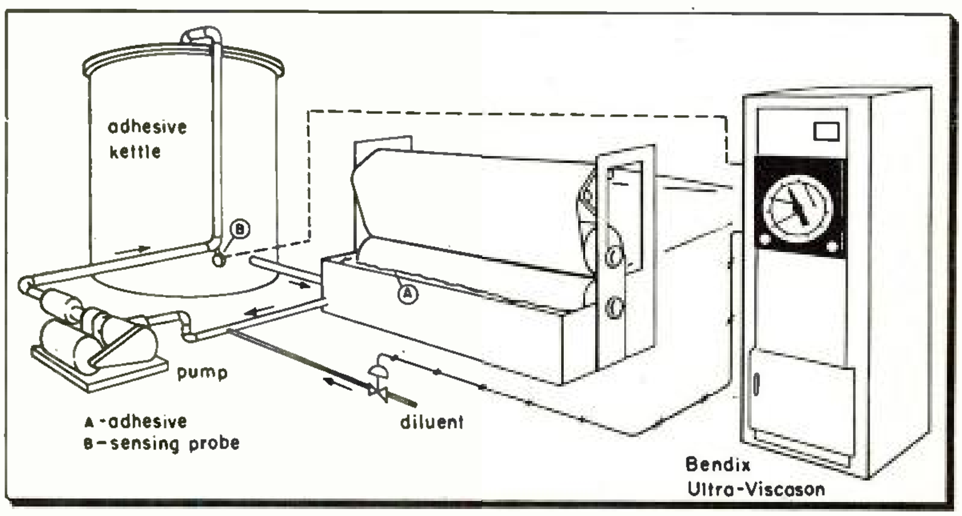


Fig. 1: Ultrasonic generator and electronic-pneumatic controller provide continuous correction

Operations conducted in Carborundum's Making Department are typical of the use of modern instrumentation in a quality control program. Here, the paper or cloth belt is coated with adhesive, has the proper weight of abrasive grain added and is dried to the correct moisture content.

There are three major variables that influence the final quality of material leaving this department. These are: (1) thickness and characteristics of cloth or paper base material; (2) characteristics and amount of adhesive applied, and (3) the weight of grain picked up. Since the first—base material thickness and characteristics—are already established when the material reaches our plant, our quality control activities must be concentrated on the remaining two—adhesive and weight of grain picked up.

Viscosity of the adhesive quite understandably has a pronounced effect on the third variable, weight of grain picked up, and for this reason offers the first logical point of attack to the quality control problem.

Although initially adhesive is mixed to the correct viscosity in the kettle that supplies the "making machine," it will not, unless continuously corrected, remain at this viscosity.

The adhesive is continuously re-

(*Continued on page* 150)

Variable-Mu Twin

The wide variations in signal strength which characterizes airborne communications calls for an r-f amplifier with low inherent high-order distortion and low noise figure

By R. E. MOE, *Manager-Engrg. Receiving Tube Sub-Dept. G.E. Tube Dept. Owensboro, Ky.*

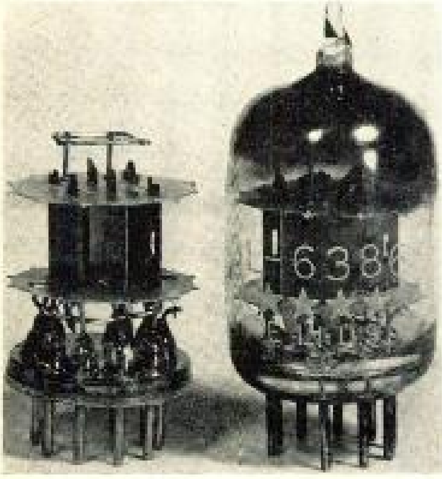


Fig. 1: Variable-mu twin triode Z-2159 (GL-6386)

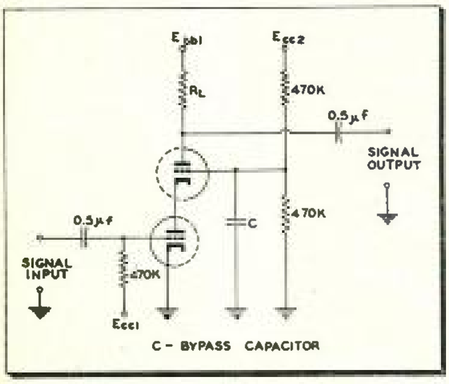


Fig. 2: Fixed-divider type cascode circuit

THE problem of overload and the necessity of automatic gain control of pentode r-f amplifiers has been with us since about 1932, when the first variable-mu tubes were introduced for that purpose. Later, it was found that excessive nonlinearity near cut-off resulted in modulation of the desired signal by an adjacent undesired signal. Recently, a third effect has become prominent, involving harmonics of the difference frequency between two large signals causing multiple side-frequencies and resulting in interference with weak signals on adjacent channels. With the use of narrow band FM transmission and reception, the first two effects are practically negligible, but the third still remains.

Signal Strengths Vary

Since this problem is particularly severe in airborne communication receivers, where there are many closely spaced channels and a likelihood of wide variation in signal strengths, especially in duplex operation, this phase of the problem will be used as an example. Specifically, the General Electric Co. was requested by Aeronautical Radio, Inc., to develop and produce a reliable successor to the 9003, a miniature, variable-mu, high transconductance pentode, which at that time was the best candidate from the standpoint of gain and input loading. In construction, it is somewhat similar to the 6AK5, except for the variable-mu grid.

Examination of the existing difficulties in making the tube reliable brought to light the fact that as increasing bias cut off conduction through the normally-spaced grid turns, all of the conduction, particularly to the screen, came from the widely spaced areas of the number 1 grid. Since the net screen current then decreased, the series screen dropping impedance would allow its voltage to rise and the screen turns immediately facing the open areas of the number 1 grid would greatly exceed their normal dissipation and become red-hot. It might have been possible to specify fixed screen voltage operation, but this would require a stiff bleeder, resulting in an uneconomical waste of dc power. Besides, the use of series screen operation was a common practice to improve AGC characteristics and extend the cut-off region.

Cascode Circuitry

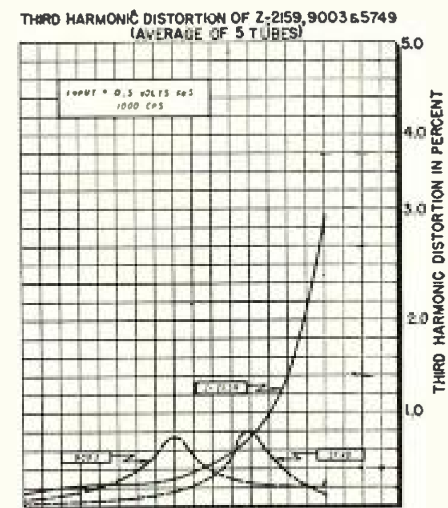
From a practical standpoint, it appeared that an entirely new approach would be more desirable, and with this in mind, the tube designer began to search for ways of increasing the power dissipation characteristics of the screen. Happily, at this time, cascode r-f circuits for TV were coming into wide use, and a very obvious answer suggested itself. Why not use an entire plate, and eliminate the screen? And although no one had ever considered the possibility of a variable-mu triode, much less two of them in cascode, it seemed worth trying, and some sample tubes were put together.

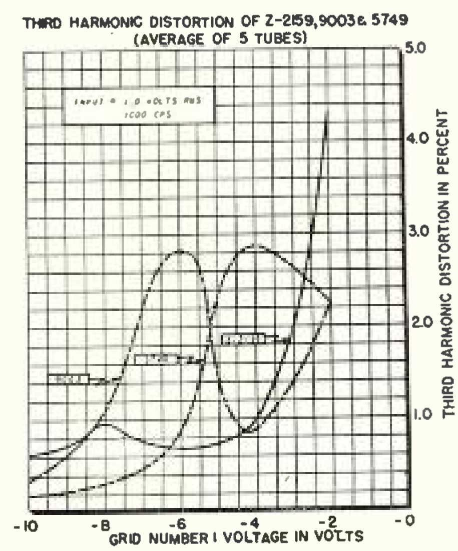
Amazingly enough, the first samples had excellent characteristics in a fixed-divider type of circuit (Fig. 2) as both halves were contributing to the variation in transconductance.

Also, an additional advantage is found in the use of this arrangement in that the screen current normally drawn in a conventional pentode amplifier is reduced in this case to the negligible current drawn by the bleeder used to establish the positive bias on the control grid of the No. 2 section of the twin triode.

At this point, it would be well to pause and examine the requirements for an ideal r-f amplifier from the stand point of the various undesired cross-modulation products. Reference to Terman's *Radio Engineers'*

Fig. 3: (top) Z-2159 vs. existing types. Fig. 4: (below) Excellent response at 1.0 v input





Triode for Airborne Receivers

Handbook (p. 466) reveals that the prime requirement is absence of harmonics above the second in the transfer characteristic. The easiest way to determine whether this has been achieved is to plot the transconductance as a function of bias on semi-log paper, as any departure from a straight line with a slope of two indicates other than the desired pure square law function. Another way is to measure the third harmonic content in the output, as this is almost the entire source of these inter-modulation products, as has been shown in the literature.

From both of these standpoints, the first lot of experimental tubes showed very desirable characteristics (Fig. 5).

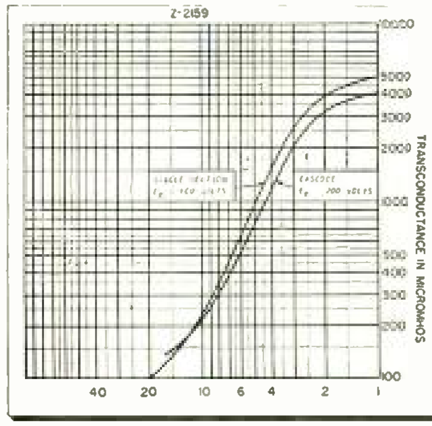


Fig. 5: (l) Log plot of transconductance vs. bias.

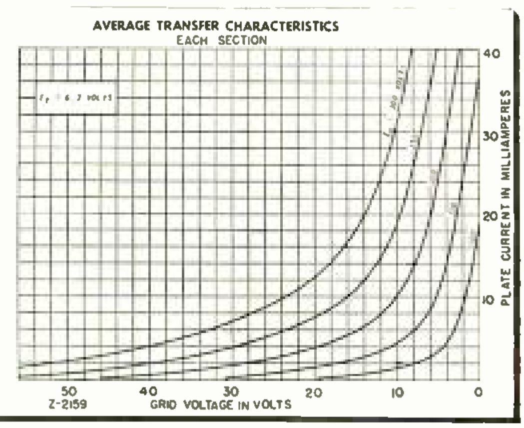


Fig. 6: (r) Characteristic curves—single section

Triode Advantages

In comparison with these results, similar data on the 9003 and 5749/6BA6W are plotted in Fig. 3 and Fig. 4. It can be seen that the double triode is superior over most of the region. Transconductance figures are all quite similar, but input loading on the triode seems to be more favorable and, of course, the inherent noise level is considerably better, as found in the conventional cascode circuitry used in recent television tuners, particularly when neutralization is used.

The final test, however, is whether performance in an actual receiver bears out the predicted improvements. These data are more difficult to obtain. In most cases, it is almost impossible to separate tube performance from the other factors like AGC characteristics, input circuit selectivity, cross-modulation in succeeding stages, etc. Suffice it to say that sufficient improvement has been demonstrated to warrant the development and introduction of such a type, but that specific performance figures are a function of the particular receiver specifications and operating conditions.

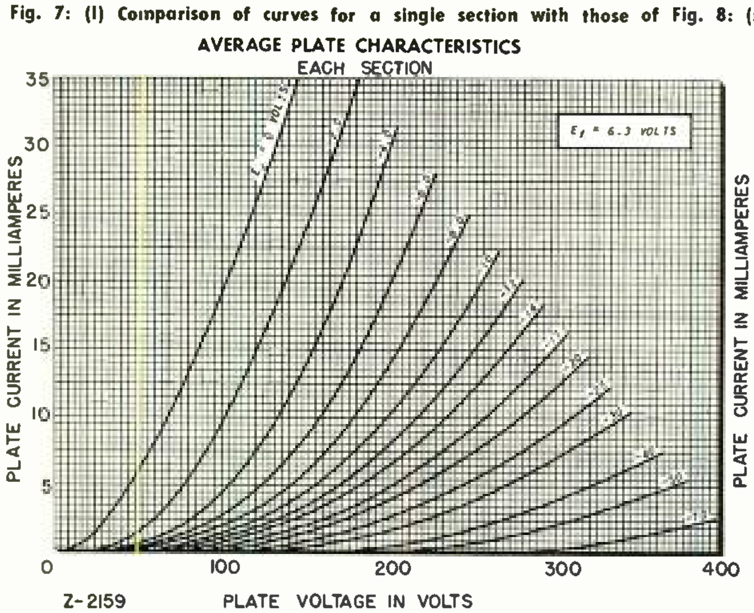
In addition to the above primary application, there should be many other circuit problems which can be solved by the use of a tube with these characteristics. One such might be in volume expander or compressor circuits where minimum distortion is required at all levels of bias coming from the audio AGC. This, of course, requires that the two triode sections be operated in push-pull in order to cancel the second harmonic arising from the square law characteristic. The inherently low level of third harmonic is then the only remaining distortion.

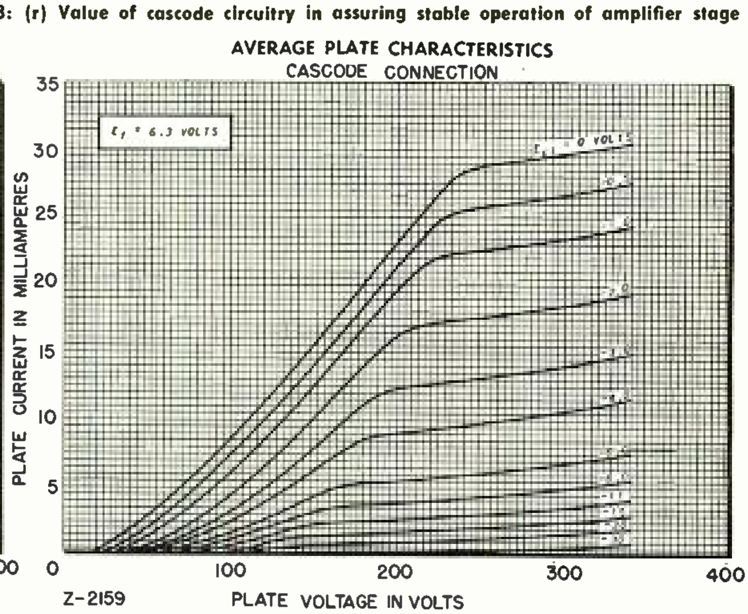
Complete characteristic curves, as well as typical operating parameters, are shown in Fig. 6, 7 and 8. It will be seen from examination of the physical structure of the tube (Fig. 1) that it is similar to the 5670 high-transconductance medium-mu twin triode except for the variable-pitch grid.

In conclusion, we have described a new variable-mu twin triode for cascode operation in AGC-operated r-f amplifier circuits. It should be superior to any existing pentodes in such applications because of low inherent high-order distortion, high gain and low noise figure. It is designed and built with the features of the other special types in the high-reliability series for minimum failures under severe operating conditions, such as airborne communication receiver applications.

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

Fig. 7: (l) Comparison of curves for a single section with those of Fig. 8: (r) Value of cascode circuitry in assuring stable operation of amplifier stage





How to Plan for Color Television Broadcasting

Part Two of Three Parts

Practical three-step sequence provides for logical expansion of facilities from handling network programs, slides and films, to live studio originations

By L. E. ANDERSON & W. O. HADLOCK
Engineering Products Dept., Radio Corp. of America, Camden, N.J.

PLAN #2 EQUIPMENT FOR 16MM, 35MM COLOR FILM AND 2"x2" SLIDES

For many stations the second step will be the addition of plan #2 facilities. This will enable these stations to telecast their own color film and slides, to insert station breaks in color and to sell "spots" to local and national advertisers. Color slide programs are relatively easy to make up since 35mm color transparencies can be used as slides. Slides and films occupy a good share of the present day monochrome program schedule and with the advent of color this may increase. Commercials on short film strips and 16mm color films can be used once the plan #2 equipment is installed.

The equipment furnished in plan #2 consists mainly of (a) *Color Bar and Local Origination Equipment* including Color Bar Generator, Burst Flag Generator, TB-2A Sync Generator and Colorplexer—plus (b) *the TK-26A "3-Vidicon" Color Film and Slide System.* Both of these groups of equipment will be described in detail. See Fig. 7.

Two colorplexers are included in plan #2, one under "Color Bar Equipment," the other under "Film." Use of two is recommended so that (a) bar output is available for system checking without having to shut down film operation (b) an automatic emergency spare is always available.

The inclusion of the aperture compensator in plan #2 with color bar allows use of the "test" colorplexer in the system as an emergency spare for film and/or live operation.

When a station decides to start color programming (whether film, slides or live) the "color bar and local origination equipment" must be installed in order to generate color sync and picture signals locally. This same equipment is also used in plan #3 and does not require duplication when adding live camera facilities.

In order to familiarize and train station personnel in advance with color TV equipment and principles, some stations may wish to install the color bar generator and local origination equipment well ahead of the film and live camera facilities. The color bar origination equipment of plan #2 provides a stable and inexpensive system for the production of color signals. While this signal does not constitute anything which could be used during a normal program period, it certainly has enormous utility value in testing and measuring of studio and transmitter systems while at the same time providing a means of familiarizing operation personnel with color principles and equipment.

Before installing any equipment, some additional space must be provided for the two extra equipment racks of plan #2, thus making a total of four (see Fig. 8). The total

PLAN #2 EQUIPMENT

COLOR BAR AND LOCAL ORIGINATION EQUIPMENT

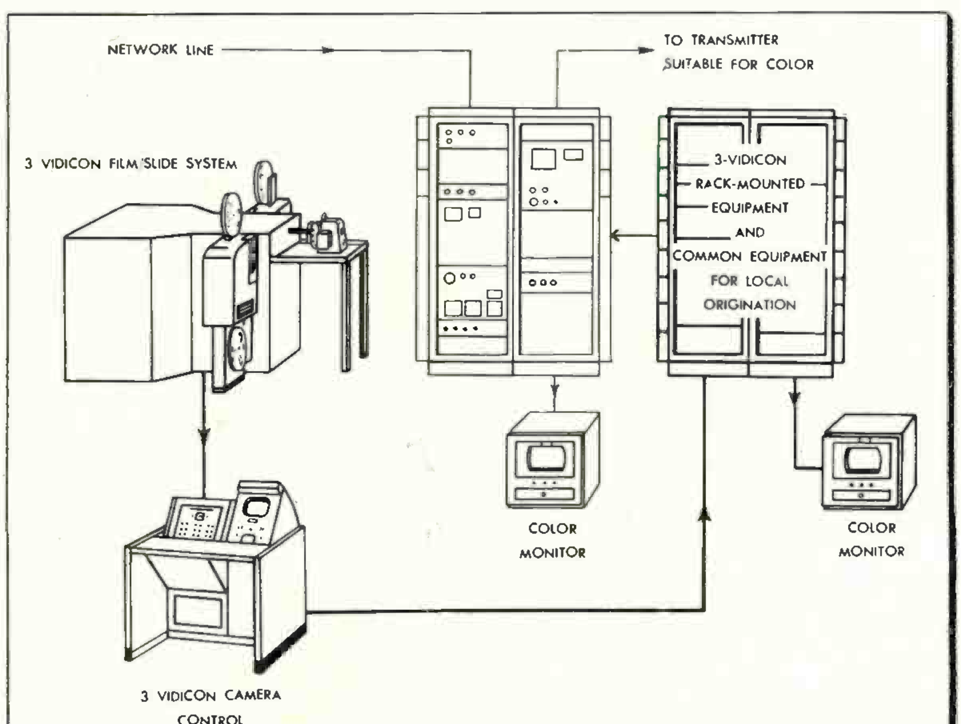
Qty.	Description
1	Color Frequency Standard
1	Burst Flag Generator
1	Type 580-D Power Supply
1	*Type TG-2A Studio Sync Generator (includes Dot and Grating outputs)
1	Sync Generator Changeover Switch
2	Type BR84 Cabinet Racks
1	Type WA-1D Color Bar Generator
1	**TX-1B Colorplexer
1	Aperture Compensator for TX-1B†
1	Type 580-D Power Supply for TX-1B
1	Test Meter
1	Changeover Switch Remote Control Panel
1	TA-3A Video Distribution Amplifier
1	TA-4A Video Distribution Amplifier
1	580-D Power Supply (for Dist. Amps.)

*An existing TG-1A Sync Generator may be modified for color. (MI-40405 Modification Kit available)

**Note that two colorplexers are included in plan #2, one under "Color Bar Equipment," the other under "Film." Use of two is recommended so that (a) bar output is available for system checking without shutting down film operation (b) an automatic emergency spare is always available.

†Addition of this unit in plan #2 allows use of colorplexer in system as an emergency spare for film and/or live operation.

Fig. 8: Four major equipment racks and color monitors for Plan #2 station



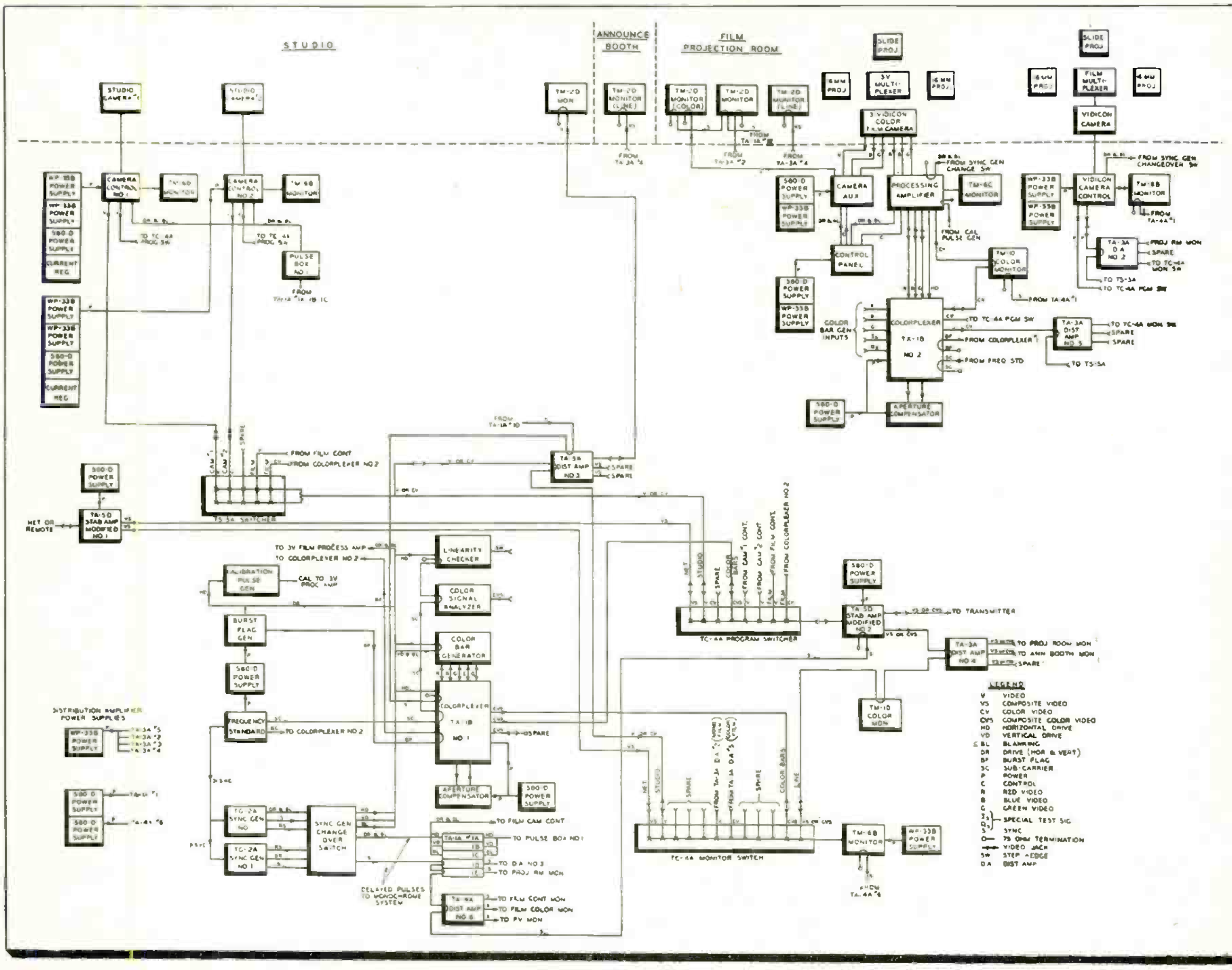


Fig. 7: Equipment and system arrangement employed in Plan #2 color TV broadcasting installation providing for film and slide organizations

space for the four racks is 7 ft. x 20 in. An approximate minimum space of 12 ft. x 14 ft. is needed for the Vidicon film and slide equipment including 16 mm projectors.

COLOR BAR AND LOCAL ORIGINATION EQUIPMENT

As pointed out briefly, the color bar and local origination equipment provides the basic elements of a color system when the step to local origination is made. Since the colorplexer is the heart of any color TV system and the bar generator provides the simplest of all color signals, this equipment is a prerequisite in the step to full local origination. In addition the color bar signal can be used as an on-the-air signal during periods when regular commercial transmission is not in progress so that servicemen may utilize this signal for the alignment of color receiver. The function of various items of origination equipment supplied are described here and are not covered again under plan #3.

The *RCA WA-1D color bar generator* produces various combinations of color bars. It has five output channels—green, red, blue, I and Q. These outputs are fed to corresponding inputs on the *RCA TX-1B colorplexer* (Fig. 9). The matrixing section of the colorplexer combines these signals and feeds them to the I and Q modulators at the proper polarity and amplitude to produce a colorplexed bar signal at the output of the colorplexer. The colorplexer also has inputs for color signal sources such as a live camera or three vidicon film chain. A switch on the colorplexer enables the operator to switch between the live or film camera and the bar generator. It is customary to loop the bar signals from the bar generator to each colorplexer used in the system so that only one bar generator is necessary regardless of how many color signal sources are available. The test pattern from the color bar generator can be used most effectively by viewers in their homes as well as by station engineers and servicemen. In order to adjust his set for best color balance, the viewer merely has to adjust the color or chroma control until the color bars in the top row are vivid and pleasing to the eye. Then he must adjust the phase or hue control to achieve the best yellow hue in the second bar from the left. If the hue control is out of adjustment on one side or the other, the yellow bar will appear either greenish or too orange. If the yellow bar is set properly in this way, all the other colors should normally fall into correct adjustment.

The *color frequency standard, MI-40201,* provides the color synchronizing information necessary for proper color operation. The subcarrier output of the frequency standard is fed to each colorplexer where it is modulated with the chroma information. Another output from the frequency standard is used to synchronize the sync generator to the frequency standard. The frequency of this output is the subcarrier frequency divided by 455/2. This frequency has been selected to eliminate cross-talk between the horizontal scanning frequency and the color subcarrier.

The *burst flag generator, MI-*

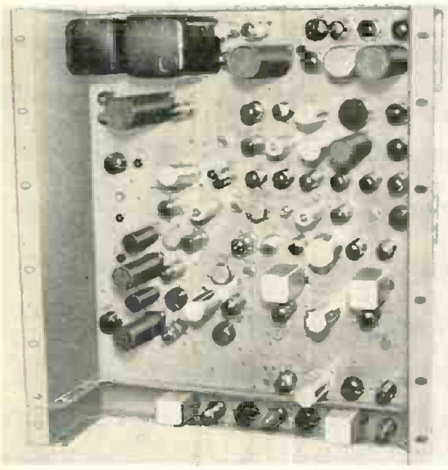


Fig. 9: Colorplexer combines r-g-b signals to form encoded color signal for transmission

40202, is used for keying in the color subcarrier burst. Its output consists of a series of horizontal pulses which key the burst of subcarrier onto the back porch of the blanking signal in the colorplexer. Those pulses are suppressed during the vertical synchronizing interval so that no burst is keyed in at this time.

TG-2A sync generator—color sync signals differ from monochrome sync signals in one major respect. This is that they have a "burst" of subcarrier frequency (3.58 MC) superimposed on the "back porch" of the horizontal sync pulse. This "burst" is supplied by a burst flag generator, as shown in Fig. 7 and described above.

A minor difference in color sync signals is that they are controlled by the subcarrier oscillator (rather than the 60-cycle supply). The thermostatically controlled 3.58 MC oscillator is contained in the color frequency standard. Divider circuits fed from this oscillator develop a 31.5 KC signal which is used to drive the sync generator.

The TG-2A sync generator has been designed especially for color operation with the color frequency standard. The outputs of the frequency standard go directly to the TG-2A. It is possible to modify the TG-1A sync generator for color operation by means of modification kit, MI-40405. This kit contains all of the necessary parts and a complete set of instructions for making this modification. It is not considered good practice to use one TG-1A for both setups, since changing over from monochrome to color, or vice versa, would cause a break in the sync signals fed the receiver. However, both station sync generators can be modified, thus providing an emergency spare for either type operation.

TK-26A EQUIPMENT

TK-26A "3-V" color film and slide equipment—as mentioned briefly before, the RCA 3-vidicon color film and slide system is a complete package of equipment which provides both film and slide facilities. See Fig. 10.

The film and slide camera outputs of the vidicon system (consisting of R, G & B) are combined with the sub-carrier into composite signals. The colorplexer previously mentioned performs this function as follows: (1) it cross-mixes the R, G, and B signals to form the luminance (or monochrome) signal and the two chrominance signals and (2) it multiplexes these signals with the sub-carrier to produce a composite color signal suitable for feeding the transmitter.

The TP-12 multiplexer for plan #2 film system offers a selection of 16mm and 35mm color films as well as 2 x 2 in. color slides to be used as color program material. Many of the excellent design features of present monochrome vidicon techniques have been incorporated in this 3-vidicon color film system to obtain greatest reliability and color picture quality.

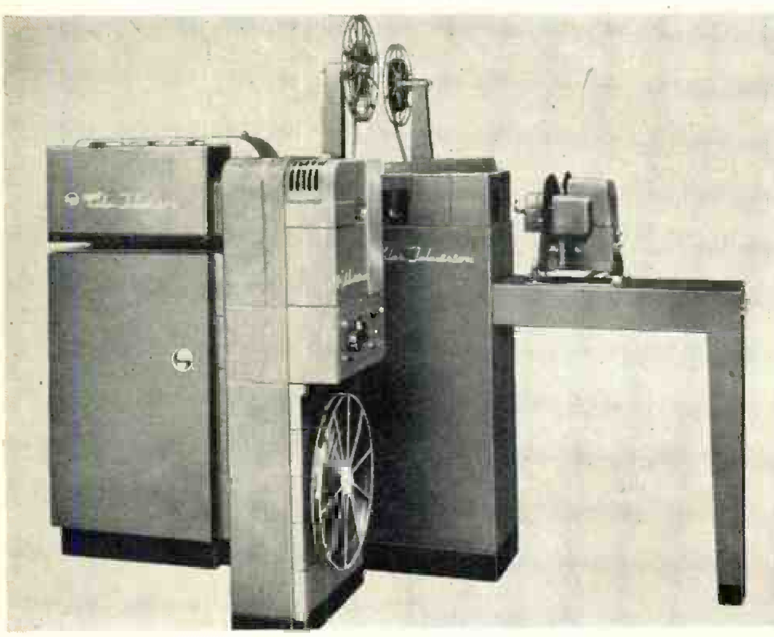
The high resolution and maximum stability of the vidicon tube is retained in this 3-vidicon system. Gamma is ideal—needs virtually no correction; while color fidelity approaches the high quality standards set by RCA's color studio camera. Use of the vidicon tube also provides a very high signal-to-noise ratio in both the color and the compatible monochrome picture. This feature is particularly important, especially in the first few years of color operation when color programs will be viewed on a great number of monochrome sets.

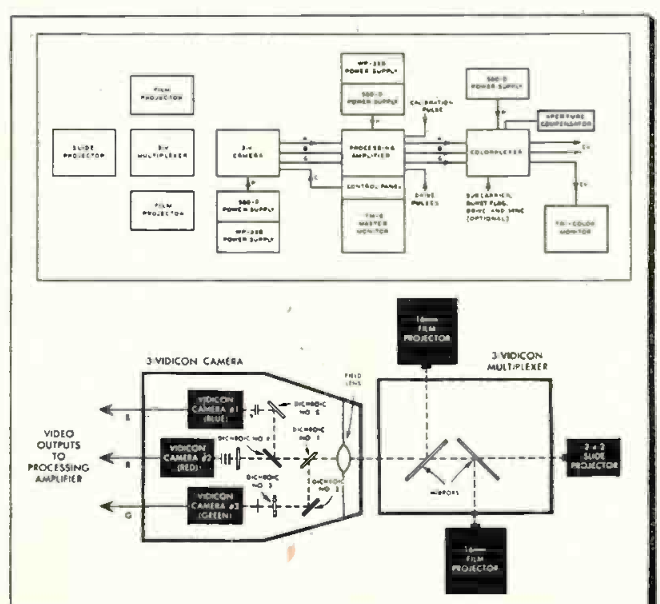
The Vidicon System includes the "3-V" film chain, TP-12 multiplexer, two 16mm film projectors, dual disc slide projector. These equipments making up the system are described below.

The RCA TK-26A color film camera employs three RCA 6326 vidicon tubes, one for each of the primary colors of the color film being transmitted. These vidicons "look" at a real image produced by the projector and reflected by the multiplexer

(*Continued on page* 186)

Fig. 10: (l) Color film and slide equipment package utilizes three vidicon tubes. Fig. 11: (r) Diagram of film and slide system





Page from an Engineer's Notebook

No. 30 — Tank Circuit Design

By
JOSEPH F. SODARO
California Registered Engineer,
3895 Main Street
Culver City, Calif.

THE inductance and capacitance values in a tank circuit of reasonably high Q give inductive reactance and capacitive reactance which are equal at the operating frequency. The network is a resistive load when resonated in this way as seen by the r-f amplifier tube. The condition of reasonably high Q is met by loaded circuit Q values of 10 to 20 which are generally used in practice. The tank circuit functions as a reservoir. It supplies power throughout the r-f cycle although the plate current flow is limited to a fraction of this cycle duration in class B and C amplifiers. Extremely low Q tends to distort the waveshape by limiting the storage capacity of the tank. As a result the output waveshape seriously deviates from a sine wave during the latter part of the cycle. At the same time harmonic attenuation and plate circuit efficiency is reduced. On the other hand extremely high Q values attenuate high audio frequency sidebands since the tank then becomes a highly selective r-f filter. Also, circuit losses become high unless very high-Q tank coils or resonant lines are used.

Diagram Terms

A simplified diagram for a triode r-f amplifier is shown in Fig. 1. In the tank circuit R_L represents the resistance of the inductor while r represents the resistance of the load reflected by the coupling system into the tank circuit. The load may be the following amplifier, transmission line, or antenna. It is assumed that the reflected load is entirely resistive. It is assumed, also, that there is no resistance in the capacitor branch of the tank circuit.

The Q for the inductor is the ratio of the inductive reactance to R_L. This Q should be made as large as possible. In other words the best coil should be used for the power involved. On the other hand, the loaded tank circuit Q should range from 10 to 20 as pointed out above. The figure of merit for a tank circuit is the change in Q from no load to full load divided by the no load Q expressed in percent. Thus, if a tank has a no load Q of 200 and a full load Q of 10 the ratio is (200-10)/200 or 0.95 or 95%.

In addition to the full load Q, the design procedure requires the selection of the load into which the tube must work. This depends upon the power which the tube is to deliver and the plate voltage. The optimum load value for a given tube can be

(*Continued on page* 155)

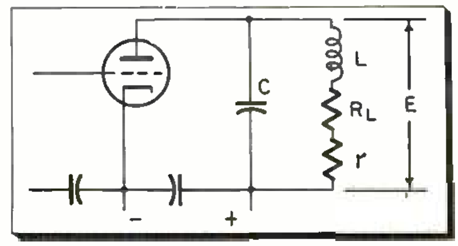
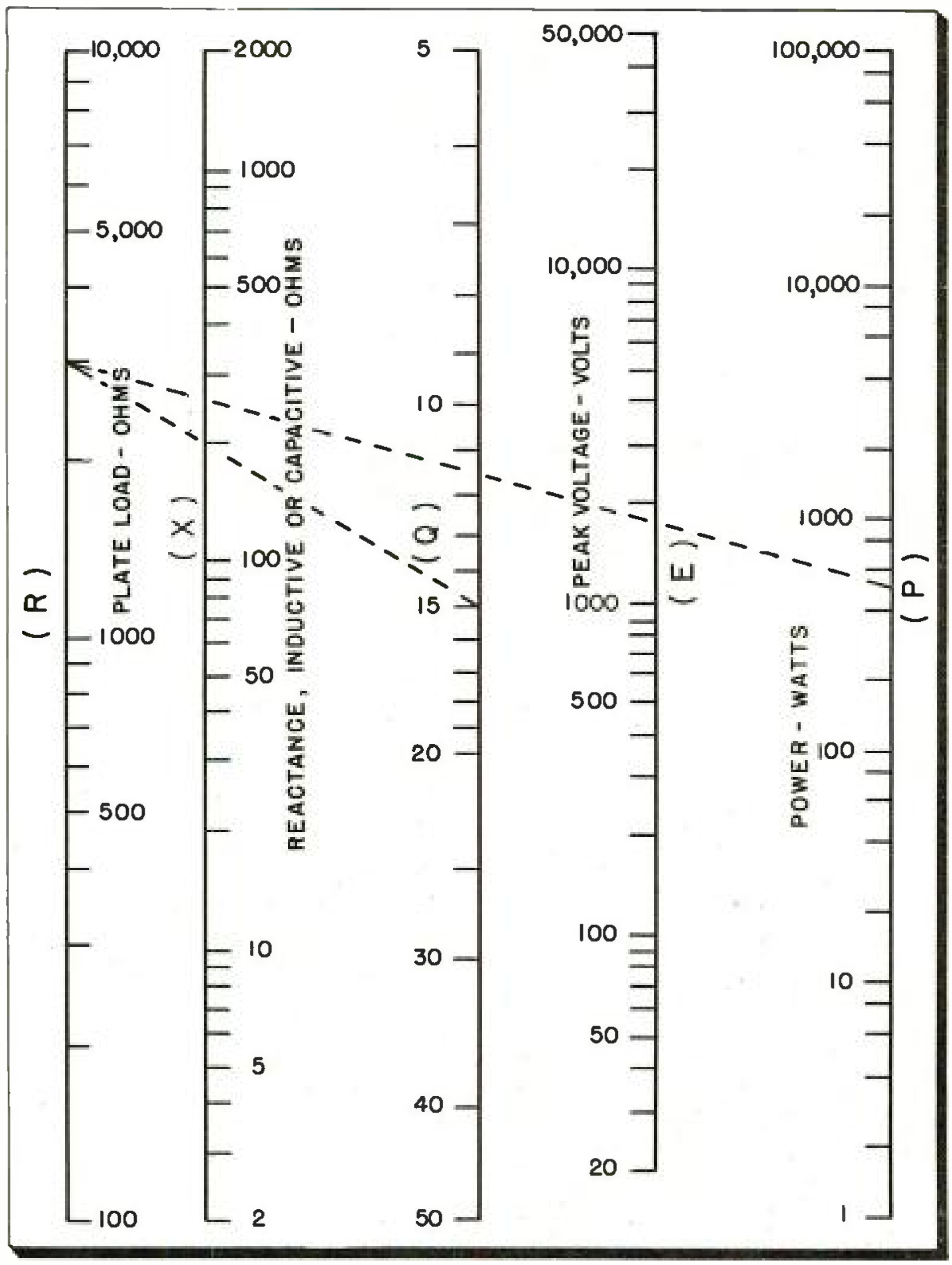


Fig. 1: Simple triode r-f amplifier circuit

Fig. 2: Nomograph for determining r-f tank circuit characteristics



Previews of IRE Exhibitors'

Useful descriptive summaries enable readers to determine what-to-look-for

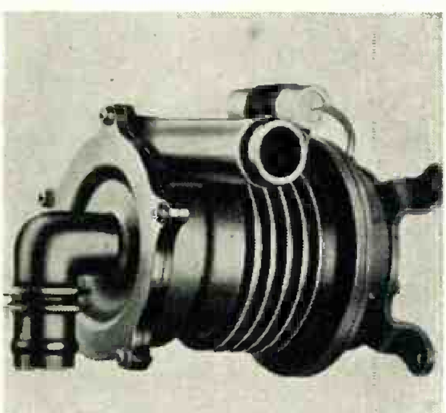
Booth 54-56 — Control Intervalometer

The Type T249 intervalometer is an automatic control for programming events in selectable sequences initiated by a single enabling impulse. A 28 v. enabling impulse produces a rapid se-

quence of 28 v. pulses, each to a separate terminal. Pulse length and spacing is determined by customer specification. The "MK" version spacing is 7 msec. Each impulse is 10 msec. long. Accuracy is to 1 msec. Overall timing accuracy is ±10%. Hermetically sealed. Fits a standard type mounting tray. **PSC Applied Research Limited, 1500 O'Connor Drive, Toronto, Can.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-28)

Booth 581-583 — Miniature Blower

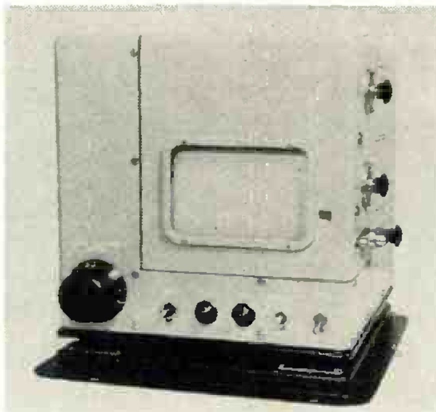
Model R, Type 201, high-pressure miniature blower is especially designed for cooling a gyrator in a pressurized waveguide system. Part of a new line of Model R, single-stage, radial blowers



with high pressure-to-volume ratios. Moves 7 CFM against 6 in. WC. Either 1 or 3 phase, 400 CPS. Total weight less than 2 lbs. **Rotron Manufacturing Co., Schoonmaker Lane, Woodstock, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-25)

Booth 10 — Flight Recorder

The Model R1021-D recorder is a ten 1% or 210 "on-off" channel fixed stylus recorder. Designed primarily as an airborne instrument, the unit is particularly adaptable to digital recording and/



or "on-off" information. Gives a large number of channels on a 5-in. width chart. Direct writing. Easily read. Requires no chart processing. Capable of automatic data reduction and digital recording. Writes on "Teledeltos" electrosensitive paper; 100-ft. length. Size 10 x 10 x 10 in. Wt., 40 lbs. **Radiation Inc., Melbourne, Fla.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-22)

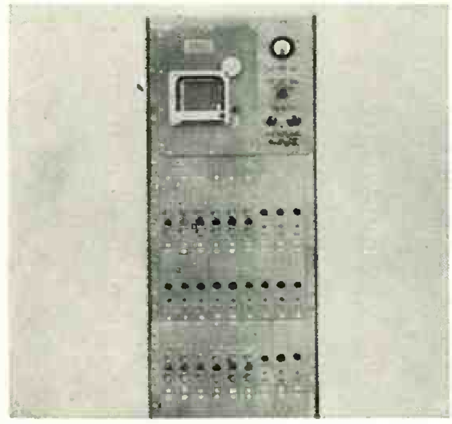
Booth 342-344 — Power Supply

The Model 450 D voltage regulated power supply features two identical regulated dc outputs, that can be used separately or in series, and one unregulated filament supply. Each of the dc outputs is continuously variable from 0 to 150 v. and delivers from 0 to 75 ma. In the range 0-150 v, the output voltage variation is less than 0.1 v. for

both line fluctuations from 105-125 v. and load variations from min. to max. current. Ripple voltage is less than 3 mv. **Kepco Laboratories, 131-38 Sanford Ave., Flushing 55, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-23)

Booth 206-208 — Drum Recorder

The Model 700 magnetic tape seismic drum recorder is a specialized geophysics instrument for obtaining optimum seismic information. The standard machine furnishes 26 recording channels—



24 geophones, 1 timing, 1 utility. Broad-band flat frequency response—1½ to 300 CPS/sec. Over 45 db signal-to-noise ratio, over 50 db from 20 to 300 cps. Less than 1% overall harmonic data distortion. Replaceable 4 x 40¼ in. tape for each shot. Operates from 12 v. battery. **Ampex Corp., 934 Charter St., Redwood City, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-27)

Booth 676 — Luneberg Lens

The 18-in. Luneberg lens produces a plane of electromagnetic energy wave emitted from a point source on its surface, or conversely focuses an incident plane wave to a point. One application is wide angle scanning by the movement of a small feed horn when the lens is stationary rather than by the movement of a reflector. Made of low-loss "Eccofoam PS," the maximum dis-

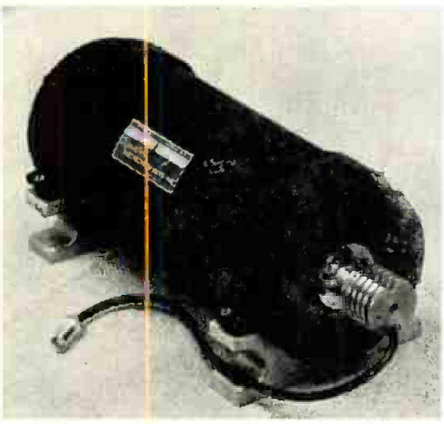
sipation factor is 0.0002. The lens core dielectric constant is 2.0±0.02, each shell decreasing it by an increment of 0.10. **Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-29)

New Electronic Products

beforehand. Additional reviews will be published in Tele-Tech's April IRE issue

Booth 80 — Backward Wave Oscillators

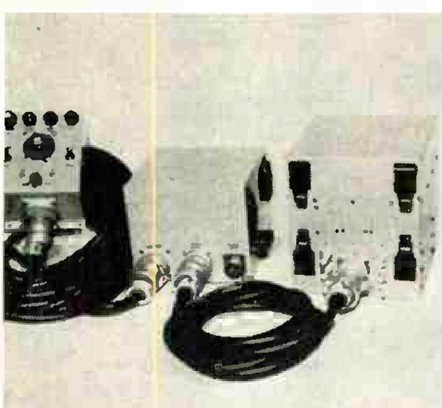
Backward wave, or voltage tunable microwave oscillator tubes are constructed with an r-f structure that has an internal feedback mechanism controlled by voltage applied to the elec-



tron beam. Entirely electronic, there is no inertia or wear. Hence, the tube can be operated at high sweep rates without effect on its life. Tubes are glass constructed, and all low output level models employ a helical r-f structure. **Roger White Electron Devices, Inc., Route 17 & Erie R.R., Ramsey, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-26)

Booth 222 — Tape Recording System

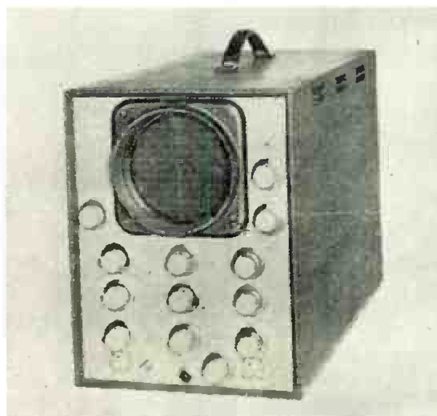
The series 550 recording system, developed to meet the requirements of airborne data recording in a minimum space, has a total volume of less than ½ cu. ft., including the remote control box. The equipment operates over a temperature range of 0.20°C to +55°C; down to —55°C can be obtained by use of an automatic electric blanket. Meets vibration requirements of MIL-E-



5272A, Procedure I. System comprises a recorder and space for electronic plug-units, a power supply, and an optional remote control box. **The Davies Laboratories, Inc., 4705 Queensbury Rd., Riverdale, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-31)

Booth 481 — Wideband Oscilloscope

The Model 320 wideband oscilloscope, a general purpose high-gain instrument, features identical horizontal and vertical amplifiers which enable frequency phase shift indication up to the



video frequencies. Adapted to phase shift measurements in color TV. Frequency on both amplifiers, flat from 10 CPS to 5 MC within 1 db. Rise time less than 0.1 μsecs. Overshoot, negligible. Deflection sensitivity. 35 mv RMS/in. deflection on both amplifiers. Calibrating voltage, self-contained, 0.106 v. RMS. **Crosby Laboratories, Inc., P.O. Box 233, Hicksville, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-30)

Booth 129-131 — Oscilloscopes

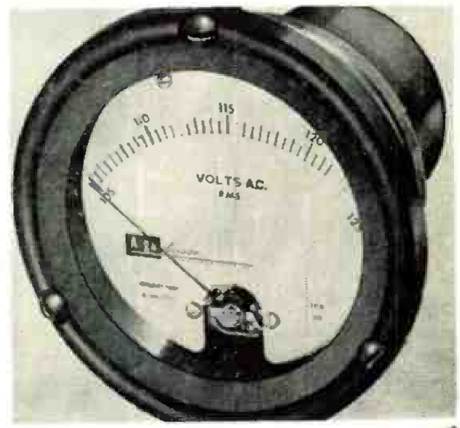
Type 532 of the new 530 Series is a dc to 5 MC oscilloscope with a sweep range of 0.2 μsec/cm to 12 sec/cm and 4 kv accelerating potential. Type 533 of the series is a decoupled oscilloscope with a vertical-amplifier rise-time of 0.012 μsec at a basic sensitivity of 0.1 v/cm, sweep range of 0.02 μsec/cm to 12 sec/cm, and 10 kv accelerating potential. Designed for extreme wide-band applications. Both types have Type 53 Series plug-in preamplifiers. **Tektronix, Inc., P.O. Box 831, Portland 7, Ore.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-24)

Booth 756-758 — Potentiometer

Used as computers, non-linear potentiometers position a miniature destroyer and bomber within broad parameters of range and altitude. "Helipot" precision potentiometers translate range and altitude into voltages r and h. Their outputs are amplified and fed to non-linear unit which solves the equation, $r = 2e^2 h \sin 40$ with great accuracy. **Helipot Corporation, 916 Meridian Ave., S. Pasadena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-33)

Booth 760 — Voltmeter

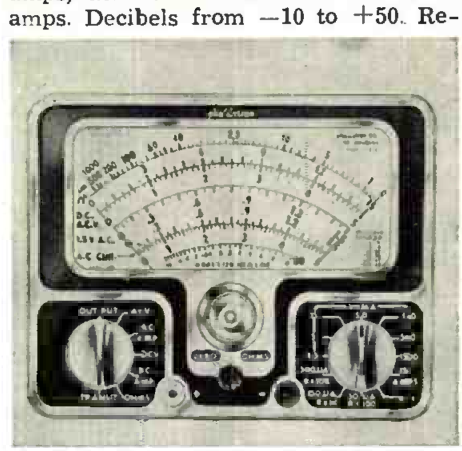
AC voltage readings accurate to 0.5% over the frequency range of 50 to 2,000 CPS are obtained with the expanded scale panel voltmeter. Use of a thermal bridge permits indication of a narrow



voltage range. The scale is expanded about a given normal voltage that can be as low as 6.25 v. with a span of ±0.25 v. or as high as 230 v. with a span of ±30 v. A line of 3½ in. and 4½ in. diam. models is supplemented by square (3½ in.) and rectangular (4 x 6 in.) models. **Beckman Instruments, Inc., Arga Div., 220 Pasadena Ave., S. Pasadena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 3-32)

Booth 428 — Multimeter

The "555" metal-cased, pocket-size multimeter offers 43 unduplicated, self-contained ranges with accuracies of 3% dc, 4% ac, and measures dc volts from 1.5 to 1,500 v at 20,000 ohms/v, ac, and ac volts from 1.5 to 1,500 v at 2,000 ohms/v, dc. Current from 50 μa to 15 amps, ac. Current from 1.5 ma to 15 amps. Decibels from —10 to +50. Re-

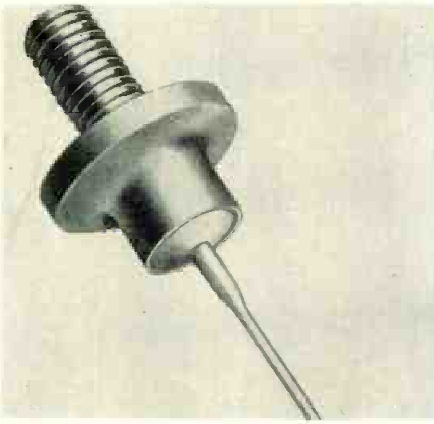


sistance from 0.25 ohms to 10 megohms. Ranges established in 3 to 1 steps. Has only two jacks. Measures 4⅝ x 6⅛ x 2⅛ in. **Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-13)

IRE New Products

Booth 580 — Power Rectifiers

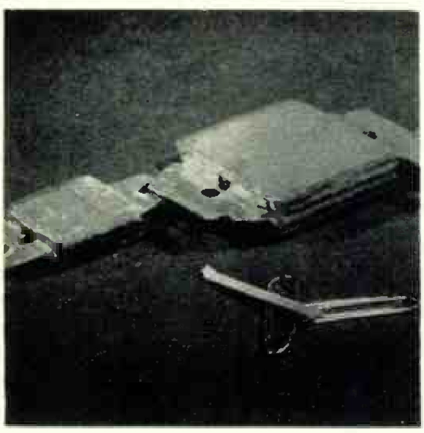
Announced silicon power rectifiers are capable of continuous operation at an ambient temperature of 125°C. Their high forward conductance and ex-



tremely low leakage current allow operation at efficiencies up to 98%. Designed for conduction cooling. Save size and weight. Both magnetic amplifier and power supply applications are available. As the units exhibit no forward aging effects, compensating networks are unnecessary. **Transitron Electronic Corp., 403 Main St., Melrose, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-36)

Booth 397-494-495 — Capacitors

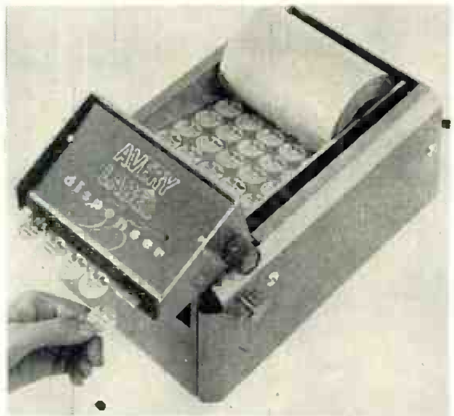
Available in types CY60, CY65, and CY70, new medium-power glass capacitors electrically replace mica capacitor



types CM45 to CY70. Generally the equivalent ratings of glass capacitors occupy less volume than their mica counterparts. The new capacitors are formed of alternate layers of glass and foil, sealed under heat and pressure to form a self-supporting monolithic unit. Further encasing is not needed. Performance is a function of the dielectric properties of the glass. **Corning Glass Works, Newton St., Corning, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-37)

Booth 389-391 — Labels and Dispensers

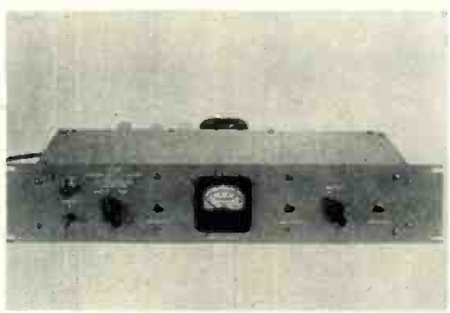
Announced is a new combination oil and heat resistant, pressure-sensitive label that adheres firmly to oily and greasy surfaces. Also announced, is the



"55" fully automatic, self-regulating dispenser that releases labels either singly or in multiples. The model "H" label dispenser is manually operated and dispenses labels singly or in multiples. **Avery Adhesive Label Corp., 1616 S. California Ave., Monrovia, Calif.** —TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-35)

Booth 666-668 — Tuning Control

The Model TL-1 "Trak" tuning lock keeps frequency-shift code receivers tuned accurately to an incoming frequency at all times. The unit is applicable to variable-tuned or crystal



controlled receivers. The tuning lock includes a control chassis and a separate electrically-controlled capacitor connected to the tuning circuit of the receiver. Draws 90 w. of ac power. **C. G. S. Laboratories, 391 Ludlow St., Stamford, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-34)

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

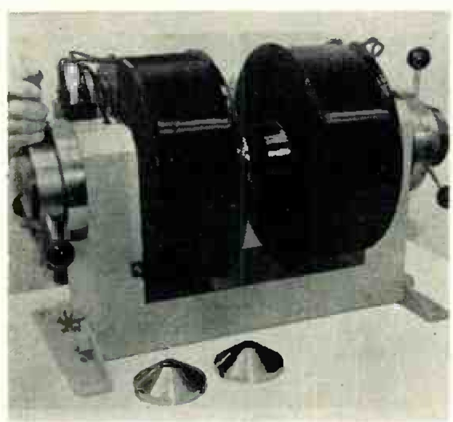
Booth 242-244-246 — Marker Generator

A crystal-positioned instrument, the "Ultra-Marker," designed for use with a sweeping oscillator, develops an ac-

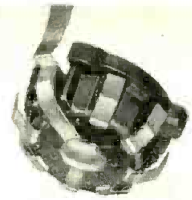
curate oscilloscope display marker signal at all UHF sound and picture frequencies covered by an associated sweeping oscillator. A switching system eliminates all but every fourth set of channel markers and enables the use of less accurately calibrated sweep generators. The instrument is enclosed, with regulated power supply, in a functionally designed steel cabinet. **Kay Electric Co., 14 Maple Ave., Pine Brook, N. J.** —TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-38)

Booth 542-544 — Electromagnet

The V-4004 electromagnet has two fixed energizing coils with adjustable poles and changeable pole caps. By a



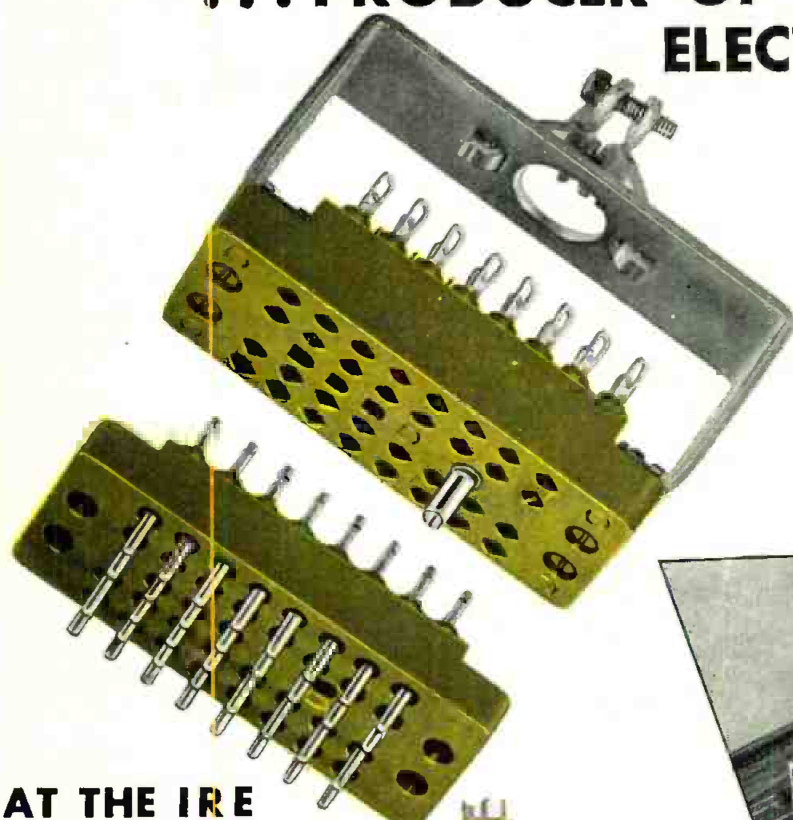
simple adjustment of each pole, any air-cap width can be made up to 4.3 in. Cylindrical, conical, and specially shaped pole caps provide a wide choice of flux patterns. Despite the small size of the magnet, a gap field flux density of as high as 28,600 gauss can be attained. Especially suited for general laboratory needs that require precise magnetic field. **Special Products Div., Varian Associates, 611 Hansen Way, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-39)



. . . automatically made, therefore made with precision metal and insulation components. CINCH automatically assembled parts assure the uniformity and quality mandatory for use in AUTOMATION in the end users equipment.

Adequate and unequaled facilities have advanced CINCH to the foremost producer of low loss Mica components in *production quantity*.

FOR OVER A QUARTER OF A CENTURY . . . PRODUCER OF THE STANDARD ELECTRONIC COMPONENT



CINCH molded general purpose connectors, from three to fifty contacts or more, are designed and made of materials as desired and necessary to meet application requirements. They are available in low loss mica for chassis mounting or assembled with cap for cable applications. Terminals gold or silver plated.

Cinch components available at leading electronic jobbers—everywhere.

Centrally located plants at Chicago, Shelbyville, Indiana and St. Louis.

AT THE IRE SHOW BOOTHS NOS. 394 & 396

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

For a component in the list that follows, or for a component to be designed to fit a specific need,

CONSULT CINCH

- ANTENNA JACKS
- BANANA PINS AND JACKS
- BARRIER TERMINAL STRIPS
- FANNING STRIPS
- BATTERY PLUGS & SOCKETS
- BINDING POSTS
- DIODE SOCKET
- CONNECTORS, MULTI CONTACT
- FUSE STRIPS, BLOCKS & BOARDS
- GRID CAPS
- GRID CAP SHIELDS
- HERMETICALLY SEALED TUBE SOCKETS
- METAL STAMPINGS
- MICRO-CONNECTORS
- MOUNTING DEVICES
- PHONO TIP JACKS
- PRINTED CIRCUIT, CONNECTORS
- SHIELDS, TUBE-MINIATURE & NOVAL & BASES SOLDERING LUGS—200 VARIATIONS
- STRAP NUTS
- TRANSISTOR SOCKET
- TUBE HOLDERS—SPRING TYPE
- VIBRATOR PLUGS AND SOCKETS

SOCKETS:

- 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

WASHINGTON
News Letter

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

SENATE PROBE—Under the chairmanship of Democratic Senator Magnuson of Washington, the Senate Interstate Commerce Committee plans to embark into an investigation of the economic plight of television stations in multiple-station markets, principally UHF but also VHF. One remedy, the Senators spearheading the study feel, may be tax relief for TV sets. Subscription television is another subject on the Senate investigations agenda. The Senate Committee which received $200,000 for the industry emphasized its goal was a nationwide system of television "operating in the atmosphere of healthy competition."

INTERCONNECTION RATES—Another significant avenue of investigation by Senator Magnuson and his committee will be into the telephone interconnection rates for television, although it is recognized that the telephone system has made tremendous contributions to the advancement of nationwide video in its facilities for network program transmission. Senator Magnuson noted that in the past two years there had been a mounting number of complaints from TV licensees on the high costs of interconnection together with "an inadequacy of service to cities which do not lie athwart transcontinental cable and microwave lines." The Senate Committee asserted there should be a careful review of "what seems to be inadequate regulation by FCC" of these rates.

DEFENSE OUTLAYS—While the 1956 government budget which starts next July 1 as submitted by President Eisenhower gave no details of the electronics-radio expenditures for national defense, an analysis of the 1224-page document showed that the Air Force and the Navy are seeking increased appropriations for procurement of new equipment and of components and parts for maintenance of present facilities. The Air Force program calls for $594,236,000 for procurement of electronics and communications equipment as well as $603 million for guided missiles where electronics is the major expenditure, and these two programs are $370 million above the expenditures for the current fiscal year. The Navy planned more than $106 million for air carrier and fleet communications and electronics procurement and maintenance, $40 million more than this fiscal period.

FCC BROADCAST-TV COSTS OFF—Even though the FCC budget proposal due to pay increases is slightly higher—$6,704,500 than the current allotment of $6,699,300—the decrease in the work backlog on broadcasting and television station applications caused a reduction in funds for this FCC activity. Safety and mobile radio services continued to record increased work for the FCC with an estimated total of 180,000 stations in this field which includes aviation, marine, police and industrial mobile and microwave communications for the upcoming fiscal year starting next July 1. This would mean a gain of 20,000 over the current fiscal period.

SPLIT RADIO CHANNEL—Aimed at relieving the tight frequency situation in mobile radio services, the FCC in a long-awaited move recently issued proposed rules which would reduce the spacing between present channels allocated to these services in the 25-50 and 152-162 megacycle bands. Comments from the mobile radio services on the plan are due March 28. Separation in the 25-50 mc band would be 20 kc between channels compared with the present 40 kc and in the 152-162 mc band it would be 15 kc compared with the existing 60 kc while there would be provision for geographic spacing of adjacent channels. The vote was 3 to 2 with dissenting commissioners Bartley and Lee stressing the need for a general allocation proceeding which would survey spectrum occupancy by the government.

FM BROADCAST BAND—The FCC was recently asked by the National Association of Manufacturers radio committee to consider the allocation of around 700 new mobile radio channels in the unused portion of the FM broadcasting space for the growing manufacturers' radio service. The NAM group cited that its plan was designed not to interfere with any existing FM broadcasting operations. The opening of the 700 channels, it was stressed, was not only to provide additional channels for the manufacturers' radio service but a wealth of channels for other mobile radio services. At the same time as it filed its proposal with the FCC, the NAM distributed copies of its plan to all other mobile radio organizations.

STANDBY PRIORITIES SYSTEM—Preliminary work on a standby system of public message service priorities, similar to those administered by the Board of War Communications in World War II, has been launched by the FCC under a proposed delegation of authority from the Office of Defense Mobilization.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

GPL has COLOR

New 3-Vidicon Film Chain, 2 Projectors Added to Color TV Equipment Available

TELECASTING • RESEARCH • PRODUCTION • EDUCATIONAL

GPL has designed, developed and put into commercial production triple-Vidicon telecine equipment with no limitation on the amount of light really needed for color film. The 3-Vidicon chain is compact, reliable, and precision balanced for color fidelity. Built for tomorrow's color, it has none of the light limitations inherent in the flying spot.

For commercial work, or research and test, GPL announces two new telecine projectors, in both 16 mm and 35 mm size. These projectors incorporate GPL color research, plus all the mechanical reliability and precision parts of the famous Simplex line.

The new film chain and projectors supplement the full line of GPL-Wickes color TV signal generating and test equipment for telecasting, research, production and educational work.

COLOR CONSULTATION SERVICE

Color equipment is available in complete packages for station conversion, or individual units to your needs. Specifications on request.

The GPL-Wickes equipment available for prompt delivery includes:

- INTERLACE SIGNAL GENERATOR
- COLOR BAR GENERATORS
- COLOR CODER
- CONVERGENCE DOT GENERATOR
- MULTI-BURST GENERATOR
- AMPLITUDE LINEARITY TESTER
- VIDEO DISTRIBUTION AMPLIFIERS
- PULSE DISTRIBUTION AMPLIFIER
- REGULATED POWER SUPPLIES
- VECTOR DISPLAY EQUIPMENT
- ENVELOPE DELAY TRACER
- COLOR VIDEO MONITOR
- PHASE CORRECTION NETWORKS
- CROSSOVER FILTER

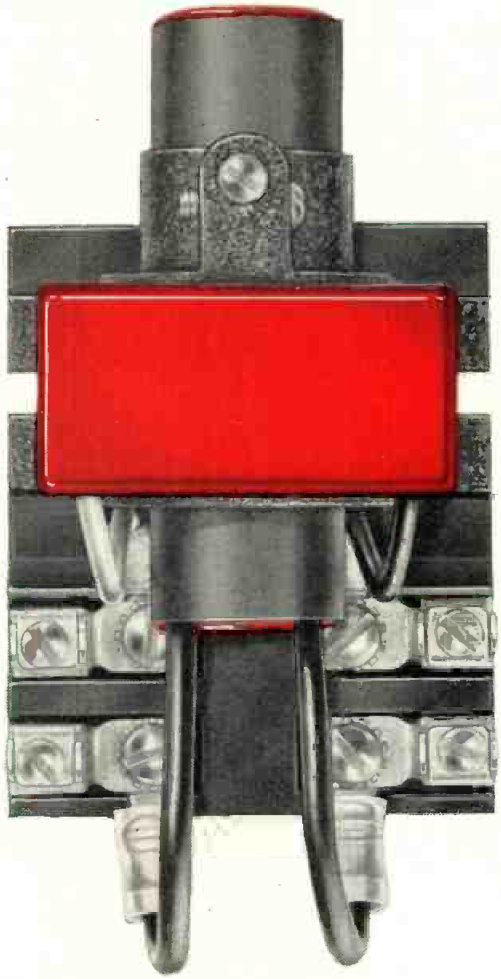
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

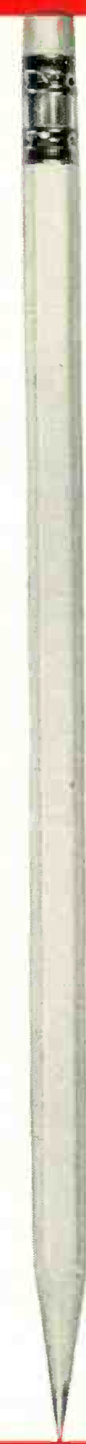
General Precision Laboratory
INCORPORATED
PLEASANTVILLE NEW YORK

REGIONAL OFFICES: CHICAGO • ATLANTA • DALLAS • PASADENA

For product information, use inquiry card on last page.

Announcing





Like all Adlake relays, these new "Mighty Midget" relays require no maintenance whatever . . . are quiet and chatterless . . . free from explosion hazard. Dust, dirt, moisture and temperature changes can't affect their operation. Mercury-to-mercury contact gives ideal snap action, with no burning, pitting or sticking.

the new Adlake

"Mighty Midget"

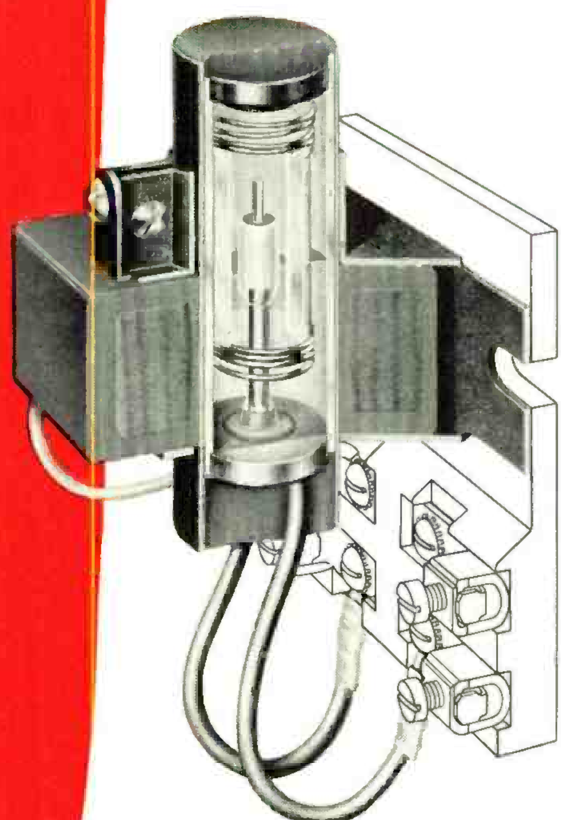
with the revolutionary **MOLDED** coil!

You expect the very latest from the company that originated the mercury plunger-type relays—and here *is* the very latest! It's the Adlake No. 1140, with molded coil in epoxy resin. That neat red coil is exclusive with Adlake, and gives these advantages:

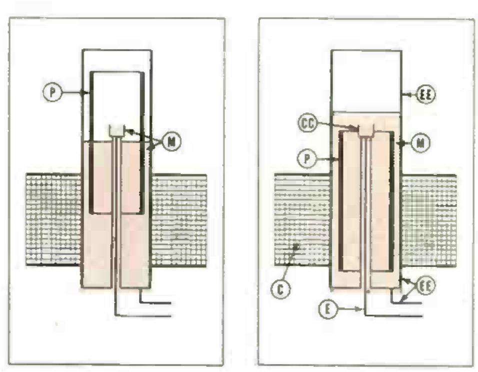
- **Better heat radiation**
- **Absolutely moisture proof**
- **Tested by 4 to 5 million operations at maximum capacity**
- **Guaranteed against coil failure—forever**

This new molded coil "Mighty Midget" is the newest reason why

it'll pay you to use Adlake mercury relays



This phantom view and operational sketches show the simple, dependable operating principle of the Adlake "Mighty Midget" Relay.



DE-ENERGIZED ENERGIZED

DE-ENERGIZED Plunger P is floating in mercury M. External circuit is open because main body of mercury M is below lip of ceramic cup CC.

ENERGIZED Coil C pulls plunger P down into mercury M. Mercury thus displaced completely covers ceramic cup CC filled with mercury. This establishes mercury-to-mercury contact between electrodes E and EE.

Adlake TRADE MARK

98th year of serving the transportation and building industries

THE Adams & Westlake COMPANY

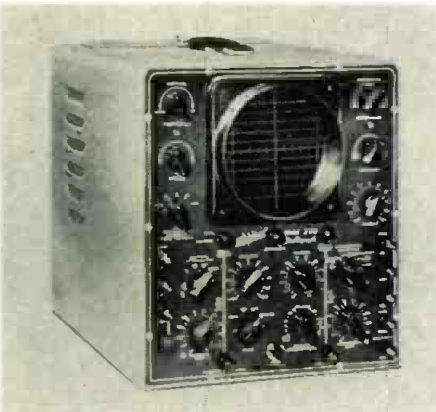
Established 1857 • Elkhart, Indiana • New York • Chicago

the original and largest manufacturers of mercury plunger-type relays

IRE New Products

Booth 458-460 **Oscilloscope**

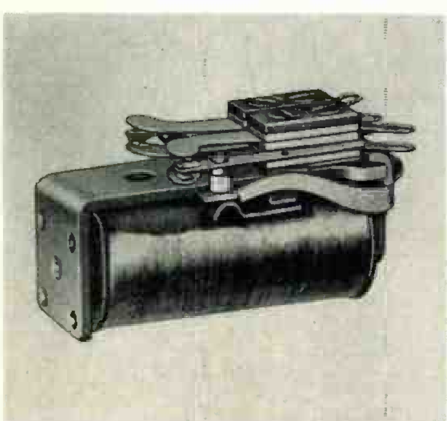
The professional laboratory oscilloscope, Model 770, a late development in the field, has the following specifications: frequency range, vertical ampli-



fier, dc to 5 MC, 3 db down, with band width switch in wide position; dc to 2.5 MC, 3 db down, with band width switch in narrow position, better than standard IRE roll-off characteristics. Horizontal amplifier, dc to 500 kc, 3 db down. Sweep circuit oscillator, 2 CPS to 30 kc. Fixed sweep frequencies, 30 CPS and 7,875 CPS. **The Hickok Electrical Instrument Co., 10514 DuPont Ave., Cleveland 8, O.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-42)

Booth 759 **Telephone Relay**

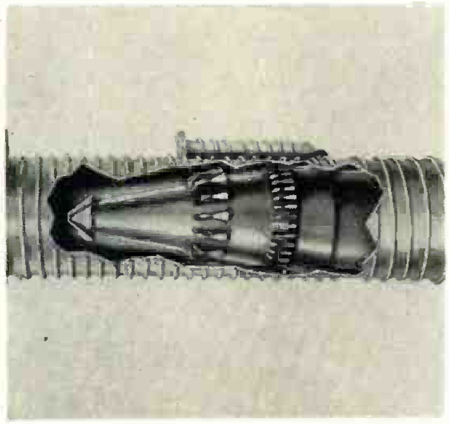
The SQ series single-coil telephone relay is available in 1 to 5 amp contact ratings in contact combinations from SPST to 6 PDT, with a maximum sensitivity of 15 mw per pole in the DPDT



combination. This is an optimum combination, withstanding 10G's vibration from 10 to 500 CPS. When power is increased to 40 mw per pole, vibration resistance rises to 30 G's. Sensitivity and vibration resistance decrease with added contact combinations and the same power. **Advance Electric & Relay Co., 2435 N. Naomi St., Burbank, Calif.** —TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-43)

Booth 84 **Pumps**

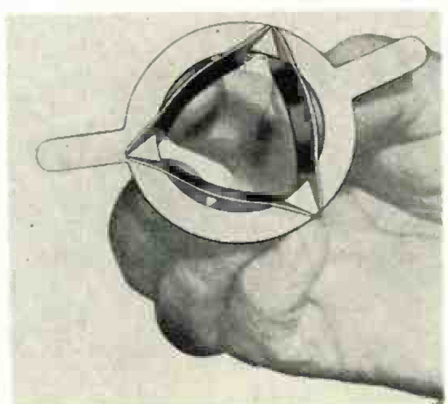
A new line of oil diffusion and booster pumps employing the "Ring Jet" increase pumping capacity over the critical pressure ranges. The 16-in. dif-



fusion pump exhausts 11,000 cfm at a pressure of 1 micron. Replacing the conventional jet cone with a ring of jets enables some models to increase pumping speed as much as 50% over conventional pumps. **F. J. Stokes Machine Co., Inc., 5500 Tabor Rd., Philadelphia 20, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-44)

Booth 854 **Centering Device**

Tilt-open slip-on design of a centering device for assembling TV sets in production has been announced. It fits

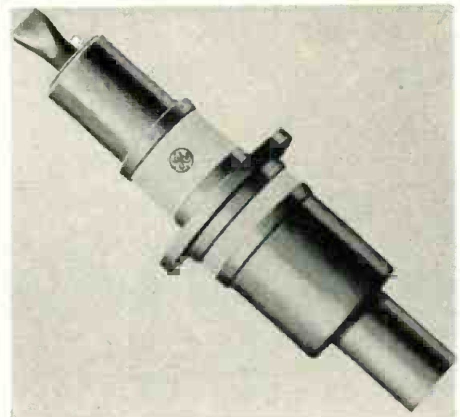


instantly over the tube's neck. A gentle squeeze tilts open the device which is adjustable from 0 to 18 gauss. A distortion-free beam is assured by uniformity of field. **Heppner Manufacturing Co., P.O. Box 612, Round Lake, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-41)

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

Booth 174-196 **Lighthouse Tube**

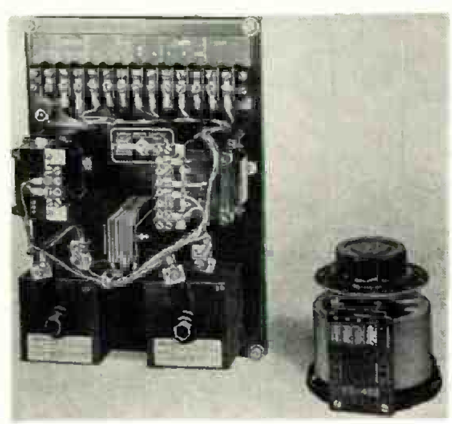
A miniaturized 2⅝ in. long metal and ceramic tube, GL-6442, enables pulsed power applications up to 4,000 MC. Peak power output at 3,500 MC is 2.0 kw.



Mechanical structure features a strong grid flange for rigid mounting. Coplanar design affords greater resistance to shock and vibration. Operates in commercial service up to 175°C seal temperature. Large-area silver plated terminals. Designed for beacons, low-power radar, microwave relays, navigation, special test equipment, etc. **General Electric Co., Schenectady 5, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-45)

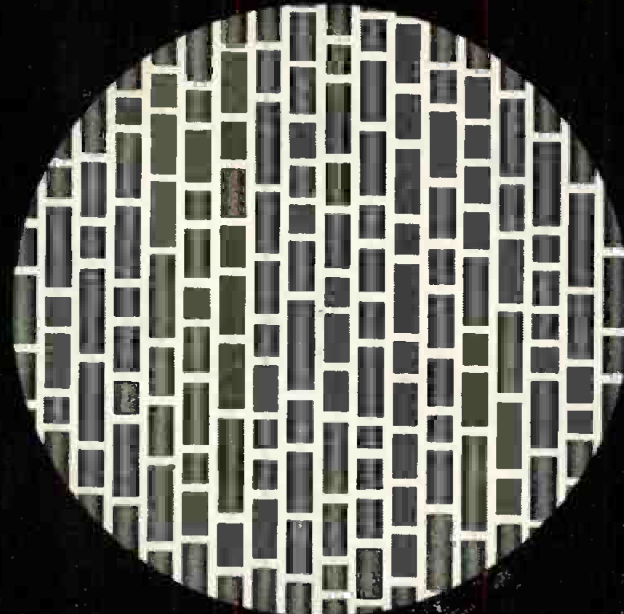
Booth 251-253-255 **Speed Controls**

"Variac" motor speed controls are now obtainable without cabinets and switching. Stripped-down models ranging from 1/15 hp. to 1½ hp. are available in this form. All parts except the "Variac" speed control element are



mounted on a metal chassis with connections brought out to a terminal strip. Only the "Variac" and switches need be at the control point. The motor speed controls are for operating dc shunt or compound motors from ac power lines. **General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-40)

Electron photo microscope's view of conventional oxide coating used by many long play tapes. (Artist's conception.)



Similar enlarged view showing exclusive oxide dispersion method developed by "Scotch" Brand for new Extra Play Tape.

SEE the difference...

then hear the difference...

You'll notice the difference at once—the way revolutionary "Scotch" Brand Extra Play Tape outperforms ordinary long play tapes with old-fashioned, *full-depth* oxide coatings. There's a crisper tone, higher fidelity on "Scotch" Brand . . . *and* a generous 3 db. boost in the high frequency range.

The secret of "Scotch" Brand's superiority? It's the completely new oxide dispersion process. By laying carefully filtered, fine-grain particles in a neat, orderly pattern, "Scotch" Brand is able to produce a super-sensitive magnetic recording surface that contains the same amount of oxide as conventional tapes, yet is 50% thinner. That's important to remember when buying tape. Because recording experts are aware that a thinner, more potent oxide coating is essential for improved results with long play magnetic tapes.

Ask for "Scotch" Brand Extra Play Tape *today!*

NEW! REG. U. S. PAT. OFF. **SCOTCH** BRAND

Extra Play Magnetic Tape 190

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

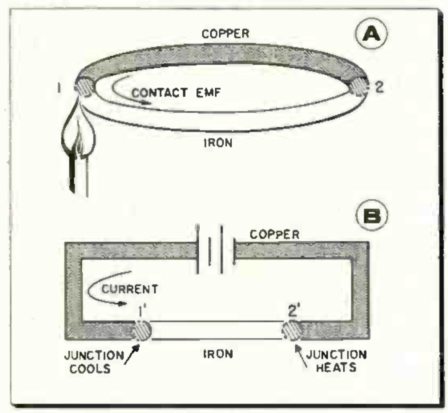
For product information, use inquiry card on last page.

The Peltier Effect

THE recently announced electronic cooling system (see page 13) utilizes the Peltier effect to obtain its cooling action. In this effect, electricity passing through a junction produces the cooling.

To understand how this operates, consider first the thermoelectric action known as the Seebeck effect, illustrated in sketch A. Here two metals, say copper and iron, are joined to form two junctions. Junction 1 is heated, causing thermal agitation which transfers electrons at the hot junction from the iron to the copper. The net result is an emf acting around the circuit in the direction of copper to iron at the hot junction.

The Peltier effect shown in sketch B is similar to the Seebeck effect, except that an external electrical source produces a temperature differential between two junctions, instead of using external heat to cause the temperature differential which produces the emf.



Demonstration of (A) Seebeck and (B) Peltier effects. Current actually cools junction 1'

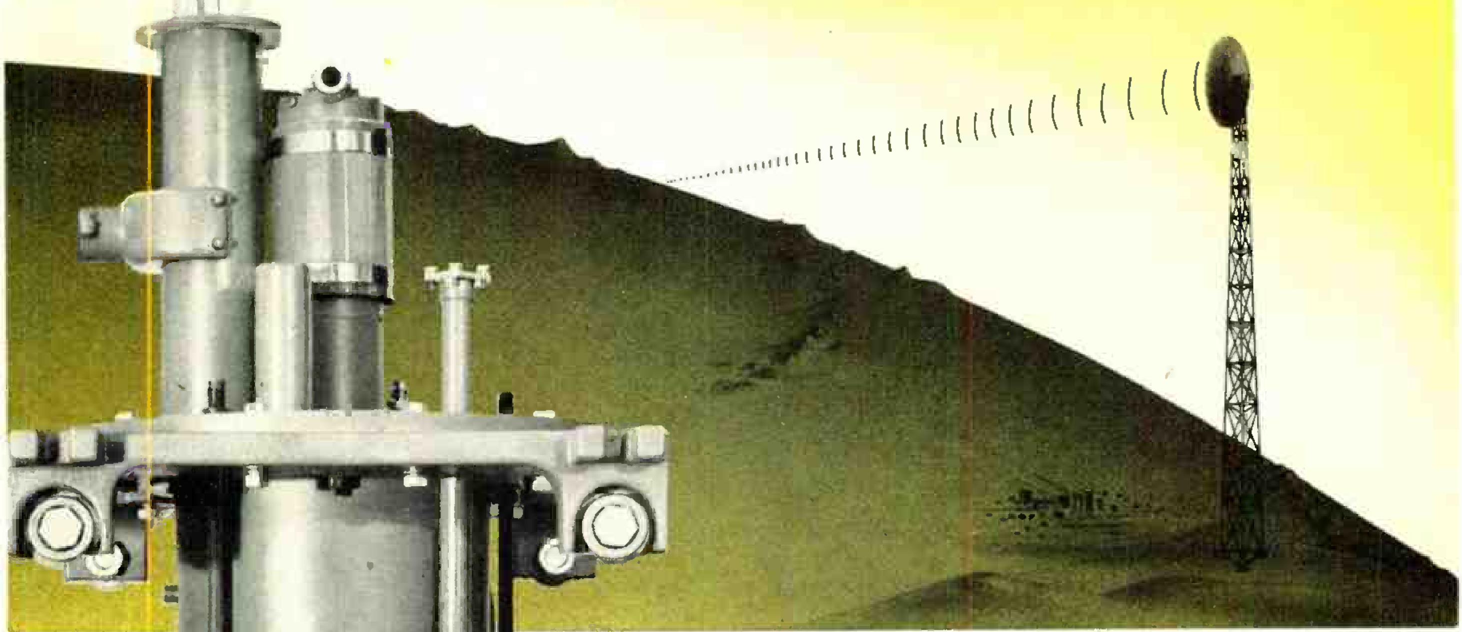
Current passing through junction 1' requires heat to be supplied to maintain these conditions, as junction 1 did in the Seebeck effect. Since no external heat source is available, the necessary heat is absorbed from the metals themselves in the neighborhood of junction 1', producing a temperature drop in this region.

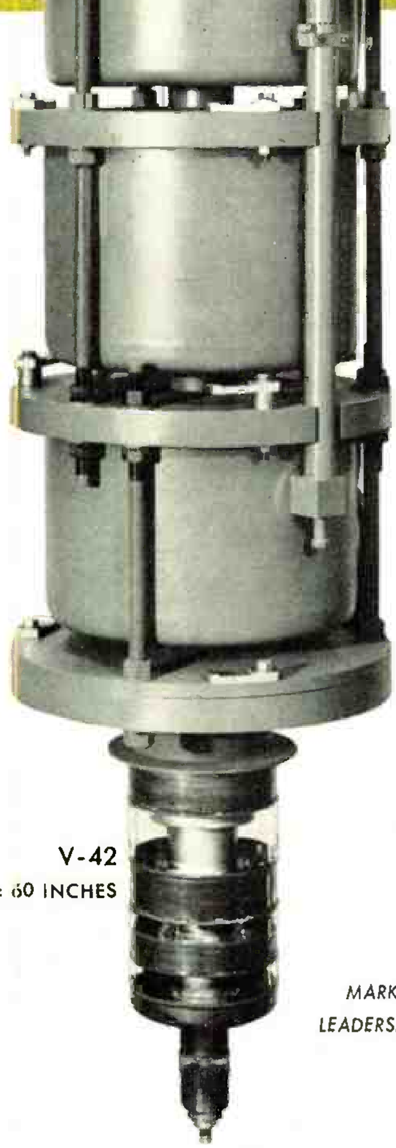
At junction 2' the current flow from iron to copper, or in other words the electron transfer from copper to iron is in the more difficult direction, so work has to be done, heating junction 2'.

In a commercial cooling system, possibly using different metals, junction 1' would be in the freezing unit, while junction 2' would have its heat removed by moving air or water.

EXTEND Your Microwave Horizons

WITH VARIAN HIGH-POWER KLYSTRONS





V-42

LENGTH: 60 INCHES

With the new series V-42 and VA-800 high power transmitter klystrons, point-to-point **microwave propagation beyond-the-horizon is a reality.**

You can now design and engineer microwave systems for long distance relay communication . . . because Varian — who has supplied the most reliable and highest power klystrons for UHF-TV — now brings you the same proved performance and economy of operation for communication service.

Varian's multi-resonator amplifiers provide you with continuous power output up to 15 kw . . . power gains up to 40 db . . . in the 500, 1000, 2000 and 7000 mc frequency bands . . . for TV-relay, and fixed telephone or telemetering in common carrier service, industrial service or control service.

V-42 Series Warranted for 3000 Hours of Service

Each V-42 and VA-800 tube incorporates Varian's exclusive built-in tuning circuits which give you proven reliability as well as simplicity of installation, operation and use.

For Radars, Beacons and Relay Communication

Varian has a complete line of high power amplifier klystrons for CW and pulsed operation.

VA-80B	V-70	V-82	V-24B	V-42 series	VA-800 series
FREQUENCY 2700-3400 mc	FREQUENCY 9400-10,000 mc	FREQUENCY 9200-9400 mc	FREQUENCY 9000-9500 mc	FREQUENCY 375-960 mc	FREQUENCY 1700-2400 mc
POWER 1 meg. Pulsed	POWER 500 watt CW	POWER 5 kw Pulsed	POWER 40 kw Pulsed	POWER 15 kw CW	POWER 10 kw CW

Don't Limit Your Horizons. For complete specifications and application data on the newest Varian V-42 and VA-800 series **high-power** klystrons, as well as others, including **high-power** oscillators, write to our Application Engineering Department . . . or contact your Varian representative, located in all principal cities.

See us at the New York I.R.E Show

THE MARK OF LEADERSHIP

VARIAN associates

PALO ALTO 10, CALIFORNIA

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

Music Synthesizer

(*Continued from page 80*)

are unknown, those which cannot be duplicated by any existing instruments. This ability leads to "electronic engineer's" compositions totally unlike any previous musical renditions. The tones can be made "perfect"—without discord—since the accuracy of the synthesizer, frequency-wise, is in the order of 1 part in 10^4. This extraordinary musical accuracy, Dr. Olson pointed out, is a mixed blessing. In order to create "natural" sounding reproductions, noise and discordant tones must be inserted to lend "presence" to the composition. The synthesizer actually incorporates a gas tube noise generator to create this effect.

To reproduce any given tone, then, the synthesizer must be able to: 1) generate any fundamental frequency within the audio range, 2) produce a tone with any overtone structure, 3) produce a tone having any growth-, duration-, or decay-time characteristic, 4) produce a vibrato —a change in amplitude or frequency modulation, 5) produce a portamento—a glide from one frequency to another, 6) change the overtone structure of the tone at any time, 7) change the intensity of the tone 0-120 db, 8) provide a deviation from the regular.

The fundamental frequencies (ranging from 30 to 15000 cps) are provided by 12 tuning fork oscillators. Relay trees select the frequencies to be amplified, and a series of filters, resonators and growth, duration and decay controls provide the waveshape and overtone structure desired.

Control over the complete operation is provided by a punched paper record not unlike the old "player piano" rolls. The perforations control the enumerated operations above. Geared to the paper record through a flexible shaft type coupling is a turntable on which is recorded the musical sound being formed by the synthesizer. The phonograph industry, Dr. Olson pointed out, would probably be the first to benefit from this equipment.

At the present state of the art, it is taking approximately 2 to 3 weeks to reproduce an average length selection. The basic arranging and tone analysis is being done by trained musicians.

In an experiment conducted to determine the fidelity of the synthesizer, as detected by the human ear, two piano selections were recorded by four prominent artists, Iturbi,

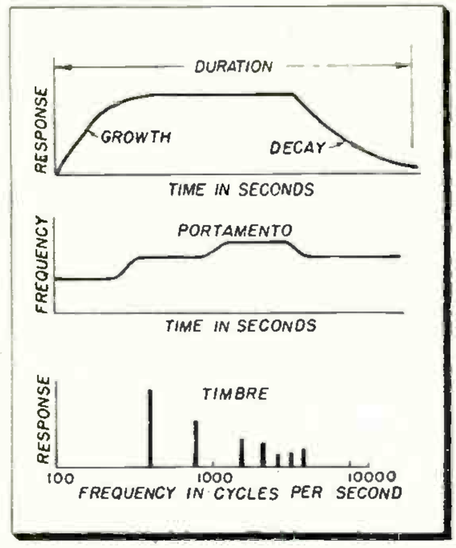


Fig. 2: Complex characteristics of a sound. Portamento is provided by frequency glider

Rubinstein, Horowitz and Pennario, and a violin selection was recorded by Fritz Kreisler. These recordings were mixed on a magnetic tape with a synthesizer version of the same pieces and played to a number of people. Expressed statistically, it can be said with 70% certainty that only 1 person in 4 can distinguish which performance is "live."

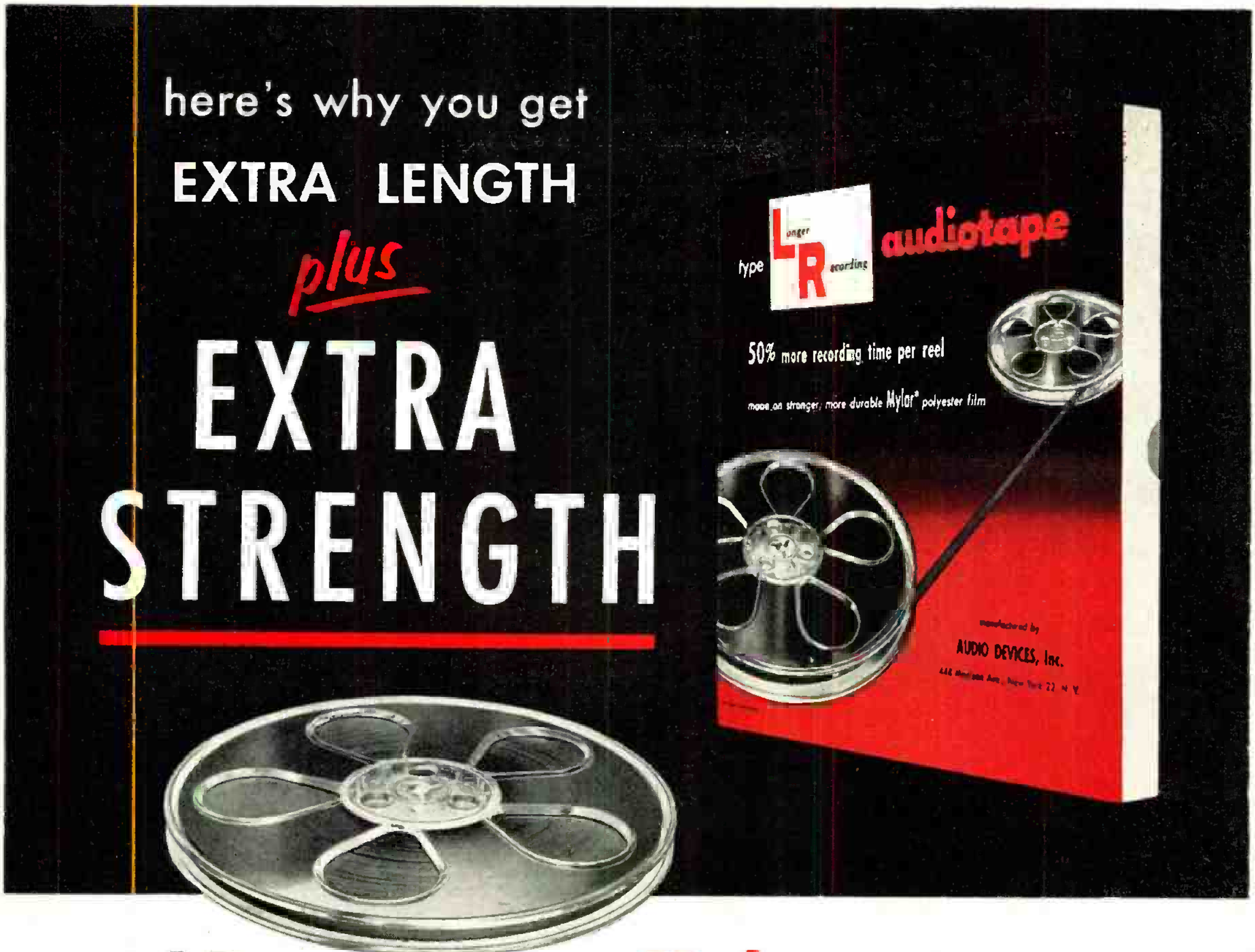
Curtiss-Wright Expands

Roy T. Hurley, President and Chairman of Curtiss-Wright Corp. has announced today that its engineering program for 1955 is the largest in the history of the corporation. This program will be under the direction of E. M. Powers, as Vice President in charge of engineering and research.

The corporation announced the formation of a research division under the management of Kenneth Campbell.

CAMRAS AWARDED MEDAL

Marvin Camras (center) of Armour Research Foundation is shown receiving the John Scott Medal from G. Curtis Pritchard at the opening session of the Winter General Meeting of AIEE in New York. Mr. Camras was awarded the medal, "For the invention of the method and means of obtaining distortion free magnetic recordings through high frequency bias." RCA's Brig. Gen. David Sarnoff is at left.



with LR audiotape on Mylar* polyester film

NOW YOU can get the *extra length* that many tape recording applications require, without any sacrifice in strength or durability. For the new Type LR Audiotape, made on 1-mil "Mylar," actually has greater impact, tensile and tear strength than even the conventional plastic-base tape of 50% greater thickness.

And because "Mylar" withstands extreme temperatures and is virtually immune to humidity, LR Audiotape stands up longer under the most severe conditions of use and storage.

This Longer Recording Audiotape is now available in 900, 1800 and 3600-ft. reels. Audio also offers a complete standard line of Audiotape on "Mylar," in 1, 1½ and 2-mil base thickness. Test it—compare it with any other tape on the market. In *performance* and *durability*, it speaks for itself!

Table I — TESTS AT 75°F, 50% RELATIVE HUMIDITY

	Yield Strength	Breaking Strength
1 mil Acetate	3.7 lb.	3.9 lb.
0.9 mil "Mylar"	4.2 lb.	7.6 lb.
1.45 mil Acetate	5.0 lb.	5.5 lb.

Table II — TESTS AT 75°F, 90% RELATIVE HUMIDITY

	Yield Strength	Breaking Strength
1 mil Acetate	1.8 lb.	2.5 lb.
0.9 mil "Mylar"	4.1 lb.	7.6 lb.
1.45 mil Acetate	3.0 lb.	4.1 lb.

The above test data, taken under conditions of both winter and summer humidity, show the marked superiority of 1-mil "Mylar," not only over the thin cellulose acetate base, but over the standard 1.45-mil acetate as well.

*Dupont Trade Mark

HOME RECORDISTS—CHURCH RECORDISTS:

Enter Audio Devices' *BIG PRIZE CONTESTS* for the best articles on "How I Use My Tape Recorder."

WIN a V-M "tape-o-matic" recorder, plus $100 cash, plus 20 7-inch reels of Audiotape. Ten other valuable awards, too!

Contest closes April 1, 1955. See your Audiotape dealer, or write to Audio Devices today for complete details. There's nothing to buy!

AUDIO DEVICES, Inc.

444 Madison Avenue, New York 22, N. Y.
Offices in Hollywood • Chicago
Export Dept., 13 E. 40th St., N. Y. 16, N. Y., Cables "ARLAB"

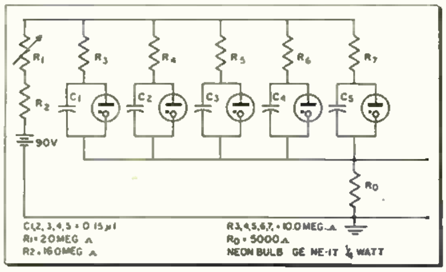
For product information, use inquiry card on last page.

Cues for Broadcasters

(*Continued from page* 81)

two resistors or capacitors have the same finite value. Nor do any two neon bulbs have the same finite striking voltage. It is because of this fact that each of the individual oscillators produce a pulse independently and non-uniformly spaced in time from its neighbor. The resultant wave forms across the output load resistor are completely sporadic and random. At no instant of time interval does the wave form repeat itself in a previous cyclic voltage wave form, due to the irregularity and mixture of the oscillator outputs, thus providing an excellent source of noise generation.

R 1 is a voltage adjustment rheostat to vary the rate of random pulse output.



Random pulse noise generator

Tuned Amplifiers

(*Continued from page* 80)

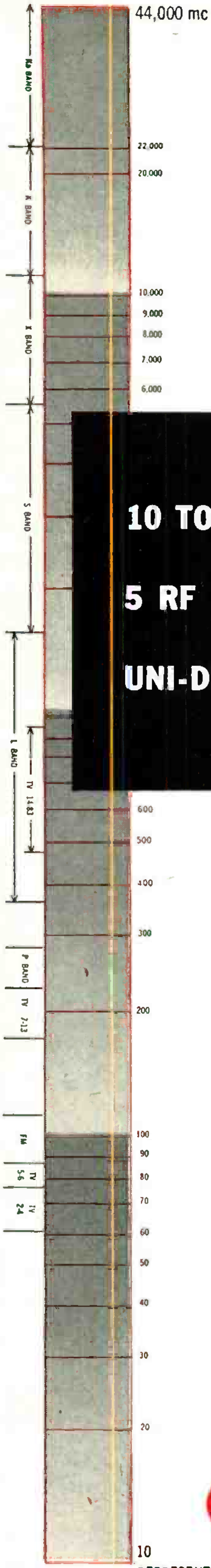
of these curves, the designer should have no difficulty in choosing the circuit which fits most closely his particular application.

REFERENCES

1. C. J. Savant, Jr. "How to Design Notch Networks" *Electronics,* May 1953.
2. L. G. Cowles, "The Parallel—T Resistance—Capacitance Networks" *Proc of IRE* Dec. 1952.

IRE Appoints Officers For 1955

The IRE Board of Directors has appointed 6 members to the Board for 1955. Reappointed as Treasurer of the IRE was W. R. G. Baker, Vice President of General Electric Co. Haraden Pratt was appointed to his 13th term as IRE Secretary, and John R. Pierce, Director of Electronics Research, Bell Telephone Labs. was reappointed Editor. Also appointed to the Board as Directors were Alfred N. Goldsmith, consulting engineer and Editor Emeritus of the IRE; A. V. Loughren, Director of Research, Hazeltine Corp., and Executive Vice Pres. Hazeltine Research, Inc.; and Howard Vollum, President, Tektronix, Inc.



PORTABLE DIRECT READING SPECTRUM ANALYZER

10 TO 44,000 mcs

5 RF HEADS

UNI-DIAL TUNING

MODEL TSA

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

This instrument is designed for maximum utility and versatility in the laboratory and on the production line providing an easy-to-read 5 inch CRT display of the RF spectrum.

Model No.	Equipment
Model DSA	Spectrum Display and Power Unit
Model STU-1	RF Tuning Unit 10-1,000 mc.
Model STU-2A	RF Tuning Unit 910-4, 560 mc.
Model STU-3A	RF Tuning Unit 4,370-22,000 mc.
Model STU-4	RF Tuning Unit 21,800-33,000 mc.
Model STU-5	RF Tuning Unit 33,000-44,000 mc.

SPECIFICATIONS:

Frequency Range: 10 mc to 44,000 mc.

Frequency Accuracy: 1%

Resolution: 25 kc.

Frequency Dispersion: Electronically controlled, continually adjustable from 400 kc to 28 mc per one screen diameter (horizontal expansion to 20 kc per inch)

Input Impedance: 50 ohms—nominal

*Sensitivity:
- STU-1 10-400 mcs −89 dbm; 400-1000 mcs −84 dbm
- STU-2A 910-2,200 mcs −87 dbm; 1,980-4,560 mcs −77 dbm
- STU-3A 4,370-10,920 mcs −75 dbm; 8,900-22,000 mcs −60 dbm
- STU-4 21,800-33,000 mcs −55 dbm
- STU-5 33,000-44,000 mcs −45 dbm

Overall Gain: 120 db

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

Input Power: 400 Watts

*Minimum Discernible Signal
**STU-1, STU-2A, STU-3A

The model TSA Spectrum Analyzer has these exclusive Polarad design and operating features:

- Single frequency control with direct reading dial. No klystron modes to set. Tuning dial accuracy 1%.
- Five interchangeable RF tuning units for the entire frequency range 10 to 44,000 mcs.
- Temperature compensation of Klystron Oscillator.
- Swept IF provides 400 kc to 25 mc display independent of RF frequency setting.
- Internal RF attenuator.*
- Frequency marker for measuring frequency differences from 100 kc to 25 mc.

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.

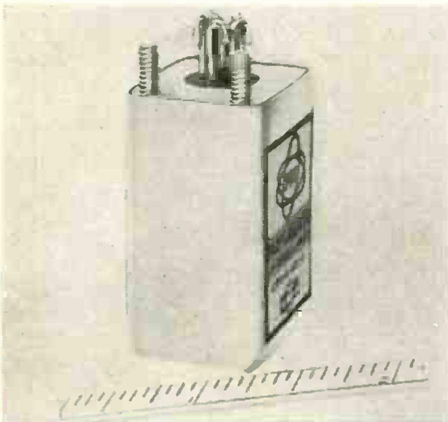
REPRESENTATIVES • Albuquerque • Atlanta • Baltimore • Boston • Chicago • Cleveland • Fort Worth • Kansas City • Los Angeles • New York
Philadelphia • San Francisco • Seattle • St. Paul • Syracuse • Washington, D C • Canada, Arnprior—Export: Rocke International Corporation

For product information, use inquiry card on last page.

New Electronic Products

MINIATURE RELAYS

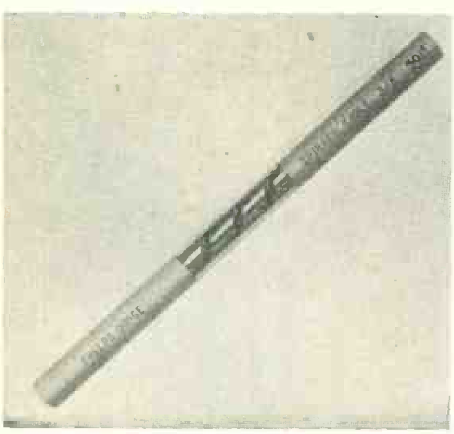
The new sub-miniature "CPL" series has been announced for applications where size, sensitivity, and low and high temperatures are major factors. The units are hermetically sealed and



are $\frac{3}{4}$ x $\frac{15}{16}$ x $1\frac{3}{8}$ in. in size and weigh 1.0 oz. Available in SPDT (CPL-1) and DPDT (CPL-2) with contacting ratings to 5 amps resistive at 28 VDC-115 VAC or 3 amps inductive. Temperature range is 55° to +125°. Vibration, 15 G's through 500 CPS. Shock, 50 G's. Operational life is in excess of 1 million CPS under 1 amp resistive load. **Pacific Relays, Inc., 6819 Melrose Ave., Los Angeles 38, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-10)

SIGNAL CABLE

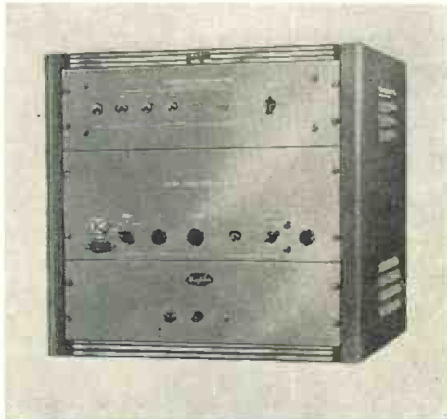
A new filament type air dielectric semi-flexible, aluminum-sheathed coaxial cable is now available with the inner solid copper conductor supported coaxially within the aluminum tube outer conductor by a polyethylene helix. Known as "Spirafil," the new cable is recommended where low attenuation, good frequency response, and freedom



from radiation are desirable. (Catalog material available.) Developed standard fittings are available at accessory manufacturers. **Phelps Dodge Copper Products Corp., 40 Wall St., New York 5, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-11)

COLOR ANALYZER

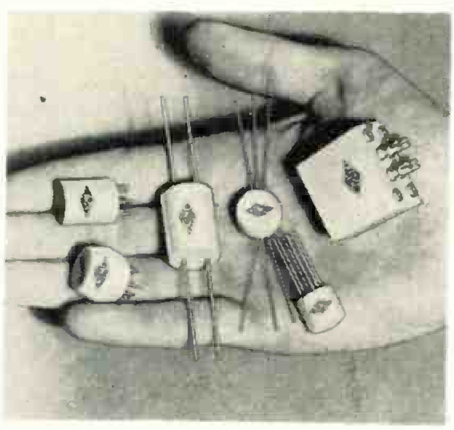
The CPA-1 color test instrument is designed to analyze the chrominance components of composite video signals. Compares phase of chrominance components with respect to reference sub-



carrier, or between any two portions of the color signal. Measures phase delay from 0 to 360 degrees. Facilitates alignment of color coders. Checks accuracy of color signal. Complete equipment includes a phase shifter, a color signal demodulator, and a regulated power supply. **Wickes Engineering and Construction Co., 12th St. and Ferry Ave., Camden 4, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-12)

PULSE TRANSFORMERS

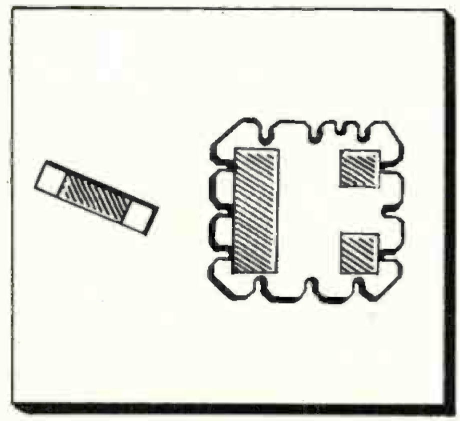
Two types of miniature pulse transformers have been especially designed for triggering and counting circuits, dc isolation, inversion pulse shaping, and pulse transmission circuits. One group, 1C, 2C, and 3C, has its core and coil assembly mounted within a metal housing with multiple terminal header plates of improved glass-seal type. The



other group, 1E, 2E, and 3E, has its core encapsulated and sealed within a molded improved epoxy resin. Both groups pass MIL T-27 specifications. **Acme Electric Corp., 1375 West Jefferson Blvd., Los Angeles, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-46)

TAPE RESISTORS

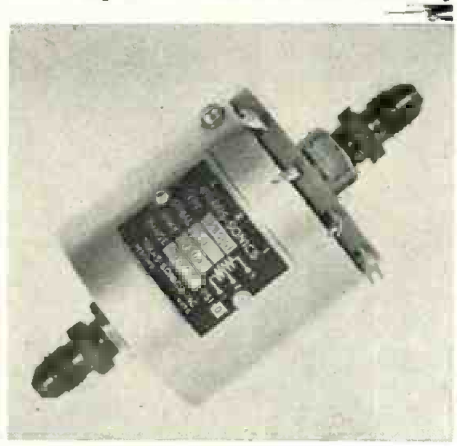
Type RTW tape resistors can be used and tested without curing new plate resistors each time one is changed, since the metal terminal can be soldered to a Project Tinkertoy type wafer with a



fired-on circuit pattern. The RTW is ½ in. long by 0.110 to 0.150 in. wide, max. and available in resistances from 39 ohms to 4.7 megohms. Temperature coefficient within characteristic F. specification MIL-R-11A. Type RNP, precured units, have overall length of 1.3 in. and 0.4 in. leads. **Hansen Electronics Co., 7117½ Santa Monica Blvd., Los Angeles 46, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-14)

POTENTIOMETER

"Baroresistors," pressure-activated potentiometers, maintain their accuracy while being subjected to ±10 G vibration to 500 CPS, in accordance with the requirements of MIL-E-5272A, Par. 4.7.1. Models are also available for operation under vibrations of ±25 G from 0 to 2,000 CPS for missile use. New developments in coil-winding techniques have improved measurement accuracy



approximately two times over that formerly available. Can be supplied in ranges from 14.7 to 60 psi. Vacuum sealed. **Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-15)

RACK ADAPTORS

Cramped for space? These convenient new rack adaptors facilitate mounting KTR-100 transmitter or receiver control units in standard 19-inch equipment racks. Pre-wired and furnished with color-coded terminal strip for quick, easy installation or removal.

ACL-3 CUE LINK

This 26 mc broadcast audio cueing link is indispensable for lining up microwave installations and for permanent, two-way communication between broadcast or microwave sites. Furnished with hand sets, cable and antennas. Packaged for portable or rack mounting.

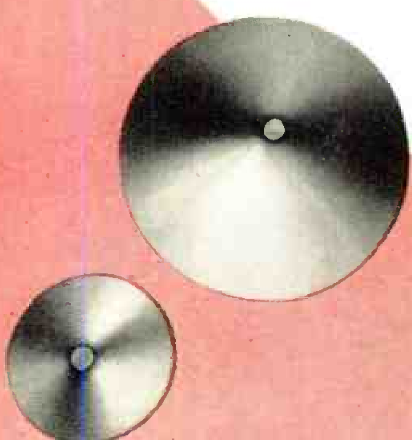
NEW RAYTHEON

MICROWAVE ACCESSORIES

Designed to extend the utility and installation ease of Raytheon KTR-100 Microwave.

UNIVERSAL PEDESTAL FOR VERTICAL OR HORIZONTAL MOUNTING

Mount your KTR-100 receiver or transmitter on tower, roof, side of building or concrete base. The same universal pedestal accepts the reflector bracket assembly for either receiver or transmitter RF heads in either vertical or horizontal position. Tubular aluminum models also available.



ALL-WEATHER RADOMES

New, lightweight, sturdy, easy-to-install Radomes . . . made of tough, durable Styrene Copolymer for long-lasting protection against severest weather conditions. Sizes to fit KTR-100, 2, 4 or 6 foot parabolas.

RAYTHEON

RAYTHEON MANUFACTURING COMPANY
Equipment Marketing Division, Dept. 6130TL
WALTHAM 54, MASSACHUSETTS

Please send complete information on the equipment or accessories checked below

☐ KTR-100 Microwave for color ☐ Rack Panels
☐ ACL-3 Cuelink ☐ Universal Pedestal ☐ Radomes

....
Name
....
Company or Station
....
Address
....
City Zone State

For product information, use inquiry card on last page.

Radar Sea Clutter

(*Continued from page* 71)

old. The threshold is caused by the fact that a certain wind velocity must be reached before water waves are formed.[7] This threshold velocity is not constant but varies with surface contamination and air turbulence. The insert in Fig. 1 is to help in visualizing the significance of the $\pm\sigma$ curves.

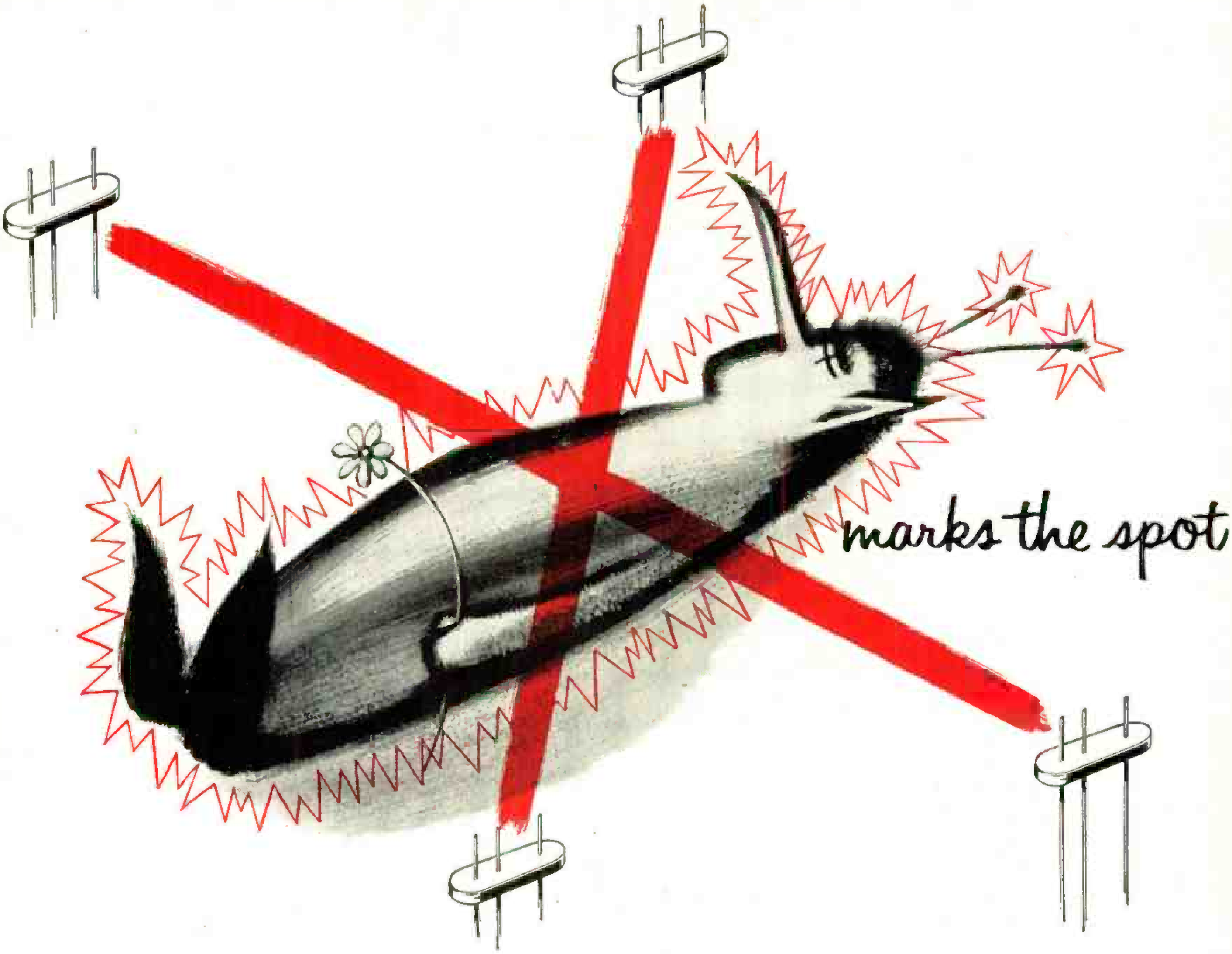
Fig. 1 shows the $+\sigma$ and $-\sigma$ standard deviation curves when looking upwind and downwind. Although not shown in Fig. 1, it is known that the distribution is skewed slightly because the surface slopes are slightly greater looking upwind than looking downwind. This may be observed qualitatively in Fig. 2 which shows waves in a transparent water wind tunnel where the wind is blowing from left to right. References 5 and 6 also show that the σ values for the cross wind case are somewhat less than shown in Fig. 1.

Curvature Distribution

Fig. 3 shows data by Schooley[8] giving the distribution of curvature of the wave facets as a function of local wind velocity. This data was the result of optical studies made using a small water windtunnel. Curvature is used instead of the ambiguous concept of facet size. Facet size has no real meaning because the wind-disturbed water surface has only infinitesimal perfectly flat areas. The concept of curvature is introduced to convey the amount of departure from flatness. It is interesting to note that here is again demonstrated a rather definite threshold of wind velocity that is necessary to create water waves.

Wind waves grow in height with increased wind velocity, increased time the wind has been blowing, and increased distance over the water that the wind has blown. The latter distance is called the "fetch." Fig. 4, adapted from references 3 and 9, shows the approximate mean wave height for various wind velocities and wind durations. There are also shown dashed lines representing the minimum fetch necessary to give the indicated mean wave heights. The $+\sigma$ and $-\sigma$ dispersion curves are not shown in Fig. 4 in order to avoid confusion. The wave height dispersion is about one foot for a mean wave height of 2 feet. The dispersion is about 2.5 feet for a mean wave height of five feet. For a mean wave height of 10 feet

(*Continued on page* 128)



... That's Where Hermetic Kills Sputter "Bugs" in Transistor Housing Bases—

We have used *all glass* in the internally exposed area of our No. 1619 Transistor Base. This all-glass construction prevents contamination of a transistor wafer when closure is made after mounting. Had we left this area as *metal* . . . your "buttoning-up" operation would float solder and flux right in under the wafer. When this occurs, the possibility of contamination or degradation of the wafer is raised, and with results that are difficult to predict.

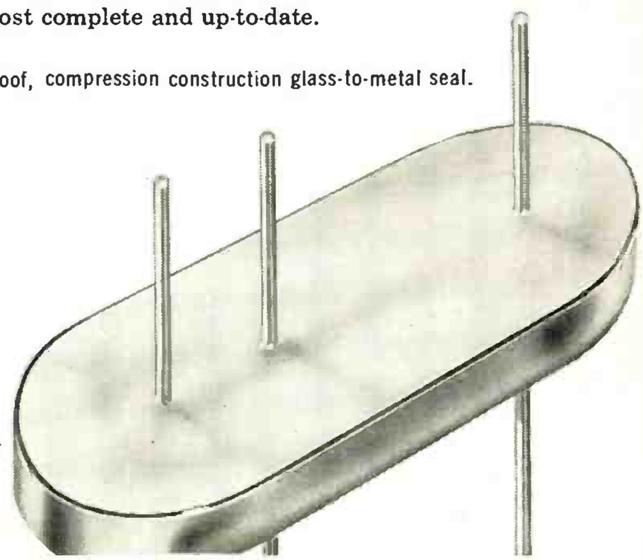
Hermetic's specialist-engineers can help you avoid trouble in all your hermetic sealing problems. Why not draw upon their knowledge and skill? . . . it covers the full range of matched glass or VAC-TITE* hermetic sealing for the most advanced components.

Write us about your problem, and for your copy of our latest addition to the "Encyclopedia Hermetica." You'll find it most complete and up-to-date.

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

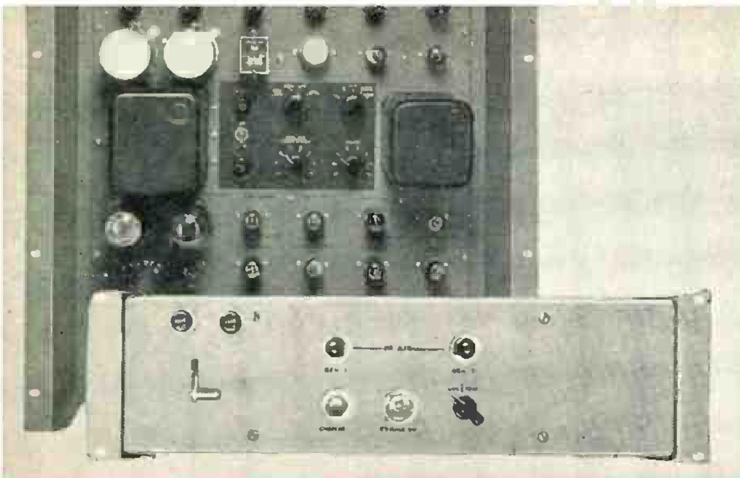
SEALED IN by HERMETIC HEADERS

Hermetic Seal Products Company
33 South Sixth Street,
Newark 7, New Jersey

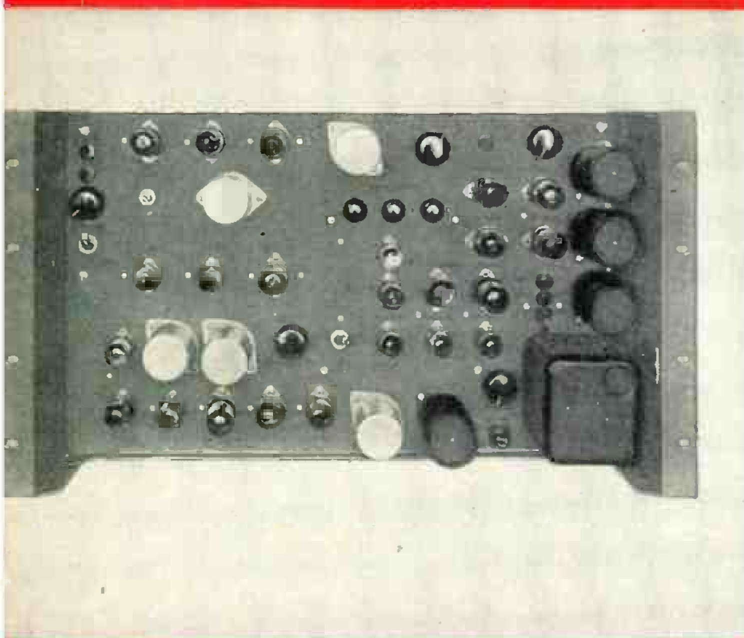


Visit us at the IRE Show—
199 Broadcast Way

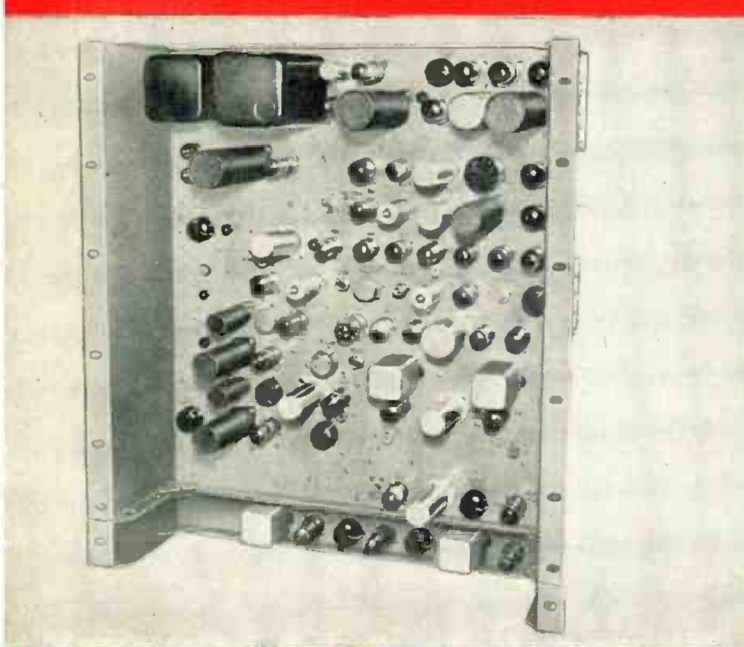
FIRST AND FOREMOST IN MINIATURIZATION



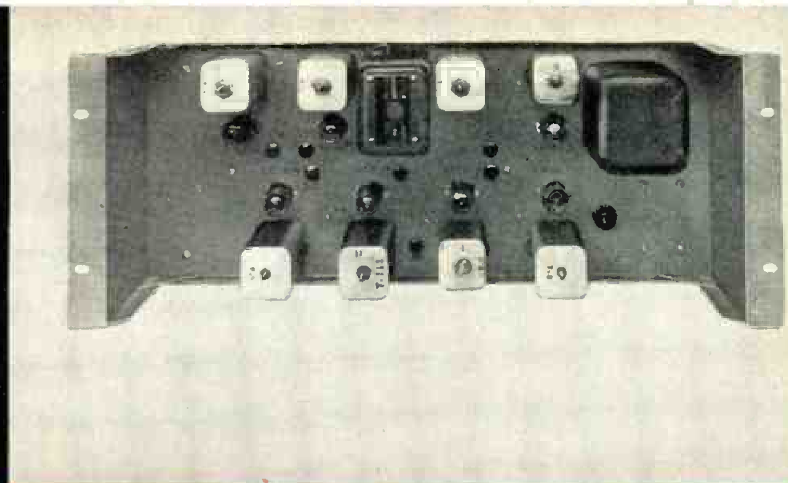
EW STUDIO SYNC GENERATOR TG-2A (Field Generator is Type -12A). Combines sync generator, dot generator, Genlock, grat-g generator, regulated power supply—on a single chassis. Auto-atic Changeover Switch MI-26289 (illustrated) is a companion it for convenient switching between two sync generators.



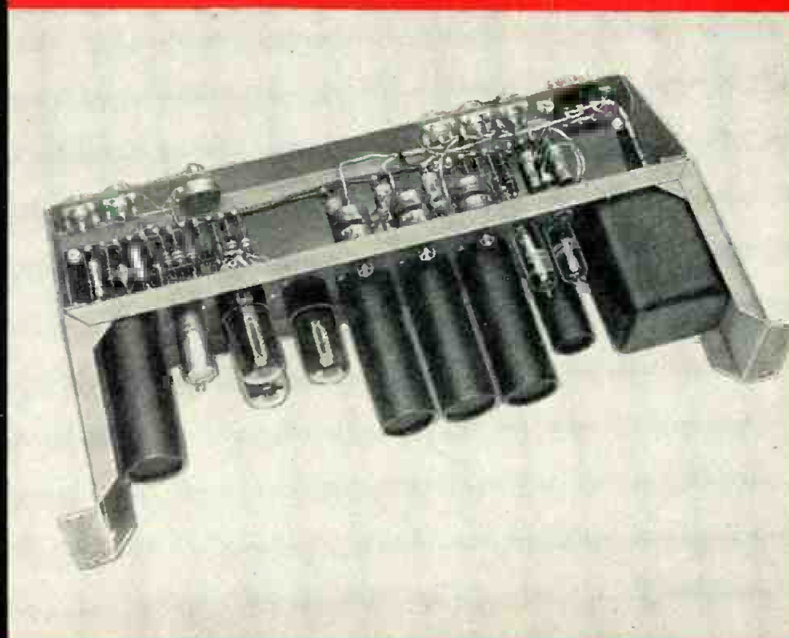
EW COLOR STABILIZING AMPLIFIER TA-7B. In the studio, it per-rms all normal Stabilizing Amplifier functions—plus improved eration with the Genlock. At transmitter, it provides the white etch required for color operation. Corrects frequency response r transmission losses.



W COLORPLEXER TX-1B combines on a single chassis all circuits eded to produce a composite color signal from color primary sig-ls of the live camera, film camera, or color bar generator. New-design features improved stability and retrace blanking.

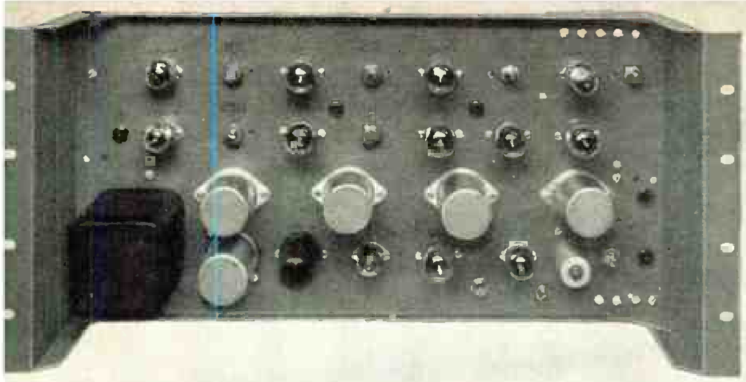


NEW COLOR FREQUENCY STANDARD MI-40201. Source of 3.58 mc color subcarrier used with sync generator to complete synchronizing function for color operation. A counter chain is in-cluded to provide means for locking the sync generator to the color subcarrier.

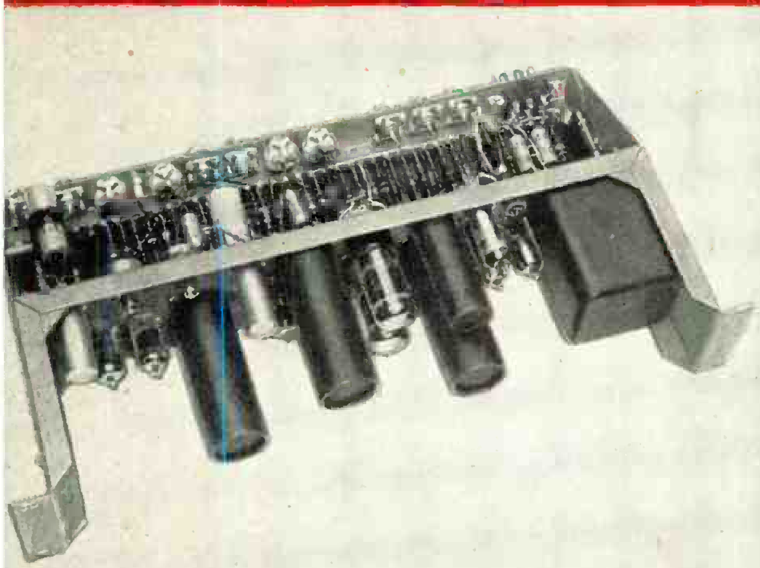


NEW PULSE DISTRIBUTION AMPLIFIER TA-4A. Regenerates de-graded pulse signals. Restores rise time. Removes overshoots and spikes. Eliminates hum, surges, tilt. Provides sending-end termina-tion for better long-line performance.

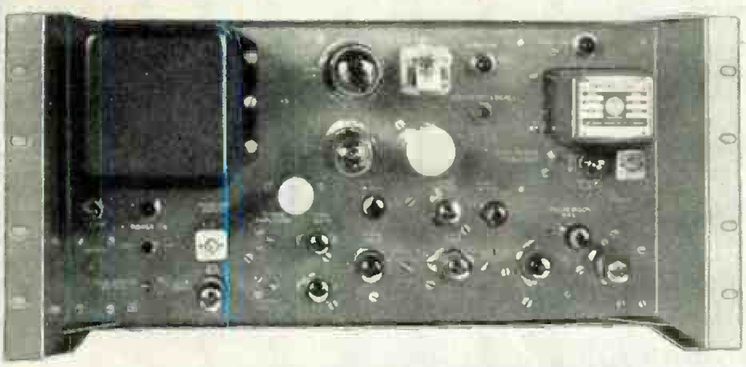
NEW VIDEO SWITCHER MI-26277. Ideal for monitor switching in announce booth, projection room, program consoles . . . wherever monitors may be located. The inexpensive means for modernizing your present switching installation.



NEW BURST FLAG GENERATOR, MI-40202A. Generates keying pulse for injecting subcarrier bursts into Colorplexer. Burst position, burst width, keying pulse amplitude are adjustable with high accuracy. A "must" equipment . . . and a companion to the RCA Color Frequency Standard.



NEW VIDEO DISTRIBUTION AMPLIFIER TA-3A. Feeds up to 3 low-impedance lines from single high- or low-impedance source. Has extended low- and high-frequency response. 40-db isolation between output lines. Excellent linearity and gain characteristics. TA-3A is good for color.



NEW COLOR STRIPE GENERATOR WA-8A. Enables you to transmit color test signals along with regular monochrome signal. Useful for receiver adjustment throughout the program day. The inexpensive "must" for TV stations planning color.

9

NEW TV EQUIPMENT

...for better monochrome and co

Illustrated here are a few of RCA's new, improv video designs for monochrome *and* color operati —*from the most comprehensive line of televisi equipment in the industry.*

Engineered in accordance with the best televisi practice, these units are designed for progressi TV stations looking for new ways to keep pictu quality "up-to-the-minute." They offer improv operating efficiency and economy. They save much as ⅔ the rack space of previous designs.

RCA improved Video Equipments are already operation in well-known TV stations througho the country—on both monochrome *and* color. F complete information on the entire line, call yo RCA Broadcast Sales Representative. In Canad write RCA Victor, Ltd., Montreal.

Free technical folders on RCA Video units. Simply tell your RCA Broadcast Sales Representative the number (listed below).

Item		Cat. No.
TA-3A	Video Distribution Amplifier	B.2502
TA-4A	Pulse Distribution Amplifier	B.2504
TA-7B	Color Stabilizing Amplifier	B.86
TG-2A	Studio Sync Generator	B.3400
TX-1B	Colorplexer	B.878
WA-8A	Color Stripe Generator	B.6067
MI-26289	Sync Generator Changeover Switch	B.3402
MI-40201	Color Frequency Standard	B.872
MI-40202A	Burst Flag Generator	B.874

RADIO CORPORATION of AMERI

ENGINEERING PRODUCTS DIVISION CAMDEN, N

Parabolic Reflector

(*Continued from page 77*)

ences the second of the two helpful characteristics of such a reflector, the reduction of background noise by the physical shielding of the microphone from interfering sounds originating behind the reflector. The deeper the parabolic, the more the microphone is shielded from interfering sounds. It is therefore apparent that the parabolic reflector can help the signal-to-noise ratio in two ways, by increasing the signal, and by reducing the noise.

The shape of the reflector is described by the equation for a parabola, $y^2 = kx$. The selection of the value of the constant k determines the flatness or depth of the parabola which influences the degree of shielding from unwanted sounds the reflector will afford the microphone. A family of parabolas showing values of k from 1 to 50 is shown in Fig. 2. The parabolic reflector we

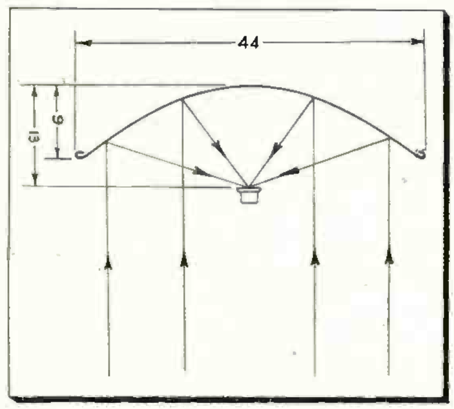


Fig. 4: Parallel rays entering parabola

have used is described by a value of k = 25. A value of k = 12 has been used by others with satisfaction.

For structural strength of the reflector, it is desirable to have a rolled edge. This gives great rigidity with insignificant increase in weight. The aluminum used was 0.064 in. thick, although rigidity is the controlling factor. To reduce the inevitable resonant effect, the back was covered with several coats of automobile undercoat, until tapping the reflector yielded only a dull thud. Without such deadening, winds or slight shocks would elicit a ringing at its resonant frequency.

The gain at the high frequencies is higher than at the mid-frequency region when the microphone diaphragm is on the axis exactly at the focal point. Moving the microphone slightly from the focal point discriminates against the highs and thus the response can be flattened by a slight defocusing.

The directivity, of course, is a function of frequency. At the very

COLOR TV

ONLY TELECHROME INCORPORATED MAKES THEM ALL

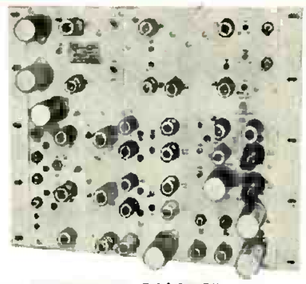
COMPLETE FACILITIES FOR TV STATIONS, MANUFACTURERS & LABORATORIES

Finest color film chains, colorplexing, transmitting, analyzing, monitoring, testing equipment.

617-BR AUTOMATIC BALANCE CONTROL FOR ALL COLORPLEXERS

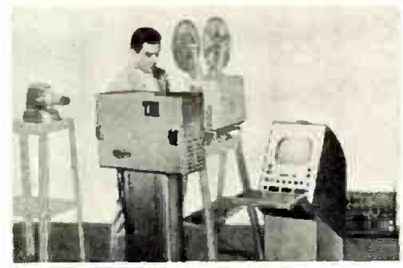
(Regardless of Manufacture)

An ingenious circuit locks the entire encoding equipment in balance within 20 seconds after being turned on. Thereafter balance is held under even the most difficult operating conditions.



609-ER AUTOMATIC BALANCE CONTROLLED COLORPLEXER

The only colorplexer which incorporates Automatic Balance Control. Eliminates all drift problem. Colorplexer automatically and instantaneously in balance at all times.



700-A 3V COLOR FILM CHAIN

Finest in quality, lowest in price. 3V provides greatest latitude in selection of color films. Designed specifically for broadcast application, requires little space. Multiplexes 35 or 16mm film, slides, opaques.

1073-A SINE-SQUARED SQUARE WAVE GENERATOR

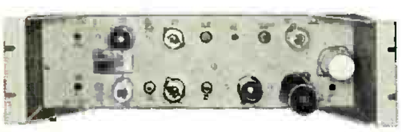
Newest test unit produces new type of wave forms for testing any part or all of a TV or pulse system for amplitude and phase characteristics. "Go-No-Go" indication simplicity.

1601-AR CHROMASCOPE

Signal Certification Equipment. Accurately measures the performance alignment, and phase errors of color TV equipment. Presents on a cathode ray screen a continuous polar plot of the phase and amplitudes of all colors in a composite color video signal. Capable of a .2° accuracy with 1604-AR phase magnifier.

1604-AR PHASE MAGNIFIER

Expanded phase indicator of a signal for measurements of differential phase to .2° or better accuracy at chroma frequencies.



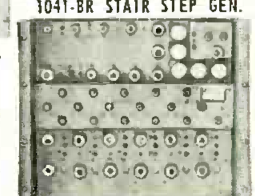
302-AR DRIVE GENERATOR

Small, portable, inexpensive unit. Provides horizontal blanking, horizontal sync, vertical drive and burst flag for driving most signal generating equipment where standard sync is not available.

1071-AR WINDOW GEN.

1041-BR STAIR STEP GEN.

OSCILLOSCOPE CAMERA MODEL 1521-A



1070-BR MULTI-BURST FREQUENCY GEN.

VIDEO TRANSMISSION TEST EQUIPMENT

Provides stairstep, window and multiburst signals. Now in wide use by the leading TV stations, networks and common carriers. Checks video facilities for color and monochrome. Polaroid camera recording.

636-B CHROMALYZER

Portable Precision Color Bar Generator for checking color broadcast studio and transmission facilities, receivers and monitors. Can be tied into a system. Provides complete composite color signals at 100 or 75% chroma.

1603-AR PHASE SLOPE (ENVELOPE DELAY) CURVE TRACER

Instantaneous scope or meter reading of the envelope delay and amplitude characteristics of any network, video amplifier, or systems. Precise-time saving. Has separate transmitter and receiver units which allow one way or loop measurements.

DELIVERY 30 DAYS

Literature on these and more than 150 additional instruments for color TV by TELECHROME are available on request.

TELECHROME INCORPORATED

The Nation's Leading Supplier of Color TV Equipment
88 Merrick Road Amityville, N. Y.
AMityville 4-4446

See These Units at BOOTHS 181-183 IRE SHOW

For new markets
—new customers
—sustained sales
impact . . .

Advertise in

THE 1955 ELECTRONIC INDUSTRIES DIRECTORY

to be published in the JUNE ISSUE of

TELE-TECH
& ELECTRONIC INDUSTRIES

Sales-building features include . . .

- **PRODUCT FINDING INDEX**—lists thousands of electronic and allied products alphabetically, referring readers to classified listings of manufacturers' names and addresses.
- **PRODUCT LISTINGS**—a section listing electronic products, names and addresses of manufacturers, and symbols to show the types of products they make.
- **ALPHABETICAL LIST OF MANUFACTURERS**—lists over 4,000 manufacturers; 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, alphabetically by states and cities.
- **DIRECTORY OF REPRESENTATIVES**—gives the names, addresses and telephone numbers of representatives, arranged alphabetically under states and cities.
- **BRAND AND TRADE NAME INDEX**—gives thousands of trade names of electronic and related products, alphabetically arranged for quick location of a manufacturer.
- **CONSULTING ENGINEERS**—a section composed exclusively of active consulting engineers in the TV-radio-electronic field.
- **ENGINEERING SOCIETIES**—this section gives the names and addresses of the organizations in or closely allied to the industry.

No other information source for the industry can match this Directory nor is any as convenient or practical to use.

How to advertise with Localizer Listings

FREE ALPHABETICAL LISTINGS

In the alphabetical index of over 4,000 manufacturers listings are free to all electronic manufacturers.

EXECUTIVE & SALES PERSONNEL

Paid listings for manufacturers' executive and sales personnel may be followed by brand names, list of products, branch or regional offices.

REPRESENTATIVES

Alphabetical arrangement of cities in Localizer section makes it easy for buyers to find local representative. These are paid listings.

Federal Shock ...
Federal Telecommun Labs 5... ...ington Pl Nutley
Federal Telephone & Radio Co Div Int'l Tel & Tel Co
100 Kingsland Rd Clifton NJ
President—R S Perry
Vice Pres—G T Scharffenberger
Vice Pres-Apparatus Div—T M Douglas
Vice Pres-Components Div—S J Powers
Vice Pres & Wks Mgr-Camp Div—W P Maginnis
Vice Pres-Dir Purchases—C G Sherwood
Comptroller—R deF Osborne
Treasurer—W E Ogilvie Jr
General Sales Mgr—J A Frabutt
Components Sales Mgr—E W Butler
Government Sales Mgr—J J McDevitt Jr
Sales Mgr PTM & Wire Transm—W D Siddall
Export Sales Mgr—A G Deane
Mgr Mobile Radio Comm Dept—B J Donnelly
Sales Mgr Service Parts—J C Giguere
Mgr R R Industry Sales Org—T A Benner
Mgr Adv & Sales Promotion—Crump Smith
Selenium Rectifiers—Coaxial Cable
Germanium Diodes
Atlantic City-IDS—Victor W Williams 5 Circle Drive
Margate ATlantic City 2-7859 Covers Maryland-District of Columbia-Delaware (Counties of Kent and Sussex)-Virginia
Boston-DS—Abbett & Hustis 1105 Commonwealth Avenue ALgonquin 4-8100 and 4-8101 Covers Maine-New Hampshire-Vermont-Massachusetts-Rhode Island-Connecticut (except Counties of Fairfield, New Haven and Middlesex)
Boston-IS—Robert W Gray Inc 572 Washing...

(Specimen listings on this page taken from 1954 Directory)

MANUFACTURERS' DISTRIBUTOR LISTINGS DISTRIBUTOR DIRECTORY

The Directory of Distributors Manufacturers can show the end of each state a list of manufacturers' distributors in that state. Listings are positioned on priority basis.

Such paid listings will be set exactly as shown in example to the right.

...er Bros
TUSCALOOSA
*Allen & Jemison Co 8-2781

SYLVANIA
Distributors
IN ALABAMA

Anniston—Radio Distributing & Supply Co.
Birmingham—Ack Radio Supply Co.
—Auto Service Co.
—Clark & Jones
—James W. Clary Co.
—Electric Constructors, Inc.
—Forbes Distributing Co.
—Long Lewis Hardware Co.
—Reid Distributing Co.
Dothan—Hand Supply Co.
Mobile—Forbes Electronic Distributors, Inc.
—Harris Supply Co.
—Nelson Radio & Supply Co.
Montgomery—Nolin-McInnis Co.
—Teague Hardware Co.
—Walther Brothers Co.
Tuscaloosa—Allen & Jamison Co.

NEW YORK, Cont'd
Sanford Elect 157 Chambers DI 9-0550
Slate & Co 2755 Webster LU 4-0614
Stan-Burn Radio 1697 Broadway CO 5-8138
Sun Radio 122 Duane BA 7-1840
Superior Radio & TV 800 W 20 CH 7-1234
President—Nathaniel K Herbert
Vice Pres & Gen Mgr—David Harris
Vice Pres chg Sales—John M Meyer
Controller—Stanley S Jones
Credit Mgr—Michael Haggerty
Chief Counterman—Wm Bullock
Warehouse Mgr—James Q Smith
Principal Lines Carried
Amphenol • Astatic • Atlas • Belden • Capitol • CBS-Hytron • Centralab • Cornell-Dubilier • Eveready • General Electric • Hallicrafters • IRC • Jensen • JFD • Kester • Littelfuse • Mallory • Mosco • Merit • National Union • Radiart • RCA tubes • Recoton • Regency • Shure • Simpson • Sprague • Taco • Ward • Webcor • Weller.
Area Served
Through its store and warehouse in New York, Superior Radio serves TV-electronic customers in all parts of the country. When you "get it from Superior," your selection is facilitated and your service expedited by a comprehensive catalog showing the major lines handled.

LOCALIZER LISTINGS FOR DISTRIBUTORS AND REPRESENTATIVES

EXECUTIVE & SALES PERSONNEL

Names may be listed here to quicken sales contacts

LINES CARRIED

May be listed here to show the availability of certain brands or types of products

AREA SERVED

May be defined in order to reach and serve more outlets in this expanding field.

... *featuring the original and EXCLUSIVE*

LOCALIZER INDEX

—cuts costs, speeds-up sales contacts with 27,000 buyers of electronic products

The Localizer Index works for YOU

Paid Localizer Listings localize your selling. It's a sales-building, cost cutting feature because it speeds up contacts between buyers and sellers. Localizer Ads cut down on correspondence, phone calls, red tape, increase inquiries, speed service to the customer.

AN INEXPENSIVE SALES PUNCH

Localizer Listing Ads are available by the inch—first inch $30, each additional inch or fraction thereof, $25.

(Sample listings shown at the left are specimens. They are not intended to imply that space has been ordered by these companies.)

SYMBOLS may be used after the name of each city to indicate the type of representative or distributor in a particular area

- DS . . Distributor Sales
- IS . . Industrial Sales
- IDS . . Indus. & Distr. Sales
- D . . Distributor
- BO . . Branch Office
- GV . . Government Sales
- R . . Representative
- SE . . Sales Engineer

How and why Localizer Space should be used by:

	MANUFACTURERS	DISTRIBUTORS	REPRESENTATIVES
In the Alphabetical List of Manufacturers	to show immediately under free listings: • names of key personnel • types of products • local offices and "Reps" • save time and money by short distance selling		
In the Directory of Electronic Distributors	to pinpoint distribution, include: • statewide list of distributors in boxes with logotypes positioned at the end of each state listing	• to give personnel • lines carried • area served • branches and services • speed-up sales contacts and encourage local buying	
In the Directory of Electronic Representatives			• to promote sales to wider area • cut distance between buyer and seller • speed up local inquiries • expedite handling of order • list key men, facilities lines carried, territorie served

Now . . . a BIGGER buying audience for your directory advertising . . .

—INCREASED CIRCULATION OF 27,000

The 1955 June Electronic Industries Directory is guaranteed to be in the hands of the industry's 27,000 top-level engineering personnel responsible for the design, specification and purchase of electronic equipment . . . the regular readers of TELE-TECH. This represents an increased distribution of 6,000 or 29% over 1954.

Get EXTRA sales punch with display advertising

Strengthen your editorial and localizer listings with your most effective display advertisements. The June Directory issue offers a great opportunity to present as many additional sales messages as desired. Display ads strategically positioned and perfectly timed will reach and sell the greatest number of buyers in your market when they are ready and looking to buy.

Remember your ads will sell for you throughout the year as the Directory issue is kept and referred to by the buyers of electronic equipment all year long!

RESERVE YOUR ADVERTISING SPACE **TODAY!**

BPA

CHICAGO—
201 North Wells Street

CALIFORNIA—Chris Dunkle & Associates
Los Angeles 5—3257 W. 6th St. DUnkirk 7-6149

Parabolic Reflector

(*Continued from page* 122)

low frequencies, say 100 CPS, the reflector is so small compared to the wavelength that the device is essentially non-directional. At higher frequencies the system is quite directional. A 44-in. parabolic at 4000 CPS would be 6 db down at approximately 30° off the axis.

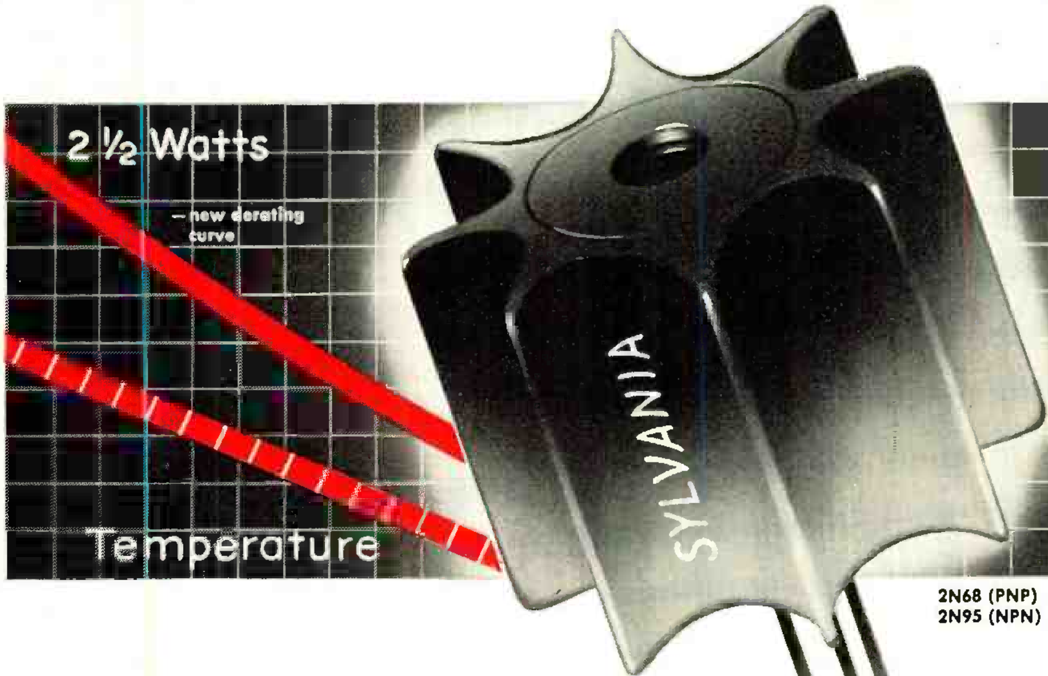
Though the crystal microphone normally supplied with the Minitape is well suited for domestic voice recording, the basic element of a crystal microphone is subject to both heat and moisture so we have found it advisable to use dynamic microphones in warm, humid climates. It is true that there are new ceramic microphones now available as well as crystal microphones, which will withstand much higher temperatures. The crystal microphone, being a capacitive device, will permit fairly long cable leads providing the capacitance of the cable is not too high. It is to be noted that on long cable lengths there is no frequency discrimination because of the capacitance, but there is an attenuation of the overall signal. It is also for this reason that the dynamic microphones lend themselves better to field use.

The pre-amplifier utilizes a single stage built around a type 1U5 pentode. (See Fig. 3.) Transformer-coupled input allows proper matching for both crystal and dynamic microphones. A two-stage monitoring amplifier drives a pair of headphones which enable the operator to hear what is being picked up without turning the recorder on. The usual operation would call for much listening and selection, but only a small amount of actual recording. The headphone level is also an indication of proper recording level. Adjusting the volume control for comfortable headphone level feeds proper signal level to the Minitape recorder also.

Pre-amplifier power is supplied by self-contained batteries. Power for the three 50 ma. filaments and the pilot lamp is supplied by two standard size flashlight cells connected in parallel and supplying 210 ma. Plate power is supplied by two 67½ v. Burgess XX45 batteries in series.

The 1U5 tube in the pre-amplifier should be carefully selected to minimize noise and microphonics. The filamentary type of tube is, of course, not the best in this position, but we found that a moderate amount of selection brought the noise level down to within a very few db of

Sylvania Power Transistors...



2N68 (PNP)
2N95 (NPN)

...now with increased ratings

dissipate 2½ watts in free air, have low thermal inertia

New Sylvania design developments achieve low thermal inertia and increased ratings in the Sylvania Power Transistors 2N68 and 2N95. Dissipation of 2½ watts in free air reflects a full watt increase over previous ratings. Power dissipation up to 5 watts is possible with an external heat sink.

With Sylvania's new design heat is conducted quickly away from active elements. Resulting low thermal inertia improves performance stability over a wider range of operating temperatures. Operated as a Class A amplifier the 2N68 or 2N95 provides a minimum power gain of 20 db.

"Another reason why it pays to specify Sylvania"
Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.,
University Tower Building, St. Catherine Street, Montreal, P. Q.

SYLVANIA

Sylvania Transistors
— for military, industrial, and commercial applications. Available in commercial quantities.

High-Gain, Low Frequency—2N35 (NPN)—2N34 (PNP)—low to medium power—use as a high-gain audio amplifier—gains up to 40 in grounded emitter circuit.

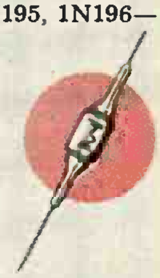
High-Power, Low Frequency—2N68 (PNP)—2N95 (NPN) increased power ratings—use for high current, low voltage applications (6-24 volts power supplies).

High Frequency—2N94 (NPN)—2N94A (NPN)—high alpha (over 0.95)—low base resistance and collector capacitance—typically 1500 ohms uufd—gains up to 40 db.

Also available in commercial quantities

Silicon Junction Diodes—1N137A—1N138A and allied types—high back resistance at high operating temperatures.

Silicon Point-Contact Diodes—1N193, 1N194, 1N195, 1N196—specifically designed for computer and high temperature general purpose applications. Excellent transient response (0.1 u sec.)



For your semiconductor requirements, check Sylvania first. Use this convenient form to indicate your interests and address it to Department C20R.

Dept. C40R
Sylvania Electric Products Inc.
1740 Broadway, New York 19, N. Y.
Gentlemen: Please forward additional information on the items checked below:

Transistors	*Silicon Diodes*
☐ High Power	☐ Point Contact
☐ High Gain	☐ Junction
☐ High Frequency	

Name____________________
Address____________________
City____________________
Zone__________State__________

LIGHTING • RADIO • ELECTRONICS • TELEVISION • ATOMIC ENERGY

For product information, use inquiry card on last page.

Radar Sea Clutter

(*Continued from page* 128)

face ($\sigma°$) for various vertical angles of a microwave antenna beam (Θ). Sea clutter actually fluctuates rapidly and irregularly. The average curve shown is quite speculative and is based on data from reference 2 and incomplete unpublished Naval Research Laboratory data. The $\Theta = 90°$ point corresponds to an airborne radar looking directly down towards the water surface (See Eq. 2). The two $\Theta = 0°$ points correspond to a very low altitude radar looking towards the horizon (See Eq. 1). The left $-0°$ point is for a low altitude radar looking downwind and the right $+0°$ point is for the upwind case. The figure shows $\sigma°$ to tend to level off in the region between $\pm 15°$ and $\pm 45°$. However, the upwind region appears to be 5 db to 10 db higher than the downwind region. Examination of a wave profile, such as that shown in Fig. 2, leads one to feel that there should be more energy scattered back when looking upwind than when looking downwind due to the greater slopes in the upwind direction.

In Fig. 5 it is evident that $\sigma°$ tends to become very small at $\pm 0°$ is approached as would be expected because of the surface null created by cancellation of the direct and reflected waves at the water surface. It is in this region where sea swell, caused by distant winds, may enter to bring the chop, caused by local winds, up out of the surface null and into the radar beam.

The maximum value of $\sigma°$ is reached in the region around 90°. With very calm water, where there is specular reflection from a large area, it is possible for $\sigma°$ to be considerably greater than unity. The width of the build-up portion of the curve in the region around 90° is less for low wind velocities and greater for high winds. Fig. 5 is roughly correct for a horizontally-polarized, three-centimeter-wavelength radar looking at a water surface disturbed by a 15-knot wind. A 20-knot wind might move the solid portion of the curve about 5 db higher and possibly lower the peak by about the same amount. The solid portion of the curve for a 10-centimeter radar would lie perhaps roughly 5 db lower than the 3-centimeter case under the same wind conditions. For a quite calm sea, horizontal polarization gives less sea clutter than vertical polarization. As the wind velocity increases, the difference becomes less marked, particularly for angles

1 to 5 ratio your quality insurance

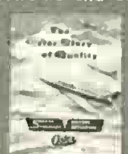
Oster®

- 21 INSPECTORS to each 100 production workers—a 1 to 5 ratio.
- ALL units thoroughly inspected on exacting custom equipment.
- UNIQUE inspection procedure for each application.

EXTREME MANUFACTURING ACCURACY

- EVERY gear cut with an AA hob and rolled against a master.
- EVERY final grind on every shaft run through a Sheffield comparator set by "jo" blocks.
- EVERY bearing bore checked with an air gauge and XX plug gauge.

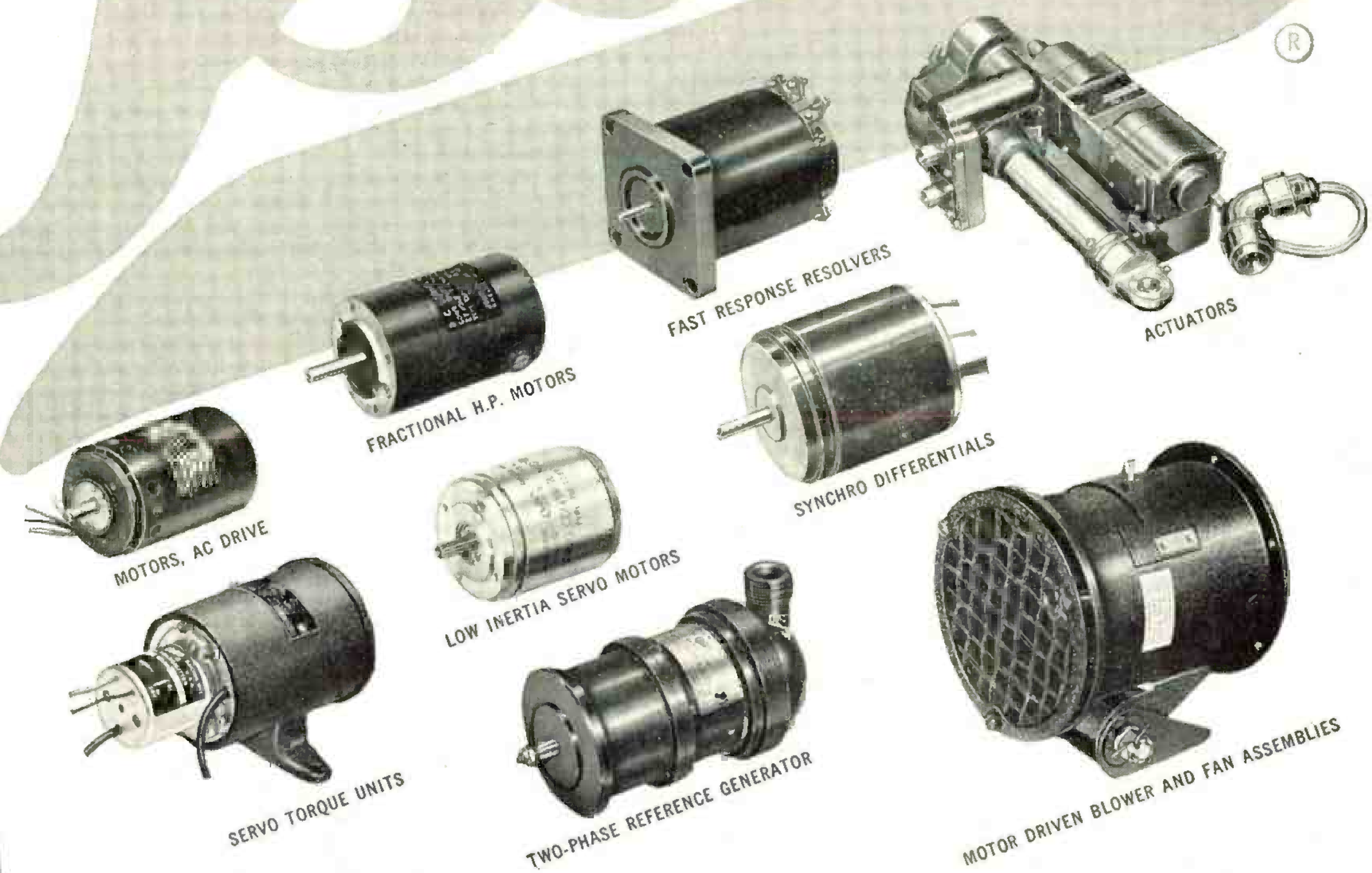
A wide variety of rotating electrical components for electronic and airborne applications . . . designed and produced to your specifications. Send your requirements to OSTER design engineers. Write for "The Oster Story of Quality" today.



John Oster

MANUFACTURING CO.
AVIONIC DIVISION
RACINE, WISCONSIN

Your Rotating Equipment Specialist



Radar Sea Clutter

(*Continued from page* 128)

greater than a few degrees.

The rather meager data given on the general nature of radar sea clutter itself are brought together here in hope that it will stimulate theoreticians and experimentalists to solve the riddle of the interrelationship. Ament[10, 12] and Eckart[11] have made initial contributions in this field. However, the magnitude of the problem yet to be done is well summarized by Ament, who says, "The problem of calculating the electromagnetic effect of surface roughness is one of combining solutions of Maxwell's equations with a statistical description of the rough surface. For the sea surface, there currently appears to be no statistical description sufficiently detailed to explain certain radio and radar measurements. In adddition no mathematical method is currently available for predicting the effect of any statistically described sea on radio propagation."

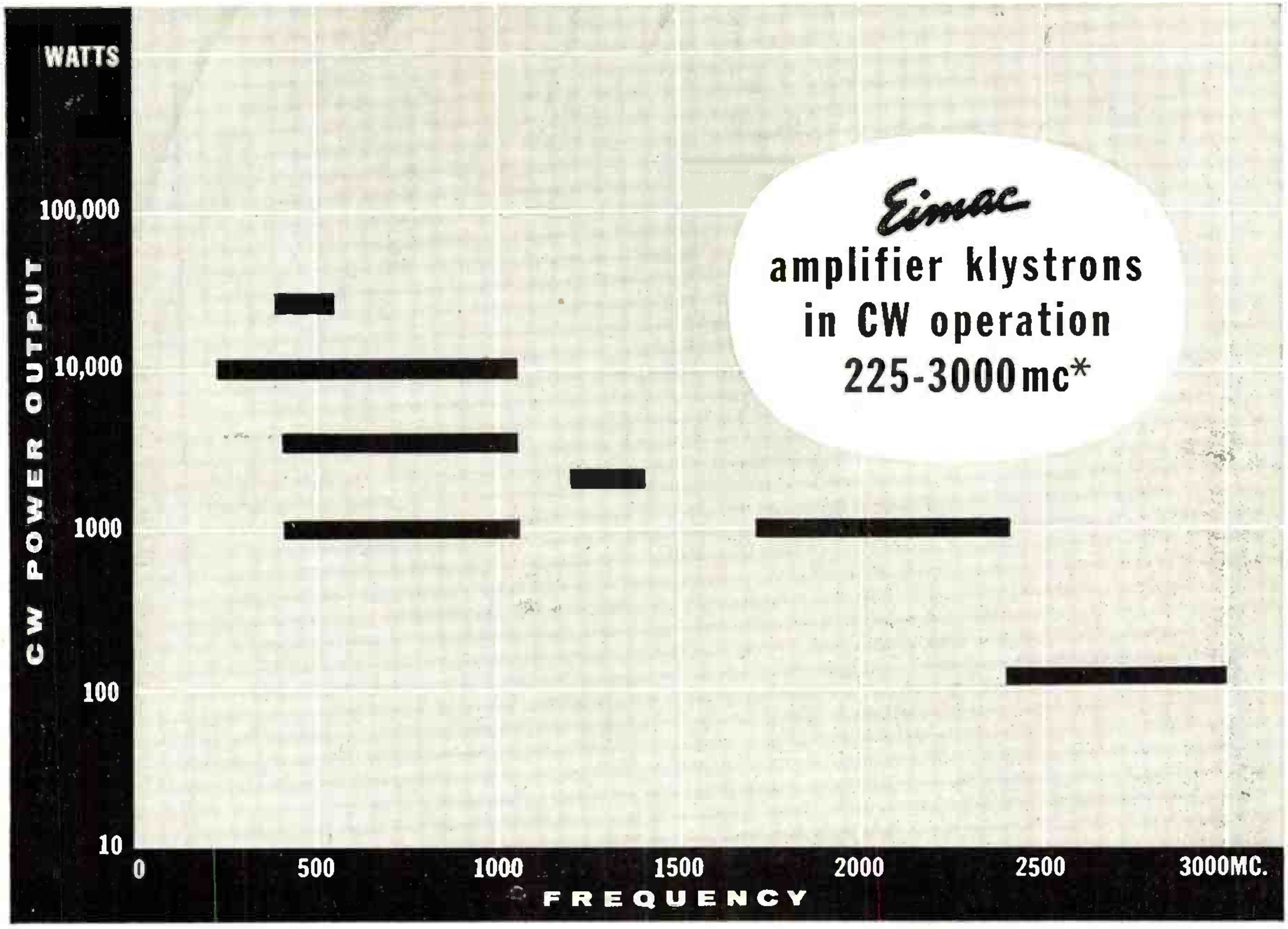
References

1. M. Katzin, "On the Phenomenology of Sea Clutter," Unclassified Reprint from the Report of Naval Research Laboratory Progress; November, 1950.
2. D. E. Kerr, "Propagation of Short Radio Waves," McGraw-Hill Book Company, Inc., New York, N. Y., Rad. Lab. Vol. 13, pp 481-527; 1951.
3. U. S. Navy Hydrographic Office, "Techniques for Forecasting Wind Waves and Swell," H. O. Pub. No. 604, Washington, D. C.; 1951.
4. E. O. Hulburt, "The Polarization of Light at Sea," *J. Opt. Soc. Am.*, Vol. 24, pp 35-42, February, 1934.
5. C. Cox and W. Munk, "The Measurement of the Roughness of the Sea Surface from Photographs of the Sun's Glitter, Part II, the Results," Air Force Tech. Report No. 3, Scripps Institution of Oceanography, LaJolla, California; August 28, 1953.
6. A. H. Schooley, "A Simple Optical Method for Measuring the Statistical Distribution of Water Surface Slopes," *J. Opt. Soc. Am.*, Vol. 44, pp 37-40; January, 1954.
7. R. C. Russell and D. H. Macmillan, "Waves and Tides," Philosophical Library, New York, N. Y., Chapter III; 1953.
8. A. H. Schooley, "Curvature Distributions of Wind-Created Water Waves," paper presented at 35th Annual Meeting of the Am. Geophysical Union, Washington, D. C.; 1954.
9. R. R. Putz, "Statistical Distribution for Ocean Waves," *Transactions, Am. Geophysical Union*, Vol. 33, pp 685-692; October 1952.
10. W. S. Ament, "Toward a Theory of Reflection by a Rough Surface," *Proc. I.R.E.*, Vol. 41, pp 142-145, January, 1953.
11. Carl Eckart, "The Scattering of Sound from the Sea Surface," *J. Acoust, Soc. A.*, Vol. 25, pp 566-570, May, 1953.
12. W. S. Ament, "Application of a Wiener-Hopf Technique to Certain Diffraction Problems," Report No. 4334, U. S. Naval Research Laboratory, Washington 25, D. C.; May 10, 1954.

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

Microwave Accelerator

High Voltage Engineering Corp., manufacturer of Van de Graaff particle accelerators, has claimed the first microwave linear accelerator offered commercially. The initial model is a radiation-producing machine designed especially for operation in the 4 to 7-million volt range.



*Pulse ratings many times CW ratings are available on most Eimac klystrons.

Eimac amplifier klystrons are performance proved
in extended range UHF and microwave communications systems

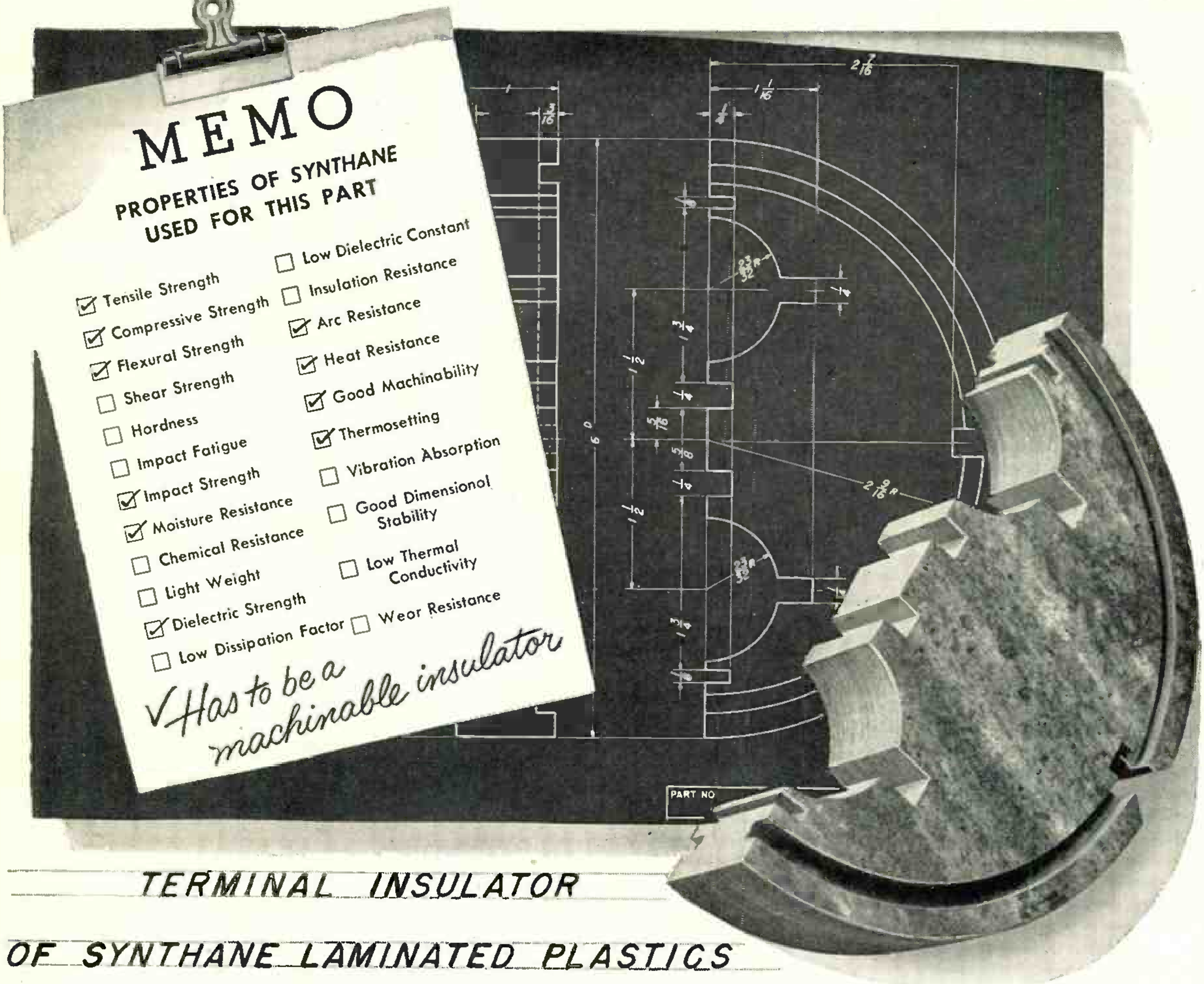
Eimac amplifier klystrons, performance proved in high power extended range microwave communications systems, now cover the spectrum from 225-3000mc. The Eimac 3K50,000L series, with 10kw/CW power output, power gains of over 1000 times, over 40% operational efficiency, long life and reliability, are typical of Eimac high power UHF klystrons. Of copper and ceramic construction, Eimac klystrons offer wide range tuning and easy input and output coupling through the use of external resonant cavities which leave the vacuum system free of RF circuitry. Light weight, allowing easy installation and maintenance, plus simplified design, minimizing production and stockpiling problems, make Eimac klystrons more practical and economical than any other.

See the klystrons selected to pioneer high power extended range microwave communications systems by visiting the Eimac booths, 549-551, at the I.R.E. show in New York March 21-24. Management and Engineering representatives will be on hand to discuss Eimac tubes and their application.

Eimac

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
THE WORLD'S LARGEST MANUFACTURERS OF TRANSMITTING TUBES

YOU FURNISH THE PRINT, WE'LL FURNISH THE PART



TERMINAL INSULATOR
OF SYNTHANE LAMINATED PLASTICS
RESISTS MOISTURE, HEAT, ARCING, BREAKAGE

Practically everything made requires a combination of several properties. And this terminal insulator is a shining example. It has to have high dielectric strength in a machinable insulator, good moisture resistance, excellent arc resistance, good heat resistance and mechanical strength. These and other requirements indicate *Synthane* laminated plastics for the job.

Starting with the blueprint, *Synthane* Corporation produces the needed base material with the right combination of properties, machines it with accuracy, and supplies the finished parts, with no waste, to the customer.

Each year *Synthane* turns out thousands of different finished parts. They are made from the more than 33 different grades of *Synthane* laminated plastics which are also regularly supplied to industry in sheets, rods, tubes, and molded parts. Good service and quality are characteristic of *Synthane* fabrication.

If you are looking for parts with many different properties — physical — mechanical — electrical — and chemical, in combination, *Synthane* may be your answer. Mail the coupon for information.

SYNTHANE CORPORATION, 11 River Road, Oaks, Pa.
Please send me more information about Synthane laminated plastics and fabrication service.

Name ____________________

Title ____________________

Company ____________________

Address ____________________

City __________ Zone ______ State ______

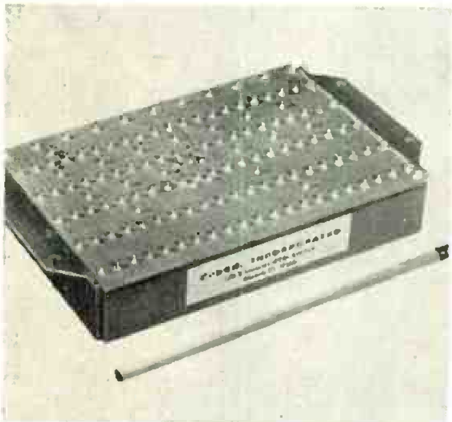
SYNTHANE
LAMINATED S PLASTICS

SYNTHANE CORPORATION • OAKS, PENNSYLVANIA

New Electronic Products

DELAY LINE

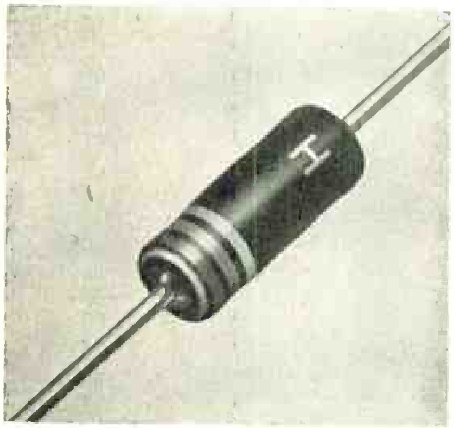
Model DL0390-200LTC ultra stable delay line has a maximum overall delay drift of less than ±0.15% over a temperature range of −65° C to +125° C. Developed for guided missiles, the unit



has found wide application in encoders and decoders. The delay line is a 100 section lumped constant type with an overall delay of 200 µsec, tapped every 2 µsec, with a rise time of 6 µsec. Characteristic impedance is 390 ohms. DC attenuation, 0.12 db/section. Pulse attenuation, 0.14 db/section. Package size, 7¼ x 4⅝ x 1½ in. **Epsco, Inc., 588 Commonwealth Ave., Boston 15, Mass.** —TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-16)

JUNCTION DIODES

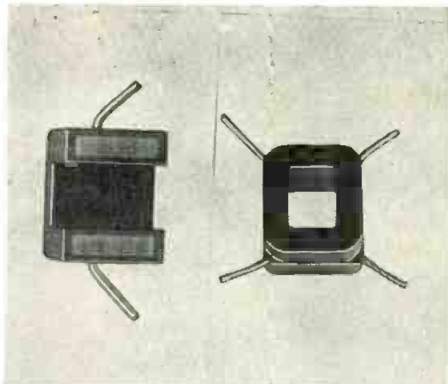
Silicon junction diodes with high forward conductance and very high back resistance of the order of 100,000 ohms have been announced. The first 8 types of a proposed line of such units includes Types HD6001, HD6002, and HD6003, previously announced, plus the new types HD6005 through HD6009. All types have an ambient operating range from



−80° to 200° C. Dimensions: glass body, 0.265 by 0.103 in. max. Specification sheets available on request. **Hughes Aircraft Co., Semiconductor Div., Florence Ave. at Teale St., Culver City, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-17)

COIL WINDINGS

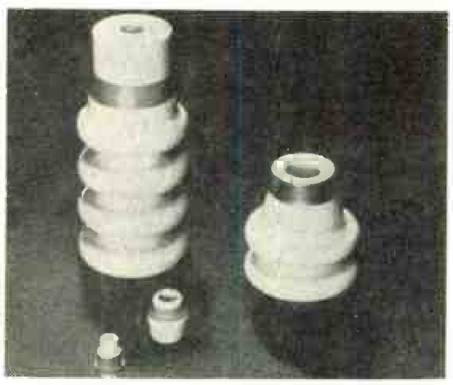
Molded from the new epoxy resins, electrical coil windings have been announced that are impervious to water, oils, dust, acids, alkali solutions, and water base hydraulic fluids. Withstand



a 200 megohm leakage test. The high dielectric value of 1800 v/mil enables high voltage applications to be miniaturized. **DeLuxe Coils, 1304 First St., Wabash, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-18)

HERMETIC TERMINALS

The "Nicote" metallized coating process enables reduction of metal oxides in a controlled atmosphere which fuses the ceramic body and the base metal banding of alumina hermetic terminals



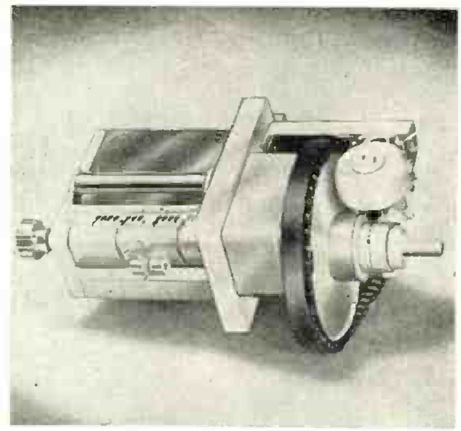
and allows use of high temperature solders, such as eutectic silver-copper alloy. The manufacturer's standard alumina body, satisfactory for use up to 2,000° F., has the high thermal shock resistance and mechanical strength inherent in high grade alumina. Sales engineering by **Lundey Associates, Waltham 54, Mass.,** for **Frenchtown Porcelain Co., Frenchtown, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-19)

MORE TECHNICAL INFORMATION

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

TAPE READERS

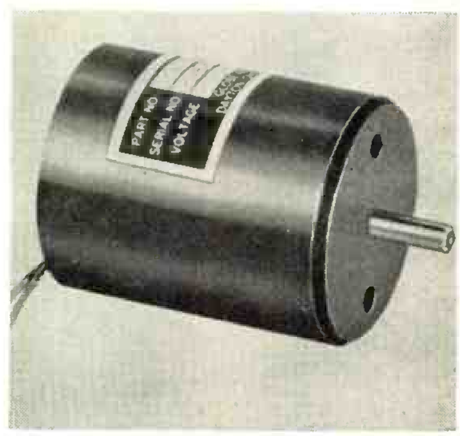
The series FR-300 paper tape readers read one or more standard perforated tapes at rates up to 60 characters/second. Model FR-350 is used for simultaneous and synchronous reading of two



perforated paper tapes of 5, 6, or 7 levels. Model FR-310 enables reading 5, 6, 7, or 8 level tapes. Solenoid-driven for speeds up to 20 characters/second. Motor-clutch driven for speeds to 60 characters/second. Also, without drive. FR-350 is suited to dual functional control; FR-350 for data inputs, remote controls, etc. **Soroban Engineering, Inc., Box 117, Melbourne, Fla.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-20)

MINIATURE MOTORS

Type SC sub-miniature motors, either 400 or 60 CPS ac, are for applications where size, weight, and high performance are governing factors. Protection for military environmental specifications has been considered in the design. Can be wound single, 2 phase, or 3 phase, and furnished as an induction or as a hysteresis motor. Further, units can be furnished with a concentric spur



gear reducer. For specific applications, details should be submitted for final design determination to **Yale J. Holt, Globe Industries, Inc., 1784 Stanley Ave., Dayton, O.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 3-21)

Letters

(*Continued from page 47*)

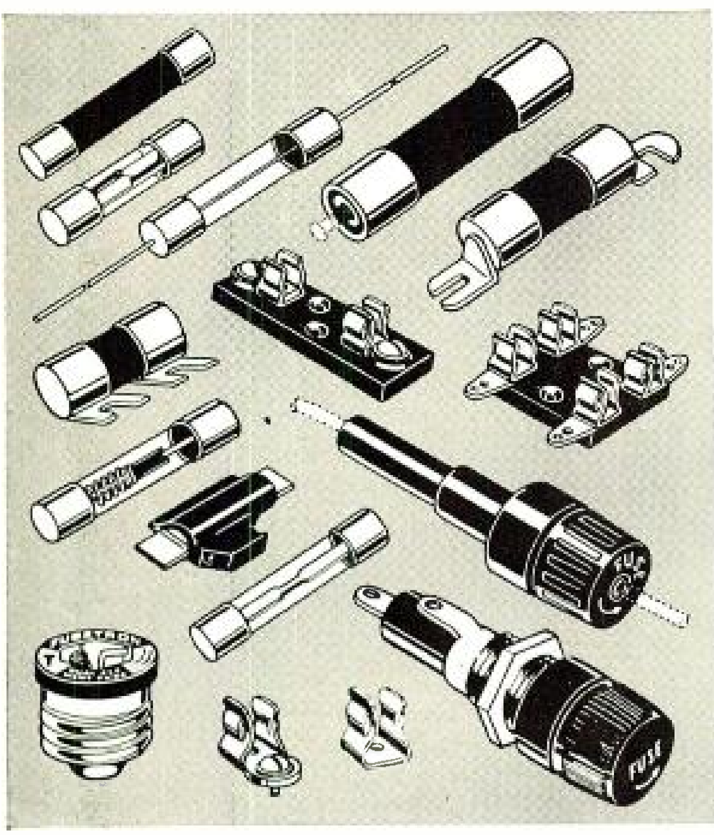
days, particularly in the industrial electronic field it is common practice to specify tolerances of ±5% on the overall performance specifications of an instrument using forty or fifty tubes and several hundred other components.

Considering first components such as resistors and capacitors, the standard tolerance is ±20%, while tolerances of ±10% and ±5% can be obtained at extra cost (in a typical case relative costs are in the ratio 14: 17: 35 respectively). Thus a component with a tolerance of ±10% is readily available at a reasonable cost. Moreover, experience indicates that in the case of resistors and capacitors bought directly from the manufacturer, the distribution curve is reasonably symmetrical about the nominal value for quantities of 1,000 pieces or even less, so that in a circuit employing a number of similar components in cascaded stages, the deviations tend to average out.

In the case of tubes however, the situation is very different. One has to go to a premium tube so as to get a tolerance of ±20% on transconductance for example and here the cost ratio between standard and premium tubes averages something like 1:3.5, a very substantial difference. Moreover, the nature of the product is such that a given production batch of tubes will tend to be reasonably uniform about a given value for a single characteristic, while the next batch may center around an entirely different value.

Consider the case of a five-stage, wide-band amplifier using pentodes with a nominal transconductance of 5,200 micromhos throughout with plate loads of 500 ohms. If all the tubes have a transconductance of 5,200 micromhos, the amplifier gain will be 119. Assuming all tubes to be 20% low, the gain will be 41, while tubes 20% high give a total gain of 286. From the point of view of the tube manufacturer and also from the standpoint of good engineering practice, one should of course design the amplifier with seven stages and use negative feedback to take up variations in transconductance. This solution however means an increase of 40% in power consumption, heat dissipation size and weight, and in some cases could mean the difference between convection cooling and forced air cooling, in which case the addition of a blower means restriction of power line frequency to 50-60 c/s or 400 c/s or else the use of an expensive

. . . dependable BUSS FUSES help protect the Product and your Reputation



BUSS fuses are made to protect — not to blow needlessly. A sensitive electronic device tests every BUSS fuse normally used by the Electronic Industries. Any fuse not correctly calibrated, properly constructed and right in all physical dimensions is automatically rejected.

This careful testing is your assurance that BUSS fuses will open and protect equipment against damage when there is trouble on the circuit. If a poorly made fuse doesn't open when it should on an electrical fault, something else will burn out.

BUSS fuses also safeguard your good-will by eliminating needless blows. A useless shutdown caused by a faulty fuse blowing when trouble doesn't exist can be most irritating to your customer. It could jolt his confidence in you.

Surely it is wise to rely on fuses that help you avoid troubles by offering dependable protection under all service conditions.

Then, why not be sure your buying and stock records specify BUSS and FUSETRON fuses . . . you'll find it convenient to use BUSS as the one source for all your fuse needs.

Makers of a complete line of fuses for home, farm, commercial, electronic and industrial use.

TT355

BUSSMANN MFG. CO. FUSETRON TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION BUSS *(Division of McGraw Electric Co.)*

University at Jefferson, St. Louis 7, Mo.

For product information, use inquiry card on last page.

Letters

(*Continued from page 136*)

D.C. blower plus a rectifier. Remember too, that this extra cost is in addition to the cost of premium tubes to ensure a tolerance of ±20% on transconductance! Under these conditions it is scarcely surprising that in some cases a design engineer decides to select tubes rather than take the ideal solution which may very easily double his production costs and price him out of the market.

It seems to me that problem is primarily one for the tube manufacturer to solve. Either he must learn how to control his manufacturing processes more closely so that tube tolerances conform to the standards which apply to other components and do so for a comparable price differential, or else he must select his output in such a way that in a batch of 1,000 tubes, say, given characteristic values must be distributed symmetrically about the nominal value so that a small user can be reasonably sure of getting the right average. As things are at present, there seems to be no alternative to some tube selection, and the main difference seems to be whether it should be done by the tube manufacturer or by the equipment manufacturer.

A. W. Russell
Market Research Engineer
Allen B. Du Mont Labs., Inc.
Clifton, N. J.

Unbreakable Radio Cases

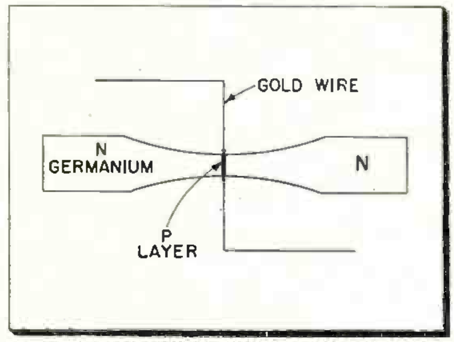
Seven all-new portable radios restyled and packaged in newly developed plastic non-breakable cases spearhead RCA Victor's new line. For the first time in radio the cases are guaranteed against breakage for five years.

RECTIFIERS FOR MAG-AMPS

Although magnetic amplifiers are usually supposed to require special selenium rectifier cells at considerably higher cost, a report of highly satisfactory performance by stock Radio Receptor rectifiers in a mag-amp application comes from Warren Dornhoefer of Regulator Equipment Co., shown inspecting a magnetic amplifier regulator which regulates voltage and frequency of 400 cycles motor generator sets aboard submarines.


Solid Side Rack Cabinet
Copper Tubing Inductor
Rack Panel And Shelf Assembly
Special Dial Plate
Sectionalized Control Desk From Gates Cabinet Factory
Power Tube Socket
Meter Shorting Switch
Gates
MANUFACTURES MANY THINGS FOR THE Electronic INDUSTRY
Yes—many Gates manufactured items are supplied to other manufacturers or directly to users. More and more for quality and fast service, Gates is relied upon for both standard and special design items. Try Gates first whether the need is large or small. You will be pleasantly surprised.
Variable Edgewise Inductor
100KW Transmission Line Bracket
Hi-Power Dummy Antenna
Solenoid Relay
ON AIR
Studio Signal Light
Cast Aluminum Rack Mounting Assembly
Power Meter Shorting Switch
Open Side Rack Cabinet
GATES
GATES RADIO COMPANY
QUINCY, ILL., U. S. A.
Manufacturing Engineers Since 1922
Houston, 2700 Polk Avenue
New York, 51 East 42nd Street
Washington, D. C., Warner Bldg.
Los Angeles, 7501 Sunset Blvd.
New York International Div., 13 East 40th St.
Atlanta, 13th & Spring Sts.
Montreal, Canadian Marconi Co.

TETRODE TRANSISTORS



Bell Labs. scientist R. P. Riesz observes automatic production of tetrode transistors by newly developed machine, dubbed "Mr. Meticulous," originated by R. L. Wallace. Inset shows transistor, with wires attached to 1/10,000 in. thick center p-layer, compared to the edge of a dime. Sketch indicates construction, with p-layer enlarged for illustrative purposes. For operational details, see page 13.

Electronic Ticket Agent

High speed electronic and mechanical equipment is credited with making the Pennsylvania RR's new ticket office at 30th St. Phila. the fastest, most efficient railroad sales and reservations sales center in the world.

Through the facsimile network which links the central branch with six other PRR offices in the Phila. area, all orders

Agent inserts metal matrix in "Ticketeer" which produces rail ticket by facsimile reproduction

placed in these branches are immediately recorded in the central branch so that an up-to-the minute record is available. Tickets for the reserved space are transmitted back through the facsimile link to the point in the network where they are to be picked up.

In all, the central office utilizes 26 facsimile machines, 20 microfilm units and 17 "Ticketeer" machines.

Special TV Tower designed by BLAW-KNOX houses automatic elevator

When WWJ-TV, Detroit, wanted an automatic elevator in their new tower, Blaw-Knox went to work on the design of the tower . . . in close cooperation with the manufacturers of both the elevator and the control system.

The result is this tremendous triangular tower . . . 14 feet on each side, 1063 feet high and weighing 265 tons . . . with special structural features to rigidly support both the 102 foot antenna and the automatic elevator.

Ready accessibility to any part of the tower up to the 980 foot level is provided by special design, completely enclosed automatic elevator. It can be stopped by the operator at any level by means of low frequency inductive carrier control. In addition an auxiliary pushbutton station, located at the lower landing, permits manual control at that point. The two controls are interlocked so that only one can be operated at a time. A telephone provides ground-to-car communication.

The advanced design and fabrication of this tower for WWJ-TV typifies the kind of service which Blaw-Knox offers you . . . to meet *your* specific requirements.

For more complete information on all types of Blaw-Knox Antenna Towers, write or phone for your copy of Bulletin No. 2417. Or send us your inquiry for prompt service, specifying height of tower and type of antenna.

BLAW-KNOX COMPANY
BLAW-KNOX EQUIPMENT DIVISION
PITTSBURGH 38, PENNSYLVANIA

Elevator-Marshall Elevator Company, Pittsburgh, Pa.
Control system—Union Switch & Signal Division of Westinghouse Air Brake Company, Wilmerding, Pa.

BLAW-KNOX **ANTENNA TOWERS**

Guyed and self-supporting — for AM • FM
TV • microwave • communications • radar

Data Encoder

(*Continued from page 73*)

ting of relays. During this period the reset pulse is blanked out so that no pulse is passed through the comparator gate. Throughout the encoder, pulse outputs which are used to drive parallel combinations of elements are shaped by blocking oscillators. The blocking oscillator provides a low-impedance output with a standard pulse amplitude and width and assures proper triggering of circuits which follow.

Comparator

Precision of this digital voltage converter is limited by the accuracy of the standard comparison voltage and also by the sensitivity and stability of the comparator device. A standard cell reference is used to maintain required accuracy of this comparison voltage, and the comparator has the following major characteristics:

1. The comparator gate passes pulses when the potential of the summing junction is negative and rejects all signals of opposite polarity regardless of amplitude.
2. Comparison sensitivity is sufficient to detect a 1 mv positive signal referred to the input of the summing amplifier.
3. Response time of the comparator is approximately 0.5 msec. and easily allows operation at the sampling rate of 40 per sec.
4. Offset and drift of the comparison circuit are less than 0.1% of full scale, or 1 mv referred to the input.

The comparator device which meets these specifications is shown in Fig. 3.

Basically the comparator which is shown in Fig. 3 consists of a wide-band, chopper-stabilized summing amplifier[7] which adds negative reference voltages to a positive input voltage. This amplifier has an overall gain of 100 and a flat frequency response from 0—10,000 CPS. Still further amplification of the sum of the input and the standard voltage is necessary before reliable operation of a gating tube may be obtained. To accomplish such reliability, a two-stage carrier type of amplifier is placed between the summing amplifier and the reset pulse gate. A bridge type of modulator[8] consisting of four germanium diodes modulates the 50 KC carrier which is then amplified and later demodulated. The output of the carrier amplifier is a dc voltage applied to the grid of a gate tube which passes reset pulses when a relay is to be reset. Within its linear region, the

ELECTRONICS ENGINEERS *and* PHYSICISTS

attending the I.R.E.

National Convention
and Radio Engineering Show
March 21-24
Waldorf-Astoria Hotel
and Kingsbridge Armory

A number of significant new studies at Lockheed Missile Systems Division has created positions for those possessing outstanding ability in:

antenna design	systems engineering	instrumentation	electromechanical design	computers
communications	servomechanisms	telemetering	nuclear physics	radar
				research

For the convenience of those attending the convention, Karl E. Zint, C. T. Petrie and other members of the technical staff will be available for consultation at the convention hotel.

Under Construction: Lockheed's new missile systems research laboratory—especially designed to provide the most modern facilities for meeting the increasingly complex problems of guided missiles. Scheduled for occupation this fall, it is the first step in a $10,000,000 research laboratory program.

Lockheed MISSILE SYSTEMS DIVISION

research and engineering staff

LOCKHEED AIRCRAFT CORPORATION • VAN NUYS • CALIFORNIA

For product information, use inquiry card on last page.

Data Encoder

(*Continued from page* 142)

gain of this amplifier is approximately 50.

A germanium diode in series with the ring modulator passes only positive signals from the output of the summing amplifier. An increment of 1 mv at the input to the summing amplifier corresponds to a change of 0.1 v at the output of the summing amplifier and to a change of approximately 5 v at the grid of the pentode gate.

The output of this comparator consists of a series of reset pulses which are generated as shown in Fig. 4 and which occur one-half of a digit period after relay closure. The top line shows the voltage at the grid of the gate tube, and the lower line, the resulting reset pulses. Corresponding binary-number output is shown on the last line.

Relay Selector Circuit

A ring circuit employing eleven thyratron stages supplies pulses necessary for relay operation and reset pulse gating, thus controlling the sequence of relay operations. Through a series of diode "and" gates, a reset pulse which is passed by the comparator gate influences only the relay which represents the digit under consideration. This reset pulse, when present, changes the state of a bistable multivibrator which in turn releases the relay. Relay current is supplied by a high-voltage supply with resistance in series so that essentially constant current is applied to the relay winding. Since the relay windings are highly inductive, the large initial voltage is desirable for rapid operation.

Fig. 5 shows the experimental two-channel encoder. Although systems of similar accuracy are available commercially, the sampling speed is too slow for use in rocket-motor instrumentation testing where tests are of short duration and a large number of points must be recorded. The encoder, together with the transcriber, provides a field recorder and an automatic-data-handling system capable of supplying engineering data of increased accuracy in a form which is easily handled by digital computing equipment.

References

1. Frank, M. E., "Data-Handling System for General Instrumentation. II. Transcriber," *Proc. of National Electronics Conference*, vol. 9, 1953.

(*Continued on page* 147)

Stabilizing Transistors

(*Continued from page 76*)

The dependence of I_c on I_{co} is obtained by differentiating Eq. 2 giving

$$\frac{dI_c}{dI_{co}} = \frac{R_1 R_2 + R_1 R_3 - b\,(R_1 + R_2 + R_3)}{(1-\alpha) R_1 R_2 + R_1 R_3 - b\,(R_1 + R_2 + R_3)} \quad (4)$$

Two of five transistors used in evaluating Fig. 7 data did not recover after the test while three others had 50% higher I_{co} readings at room temperature after the test. At this point Fig. 7 data was considered valid and no further transistors were subjected to such rigorous treatment. In all 80 transistors were tested including several silicon types which were operated to 125°C and 150°C with gains stabilized to better than 3 db over the temperature range. Table 2 gives the complete performance data on all transistors tested, including the effect of the temperature range on parameters. We may conclude from this table that different performance characteristics may be expected from different manufacturers insofar as temperature range is concerned. These data are presented as applicable only to those transistors actually tested, and are not necessarily characteristic of all transistors made by the manufacturers, or of those made after the dates on which the transistor used in these measurements were manufactured. All transistors used in this investigation were received prior to June, 1954. The failure point for all transistors was considered to be the point at which the gain was down 3 db from the room temperature value. Of all the transistors tested, none failed to operate successfully over a much wider range than when unstabilized and with results in good conformance with predicted performance. Several units with I_{co} below 2.5 μa were operable up to 115°C with less than 3 db gain change. The silicon transistors had I_{co} values well below 1 μa and could have been used at 80°C with no stabilization. However, for operation to 125°C and 150°C some stabilization was necessary for reliable performance.

200 Hr. Life Test

As a final test of the efficiency of the stabilization, several Raytheon CK 722's, in the circuit shown in Fig. 6, operating with $I_{c25°} = 2$ ma and $I_{co25°} = 6$ μa, were subjected to temperatures ranging between 75°

Stabilizing Transistors

(*Continued from page 145*)

to 80°C for a period of 200 hrs. No significant loss in gain was measured over the time period nor did the I_c increase any more than the calculated amount of 0.43 ma from the 25°C value. The transistors had an $I_{co25°}$ after being subjected to this test of 4-5 μa. This decrease may be due to the dry out of the transistors during the test thus increasing the leakage resistance. In any event, no deterioration in transistor characteristics was noted during or after the performance of this test. In addition, 6 Germanium Products type 2517 were subjected to a 200 hr. heat test at temperatures above 80°C with a loss in gain of less than 3 db. These results give promise of extended operation at elevated temperatures if the stabilization methods described above are employed. It was found necessary to make R_L very much less than r_c to maintain constant gain at 80°C for this length of time. This design minimizes the effect of unstabilized changes in r_c due to high temperatures and still permits gains in the order of 100 from one transistor.

Conclusion

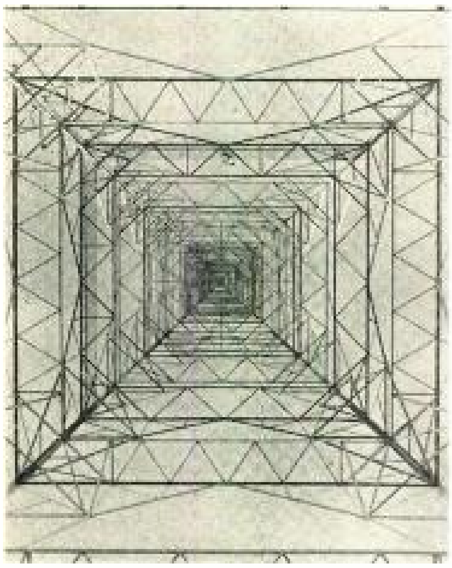
These results show that it is possible to extend the operating ambient temperature range of transistors by significant amounts, and for usable periods of time through the use of either version of this circuit. The one battery version offers certain advantages, in terms of improved performance and the saving of one battery, at the cost of a small increase in power dissipated in the stabilizing resistances. The majority of the tests were performed with this circuit. Similar results were obtained on a number of transistors of different types and manufacturers. Indeed the method is generally applicable to all types and will insure uniformity of performance.

References

1. R. F. Shea, "Transistor Operation, Stabilization of Operating Points." *Proc. IRE.* Vol. 40, pp. 1435-1437, Nov. 1952.
2. R. F. Shea, "*Principles of Transistor Circuits*," John Wiley and Sons, Inc., New York, N. Y., 1953, pp. 97-115, 175-176.
3. Jacob Tellerman, "Transistor Circuit Design for All Transistor A. C. Servo Amplifier," *Proc. Symposium on The Application of Transistors to Military Electronics Equipment*, pp. 61-70, Sept. 1953.
4. R. M. Ryder, "Aging and Temperature Response of Point-Contact Transistors." *The Transistor: Selected Reference Material on Characteristics and Application*, Bell Telephone Laboratories, Inc., New York, 1951, (Prepared for Western Electric Company) pp. 123-126.
5. Abraham Coblenz and Harry L. Owens, "Variation of Transistor Parameters with

Temperature," *Proc. IRE*, Vol. 40, pp. 1472-1476, Nov. 1952.
6. L. B. Armstrong and D. A. Jenny, "Behavior of Germanium Junction Transistors at Elevated Temperatures and Power Transistor Design," *Convention Record of the 1953 IRE National Convention*, Part 6, pp. 22-26.
7. E. R. Kretzmer, "An Amplitude Stabilized Transistor Oscillator," *Proc. IRE*, Vol. 42, pp. 391-401, Feb. 1954.

TV TOWER FOR WENS



Unusual photo from base of new 500 ft. tower built by Blaw-Knox Co. Tower is 49 ft. square at the base and 3 ft. square at top. Contains 74 tons structural steel

Data Encoder

(*Continued from page* 144)

2. Kuder, M. L., "Anodige, An Electronic Analog-to-Digital Converter," *Report No. 1117*. Washington: N. B. of S., Aug. 24, 1951.
3. "High Speed Analog to Digital Converter," *Review of Scientific Instruments*, vol. 22, p. 544, July 1951.
4. Rich. E. S., "High Speed Pulse Recording on Magnetic Tape," *Report No. 159*. Cambridge: Servomechanisms Laboratory, M.I.T., April 6. 1949.
5. Shumard, C. C., "Ring Counter Circuits," *Electrical Engineering*, vol. 57, p. 209, May 1938.
6. Chen, Tung Chang, "Diode Coincidence and Mixing Circuits in Digital Computers," *Proc. of IRE*, vol. 38, p. 511, May 1950.
7. Goldberg, E. A. "Stabilization of Wide-Band Direct-Current Amplifiers for Zero and Gain," *RCA Review*, vol. 11, p. 296, June 1950.
8. Belevitch, V.. "Linear Theory of Bridge and Ring Modulator Circuits," *Electrical Communications*, vol. 25, p. 62, March 1948.

Elgin Purchases American Microphone

Elgin National Watch Co. has purchased American Microphone Co., Pasadena, Calif., manufacturers of microphones, phonograph pick-ups, cartridges and related items in the communications field. Four months ago Elgin acquired Neomatic, Inc., Los Angeles manufacturers of subminiature relays.

J. G. Shennan, president, described both purchases as part of Elgin's planned diversification program announced in 1953, through which it is entering the growth fields of miniature electronic components and automatic production instruments.

Transmission Lines

(*Continued from page 93*)

ing pins, and its center conductor is soldered to the center strip of the Tri-plate line.

Hybrid Ring and Crystal Holder

A balanced mixer consisting of a hybrid ring with crystal holder circuits etched on two of the complementary arms is shown in Fig. 17. The crystals are standard cartridge type 1N23B's. By cutting off the tips of these crystals and placing them in their holders with the disc at the end of the ceramic in contact with the center strip of the Tri-plate line, an appreciable reduction in frequency sensitivity was realized.

Tests using matched crystals and equal DC loads revealed an input VSWR of less than 1.23 for this hybrid ring over the 4100 to 4500 MC frequency range, and a minimum isolation of 39 db between the out-of-phase arms. VSWR and coupling measurements on a Tri-plate hybrid ring are shown below.

Frequency MC	INPUT VSWR	RELATIVE POWER			
		P_1	P_2	P_3	P_4
4100	1:19	0db	—3.2db	—44db	—3.1db
4300	1.09	0db	—3.1db	—49db	—3.1db
4500	1.23	0db	—3.1db	—39db	—3.2db

Gyrators and Resonators

It is a simple matter to construct gyrators and resonators in Tri-plate transmission lines. Fig. 18 illustrates a gyrator coupled to a Tri-plate line.

Inside the cylinder shown in the illustration is a central core of ferrite. This is surrounded by polyfoam which is enclosed in a thin dielectric casing. A metal cover encases the entire cylinder. Cylinder diameter is selected so that only TE_{1-1} fields are excited.

The two outside surfaces of the Tri-plate line are shorted to the outside metal cover of the cylinder, while the center strip of the Tri-plate is helically wound through several turns inside the dielectric casing.

With this arrangement, phase shifting can be accomplished through the influence of external magnetic fields. By removing the ferrite core, cutting the cylinder to the correct length, and capping its ends, the unit can be made to function as a resonator for use with Tri-plate transmission lines.

S-band Generator

The S-band signal generator demonstrates the practicability of constructing functional microwave test equipments in Tri-plate with an ease and economy which are unattainable when using conventional waveguide techniques. The equipment consists of a 726C klystron which series-feeds, through a coax-to-Tri-plate transition in series with a flap attenuator, through a Tri-plate-to-coax transition as a useful output. The output signal is sampled by a 20 db stub type directional coupler which feeds into a matched bolometer.

For sponsoring studies which have led to the development of the tecnniques and equipments discussed, grateful acknowledgement is made to the following: Bureau of Aeronautics, Industrial Planning Div.; Cambridge Air Force Research Center; National Bureau of Standards.

Stearns Elected S-F Council Chairman

The San Francisco Council of the West Coast Electronic Manufacturers Association has elected H. Myrl Stearns chairman for 1955. Stearns is executive vice-president of Varian Associates. Elected to the position of vice-chairman of the 180-company electronics association was Winfield G. Wagener, director of technical services for Eitel-McCullough. Calvin K. Townsend, vice-president and general manager of Jennings Radio Manufacturing Corp. was elected secretary-treasurer. New directors of the association for 1955 are John A. Chartz, vice-president and general manager of Dalmo Victor Co.; J. J. Halloran, vice-president and chief engineer of Electro Engineering Work; George I. Long, executive vice-president and general manager of Ampex Corp.; and Douglas C. Strain, president and general manager of Electro-Measurements, Inc.

TV IN JAPAN

JOKR-TV personnel pose with Philco and Nissho representatives upon completion of new Philco TV film installation at JOKR-TV, Tokyo. Shown are (l to r): Messrs. Patteson, Philco Field Engineer; Takekawa, Representative of Nissho Co.; Endo, Chief Engineer of JOKR-TV; engineers Yoshida, Yanase and Akagi.

Sandpaper Production

(*Continued from page 93*)

circulated, flowing by gravity from the machine vat to a Moyno pump which returns it to the adhesive kettle. Over a period of time, diluent evaporates from the adhesive in the open vat and the viscosity of the solution increases.

Along with this increased viscosity comes a change in adhesive qualities so that in order to maintain the correct grain weight of the finished product it would be necessary to slow down the machine. It is extremely important to prevent such viscosity change because a variation of one-half pound of adhesive pick-up in one ream of abrasive paper can cause the entire lot to be scrapped.

Continuous Correction

Since the making machines run at a rather high speed, spot checking of viscosity with periodic corrective measures obviously was not an economically satisfactory answer to our problem. Between checking periods, a considerable quantity of off-quality material could be produced. This, of course, would mean rejected material with accompanying financial loss.

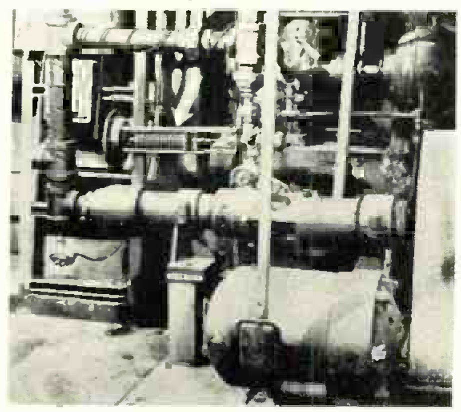


Fig. 2: Diaphragm operated valve controls diluent supply to the adhesive flow line

Some means of continuous measurement and corrective action was needed. The Bendix Ultra-Viscoson (see Fig. 1), which utilizes an electronic circular chart pneumatic controller developed by Minneapolis-Honeywell, supplied the answer. In this system a probe is inserted into the adhesive flow line downstream from the pump. This probe, resembling in size and shape the bulb of an industrial pressure-type thermometer, produces ultrasonic waves and measures the energy required to cause layers of the adhesive to slip back and forth over one another as the result of these waves. Since this energy is proportional to the viscosity of the material, an electronic computer makes necessary calculations and supplies an indication of the viscosity, at the same time transmitting to the electronic recording controller a continuous dc signal which constitutes a measure of viscosity.

Controlled air from the recording instrument positions a ⅛ in. diaphragm operated valve (Fig. 2) in a line that supplies diluent to the adhesive flow line just upstream from the pump suction. This location insures thorough mixing with the adhesive before the mixture flows past the viscosity sensing probe. When the adhesive tends to "go heavy," the instrument automatically adds just enough diluent to return the viscosity to the correct value. Although maintenance of product quality and uniformity was the primary reason for the installation of these control units, additional benefits that have resulted are a saving in operators' time and a saving in the amount of adhesive used.

RCA Reduces Color-TV Tube Prices

An immediate reduction in the price of the 21-in. color television picture tube from $175 to $100 has been announced. The reduction is made possible by manufacturing techniques recently achieved which permit substantial economies in the production of the tube.

RCA placed its 21-in. color tube into commercial production, and began deliveries to television set manufacturers, during November, 1954. This tube provides a viewing area of 255 square in., approximately 25% greater than the viewing area of any color tubes now available. All metal round construction, in addition to its inherent manufacturing advantages, continues to offer a 25% weight saving over competitive color tubes. This weight saving is important in receiver design and in transportation costs.

1955 "Radio's Master" Available Now

The 19th edition of "Radio's Master" for 1954-55, is now available according to United Catalog Publishers, 106-110 Lafayette St., New York 13, N.Y. This buying guide of TV-electronic parts and equipment contains 1440 pages, and lists the products of some 350 manufacturers. Publisher's price is $6.50, but it may be obtained from local parts distributors for as low as $1.95.

Telephone Circuits

(*Continued from page* 87)

read —56 dbm (equivalent to 29 dba from Table 2). These readings would result in a signal-to-noise ratio of 47[—9—(—56)] with F1A weighting. With 144 weighting the signal would read the same but the noise would be —61 dbm which will give a signal-to-noise ratio of 52 [—9—(—61)] with 144 weighting.

If the signal-to-noise ratio for either F1A or 144 weighting is known, the magnitude of the noise can be obtained from Table 2. Consider first a point in the circuit where the magnitude of the test power is 0 dbm or 1 mw. For a signal-to-noise ratio of 47 db with F1A weighting at a point where the signal power is 0 dbm, the noise reading on a TMS with F1A weighting is —47 dbm. For a signal-to-noise ratio of 47 db with 144 weighting, at a point where the signal is 0 dbm, the noise reading on a TMS with 144 weighting is —47 dbm.

With the 2B set the following values are obtained. For a signal-to-noise ratio of 47 db with F1A weighting, at a point where the signal is 0 dbm, from Table 1 the signal reads 85 dba; hence the noise is 85—47=38 dba. For a signal-to-noise ratio of 52 db with 144 weighting, where the signal is 0 dbm, the signal reads 90 dbRN; hence the noise is 90—52=38 dbRN.

Correction

To obtain the noise at a point where the signal power is other than 1 mw or 0 dbm, a correction must be applied. As an example, at a point where the signal power is —9 dbm, the corresponding noise for the values assumed above would be (38—9) or 29 dba or dbRN.

In the above discussion it has been assumed that the signal was read in the absence of noise. If the two readings, signal and noise, differ by more than 10 db, the magnitude of the signal can be considered the true value for practical purposes. In cases where these two quantities differ by less than 10 db, the magnitude of the signal (actually signal plus noise) measurement will require correction in order to ascertain the magnitude of the signal alone. This correction in db can be found in Table 3.

Assume that the measurement of the signal (actually signal plus noise) on a TMS is —5 dbm and the noise at the same point in the absence of signal measures —7 dbm. Column 1 of Table 3 shows the difference in db between the combined signal and noise measurement and the noise measurement alone, corresponding to the two measurements assumed above. For a difference of 2db between the two measurements, the correction to be applied to the signal plus noise reading is shown in column 2 of Table 3 or —4.3 db. The magnitude of the signal alone would be —5, —4.3 or —9.3 dbm.

As the difference between the measurements of the combined signal and noise and the noise alone approaches zero, the determination of the signal becomes less accurate until this difference becomes zero at which point the signal is indeterminate.

References:

[1] *Standards on Antennas, Modulation Systems and Transmitter*, IRE, 1948.

[2] *Engineering Reports of the Joint Subcommittee on Development and Research*—Edison Electric Institute and Bell Telephone System—Volume V., January 1943; Engineering Report No. 45.

Tuner Inputs

(*Continued from page* 91)

keep L_1 as small as possible makes the relation (9) a good compromise. The secondary should have two windings, one for low channels (2 to 6), the other for high channels (7 to 13), both coupled to the primary as tightly as possible. The number of turns of the secondary windings is determined by Eqs. 3, 4, and 8.

In order to increase the rejection of the unbalanced signal, the primary must be cross-wound as shown in Fig. 5. For the same reason, the secondary should be wound on the "cold" end of the primary in order to reduce the capacitive coupling.

Transmission Line

This is the information obtained considering the transformer as a lumped circuit. Actually, however, the transformer is not a lumped circuit. Its cross-wound primary is a transmission line because the two halves of it, wound in opposite directions, possess a certain inductance per unit length and certain mutual distributed capacity. This transmission line is shorted at the center tap. As any transmission line, the primary of the transformer has multiple resonances. This can easily be proven by a grid-dip meter. The lowest frequency of resonance is found when the primary winding of the transformer is open. Shorting the primary, another resonance at more than twice this higher frequency can easily be seen. The resonances of higher order can not always be

Tuner Inputs

(*Continued from page* 153)

detected on a small transformer, but can easily be seen in a transformer of larger dimensions.

Using the transmission line terminology, the first resonance may be called $\lambda/4$ resonance, the second $\lambda/2$ resonance, etc. These resonances change the performance of the transformer appreciably at various frequencies producing unexpected changes of the antenna transformed impedance r. Referring to Fig. 6, if AC is the line representing the primary of the transformer and BC is the loop coupled to it and representing the secondary winding, then the voltage induced in the secondary is proportional to the line voltage V_B at the point B.

$$V_B = V_A \frac{\sin \beta X}{\sin \beta l}$$

where V_A is the line voltage at A

$$V_A = E \frac{jK_T \tan \beta l}{R + jK_T \tan \beta l}$$

where: R is the internal resistance of the generator feeding the transformer.

E is the open-circuit voltage of the generator.

K is the surge impedance of the antenna line (K = R).

$K_T = \sqrt{\frac{L_1}{C_P}}$ is the surge impedance of the primary winding considered as a line.

C_P is the low frequency capacity between the two halves of the primary.

Thus

$$|V_B| = E \frac{\tan\beta l \sin\beta X}{\sqrt{\left(\frac{R}{K_T}\right)^2 + \tan^2\beta l} \sin\beta l} \quad (10)$$

Fig. 7 shows graphically Eq. 10 for $\frac{R}{K_T} = \frac{2}{3}$ and three different values of X/l.

Fig. 8 shows the same equation for $X/l = 1$ and three values of R/K_T.

The transformed antenna impedance γ varies with the square of these graphs because the available power $K_1{}^2E^2{}_B/4r$ at the output of the transformer has to remain constant and equal to the available power of the generator. K_1 is the degree of coupling of the loop to the line.

The graphs of Figs. 7 and 8 give only a qualitative picture of the variation of the secondary voltage with frequency because of many simplifying assumptions taken in deriving Eq. 10.

Nevertheless the four crosses indicate the results obtained by measurement of the antenna transformed impedance on Chs. 2, 6, 7, and 13. The ordinates of the four points are the square roots of the measured impedances.

Thus the following information can be added to that obtained from the study of the transformer as a lumped circuit:

1) It is desirable to keep

$$K_T, \text{ which is equal to } \sqrt{\frac{L_1}{C_o}},$$

as high as possible.

2) It is important to keep the second resonance considerably higher than the Ch. 13 frequency. Both of these requirements are favored by the cores of higher permeability. Such cores, however, usually have higher losses at high frequencies. Thus, the core to be used need not be made of the material best qualified for upper frequency limit of the range (200 MC). Materials with more losses at the upper VHF frequency limit, but of higher permeability, can give better results.

In conclusion, some typical results are shown which can be expected from a TV tuner with a wide band antenna input transformer and 6BQ7 tube as a cascode r-f amplifier.

	NF	of unbalanced signal
ch. (2 to 6)	5-6 db	-26 db or better
ch. (7 to 13)	7-8 db	-22 db or better

Tank Circuit

(*Continued from page* 99)

obtained from a tube manual or directly from the tube manufacturer. From these quantities the required inductive reactance (or capacitive reactance which is equal) can be calculated. Finally, the effective and peak voltages across the tank circuit can be determined from the power output and plate load.

To facilitate this procedure, the calculator shown in Fig. 2 has been designed. To use this calculator, locate the value of load on the R scale and Q on the Q scale. Join these points with a straight line and read reactance at the intersection of this line with the X scale. From this value and the operating frequency determine L and C on a reactance nomograph. Construct a second straight line from R to the output power on the P scale. Read the peak tank circuit voltage at the intersection of this line with the E scale. Multiply this reading by 0.707 to obtain the tank circuit RMS voltage, if required.

This procedure can be reversed. Thus, select the power delivered from the tube on the P scale and

For product information, use inquiry card on last page.

Tank Circuit

(*Continued from page 155*)

peak voltage on the E scale. (Peak voltage is approximately 0.8 or 0.9 of the plate supply voltage. For instance when using a 1000 v. supply, peak tank voltage may be estimated as 850 v.) Draw a line through these points and extend the line until it reaches the R scale. At this point read the required tube load in ohms. From this point draw a second straight line to the chosen Q value on the Q scale. Read the required inductive or capacitive reactance in ohms on the X scale. Determine L and C on the reactance chart using this value and the operating frequency.

As an example design a 500 watt tank circuit which presents 3000 ohms to the amplifier tube. Select a Q of 15. From 3000 on the R scale to 15 on the Q scale construct a straight line. Read 200 ohms at the intersection of this line with the X scale. Compute L and C on a reactance chart. From 3000 on the R scale to 500 on the P scale construct a second straight line. Estimate 1700 peak volts at the intersection of this line with the E scale.

This procedure applies to any single-ended Class B or C amplifier including grounded-grid amplifiers. It also applies to push-pull or other split-stator tapped-coil tank. However, the capacitance of each condenser section in the push-pull tank is one-half the calculated value.

The nomograph solves the following equations:

$$X_L = R/Q \quad (1)$$

$$E\ peak = \sqrt{2PX_LQ} \quad (2)$$

In which R = Resonant tank circuit resistance

Q = Full-load tank circuit Q

X_L = Inductive branch reactance

Epeak = Peak voltage across the tuned tank

P = Tube power output

WCEMA PLAQUE

At the annual WCEMA party, Noel E. Porter (l) 1955 WESCON Chairman, presented Heckert L. Parker, upon his retirement, a plaque of appreciation for his many years of service. Mr. and Mrs. Winfield G. Wagener look on. Mr. Wagener is President of WCEMA.

Reliable Connections

(*Continued from page 87*)

braid in any way, carefully remove a $\frac{5}{16}$ in. length of cable jacket and unwind and cut off the exposed cotton yarn binding. Carefully spread apart the projecting ground braid and apply a counter-clockwise wrapping of ½ in. cellulose acetate adhesive tape to the underlying teflon tape to keep it tightly in place during subsequent steps in the fabrication procedure, as shown at (a). This is important in that accidental displacement of the teflon tape ruins the termination and necessitates cutting off the spoiled end and starting again from the beginning.

2. Unweave the projecting strands of ground braid by combing or by some other convenient method and lay them back over the outside of a split cone-shaped ferrule of cold rolled steel, parallel to each other as shown at (b). The ferrule supports the strands as they are carefully presented to a motor-driven fine-wire scratch wheel for removal of the Formex insulation as the end of the line is slowly rotated about its own axis.

3. Remove the split ferrule, lay the strands back over the cable jacket without touching the cleaned surface of the copper, and bind tightly in place with two turns of #18 solid tinned copper wire, as shown at (c). Solder the strands of braid to the encircling #18 wire, *all the way around* with rosin-core solder.

Acetate Tape

4. Next, cut off $\frac{3}{16}$ in. of the remaining portion of the acetate tape wrapped cable core protruding from the braid by rolling it on a flat surface under a sharp knife, as shown at (d). The knife must be held exactly at right angles to the rolling axis of the cable, or the cut will not meet after one turn, but will spiral to one side or the other, and a ragged uneven end will result. Do not remove the remaining acetate tape wrapping.

5. From the remaining ⅛ in. of core protruding from the braid, carefully fish out the end of the #40 winding and pull out enough of the wire so that the end of the winding shows through the translucent teflon tape no more than approximately $\frac{1}{32}$ in. beyond the ground braid as shown at (e). Leave 2 in. of the pulled out wire in place; cut off and discard the rest.

6. Stake and solder a 4 in. length of #18 solid tinned copper wire into the slot of a #5-40 x ¼ in. brass fillister head machine screw, with

Reliable Connections

(*Continued from page 157*)

⅛ in. of the wire extending from the slot and bent down approximately 60°, as shown at (f).

7. Screw the machine screw all the way into the center hole of the saran tubing, wind two turns of the #40 wire around the bent down tip to anchor it, carefully remove the Formex insulation with X-Var stripping liquid (WARNING: Avoid getting X-Var on any part of the cable, braid, or windings. Use a clean piece of solvent-moistened cloth or tissue for each wiping and discard.) to a point not less than ¼ in. from the anchoring turns, thoroughly clean off all traces of the X-Var with a clean cloth or tissue moistened with alcohol, and wrap six or more turns of the cleaned wire around the bent down tip.

8. Grip the head of the machine screw firmly in a *copper-jawed* clamp or vise to prevent heating of the screw and damaging of the saran tubing, and solder the turns of #40 wire in place with rosin-core solder. Overheating of the saran tubing may weaken the tubing and will cause formation of corrosive products that may attack the wire. After slipping 3 in. lengths of spaghetti over each of the leads, the input-end of the delay line should appear exactly as shown at (g).

Output-End Fabrication

Experience will dictate just how long a piece of line must be cut from the reel to allow sufficient surplus for fabrication of the input-end, calibration of the line to the desired delay time by cutting off short pieces from the output-end of the line, and fabrication of the output-end.

Calibration of the delay line and fabrication of the output-end are as follows:

1. The completed input-end of the line is connected to a test equipment set-up, such as used for pulse-testing new lines, and the 0.1-μsec input pulse and its reflection from the unterminated output-end observed simultaneously on a synchroscope. Knowing the sweep speed of the scope and the desired delay time, the distances between the observed pulses can be calculated. Short pieces are then cut off from the output-end of the line.

2. The output-end of the delay line is prepared exactly as described for the input-end, except that paragraphs -2- and -3- are omitted and the Formex insulated braid is combed out and laid back over the

jacket and held in place with several turns of ¼ in. black electrical adhesive tape. *Do not* remove Formex insulation from the strands at the output-end, otherwise mutual coupling of shorted turns formed by the braid will destroy the transmission characteristics of the line.

3. The final step consists of applying 300 volts dc between the input and ground leads for several seconds as a preliminary insulation test, taping up the completed ends with ¼ in. black electrical tape in a neat workmanlike manner as shown at (h), and then repeating the insulation test.

Electronic Depth Sounder

A new electronic depth sounder, for charting the bottoms of lakes, rivers, and shoal waters, has been announced by Raytheon Mfg. Co. Called the DE 119, it weighs only 40 pounds, and is powered by a standard, 6 V. storage battery which will operate the equipment for eight hours. On the face of the case, a glass window reveals the chart paper which can be operated at three speeds 12, 30 or 60 in./hr. The instrument is highly accurate over its entire range from zero to 240 feet of depth, readable in four phases.

"Fathometer" depth sounder utilizes echo effect to chart river bottoms and locate schools of fish. It weighs 40 lbs., is battery powered

The DE 119 is claimed to be the smallest and lightest ever developed. It sells for $1185 F.O.B. Waltham, Mass. The transducer, which generates the ultrasonic signal and "listens" for its echo, is lowered over the side on the end of a short pipe. It is held a foot or two below the surface of the water. The sound signal travels through the water until it strikes the bottom, then returns in the form of an echo. The sensitive transducer picks up the echo, and the equipment converts the time interval automatically into a reading of feet or fathoms.

For product information, use inquiry card on last page.

Electronic Press Day

LAST month the Electronics Committee of the Los Angeles Chamber of Commerce held its first "press" day, purpose of which was to present a complete picture of local Electronic Industries for both local and national, trade and consumer press.

The coupling of civic or municipal and industrial interests was quite successful with ten speakers presenting the subject in an all morning session.

Electronic Outlook

R. C. Fuller, Chairman, made the introductory remarks and Dr. A. M. Zarem followed with an overall review on the Electronic Outlook for 1955. He defined electronic equipment as being built to detect, measure, analyze, compute, store, control or convey information or intelligence. In this respect, it fulfills the type of activity engaged in by human beings, which combines their sensory and intellectual mechanisms with their muscle to accomplish tasks. He divided the industries into five basic parts as 1. radar; 2. computers; 3. research and development, including guided missiles; 4. radio-TV; 5. components. Individual speakers then gave detailed information on each of these activities.

For example, Les Hoffman of Hoffman Electronics Corp. speaking on Radio and TV in Southern California said that 250,000 television sets would be sold in the area during 1955 and that he expected color television to play an important sales role in the latter part of 1956. L. D. Callihan, Gilfillan Bros., Inc. reported that the eight prime radar system manufacturers do a combined dollar volume of $335 million and that they depend on more than 1000 subcontractors for $200 million of vital components. He predicted that by 1960 the total volume would swell to more than a billion dollars annually.

Speaking on the growth and future prospects of the component parts industries, Paul H. Tartak, Pres., Electronic Industries, Inc., said that there are now approximately 95 component manufacturers in the area. Of this number approximately 20% are engaged in production of various types of transformers. There still is need for basic components producers in the West.

S. F. Arn, Packard Bell Co., reporting of research and development said that the airframe manufacturers expected their staffs of some 6000 electronic engineers to double by

1960. In addition to airframe manufacturers, some 203 electronic companies are engaged in significant R&D work. M. V. Kiebert of Convair-Pomona reviewed basic aspects of guided missiles and indicated the direction of R&D in this activity. C. J. Breitwieser, Vice President, Lear Inc., reviewed the needs of R&D in fields of automation, audio devices, industrial instrumentation, atomic energy, communication and semi-conductive devices. J. R. Bradburn, president, ElectroData Corp. pointed out that about one fourth of the nation's data processing equipment manufacturers are located in metropolitan Los Angeles. About 35% of their dollars is for purchased or subcontracted parts and assemblies. He expects this industry segment to expand eight-fold by 1960.

Julian K. Sprague, President of Sprague Electric Co. delivered the luncheon address at which time he noted that the West Coast now has about 75% of the instrumentation industry. This is due in part to the relatively great number of small firms specializing in the solution of design and assembly problems. The great majority of these firms have less than 100 employees and annual sales of under one million dollars. Mr. Sprague traced the continuing growth pattern of Western Electronic Industries in the fields of military and entertainment electronics. The fact that 60% of annual WESCON exhibitors were eastern manufacturers is further evidence that this rich market with its expanding population has been recognized.

Truscon Anniversary

America's broadcasting towers are getting so tall that the 1,000-footers may soon be "just average," Truscon Steel Div. of Republic Steel Corp., suggested as it ticked off its own 20th anniversary as one of the pioneer fabricators of such structures. In those 20 years, C. B. McGehee, General Manager of Sales, estimated the company has produced more than 900 towers. Placed one atop another, the total would reach to a height of 48 miles. Television's special broadcasting requirements are largely responsible for the skyscraping trend, Mr. McGehee said.

New Lab Announced

Donald R. Larimer, Pres. of General Crystal Co., Burlington, Wis., has announced the formation of Northern Engineering Labs. as an affiliate of his company.

IRE Convention

(*Continued from page 89*)

Application of a Magnetic Amplifier to a High-Performance Instrument Servo, Paul R. Johannessen, Servomechanisms Lab., M.I.T., Cambridge 39, Mass.

A Non-Linear Compensating Configuration for Saturating Servomechanisms, W. H. Surber, Electrical Engineering Dept., Princeton University, Princeton, N. J.

Delay-Line Methods for Compensating Closed-Loop Systems in the Time Domain, R. E. Scott and Y. C. Ho, Research Lab. of Electronics, M.I.T., Cambridge, Mass.

Tuesday, March 22, A.M.

TELEMETRY & REMOTE CONTROL—II—REMOTE CONTROL

Chairman: Charles H. Doersam, Jr., Sperry Gyroscope Co., Div. of The Sperry Corp., Great Neck, N. Y.

New Apparatus and Techniques of Air Traffic Control Data Handling and Display, David J. Anthony, Consolidated Vultee Aircraft Corp., San Diego, Calif.

The Role of the Digital Computer in Processing Guided Missile Data, H. N. Morris, RCA Missile Test Project, Air Force Missile Test Center, Patrick Air Force Base, Fla.

A New Method for Designing the Compensation of Feedback Control Systems, Gilbert S. Stubbs, The Franklin Institute, Philadelphia 3, Pa.

Analysis of Sampled Data Systems and Digital Computers in the Frequency Domain, Rubin Boxer, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

ANTENNAS & PROPAGATION—II—ANTENNAS

Chairman: George Sinclair, President, Sinclair Radio Laboratories, Ltd., 1197 Lawrence Ave., W., North Park P.O., Ontario, Canada

Omnidirectional Circularly Polarized Antennas, K. S. Kelleher and C. W. Morrow, Melpar, Inc., 452 Swann Ave., Alexandria, Va.

The N.R.L. Precision "Big Dish" Antenna, D. L. Holzschuh, Collins Radio Co., Cedar Rapids, Ia.

The Omniguide Antenna; an Omnidirectional Waveguide Array for UHF-TV Broadcasting, O. M. Woodward, Jr., RCA Labs., Princeton, N. J. and James Gibson, Huskvarnavagen 122, Vattersnas, Sweden

The Circular Traveling-Wave Antenna, W. J. Bergman and F. V. Schultz, Univ. of Tenn., Knoxville, Tenn.

Stripline Radiators, James A. McDonough, Airborne Instruments Lab., Inc., Mineola, N. Y.

AERONAUTICAL & NAVIGATIONAL ELECTRONICS—I—AIRBORNE DEVICES AND ENVIRONMENT

Chairman: G. L. Haller, General Electric Company, Syracuse, N. Y.

Aircraft Electronics—Environment, Specifications and Survival, M. B. Levine and F. Mintz, Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill.

Dynamic Environmental Testing of Airborne Electronic Components, R. H. Jacobson and M. B. Levine, Armour Research Foundation, Illinois Institute of Technology, Chicago 16, Ill.

A Communication Theory Approach Toward the Design of Aircraft Instrument Displays, Lawrence J. Fogel, Stavid Engineering, Inc., 312 Park Ave., Plainfield, N. J.

The C19K Charactron, J. T. McNaney, Consolidated Vultee Aircraft Corp., San Diego 12, Calif.

Versatility of Floated-Type Rate Integrating Gyroscopes in Systems Applications, J. W. Lower, Minneapolis-Honeywell Regulator Co., Minneapolis 13, Minn.

BROADCAST TRANSMISSION SYSTEMS—I—TV BROADCASTING

Chairman: Ronald J. Rockwell, WLW, Crosley Broadcasting Corp., 140 West 9 St., Cincinnati 2, Ohio

Synchronization of Multiplex Systems for Recording Video Signals on Magnetic Tape, Donald E. Maxwell and William P. Bartley, Electronics Lab., General Electric Co., Syracuse, N. Y.

Channel Response Requirements of Multiplex Systems for Recording Video Signals on Magnetic Tape, Benjamin G. Walker, Electronics Lab., General Electric Co., Syracuse, N. Y.

Ferrite Heads for Magnetic Recording in the Megacycle Range, William R. Chynoweth, Electronics Lab., General Electric Co., Syracuse, N. Y.

Attenuation Measurements on Short Line Samples, Louis E. Raburn, Crosley Div., Avco Mfg. Corp., 4890 Spring Grove Ave., Cincinnati 32, Ohio

A New Television Transmitting Antenna, R. W. Masters and C. J. Rauch, The Antenna Lab., The Ohio State University, Department of Electrical Engineering, Columbus 10, Ohio

Spurious Emission Filters for High Power TV Transmitters, William J. Judge, Jr., Allen B. DuMont Labs., Inc., Communication Products Div., Development Engineering Dept., 1500 Main Ave., Clifton, N. J.

AUDIO—I—GENERAL

Chairman: Harry F. Olson, Acoustical Lab., RCA Labs., Princeton, N. J.

Electronically Controlled Audio Filters, L. O. Dolansky, 360 Huntington Ave., Boston, Mass.

Distortion in Class B Transistor Amplifiers, Maurice V. Joyce, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N. Y.

Detection of Audio Power Spectrum Dispersion, H. S. Littleboy and J. Wiren, Northeastern University, 360 Huntington Ave., Boston, Mass.

Calibration of Test Records by B-Line Patterns, Benjamin B. Bauer, Shure Bros., Inc., 225 W. Huron St., Chicago 10, Ill.

Design and Performance of a High Frequency Electrostatic Speaker, Lloyd J. Bobb, R. B. Goldman and R. W. Roop, Philco Corp., C & Tioga Sts., Philadelphia 34, Pa.

Electronic Music Synthesizer, Harry F. Olson and Herbert Belar, RCA Labs., Princeton, N. J.

INFORMATION THEORY—I

Chairman: Louis A. deRosa, Federal Telecommunication Labs., 500 Washington Ave., Nutley, N. J.

Coding for Noisy Channels, Peter Elias, M.I.T., 77 Massachusetts Ave., Cambridge 39, Mass.

The Rate of Approach to Ideal Coding, Claude E. Shannon, Bell Telephone Labs., Murray Hill, N. J.

The Mathematics of Information Theory, Brockway McMillan, Bell Telephone Labs., Murray Hill, N. J.

Session Commentary, Robert M. Fano, M.I.T., 77 Massachusetts Ave., Cambridge 39, Mass.

INSTRUMENTATION & TELEMETRY AND REMOTE CONTROL

Chairman: Robert L. Sink, Consolidated Engineering Corp., 300 North Sierra Madre Villa, Pasadena, Calif.

Compound Modulation: Method of Recording Data on Magnetic Tape, George B. Newhouse, Consolidated Engineering Corp., 300 No. Sierra Madre Villa, Pasadena 15, Calif.

Development of a Portable Magnetic Tape Recorder for Precision Data Recording, Glenn D. Maxwell, Consolidated Engineering Corp., 300 No. Sierra Madre Villa, Pasadena 15, Calif.

A System for Precise Time-Storage and Expansion of Electrical Data, Clarence B. Stanley, Ampex Corp., 934 Charter St., Redwood City, Calif.

Automatic Oscillograph Readers, Louis L. Fisher and George L. Hatchett, J. B. Rea Co., Inc., 1723 Cloverfield Blvd., Santa Monica, Calif.

Analysis of Data Recording Systems, Thomas L. Greenwood, Recorder & Electronics Lab., Redstone Arsenal, Huntsville, Ala.

ELECTRON DEVICES—I—TUBES

Chairman: G. D. O'Neill, Sylvania Electric Products, Inc., Sylvania Center, Bayside, N. Y.

A Gas Discharge Noise Source, Philip Parzen and W. Honig, The Johns Hopkins University, Radiation Lab., 1315 St. Paul St., Baltimore 2, Md.

Corrections to the Theory of the Grounded-Grid Triode, W. A. Harris, Radio Corp. of America, Tube Div., Harrison, N. J.

Development of a Large-Diameter Dumet Lead for Sealing to Soft Glass, D. L. Swartz and J. C. Turnbull, Radio Corp. of America, Tube Div., Lancaster, Pa.

Novel Design Approach for Microwave Tubes, J. E. McLinden and D. Lichtman, Airborne Instruments Lab., Inc., Mineola, N. Y.

IRE Convention

(*Continued from page 163*)

Magnetron Operation at Very-Long Pulses, Marcus Nowogrodzki, Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y.

Tuesday, March 22, P.M.

INSTRUMENTATION—II

Chairman: Edwin P. Felch, Bell Telephone Laboratories, Inc., Whippany, N. J.

A New Instrument for the Automatic Measurement of Transistor Noise Figure, D. D. Grieg and S. Moskowitz, Electronic Research Associates, Inc., P.O. Box 29, Caldwell, N. J.

A Radio Frequency Parameter Bridge for Junction Transistors, Anthony Hlavacek and Ge Yao Chu, Sylvania Electric Products Inc., Electronic Div., Ipswich, Mass.

A Versatile Transistor Tester for Measuring Open Circuit "T" Parameters, R. P. Crow, Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.

A Transistorized Oscillograph, W. G. Reichert, Jr., Allen B. DuMont Labs., Inc., Instrument Div., 760 Bloomfield Ave., Clifton, N. J.

A 200 CPS to 5 MC Recording Equipment, Charles C. Comstock, Signal Corps Engineering Labs., Ft. Monmouth, N. J.

ENGINEERING MANAGEMENT—I PANEL DISCUSSION: OPERATIONS RESEARCH—A TOOL OF ENGINEERING MANAGEMENT

Chairman: C. M. Jansky, Jr., Jansky & Bailey, Inc., 1735 DeSales St., N.W., Washington 6, D. C.

AERONAUTICAL & NAVIGATIONAL ELECTRONICS—II—RADAR AND AIRCRAFT LANDING AIDS

Chairman: Bernal M. Meador, Trans World Airlines, 400 E. Donovan Rd., Kansas City 15, Kans.

Airport Surface Detection Equipment, J. E. Woodward, Airborne Instruments Lab., Inc., Mineola, N. Y.

A Marine Radar Identification System, Charles M. Tiffin, Federal Telecommunication Labs., 500 Washington Ave., Nutley 10, N. J.

Statistical Techniques for Analysis of ILS Flight-Test Data, Abe Tatz, Airborne Instruments Lab., Inc., Mineola, N. Y.

An Analysis of Angular Accuracy in Search Radar, Robert Bernstein, Electronics Research Labs., Columbia University, 632 West 125 St., New York 27, N. Y.

Radio Direction Finding from the Standpoint of Sampling and Interpolation, M. Masonson, Federal Telecommunication Labs., 500 Washington Ave., Nutley 10, N. J.

BROADCAST TRANSMISSION SYSTEMS—II—COLOR TELEVISION

Chairman: Robert E. Shelby, Vice-Pres. & Chief Eng., NBC, Inc., 30 Rockefeller Plaza, N. Y. 20

Proposed Controls for Electronic Masking in Color Television, W. L. Brewer, J. H. Ladd and J. E. Pinney, Color Technology Div., Eastman Kodak Co., Rochester, N. Y.

Experimental Equipment for Recording and Reproducing Color Television Images on Black and White Film, William L. Hughes, Iowa State College, Engineering Experiment Station, Ames, Ia.

Cathode-Ray Vectrograph, Frank Uzel, Jr., Allen B. DuMont Labs., Inc., Instrument Div., 760 Bloomfield Ave., Clifton, N. J.

Automatic Balance Control of Colorplexers in Color TV, J. R. Popkin-Clurman, Telechrome, Inc., 632 Merrick Rd., Amityville, N. Y.

Television in Europe, Hubert A. S. Gibas, Uster, Bahnstr. 7, Switzerland

AUDIO—II—SYMPOSIUM: MUSIC, HIGH FIDELITY, AND THE LISTENER

Chairman: Leo L. Beranek, Bolt Beranek & Newman, Inc., 16 Eliot St., Cambridge 38, Mass.

Electronic Organ Tone Radiation, Daniel W. Martin, The Baldwin Co., 1801 Gilbert Ave., Cincinnati 2, Ohio

The Role of Room Acoustics in Music Listening, John A. Kessler, Acoustics Lab., M.I.T., Cambridge 39, Mass.

Environment-Fitness Considerations of High-Fidelity Audio Systems, Robert D. Darrell, Balmoral, The Vly, Stone Ridge, N. Y.
Acoustic Requirements of a Sound System Determined by the Listener, Cyril M. Harris, Acoustics Lab., Columbia University, 632 West 125 St., New York 27, N. Y.
Man, A Somewhat Neglected Component of Hi-Fi Systems, Walter A. Rosenblith, Department of Electrical Engineering, M.I.T., Cambridge 39, Mass.

TELEMETRY AND REMOTE CONTROL—III—RECENT TELEMETERING DEVELOPMENTS

Chairman: Martin V. Kiebert, Jr., Convair, Box 1011, Pomona, Calif.
A Multiple Frequency Antenna Coupling System, Harvey R. Sigler, Bendix Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, N. Hollywood, Calif.
Germanium Photo-Conductor as Missile Spin Counter in an All-Transistor FM/FM Telemeter Transmitter, C. M. Kortman, Bendix Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, N. Hollywood, Calif.
Linear Voltage Controlled Frequency Modulation of the Hartley Oscillator, W. F. Link, Bendix Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, N. Hollywood, Calif.
Application of Process Circuitry to Telemetering Components, L. A. G. Ter Veen, Bendix Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, N. Hollywood, Calif.
Wide Band AC Rate Networks, L. F. Lyons, Bendix Pacific Div., Bendix Aviation Corp., 11600 Sherman Way, N. Hollywood, Calif.

ELECTRON DEVICES—II—MICROWAVE TUBES

Chairman: Wellesley J. Dodds, RCA Tube Division, Harrison, N. J.
Klystron Power Amplifiers for Long-Hop Microwave Relay, N. P. Hiestand, Varian Associates, 611 Hanson Way, Palo Alto, Calif.
Wide-Band, High Power Traveling-Wave Tubes at S-Band, S. F. Kaisel and W. L. Rorden, Electronics Research Lab., Stanford University, Stanford, Calif.
A 1 KW Pulsed Traveling-Wave Tube Amplifier at X-Band, J. E. Nevins, S. F. Kaisel and M. Chodorow, Electronics Research Lab., Stanford University, Stanford, Calif.
Noise Analysis of Traveling-Wave Tube Video Detector, Glen Wade, Electronics Research Lab., Stanford University, Stanford, Calif.

AUTOMATIC CONTROL—II—TRENDS IN AUTOMATIZATION OF PROCEDURES AND PROCESSES IN BUSINESS AND INDUSTRY

Chairman: Gordon S. Brown, Head, Electrical Engineering Dept., M.I.T., Cambridge 39, Mass.
Panel Members: Professor Richard L. Meier, Department of Sociology, University of Chicago, 1126 East 59 St., Chicago 37, Ill. Dr. W. R. G. Baker, Vice President of Electronics, General Electric Co., Electronics Park, Syracuse, N. Y. Mr. Low K. Lee, Head, Advanced Techniques Lab., Dept. of Engineering Res., Stanford Research Institute, Stanford, Calif. Mr. Roger W. Bolz, Editor, Automation, Penton Publishing Company, Cleveland, Ohio

AUDIO—III—SEMINAR: MAGNETIC RECORDING FOR THE ENGINEER

Chairman: Semi J. Begun, Clevite-Brush Development Co., 540 E. 105th St., Cleveland 8, Ohio
Magnetic Tape as a Recording Medium, Frank Radocy, Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.
Recorder-Reproducer Design, Walter T. Selsted, Ampex Corp., 934 Charter St., Redwood City, Calif.
Tape Recording Applications, Marvin Camras, Armour Research Foundation, 55 East 33rd St., Chicago 16, Ill.
Tape Life, William S. Latham, 658 Eastern Point Road, Groton, Conn.
The Future of Magnetic Recording, John S. Boyers, The National Co., 61 Sherman St., Malden, Mass.

Wednesday, March 23, A.M.

ULTRASONICS—I

Chairman: Frank Massa, Massa Labs., Inc., 5 Fottler Rd., Hingham, Mass.

For product information, use inquiry card on last page.

IRE Convention

(*Continued from page 165*)

Antenna-Type Transducers for Ultrasonic Flowmetering, R. C. Swengel, Pennsylvania Water & Power Co., 405 Fulton National Bank Bldg., Lancaster, Pa.

Electrokinetic Hydrophones, Ernest Yeager, Ultrasonics Research Lab., Western Reserve Univ., Cleveland, Ohio

Characteristics of Torsional Transducers, R. N. Thurston and Peter Andreatch, Bell Telephone Labs., Inc., Murray Hill, N. J.

Parameters Affecting the Q of Quartz Crystal Units, A. W. Warner, Bell Telephone Labs., Inc., Whippany, N. J.

The Frequency-Temperature Behavior of Piezoelectric Resonators Made of Natural and Synthetic Quartz, Rudolph Bechmann, The Brush Labs. Co., Div. of Clevite Corp., 540 East 105th St., Cleveland, Ohio

Ultrasonics in the Decortication of Natural Fibers, Ethel R. Fleming, B. M. Harrison Labs., Newton Highlands, Mass.

ELECTRONIC COMPUTERS—I

Chairman: Harry Larson, Computer Systems Div., Ramo-Wooldridge Corp., 8820 Bellanca Ave., Los Angeles 45, Calif.

Experiments on a Three-Core Cell for High-Speed Memories, J. Raffel and S. Bradspies, M.I.T., Lincoln Lab., P.O. Box 73, Lexington 73, Mass.

Bimag Circuits for Digital Data-Processing Systems, David Loev, William Miehle, John O. Paivinen and Joseph Wylen, Burroughs Corp., Research Center, Paoli, Pa.

A Transistor-Magnetic Core Circuit; A New Device Applied to Digital Computing Techniques, S. S. Guterman and W. M. Carey, Jr., Raytheon Mfg. Co., 100 River St., Waltham 54, Mass.

A "One-Turn" Magnetic Reading and Recording Head for Computer Use, D. F. Brower, Business Systems Dept., Hughes Aircraft Co., Research and Dev. Labs., Culver City, Calif.

Magnetic Selection Systems Using a Single Pyramid for Both Selective Writing and Reading in Large Scale Electronic Computers, Amir H. Sepahban, Monrobot Lab., Monroe Calculating Machine Co., Hanover Ave., Morris Plains, N. J.

MICROWAVE THEORY & TECHNIQUES—I—MICROWAVE COMPONENTS

Chairman: N. F. Englemann, Federal Telecommunications Labs., Inc., 500 Washington Ave., Nutley 10, N. J.

Wideband Waveguide Rotary Joint, Henry Schwiebert, Wheeler Labs., Great Neck, N. Y.

The Use of Modified Coaxial Structures for the Instrumentation of Components in Coaxial Line. Bernard Dwork, Harvard University, Cambridge, Mass. and Arthur A. Oliner, Polytechnic Institute of Brooklyn, Microwave Research Institute, 55 Johnson St., Brooklyn 1, N. Y.

High Power Breakdown of Microwave Components, G. K. Hart and M. S. Tanenbaum, Sperry Gyroscope Co., Greak Neck, N. Y.

A Low Noise Figure Microwave Crystal Diode, G. Messenger and C. T. McCoy, Philco Corporation, Philadelphia 34, Pa.

Tapered Velocity Couplers, J. S. Cook, Bell Telephone Labs., Inc., Murray Hill, N. J. and A G. Fox, Bell Telephone Labs., Inc., Box 107, Red Bank, N. J.

PRODUCTION TECHNIQUES—ELECTRONIC EQUIPMENT ASSEMBLY METHODS

Chairman: Ralph R. Batcher, 2402 42nd Ave., Douglaston, N. Y.

Electronic Design for a Digital Computer, R. J. O'Neill, Business Systems Dept., Hughes Research and Development Labs., Culver City, Calif.

A Flexible Automatic Component Assembly System, Ben Warriner and George W. Gamble, General Electric Co., Advanced Electronics Center, Cornell University, Ithaca, N. Y.

Principles of Circuit Packaging for Auto-Sembly, Sherman G. Bassler, Signal Corps Engineering Labs., Ft. Monmouth, N. J. and Myron Hinebaugh, P. R. Mallory & Co., Inc., 3029 East Washington St., Indianapolis, Ind.

Standards for Automation, J. J. Graham, Mfg. Engineering Administration, Production Dept., Radio Corp. of America, Camden, N. J.

Mechanization of Electronic Equipment, Frank B. Iles, Mfg. Engineering Administration, Production Dept., Radio Corp. of America, Camden, N. J.

An Engineering Approach to Printed Circuitry and Automation for Television Receivers, Rinaldo DeCola and George Harrigan, Admiral Corp., 3800 Cortland St., Chicago 47, Ill.

INSTRUMENTATION AND NUCLEAR SCIENCE

Chairman: Urner Liddel, Bendix Aviation Corp., 1104 Fisher Bldg., Detroit 2, Mich.

An Atomic Frequency Standard, Jerrold R. Zacharias, James G. Yates and R. D. Haun, Jr., Research Lab. of Electronics, M.I.T., Cambridge, Mass.

A Molecular Microwave Amplifier, Oscillator, and Frequency Standard, Charles H. Townes, Columbia University, New York, N. Y.

Collision Reduced Doppler Effect. A Sodium Clock?, R. H. Dicke, Palmer Physical Lab., Princeton University, Princeton, N. J. (On leave at Physics Dept., Harvard University 1954-1955)

Eddy-Current Bridge for Measurement of Skin Losses, Quentin A. Kerns, Radiation Lab., Dept. of Physics, Univ. of Calif., Berkeley, Calif.

Modifications to the Hutchison-Scarrott Pulse Height Analyser to Obtain a Coded Decimal Presentation and a Decimal Print-Out, J. L. McKibben, J. D. Gallagher and H. J. Lang, Los Alamos Scientific Lab., Los Alamos, N. M.

SYMPOSIUM ON SPURIOUS RADIATION

Chairman: Dr. Lloyd V. Berkner, President, Associated Universities, Inc., 350 Fifth Ave., New York 1, N. Y.

CIRCUIT THEORY—II—GENERAL THEORY

Chairman: Samuel J. Mason, M.I.T., Cambridge, Mass.

A Generalization of Foster's and Cauer's Theorems, F. M. Reza, M.I.T., Electrical Engineering Dept., Cambridge, Mass.

On the Separability of LaPlace Transform Variable and Its Applications in Carrier Systems, Sheldon S. L. Chang, New York University, Dept. of Electrical Engineering, University Heights, New York 53, N. Y.

A New Approach to the Approximation Problem, Walter L. Baker, Pennsylvania State University, Ordnance Research Lab., P.O. Box 30, State College, Pa.

A New Series Representation for Correlation Functions, W. M. Kaufman and J. B. Woodford, Carnegie Institute of Technology, Dept. of Electrical Engineering, Pittsburgh 13, Pa.

Theory of Low-Frequency Oscillators Employing Point-Contact Transistors, B. J. Dasher, D. L. Finn and T. N. Lowry, Georgia Institute of Technology, Atlanta, Georgia

ANTENNAS AND PROPAGATION—III—EXTENDED RANGE VHF AND UHF PROPAGATION—PANEL DISCUSSION

Chairman: Jerome B. Wiesner, Professor and Director, Research Lab. of Electronics, M.I.T., 77 Massachusetts Ave., Cambridge 39, Mass.

Panel Members: Kenneth Bullington, Bell Telephone Labs., Inc., 463 West St., New York, N. Y. William E. Gordon, Cornell University, Ithaca, N. Y. Oswald Villard, Stanford University, Stanford, Calif. Dana Bailey, National Bureau of Standards, Washington, D. C. Walter Morrow, Lincoln Laboratory, M.I.T., Cambridge, Mass. Ross Bateman, Central Radio Propagation Labs., Washington, D. C.

Wednesday, March 23, P.M.

ULTRASONICS—II

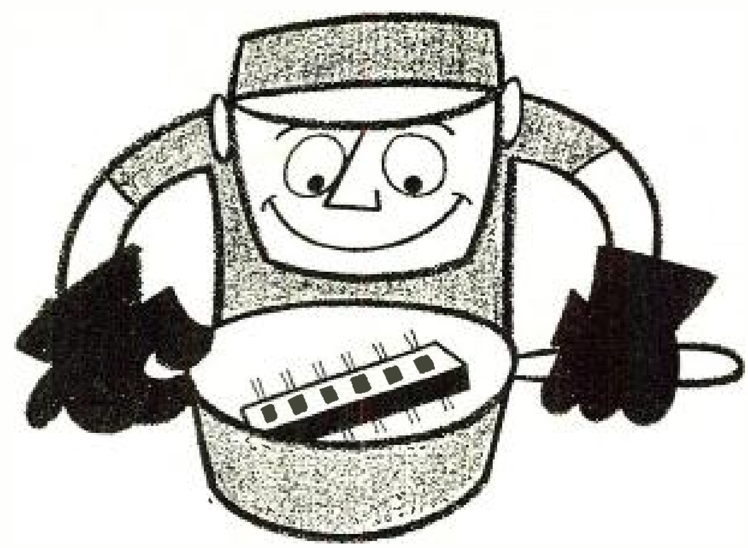
Chairman: Oskar E. Mattiat, The Clevite-Brush Development Co., 540 East 105th St., Cleveland 8, Ohio

Nondestructive Testers by Means of Ultrasonics, Bertram M. Harrison, B. M. Harrison Labs., Newton Highlands, Mass.

Ultrasonic Echo-Ranging for Tissue Diagnostic Studies, John M. Reid and John J. Wild, St. Barnabas Hospital, Medico-Technological Research Dept., 815 S. 11th St., Minneapolis 4, Minn.

Techniques Used in the Ultrasonic Visualization of Soft Tissue Structures of the Body, Douglas H. Howry, Ultrasonic Research Unit, University of Colorado Medical Center, Denver, Colo.

Technical Aspects of the Cavitron Ultrasonic Process in Dentistry, Lewis Balamuth, Cavitron Equipment Corp., 42-26 28th St., Long Island City 1, N. Y.



IRE Convention

(*Continued from page 167*)

Application of Ultrasonics to Clinical Dentistry, Alvin E. Strock, Associate Dental Surgeon, Peter Bent Brigham Hospital, 721 Huntington Ave., Boston 15, Mass.

Ultrasonic Destruction of Erythrocytes, Eugene Ackerman and David B. Lombard, Physics Dept., Pennsylvania State University, State College, Penna.

ELECTRONIC COMPUTERS—II—SYMPOSIUM: THE DESIGN OF MACHINES TO SIMULATE THE BEHAVIOR OF THE HUMAN BRAIN

Chairman: Howard E. Tompkins, Burroughs Research Center, Paoli, Pa.

Panel Members: Anthony G. Gettinger, Harvard Computation Lab., Cambridge 38, Mass. Warren S. McCulloch, Research Lab. of Electronics, M.I.T., Cambridge, Mass. Nathaniel Rochester, I.B.M. Corp., Engineering Lab., Poughkeepsie, N. Y. Otto H. Schmitt, Physics Dept., University of Minnesota, Minneapolis, Minn.

MICROWAVE THEORY & TECHNIQUES—II—MICROWAVE TECHNIQUES

Chairman: W. L. Pritchard, Raytheon Mfg. Co., 148 California St., Newton, Mass.

A Broadband Electronic Doppler Simulator, Gershon J. Wheeler and John Reed, Raytheon Mfg. Co., 148 California St., Newton 58, Mass.

A Contribution to Microwave Measurements, F. J. Tischer, 114 Hillendale Rd., Huntsville, Ala.

Measurement of Electromagnetic Parameters by Use of Spheres Placed Near a Wall in a Resonant Cavity, W. E. Saunders, Ordnance Corps, Diamond Ordnance Fuze Labs., Washington 25, D. C.

Impedance Measurement Through a Discontinuity in a Transmission Line, R. Mittra, University of Toronto, Dept. of Electrical Engineering, Toronto, Ontario, Canada

Measurement of Small Complex Reflection Coefficient, Howard Scharfman, Raytheon Mfg. Co., Missile and Radar Div., Bedford, Mass.

QUALITY CONTROL AND RELIABILITY STUDIES OF ELECTRONIC TUBES AND SYSTEMS

Chairman: Marcus A. Acheson, Sylvania Electric Products, Inc., 83-30 Kew Gardens Road, Kew Gardens, L. I., N. Y.

Prediction of Missile Reliability, M. J. Kirby and H. R. Powell, Sperry Gyroscope Co., Great Neck, N. Y.

Detection of Intermittent Circuit Faults, Sidney Wald, Advanced Development, The Glenn L. Martin Co., Baltimore 3, Md.

Statistics of Electronic System Failures, J. H. Parsons, K. L. Wong, and A. S. Yeiser, Computing and Control Dept., Radar Div., Hughes Aircraft Co., Culver City, Calif.

New Reliable Voltage Reference Tubes for Severe Environmental Conditions, Earl J. Handly, Raytheon Mfg. Co., Receiving and Cathode Ray Tube Operations, 55 Chapel St., Newton 58, Mass.

Guided Missile Reliability and Electronic Production Techniques, Alfred R. Gray, Electronic Engineering Dept., The Glenn L. Martin Co., Baltimore 3, Md.

BROADCASTING AND TELEVISION RECEIVERS

Chairman: Edwin B. Hassler, Director of Engineering, Warwick Mfg. Corporation, 4740 West Madison Street, Chicago, Ill.

A Developmental Pocket-Size Broadcast Receiver Employing Transistors, D. D. Holmes, T. O. Stanley, and L. A. Freedman, RCA Labs., Princeton, N. J.

Progress in Ferrite Components for Television and Radio Receivers, H. M. Schlicke, Allen-Bradley Co., Milwaukee 4, Wis.

What Price—Horizontal Linearity, Monte Burgett and John Tossberg, Philco Corp., Phila., Pa.

A Compatible High Definition Monochrome Television System, Pierre M. G. Toulon and Francis T. Thompson, Westinghouse Electric Corp., Research Labs., East Pittsburgh, Pa.

Determination of the Optimum Demodulation Angles in Color Receivers, Stephen K. Altes, General Electric Co., Syracuse, N. Y.

A Color Projection Receiver, W. F. Bailey and R. P. Burr, Hazeltine Corp., Little Neck, L. I., N. Y.

CIRCUIT THEORY—III—FILTERS AND LINES

Chairman: William H. Huggins, Department of Electrical Engineering. The Johns Hopkins University, Baltimore, Md.

A Method of Rational Function Approximation for Network Synthesis, N. DeClaris, M.I.T., Dept. of Electrical Engineering, Research Lab. for Electronics, Cambridge 39, Mass.

Input Capacitance of Maximally-Flat Filters, John L. Stewart, University of Michigan, Dept. of Electrical Engineering, Ann Arbor, Michigan

Application of Time Series to the Calculation of the Transient Response of Band-Pass Systems, C. J. Peters, Gulf Research & Development Co., Box 2038, Pittsburgh, Pa., and J. B. Woodford, Carnegie Institute of Technology, Schenley Park, Pittsburgh 13, Pa.

Maximizing the Band-Pass Ratio in Impedance Transforming Filters, D. H. Geipel, North American Aviation, Guidance Analysis Group, Downey, Calif., and R. L. Bright, Materials Div., Westinghouse Electric Corp., Pittsburgh 8, Pa.

Miniaturized High Impedance Magnetic Core Delay Line, H. W. Katz and R. E. Schultz, General Electric Co., Electronics Div., Syracuse, N. Y.

ANTENNAS & PROPAGATION—IV—PROPAGATION

Chairman: Kenneth A. Norton, Assistant Chief, Central Radio Propagation Labs., National Bureau of Standards, Boulder, Colorado

Air-Borne Measurement of Effective Ground Conductivity at Low Frequency in Alaska, Glenn M. Stanley and T. Neil Davis, Geophysical Institute of the University of Alaska, College, Alaska

Atmospheric Attenuation of Microwave Radiation, Gene R. Marner, Collins Radio Co., Cedar Rapids, Ia.

Back-Scattering from the Sea Surface, Martin Katzin, Naval Research Lab., Washington 25, D. C.

Measurements of Correlation, Height Gain, and Path Antenna Gain at 1046 Megacycles on Spaced Antennas Far Beyond the Radio Horizon, A. F. Barghausen, M. T. Decker and L. J. Maloney, U. S. Dept. of Commerce, National Bureau of Standards, Boulder, Colorado

An Airborne Radar and Wave Propagation Laboratory, David L. Ringwalt, Naval Research Lab., Washington 25, D. C.

Thursday, March 24, A.M.

MEDICAL ELECTRONICS—I—PANEL DISCUSSION

Chairman: Otto H. Schmitt, Physics Dept., University of Minnesota, Minneapolis, Minn.

Members of the Panel:

Doctors of Medicine:
Stanley Briller, Bellevue Medical Center, New York University, New York, N. Y. Coleman C. Johnston, 211 West Second Street, Lexington, Kentucky. Joseph Moldaver, Institute of Physical Medicine and Rehabilitation, New York, N. Y.

Electronic Engineer and/or Biophysicists:
Britton Chance, The Johnson Foundation, University of Pennsylvania, Philadelphia, Pa. Saul R. Gilford, The Colson Corp., Elyria, Ohio

Physicists:
J. W. Buchta, Physics Dept., University of Minnesota, Minneapolis, Minn. Hector F. Skifter, Airborne Instruments Laboratory, 160 Old Country Road, Mineola, L. I., N. Y.

INFORMATION THEORY—II

Chairman: Thomas P. Cheatham, Melpar, Inc., Galen Street, Watertown, Mass.

Time-Varying Filters for Nonstationary Signals on a Finite Interval, Arnold H. Koschmann, Department of Electrical Engineering, University of Minnesota, Minneapolis 14, Minn.

Analysis of Linear Systems with Randomly Varying Inputs and Parameters, A. Rosenbloom and J. Heilfron, The Ramo-Wooldridge Corp., 6316 W. 92 St., Los Angeles 45, Calif. and D. L. Trautman, Hughes Aircraft Co., Research and Development Labs., Culver City, California

Detection of Coherent and Noncoherent Pulsed Signals, P. Nesbeda, R. F. Drenick and S. Gartenhaus, Radio Corp. of America, RCA Victor Division, Camden 2, N. J.

The Linear Filtering of Sampled Data, Gene Franklin, Columbia University, Electronics Research Labs., New York 27, N. Y.

ELECTRONIC DEVICES—III—CATHODE RAY TYPE TUBES

Chairman: Russell R. Law, CBS-Hytron,

For product Information, use inquiry card on last page.

IRE Convention

(*Continued from page 169*)

Danvers, Mass.

A Time-Samping and Amplitude-Quantizing Tube, R. P. Stone, C. W. Mueller and W. M. Webster, RCA Labs. Div., Princeton, N. J.

Cathode-Ray Tube with Single Step Intensifier, Jenny E. Rosenthal, Tube Research Lab., A. B. DuMont Labs., Inc., 2 Main Ave., Passaic, N. J.

An Electrostatic Shutter Image Converter Tube, B. R. Linden and P. A. Snell, Tube Research Lab., A. B. DuMont Labs., Inc., 2 Main Ave., Passaic, N. J.

A New High Efficiency Parallax Mask Color Tube, M. E. Amdursky, R. G. Pohl and C. S. Szegho, The Rauland Corp., Research Dept., 4245 North Knox Ave., Chicago 41, Ill.

The Tricolor Vidicon—An Experimental Camera Tube for Color Television, P. K. Weimer, S. Gray, H. Borkan, S. A. Ochs and H. C. Thompson, RCA Labs., Princeton, N. J.

COMPONENT PARTS—I—ELECTRO-MAGNETIC DEVICES

Chairman: Reuben Lee, Advisory Engineer, Electronics Div., Westinghouse Electric Corp., 2519 Wilkins Ave., Baltimore 3, Md.

Blocking Oscillator Transformer Design, P. R. Gillette, K. W. Henderson and K. Oshima, Stanford Research Institute, Stanford, Calif.

Improvements in Pulse-Switching Reactor Design, R. A. Mathias and E. M. Williams, Carnegie Institute of Technology, Pittsburgh 13, Pa.

Magnetostriction Resonators as Circuit Elements, R. T. Adams, Federal Telecommunication Labs., 500 Washington Ave., Nutley 10, N. J.

Wide-Range Electrically Tunable Oscillators, John L. Stewart and Kermit S. Watkins, University of Michigan, Dept. of Electrical Engineering, Ann Arbor, Mich.

Fluorochemical Liquid and Gases as Transformer Design Parameters, L. F. Kilham, Jr., and R. R. Ursch, Raytheon Mfg. Co., Transformer Div., Waltham 54, Mass.

NUCLEAR SCIENCE—I

Chairman: Jerome D. Luntz, Editor, Nucleonics, McGraw-Hill Publishing Co., 330 W. 42nd Street, New York 36, N. Y.

A Study of a Variable Frequency Cyclotron Resonant System, M. R. Donaldson, R. E. Worsham and N. F. Ziegler, Oak Ridge National Lab., Oak Ridge, Tenn.

Bevatron Operation, Dick A. Mack, Radiation Lab., University of California, Berkeley, Calif.

A 100 Channel Pulse Height Analyser Using Magnetic Core Storage, Preston W. Byington and C. Wilkin Johnstone, Los Alamos Scientific Lab., Los Alamos, N. M.

One Hundred Channel Serial Memory Pulse Height Analyser, T. L. Emmer, Oak Ridge National Lab., Oak Ridge, Tenn.

Nuclear Reactor Control Systems Utilizing Solid-State Devices, Stephen F. Malaker and Edward Rathje, Daystrom Instrument Co., Archbald, Pa.

A New Frequency-Modulation System for the UCRL 184-Inch Cyclotron, Quentin A. Kerns, Radiation Lab., Dept. of Physics, University of California, Berkeley, Calif.

ENGINEERING MANAGEMENT—II—GENERAL

Chairman: John F. Byrne, Motorola, Inc., 8330 Indiana Ave., Riverside, Calif.

Cost Considerations in Automatic Production, Finley E. Carter, Stanford Research Institute, Stanford, Calif.

Personal Responsibilities of the Professional Engineer, D. J. Simmons, Consolidated Vultee Aircraft Corp., Grant's Lane, Fort Worth, Tex.

The Management of Basic Research, T. M. Linville, General Electric Co., Schenectady, N. Y.

The Organization and Management of Engineering in a Small Company, Roderick M. Scott, Perkin & Elmer, Norwalk, Conn.

MICROWAVE THEORY & TECHNIQUES—III—FERRITES

Chairman: Tore N. Anderson, Airtron, Inc., Linden, N. J.

Behavior of Ferroxdure at Microwave Frequencies, Max T. Weiss, Bell Telephone Labs., Inc., Holmdel, N. J.

Some Applications and Characteristics of

Ferrite at Wavelengths of 0.87 CMS and 1.9 CMS, Clyde Stewart, Collins Radio Co., Cedar Rapids, Ia.

Microwave Devices Using Ferrite and Transverse Magnetic Field, Jorgen P. Vinding, Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif.

Broadband Ferrite Characteristics, Murray B. Loss, Sperry Gyroscope Co., Great Neck, N. Y.

Measurement of Microwave Electric and Magnetic Susceptibilities of Ferrite Spheres, E. G. Spencer, R. C. LeCraw and F. Reggia, Ordnance Corps, Diamond Ordnance Fuse Lab., Washington 25, D. C.

ELECTRONIC COMPUTERS—III

Chairman: Ralph E. Meagher, University of Illinois, Urbana, Ill.

The Typotron—A Novel Character Display Storage Tube, H. M. Smith, Electron Tube Lab., Hughes Aircraft Corp., Culver City, Calif.

Electrographic Recording, Herman Epstein and Frank T. Innes, Burroughs Corporation, Research Center, Paoli, Pa.

Surface-Barrier Transistor Computer Circuits, R. H. Beter, Wm. E. Bradley, Ralph B. Brown of Philco Corp., G & I Division, Philadelphia 34, Pa., and Morris Rubinoff, Moore School of Electrical Engineering, University of Pennsylvania, 200 South 33 St., Philadelphia 4, Pa.

Semi-Conductor Diode Amplifier Considerations, Henry W. Kaufmann, Eckert-Mauchly Division, Remington Rand Inc., Philadelphia, Pa.

An Electronic Circuit for the Generation of Functions of Several Variables, Hans F. Heissinger, Reeves Instrument Corp., 215 East 91 St., New York 28, N. Y.

Thursday, March 24, P.M.

MEDICAL ELECTRONICS—II—GENERAL

Chairman: L. H. Montgomery, Dept. of Anatomy, School of Medicine, Vanderbilt University, Nashville 4, Tenn.

New Linear Electron Accelerators for Radiotherapy, John C. Nygard, and M. Kelliher, Associate Chief Engineer, High Voltage Engineering Corp., 7 University Road, Cambridge, Mass., and L. S. Skaggs, Associate Professor, Medical Physics, Argonne Cancer Research Hospital, Chicago, Ill.

Cineradiography, Lee B. Lusted, Earl R. Miller and Eldon Nickel, Dept. of Radiology, University of California Hospital, University of California Medical School, San Francisco 22, Calif.

The Use of U-V Microspectrophotographic and Phase and U-V Television Densitometry Techniques in Medical Research, Philip O'B. Montgomery, Associate Professor of Pathology, Southwestern Medical School, Dallas, Texas

Application of the Television Ultraviolet Microscope to the Direct Visualization of Cytological Absorption Characteristics, George Z. Williams, Chief, Department of Clinical Pathology, National Institutes of Health, Bethesda, Md.

Some Applications of Scanning Techniques in Instrumentation, C. Berkley and H. P. Mansberg, A. B. DuMont Labs., Inc., Instrument Div., 760 Bloomfield Ave., Clifton, N. J.

ENGINEERING MANAGEMENT—III—SYMPOSIUM: MANAGEMENT SELECTION AS VIEWED BY PSYCHOLOGISTS AND ENGINEERING EXECUTIVES

Chairman: Robert D. Loken, Assistant to Publisher, Life Magazine, New York, N. Y.

Industrial Psychologists:

Selection of Technical Managers as Viewed by a Personnel Psychologist, A. P. Johnson, Educational Testing Services, Princeton, N. J.

Psychological Means for the Selection of Managers, John C. Flannigan, Dept. of Psychology, Univ. of Pittsburgh, Pittsburgh, Pa.

Selection of Engineering Executives, Leroy N. Vernon, Director, The Personnel Lab., 221 N. LaSalle St., Chicago 1, Ill.

Representatives from Engineering Management: Balance in Management Selection, Ronald L. McFarlan, Executive Asst. to Dir. of Engineering, Raytheon Mfg. Co., 148 California St., Newton, Mass.

The Selection of Technical Management Personnel, Dean E. Wooldridge, Pres., Ramo-Wooldridge Corp., 8820 Bellanca Ave., Los Angeles, Calif.

ELECTRON DEVICES—IV—TRANSISTORS

Chairman: Harper Q. North, Pacific Semiconductor, Inc., 6316 West 92 St., Los An-

IRE Convention

(*Continued from page 171*)

geles 45, Calif.

Thermal Properties of Semiconductor Diodes, J. N. Carman and W. R. Sittner, Pacific Semiconductors, Inc., 10451 West Jefferson Blvd., Culver City, Calif.

Grain Boundaries and Transistor Action, Herbert F. Matare, Signal Corps Engineering Labs., Ft. Monmouth, N. J.

Developments in Silicon Junction Diodes and Power Rectifiers, H. Gunther Rudenberg, Transitron Electronic Corp., 403-7 Main St., Melrose 76, Mass.

Comparative High-Frequency Operation of Junction Transistors Made of Different Semiconductor Materials, L. J. Giacoletto, Radio Corp. of America, RCA Laboratories Division, Princeton, N. J.

Characteristics and Some Applications of Fused Junction PNP Germanium Transistors for High Frequency Use, R. D. Greene, Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass.

COMPONENT PARTS—II—GENERAL

Chairman: Lloyd T. DeVore, Manager, Electronics Laboratory, General Electric Co., Electronics Park, Syracuse, N. Y.

A Miniature Precision Delay Line, James B. Hickey, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.

Criteria and Test Procedures for Electro-Magnetic Delay Lines, Norman Gaw and David Silverman, Helipot Corp., Mountainside, N. J.

Evolution of Selenium Rectifier Voltage Ratings, Norman Bechtold, Signal Corps Engineering Labs., Ft. Monmouth, N. J.

A Precision Deflection Yoke, Harold J. Benzuly, Radio Corp. of America, TV Camera Equipment Engineering, Building 10-3, Camden, N. J.

Ceramic-to-Metal Seals for Magnetrons, Leo J. Cronin, Dept. Head, Special Techniques Dept., Raytheon Mfg. Co., Waltham 54, Mass.

MICROWAVE COMMUNICATIONS AND SYSTEMS

Chairman: S. M. Kaplan, General Electric Co., Advanced Electronics Center, Cornell University, Ithaca, N. Y.

Evaluation of Survey Methods for Use in Microwave Path Analysis, W. C. Eddy, Television Associates of Indiana, Inc., East Michigan St., Michigan City, Ind.

A Monopulse Radar Technique, R. M. Page, Naval Research Lab., Washington 25, D. C.

A Frequency Selective Directional Coupler for Multiplexing, Herbert J. Carlin, Polytechnic Institute of Brooklyn, Microwave Research Institute, 99 Livingston St., Brooklyn 1, N. Y.

Application of Ferrites for Audio Modulation of Microwaves, Philip Zirkind, Rome Air Development Center, Griffiss Air Force Base, Rome, New York

A Narrow Band Radar Relay System, C. W. Doerr and J. L. McLucas, Haller, Raymond & Brown, 124 N. Atherton Street, State College, Pa.

AERONAUTICAL & NAVIGATIONAL ELECTRONICS—III—NAVIGATION

Chairman: George Rappaport, Countermeasures Branch, Aircraft Radiation Lab., Wright Field, Dayton, O.

An All Weather Radio Sextant, D. O. McCoy, Collins Radio Co., Cedar Rapids, Ia.

A UHF Ground Based Automatic Direction Finder, Robert L. Cattoi, Collins Radio Co., Cedar Rapids, Ia.

Wellenweber Type Ultra High Frequency Radio Direction Finder, Richard C. Benoit, Jr., Rome Air Dev. Center, Griffiss Air Force Base, Rome, N. Y., and W. M. Furlow, Jr., Melpar, Inc, 452 Swann Ave., Alexandria, Va.

High Precision Computer for Automatic Solution of the Celestial Triangle, Gene R. Marner, Collins Radio Co., Cedar Rapids, Ia.

Jainco: A High Precision Lightweight Aircraft Navigational System, Donald H. Jacobs, The Jacobs Instr. Co., Bethesda, Md.

INFORMATION THEORY—III

Chairman: John W. Mauchly, Remington Rand Inc., 1624 Locust St., Philadelphia 3, Pa.

(*Continued on page 175*)

NAM Files For 700 New Communication Channels in FM Broadcast Band

The National Association of Manufacturers' Committee on Manufacturers Radio Use last month, filed a plan with the FCC looking toward the creation of a manufacturers radio service and the establishment of 700 new frequency channels for communication purposes to be taken from the FM broadcast frequency band with no disturbance to present broadcasting operations. The petition contemplates the shared use of unassigned FM broadcast frequencies by the new manufacturers service as well as all present safety and industrial radio services in a plan leaving existing broadcast stations untouched and providing for any possible growth in the broadcasting operations.

The manufacturers' committee explained that, while the plan is "primarily designed to satisfy the increasing need for radio use by manufacturers," it "paves the way for expansion of radio use by all safety and industrial services." The document will be distributed to all mobile radio user organizations as soon as possible, NAM said.

A summary of the NAM petition pointed out that "The plan destroys the myth current in many quarters that there is a shortage of frequencies. It shows the way toward creating a minimum of 700 new channels for communication purposes.

"Present FM broadcasting will not be disturbed since assignments will be made only on a non-interference basis. The FCC has previously adopted such a sharing plan in connection with the safety services which are considered much more important in the public interest than the entertainment bands."

The statement explained that the country's manufacturers "are presently included in a catchall group of diverse radio users known as the special industrial services," and the number of stations in this group has increased 800% in the past five years, while the number of FM broadcast stations has declined 25%." It declared that "Manufacturers of products such as steel, battleships, planes, tanks and other heavy equipment are hampered by their present allocations in the special industrial radio service," since the "general rules regulating all users in this service are not compatible with the growth of radio in manufacturing plants."

The petition was prepared under the supervision of Committee Chairman Victor G. Reis, of the Bethlehem Steel Co., Executive Assistant Frank M. Smith, and Washington attorney Jeremiah Courtney, counsel for the committee, while the engineering studies were made by George P. Adair, owner of the George P. Adair Engineering Co., in Washington.

IRE Convention

(*Continued from page* 173)

Communication Theory Model and Economics, Samuel Bagno, Alertronic Corp., 4318 Van Dam St., Long Island City 1, N. Y.
Removal of the Redundancy Due to Intersymbol Interference, H. Davis, University of California, Los Angeles 24, Calif. and D. L. Trautman, Hughes Aircraft Co., Research and Development Labs., Culver City, Calif.
Noise Through Non-Linear Devices, Ralph Deutsch, Hughes Aircraft Co., Radar Research and Development Div., Culver City, Calif.
Linear Filter Optimization with Game Theory Considerations, M. C. Yovits and J. L. Jackson, Applied Physics Lab., The Johns Hopkins University, Silver Spring, Md.
The Effect of ACC on Radar Tracking Noise, Richard H. DeLano, Hughes Aircraft Co., Guided Missile Div., Culver City, Calif. and I. Pfeffer, 1009 N. Sweetzer Ave., Los Angeles 46, Calif.

Coming Events

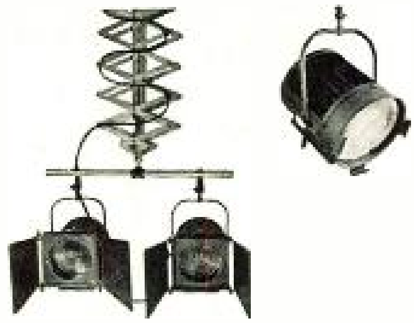
(*Continued from page* 16)

putation Meeting, Brussels, Belgium.
Sept. 30—Oct. 2—High Fidelity Show, Palmer House, Chicago, Ill.
Nov. 2-5—World Symposium on Applied Solar Energy, conducted under leadership of Stanford Research Institute, Phoenix, Arizona.
Nov. 14-17—2nd International Automation Exposition, Navy Pier, Chicago, Ill.

ACM: Assoc. for Computing Machines.
AES: Audio Engineering Society.
AIEE: American Institute of Electrical Engineers.
ASTM: American Society for Testing Materials.
IRE: Institute of Radio Engineers.
IAS: Institute of Aeronautical Sciences.
ISA: Instrument Society of America.
NACE: National Assoc. Corrosion Engineers.
NARTB: National Assoc. of Radio and TV Broadcasters.
RETMA: Radio-Electronics-TV Manufacturers Assoc.
RTCA: Radio Technical Commission for Aeronautics.
RTCM: Radio Technical Commission for Marine Services.
URSI: International Scientific Radio Union.

"Univac" File Available

The new Univac File-Computer, featuring the introduction of fast random access and multiplex monitoring to standard electronic data processing systems, has been announced for delivery this year by Remington Rand Inc. In practical terms, this means that the inventory, cost, or other figures on any item right up to a specific moment may be had by pressing a key; unsorted data can be processed completely in a single high-speed program; and all input media—paper or magnetic tape, 80- or 90-column punched cards, 10-key devices or typewriters —may be used.



FIXED
and adjustable

CINEMA *attenuators*

for

CONTROL CONSOLES

Mixing, branching corrective loss networks. Write for catalogue on your letterhead.

CINEMA ENGINEERING CO.
DIVISION AEROVOX CORPORATION
1100 CHESTNUT ST. • BURBANK, CALIF.

PANEL INSTRUMENTS! BY "SENSITIVE RESEARCH"

A Magic Phrase

FOR ONLY "SENSITIVE" CAN SUPPLY YOU WITH A PANEL INSTRUMENT WITH THE SAME PRECISION AND ACCURACY OF A HORIZONTAL REFERENCE STANDARD INSTRUMENT

MODEL EW
5" hand drawn mirrored scale. Accuracy .25 of 1%

MODEL UPP
4" hand drawn mirrored scale. Accuracy .5 of 1%

VISIT SRIC AT BOOTH 278, INSTRUMENTS AVENUE, NEW YORK CITY I.R.E. SHOW, MARCH 21—MARCH 24

Write for descriptive bulletin on panel instruments

Symbol of Quality

SENSITIVE RESEARCH INSTRUMENT CORPORATION
MOUNT VERNON, N.Y.

ELECTRICAL INSTRUMENTS OF PRECISION SINCE 1927

Drawn Aluminum Cover

Drawn Aluminum Box

New 1955 models of Bendix Depth Recorders. This popular small, low-priced line of depth recorders is made even better for '55.

CASE and COVER PRODUCED for BENDIX by the ZERO METHOD of DEEP DRAWING at a 66⅔% SAVING

Many of America's finest instruments are now housed in precision drawn aluminum cases by Zero. Why? Check costs and quality on the Zero Method of deep drawing—and you'll understand.

For custom or stock (over 900 standard sizes) precision, seamless, deep drawn boxes—call on Zero. Write for our latest catalog.

ZERO MANUFACTURING COMPANY
ZERO BUILDING, BURBANK 1, CALIF.

FORM FLEX TRANSFORMERS

See How FORM-FLEX Saves! CUTS WEIGHT 40%—BULK BY 30%

. . . gives Absolute Transformer Protection at Lower Cost.

Pioneering the development of encapsulation in transformer manufacture has brought Aircraft Transformer a high degree of proficiency in the production of hermetically sealed high and low temp. transformers that far exceed the requirements of MIL-T-27, Grade 1.

If you are faced with weight, space or cost limitations in your components, we invite you to explore the possibilities of our advanced methods. Our engineers and production people will gladly consult with you.

Write for complete data on transformer encapsulation with neoprene and other materials.

AIRCRAFT TRANSFORMER CORPORATION

Manufacturers of Inductive Equipment
Long Branch, New Jersey

Dubilier Awarded Medal

The Cooper Union Alumni Association designated William Dubilier, founder of the Cornell-Dubilier Electric Corp., to receive the first annual award of the Gano Dunn medal. Established this year, the medal is awarded annually to an alumnus of Cooper Union for outstanding professional achievement. Mr. Dubilier was selected from thousands of distinguished Cooper Union men to be the first recipient.

William Dubilier

Subscription TV Battle

Zenith's request that the FCC issue immediate authorization of subscription TV has been followed up by a series of opposition petitions and heated exchanges of letters. NARTB requested that FCC follow customary regulatory procedure rather than approve subscription TV immediately. Commander E. F. McDonald, Jr., President of Zenith, charged that Harold E. Fellows, NARTB President, acted without the authority of the Association membership, and that the NARTB request would scuttle fee TV. NARTB denies this. At about the same time, the Joint Committee on Toll-TV, which includes a group of theater owners opposed to subscription TV, filed a petition opposing Zenith's request. Cmndr. McDonald said that the theater interests were trying to stifle a competitor.

Purchasing Agents Elect

The Purchasing Agents Association has elected officers for 1955. They are: President, H. M. Munson, Bendix Radio; Vice President, S. Oser, Tech-Master; Treasurer, M. A. Schneiderman, Olympic Radio; Corresponding Secretary, B. Trinboli, CBS-Columbia; Recording Secretary, S. Woolfson, Emerson. All East Coast electronic purchasing agents are eligible for membership.

For product information, use inquiry card on last page.

News of MANUFACTURERS' REPS

Reps for precision electrical indicating instruments manufactured by long established firm, are needed in two areas. The first comprises N. Dakota, S. Dakota, Nebraska, Minnesota, Iowa, N. Wisconsin. The second is composed of Alabama, Georgia, Tennessee and Kentucky. (Ask for R-3-1)

Manufacturer of precision electromechanical equipment seeks additional contract sales representatives in U.S. except in New England and Eastern seaboard south through District of Columbia. (Ask for R-3-2).

Precision potentiometers are offered for representation in Texas, Arizona, Nevada and California. Also Eastern Canada, Alaska and Hawaii. (Ask for R-3-3)

Representatives for precision test equipment are needed in West Va. and District of Columbia. (Ask for R-3-4)

Jack D. Bruce has become sales rep. for Mathia Klein & Sons, Chicago tool mfr., in the East Central states.

Tom Hunter, Sr., 4410 Irving Park, Chicago, Ill., has become factory representative in Illinois, Ia., S. Wis. and Gary, and Michigan City, Ind. for Cinema Engineering Co. Div. of Aerovox Corp.

Russell G. Ragon has become Sales Rep for Industrial Div. of J. M. Ney Co. of Hartford, Conn. Mr. Ragon makes his headquarters in St. Paul, Minn. and will cover the territory of Ia., Minn. and Wis.

Charles A. Hansen has established his own manufacturers' rep firm in Los Angeles, Calif. He was formerly distributor sales manager of Gramer-Halldorson Transformer Corp., Chicago, Ill.

Andrew H. Baxter, 412 Albee Bldg., Washington, D.C. has been appointed sales rep for Richardson-Allen Corp. of College Point, L.I. in the territory of Dist. of Columbia, Md. and Va.

Joseph Spring, whose offices are at 254 W. 35th St., New York, N.Y. has been appointed to represent Crescent Industries Inc., Chicago, Ill. in the Greater New York area.

R. C. Nordstrom & Co., 580 N. Woodward Ave., Birmingham, Mich. have been named to represent Tobe Deutschmann Corp. in Michigan, excluding the Upper Peninsula.

The Carl H. Schmidt Co. 2405 West McNichols Rd., Detroit 21, Mich. has been appointed sales agents by the Jelliff Mfg. Corp., Southport, Conn. The organization will concentrate on alloy resistance wires, wire-wound precision electrical and electronic components, heating elements, etc., in Michigan, and Toledo, O.

Robert L. Iversen has become associated with **Allen Woods** of 3403 Broadway, Chicago 13, Ill. Mr. Woods is Sales Engineer for Stackpole Carbon Co. and United Transformer Co.

Edward Hoffman of St. Paul, Minn. has been appointed sales representative for Erie Resistor Corp. and will represent the Electronic Div. in Minn. and N. & S. Dakota.

Louis A. Garten, formerly Sales Mgr. of Kay Electric Co. has announced the opening of offices at 25 Valley Rd., Montclair, N.J. and will represent manufacturers in the areas of L.I., N.Y.C., Westchester, N.J., and eastern Pa. The firm now represents Airborne Instruments Lab., Inc., Detectron Co., Edin Co., Inc., Federal Telephone & Radio Co. Instrument Div., Kepco Labs., Inc., Lavoie Labs., Inc., Rutherford Electronics Co. and Technology Instrument Corp. (Instruments).

Gawler-Knoop Co., Roseland, N. J., with offices in Wyncote, Pa. and Silver Spring, Md., has been appointed to represent Offner Electronics, Inc. Chicago, Ill., in Greater N. Y., the eastern half of Pa., Va., N.J., Md., Del., and the District of Columbia. Representation in western Pa., Ohio, and Mich., will be handled by **J. R. Dannemiller Associates**, Cleveland, O. who have offices in Detroit, Mich., and Dayton, O.

George Davis, of the **George Davis Sales Co.**, and past president of the Los Angeles Chapter of the Representatives, now heads the board of governors according to an announcement by W. Bert Knight, president.

NE Reps Directory

The newly published Directory of the New England Chapter of "The Representatives" lists the names and product categories of manufacturers handled by member reps. Copies are available from Henry P. Segel, 131 Newbury St., Boston 16, Mass.

CONSTRUCTION FOR NEELY

Norman B. Neely (l), Pres. and Robert L. Boniface, Gen. Mgr. Neely Enterprises Inc., L.A. Reps, flank Vance Young, Supt. for Bibb, Remmen and Bibb contractors. They are discussing plans for new $250,000 headquarters building being built on historic Campo de Cahuenga site. Completion is expected in April 1955.

"Automated" Production

An "automated" production machine capable of effecting important time-and-cost savings has been developed by RCA for its own use, as well as for sale to the general industry according to T. D. Smith, Vice President and General Manager, RCA Engineering Products Div.

The new machine is designed to "trigger" punches of virtually any pattern of holes for components in electronic printed-circuit panels. The machine is expected to sell for around $14,500, and in addition to this standard model, RCA also will make custom versions to customer specifications.

Operation is by a glass-based cloth tape into which 'master' holes are punched to produce any combination of component holes in printed-circuit panels. Under actual production conditions, the "automated" machine demonstrated two principal advantages:

1. Important cost savings over conventional drill and punch-die methods. In a typical example, in quantities of over 1,000, punching of printed-circuit boards by the automated machine cost an average of five cents each compared with $1.73 and $1.10, respectively for punching boards by drill and punch-die methods. Tool costs for the tape-operated unit are less than $30 for the completed standard tape, compared with hundreds of dollars required by conventional equipment for dies and templates.

2. Valuable saving in time. Conservative estimates of tool-up time required for punch-die and drill equipment are one month and one week respectively. It takes only about four hours to "tool" or prepare the tape for the RCA automated machine, and only three minutes to install the prepared tape.

This push-button machine triggers punches for any combination of holes for printed circuit panel components. Punched tape determines hole pattern. Machine punches up to 12000 holes/min.

Military Contract Awards

Electronic products, dollar value, and names of manufacturing contractors receiving awards as reported by U.S. Dept. of Commerce.

Modification Kit—75,196—Hughes Tool Co., Culver City, Calif.
Modification Kit—46,180—National Cash Register Co., Dayton 9, O.
Accelerometer—93,726—Hughes Tool Co., Culver City, Calif.
Tube, electron—110,124—Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.
Public Address Set—222,750—Audio Equipment Co., Inc., Great Neck, N. Y.
Keyer—26,658—Thieblot Aircraft Co., Inc. Washington, D. C.
Radio Receiver—1,315,005—International Telephone and Telegraph Corp., Clifton, N. J.
Tube, electron—91,061—Raytheon Mfg. Co., Waltham, Mass.
Facsimile Print—175,430—Recordak Corp., 444 Madison Ave., New York 22, N. Y.
Disconnect—34,938—R. E. Darling Co., Inc., 6825 Reed St., Bethesda 14, Md.
Battery—67,633 Gould-National Batteries, Inc., 35 Neoga St., Depew, N. Y.
Oscillograph—125,894—Allen B. DuMont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J.
Copper Bar—27,515—Revere Copper and Brass, Inc., 1301 Wilcomico St., Baltimore 3, Md.
Cable, power—15,085—General Electric Co., 1285 Boston Ave., Bridgeport, Conn.
Anode, silver—220,625—Handy and Harmon, 82 Fulton St., New York, N. Y.
Radar Set, overhaul and repair—3,000,000—Western Electric Co., New York, N. Y.
Generator Sets, conversion—60,000—Air Prod., Inc., Allentown, Pa.
Generator Set—355,555—Wolverine Diesel Power Co., Detroit, Mich.
Tube, electron—64,706—Raytheon Mfg. Co., Power Tube Div., 138 River St., Waltham, Mass.
Tube, electron—27,200—Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.
Tube, electron—28,622—Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.
Tube, electron—38,176—Raytheon Mfg. Co., Microwave and Power Tube Operation, Waltham, Mass.
Indicator—92,512—Eclipse Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.
Generator Sets—65,793—Cummins Engine Co., Inc., Columbus, Ind.
X-Ray Unit—96,637—Picker X-Ray, Southern California Inc., 710 South Lake St., Los Angeles 15, Calif.
Inverter Assys—194,792—Red Bank Div., Bendix Aviation Corp., Eaton, N. J.
Inverter—142,194—Leland Elec. Co., Div., American Mach. & Fdry. Co., Dayton, O.
Generator, synchronizing—92,980—Sperry Gyroscope Co., The Sperry Corp., Great Neck, L. I., N. Y.
Headset—171,640—Radio Corp. of America, Engineering Products Div., Camden, N. J.
Keyer and Operating Spare Parts—46,567—H. O. Boehme Inc., 915 Broadway, New York 10, N. Y.
Switch, pressure—25,370—Cook Electric Company, 2700 North Southport Ave., Chicago 14, Ill.
Q Meter—26,640—Triumph Manufacturing Co., 913 West Van Buren St., Chicago 7, Ill.
Relay Assy—92,879—Curtiss Wright Corp., Caldwell, N. J.
Connector Tube—53,563—Curtiss-Wright Corp., Caldwell, N. J.
Receptacles, electrical—53,563—Curtiss-Wright Corp., Caldwell, N. J.
Kit, replacement—80,365—General Motors Corp., Milwaukee, Wis.
Spare Parts, field coil—Westinghouse Electric Corp., 1625 K. St., N.W., Washington 6, D. C.
Switching Unit, cavity—34,131—Bogart Manu-

(*Continued on page 182*)

Military Contract Awards

(*Continued from page 181*)

facturing Corp., 315 Seigel St., Brooklyn, N. Y.
Battery, silver zinc—680,001—Yardney Electric, New York, N. Y.
Battery, silver zinc—211,130—Electric Storage Battery, Washington, D. C.
Generator, diesel—229,580—Hallett Manufacturing Co., Inglewood, Calif.
Switchboard, degaussing—221,803—Vickers Electric Div., Vickers, Inc., St. Louis, Mo.
Transmitter, radio—63,226—MacKay Radio & Telegraph Co., Inc., New York, N. Y.
Transformer—69,090—Jefferson Electric Co., Bellwood, Ill.
Computer—34,034—G. Felsenthal & Sons, Inc., 3500 N. Kedzie Ave., Chicago 18, Ill.
Actuators—42,205—Airesearch Mfg. Co., Div. of Garrett Corp., 9851 Sepulveda Blvd., Los Angeles 45, Calif.
Modified Equipments—2,120,520—Radio Corp. of America, RCA, Victor Div., Camden, N. J.
Tube, electron—38,870—General Electric Co., Owensboro, Ky.
Switch, rotary—37,122—The Sperry Corp., Sperry Gyroscope Co. Div., Marcus Ave. and Lakeville Rd., Great Neck, L. I., N. Y.
Electrode Assy—79,362—Auto-Lite Battery Corp., Champlain St., Toledo 1, O.
Handsets, telephone—47,875—United States Instrument Corp., 407-11 Broad St., Summit, N. J.
Test Set—88,068—Heyer Products Co., Inc., 471 Cortlandt St., Belleville 9, N. J.
Test Equipment—128,150—General Electric Co. Schenectady, N. Y.
Booster Motors — 97,483 — Aerojet — General Corp., Azusa, Calif.
Plug and Receptacle—36,410—Barlow Electrical Mfg., Co., Inc., 57 State St., Paterson 3, N. J.
Amplifier—52,592—Admiral Corp., 3800 Cortland St., Chicago 47, Ill.
Tube, electron—51,077—Raytheon Mfg., Co., Power Tube Division, 138 River St., Waltham, Mass.
Tube, electron—29,458—Varian Associates, 611 Hansen, Palo Alto, Calif.
Tube, electron—26,213—Radio Corp. of America, Tube Division, 415 S. 5th St., Harrison, N. J.
Tube, electron—43,095—Sylvania Electric Products, Inc., 1740 Broadway, New York, N. Y.
Oscillator—218,944—Collins Radio Co., 855-35th St., N. E., Cedar Rapids, Ia.
Tube, electron—59,948—Raytheon Mfg., Co., Microwave & Power Tube Div., Chapel St., Newton, Mass.
Tube, electron—25,200—CBS-Hytron, Div. of Columbia Broadcasting System, Inc., 100 Endicott St., Danvers, Mass.
Tube, electron—33,750—Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.
Goniometer—100,406—Bendix Aviation Corp., Pioneer Div., Teterboro, N. J.
Amplifier & Gyro Assy—1,856,111—Lear, Inc., Grand Rapids Div., Grand Rapids, Mich.
Calibrator, diffuser-mechanism — 26,982 — Bendix Aviation Corp., Eclipse-Pioneer, Teterboro, N. J.
Floating Target, radar—126,340—Dallenbarger Machine Co., 379 West Broadway, New York 12, N. Y.
Multimeter—27,824—Crescent Communications Corp., 81 Hamilton St., New London, Conn.
Battery—250,950—Reading Batteries, Inc., Reading, Pa.
Control, antenna—236,710—J. H. Smith Mfg. Co., Little Britain Rd., Newburgh, N. Y.
Tube, electron—28,410—Raytheon Mfg. Co., Newton, Conn.
Tube, electron—44,211—Lewis & Kaufman Ltd., P. O. Box 337, Los Gatos, Calif.
Control, frequency—85,575—Western Electric Co., 120 Broadway, New York 5, N. Y.
Target Drone—5,195,558—Radioplane Co., Van Nuys, Calif.

Box Relay, resistor—42,527—Bendix Aviation Corp., Scintilla Div., Sidney, N. Y.
Inverter—141,081—Bendix Aviation Corp., Red Bank Div., Eatontown, N. J.
Generator—489,644—General Electric Co., Schenectady, N. Y.
Generator, acft—421,962—Bendix Aviation Corp., Red Bank, Div., Eatontown, N. J.
Cable—27,984—Airtron, Inc., 1101 W. Elizabeth Ave., Linden, N. J.
Magneto Assy—36,355—American Bosch Arms Corp., American Bosch Div., 3664 Main St., Springfield 7, Mass.
Actuator—32,450—Aeroproducts Operations Allison Div., General Motors Corp., Municipal Airport, Dayton 1, O.
Generator Set—6,060,407—Beech Aircraft Corp., Wichita, Kan.
Actuator—495,066—Lear, Inc., Grand Rapids, Mich.
Actuator—547,234—Airesearch Mfg. Co., Garrett Corp., Los Angeles, Calif.
Thermostatic Assy—46,425—Robertshaw-Fulton Controls Co., Fulton Syphon Div., 2400 W. Cumberland Ave., Knoxville, Tenn.
Antenna—175,492—Raytheon Mfg., Co., 100 River St., Waltham, Mass.
Countermeasure Set — 3,543,244 — Gilfillen Bros., Inc., 1815 Venice Blvd., Los Angeles, Calif.
Radio Set—2,418,859—Federal Telephone and Radio Corp., 100 Kingsland Rd., Clifton, N. J.
Chest Set, radio—90,570—Ampco Mfg. Co., 9 River St., Morristown, N. J.
Test Set—26,829—Belock Instrument Corp., College Point, New York.
Receiving Set, radio—69,473—Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.
Bridge, resistance—173,574—Gray Instrument Co., 64 West Johnson St., Phila., Pa.
Rawin Set—369,888—The Allen D. Cardwell Electronics Products Corp., 97 Whiting St., Plainville, Conn.
Tube, electron—175,316—Tung-Sol Electric Inc., 95 Eighth Ave., Newark 4, N. J.
Tube, electron—83,411—General Electric Co., 1 River Rd., Schenectady, N. Y.
Switchboard, telephone—94,336—Automatic Mfg. Co., 1033 West Van Buren St., Chicago, Ill.
Crystal Unit—37,545—Hughes Aircraft Co., Culver City, Calif.
Tube, electron—40,634—Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.
Tube, electron—56,307—Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass.
Tube, electron—47,628—Radio Corp. of America, Tube Dept., Harrison, N. J.
Tube, electron—126,511—Radio Corp. of America, RCA, Victor Div., Harrison, N. J.
Tube, electron—46,531—Lewis & Kaufman, Ltd., P.O. Box 337, Los Gatos, Calif.
Tube, electron—38,669—Radio Corp. of America, RCA, Victor Div., Harrison, N. J.
Heating Element, thermocouple—29,222—Weston Electrical Instrument Corp., 101 N. 3rd St., Philadelphia, Pa.
Tube, electron—29,828—Chatham Electronics, Div. of Gera Corp., 630 Mt. Pleasant Ave., Livingston, N. J.
Cable Assy—27,486—Hallett Mfg. Co., 160 W. Florence Ave., Inglewood, Calif.
Test Set—69,960—Telectro Industries Corp., 35-16 37th St., Long Island City, N. Y.
Tube, electron—142,800—Sonotone Corp., Elmsford, N. Y.
Controller, manual acoustic—58,654—Electronic Engineering and Service Co., Inc., Falls Church, Va.
Controller, A automatic—135,168—Cline Electric Manufacturing Co., Chicago, Ill.
Brass Welding Rod—52,202—American Brass Co., Waterbury, Conn.
Field Coil—13,180—Elliott Co., 1001 Washington Gaslight Bldg., 740 11th St., N.W. Washington, D. C.
Mass Spectrometer—42,650—CEC Instruments, Inc., 300 N. Sierra Madre Villa, Pasadena, Calif.

PERSONAL

Nello Coda has been promoted to Chief Engineer of the Electronics Div. of Erie Resistor Corp., Erie, Pa. Before this promotion Mr. Coda was Chief Electrical Engineer for the firm.

Dr. George L. Haller has become Mgr. of the Laboratories Dept. of General Electric Co.'s Electronics Div. Prior to this appointment Dr. Haller was dean of the College of Chemistry and Physics at Pennsylvania State Univ.


G. L. Haller


W. Firestone

Dr. William Firestone has been advanced to the newly created position of Assistant Chief Engineer of the Research Dept. of Motorola's Communications and Electronics Div. He also continues in his present position as head of the Advanced Investigation section of the Research Dept.

A. C. Boss has been named chief field engineer of the Television and Broadcast Receiver Div. of Bendix Aviation Corp. He has been on the Bendix staff for 8 years, his most recent position being supervisor of television test and inspection.

Conrad E. DeHorn has been appointed Chief Engineer and Director of Quality Control of Crest Transformer Corp. N. Chicago, Ill.

Percy Halpert has been appointed engineering director of aeronautical equipment at the Sperry Gyroscope Co., Great Neck, N. Y. He succeeds **O. E. Esval**, who has been named vice-president and chief engineer of Sperry Corporation's Wright Machinery Co., Durham, N. C.

Otto K. Weltin has been appointed assistant director of Cook Research Laboratories, Skokie, Ill., Division of Cook Electric Co., Chicago, Ill. **Charles E. Durkee** has been appointed head of the radar and communications section.

Theodore C. Gams has been appointed Director of Research at N. J. Electronics Corp. of Kenilworth, N. J.

Armand F. DuFresne has been named to the newly created post of chief product engineer at Consolidated Engineering Corp., Pasadena, Calif. He will head a new product engineering department.

Lawrence J. Perenic has been named Manager of the Electronics Dept. at U. S. Testing Co., Hoboken, N. J. Mr. Perenic supervises the electronic services of the company.

L. J. Perenic

A. M. Skellett

Dr. A. Melvin Skellett is the new director of color television tube planning and development for Tung-Sol Electric Inc., Newark, N. J. Dr. Skellett holds a patent for a radial beam tube used in military equipment and industrial instruments.

Sam Hyman has been appointed to the newly created position of Chief Commercial Engineer at Permoflux Corp., Chicago, Ill., **Walter Padgett** replaces him as Chief Engineer.

Floyd Reid has become development engineer of ORRadio Industries, Inc., Opelika, Ala. Following World War II, and later service with Link Aviation, Mr. Reid developed an electronic laminating machine in his own corporation.

Dr. Gordon K. Teal, assistant vice-president, Texas Instruments, Inc., Dallas, Texas, has been appointed head of the research division where he will have charge of TI research in many phases of electronics and geophysics.

G. K. Teal

A. E. Abel

A. E. Abel has been made director of engineering and research for Bendix Aviation Corp., Baltimore, Md. He succeeds **Arthur C. Omberg** who has been promoted to assistant general manager of the Bendix Missile Section (Products Div.) Mishawaka, Ind.

Dr. Rudolph G. E. Hutter, formerly manager of the physical electronics branch, has been appointed manager of the Physics Laboratory of Sylvania Electronic Products Inc., New York, N. Y. **Harry H. Martin** succeeds **Ned J. Marandino** as manager of the TV set assembly plant at Batavia, N. Y.

For product information, use inquiry card on last page.

Color Television

(*Continued from page* 98)

to a field lens in the camera. By use of a separate lens at each camera and appropriate choice of dichroics and color shaping filters, each camera sees only the red, the green, or the blue component of the color image (see diagram of Fig. 11).

The three identical vidicon camera sub-chassis are located together with the light-splitting optics in the front portion of the optical assembly. Mechanical alignment of the three sub-chassis is easily achieved by thumbscrew adjustment. The "in line" arrangement of the camera sub-chassis also simplifies this initial set-up. Final precise registration is easily achieved electronically, and once registered, there is excellent stability of registration. In day-to-day operation, only minor touch-up of controls will be necessary.

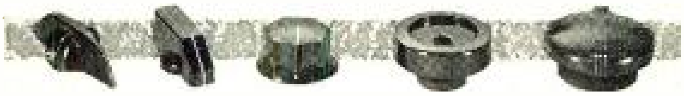
CAMERA CONTROL

Camera control—The 3-vidicon camera control units may be conveniently mounted in two control housings. The control position includes (1) a TM-6C master monitor mounted in a 13-in. console housing, and (2) a 19-inch master console housing, in which the camera control panel and the processing amplifier may be mounted (see Fig. 12). The 19-in. housing accommodates a 19 in. camera control panel in the indented desk section and the processing amplifier in the top sloping portion of the console. To complete the control function a TM-10B color monitor is needed. This may be suspended either from the wall or ceiling or set upon the flat top of the master console housing as space requirements dictate.

Several alternative arrangements will make themselves apparent to stations who wish to integrate their color and monochrome equipment or are otherwise limited by space. For example, all of the 3-vidicon color film control equipment may be rack mounted. In this case a rack mounted control desk and accessory kit, MI-40415, is available to provide desk space at the rack location. Here it is recommended that the TM-10B color monitor be mounted in an adjoining rack at approximately the level of the monochrome TM-6C master monitor. Another alternative is to place the TM-6C in its accessory field case, MI-26521-A, and set this on the flat top of the master console housing. The TM-10B color monitor may be conveniently located nearby.

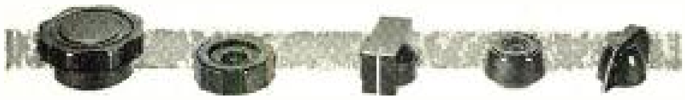
Processing Amplifier—a process-

INSTRUMENT and CONTROL KNOBS at Interesting Prices! — no Tooling

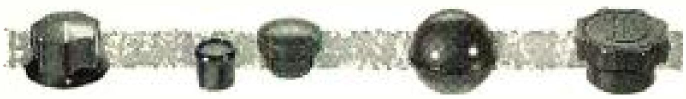


See us for "best buys" in standard parts

Parts of hard-finish thermosetting plastic
Readily available — often in stock



Many more models than illustrated — most in complete size ranges



Send for complete catalog

KURZ-KASCH, INC.

Standard Parts Division
1418 S. Broadway, Dayton 1, Ohio

GLOBE A.C. or D.C. MOTO-MITE* MOTORS

...for MAXIMUM POWER in MINIMUM SPACE!

D.C. MOTO-MITE* Shown actual size. Length 1¾" Diameter 1 3/16" Weight 3.5 oz. Larger, smaller sizes available.
A.C. MOTO-MITE* Length 2¼" Diameter 1¼" Weight 6 oz. Larger and smaller sizes available.

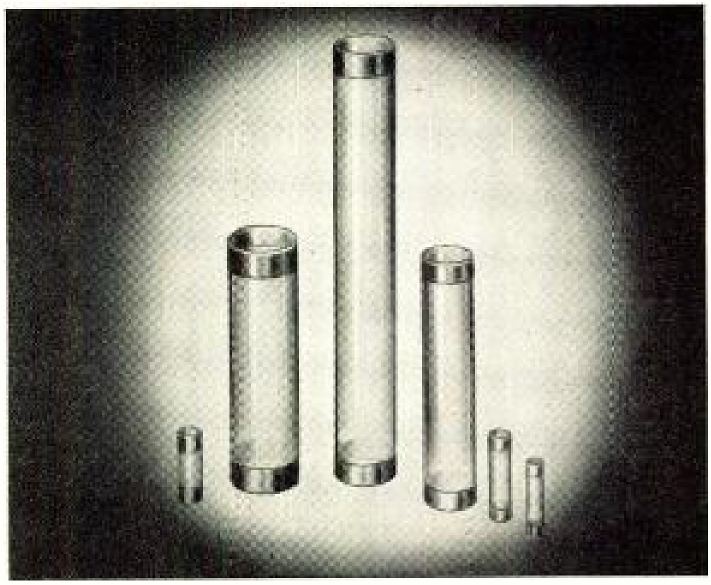
*Trademark

Miniature, compact, powerful, custom-built and quality controlled motors, characterized by high output and high efficiency. Designed as components for precision airborne accessory equipment, Globe Motors meet all military requirements. Speed governors, gear reducers, radio noise filters, electromagnetic clutches, brakes, etc., are available as standard assemblies. D. C. Motors can be made for various voltage applications ranging from 6 to 100V, and from 5,000 to 22,000 R.P.M. and with power output from 1/100 H.P., and up to 1/50 H.P. dependent on frame size. A.C. Motors, 400 C.P.S. Hysteresis-Synchronous type, can be made for voltage applications up to 115V, with power output up to 1/200 H.P. for 4-pole types, and up to 1/100 H.P. for 2-pole types. Single phase capacitor-run or two phase windings available. A.C. Motors, 60 C.P.S. also available.

Let Globe's complete engineering facilities investigate and resolve your motor problems. WRITE FOR COMPLETE INFORMATION TODAY!

Globe industries, inc.

MOTORS • GEAR REDUCERS • GENERATORS • GOVERNORS • SERVOS
BLOWERS • FANS • ACTUATORS • SWITCHES • GYROS • VIBRATORS



Corning Metallized Glass Enclosures like these are used for hermetically sealing rectifiers, resistors and capacitors.

How to protect delicate components *from moisture, mold, dirt, thermal shock*

You've got to safeguard delicate components so they can stand up under rough and tumble operating conditions.

Encapsulate sensitive components in rugged Corning Metallized Glass Tubes and you give them stamina they otherwise lack.

You protect them in a hermetic seal from moisture. You keep out dust and dirt. You prevent moulds and fungi from settling on them.

When assembled with metal end caps, Corning Metallized Glass Enclosures can take sudden temperature changes—from as much as 275° C. to ice water. And they are not affected by atmospheric changes.

The protection of metallized glass enclosures is permanent. Bond strength for metallizing used on enclosure tubes has been measured at 1500 to 2000 pounds per square inch. Because the glass is transparent, you can see inside the tubes to check the conditions of components. The electrical characteristics of the glass are excellent.

You can get metallized glass enclosures in a variety of sizes. We'll be happy to send you a descriptive catalog sheet telling you more about them. Or, if you have some specific problems metallized glass enclosures might help you solve, we'll be pleased to work with you. Write, wire or phone us.

Corning means research in Glass

CORNING GLASS WORKS, 37-3 Crystal St., Corning, N. Y.
New Products Division

Please send me descriptive catalog sheet on Corning Metallized Glass Enclosures.

Name .... Title ....

Address ....

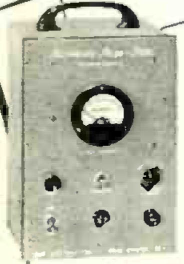
Company ....

City .... Zone .... State ....

NOW

Measure Noise-
Check Performance

IN MICROWAVE SYSTEMS



KAY
MICROWAVE
Mega-Nodes

Employing radiated monochromatic light, the eight waveguide sizes of KAY *Mega-Nodes* provide *primary standards* covering the microwave spectrum. Useful for measurement of noise figures and receiver gain and sensitivity, and for the calibration of standard signal sources, they also provide a fast and simple check on the performance of radar and other microwave systems. Available in the following waveguide sizes to cover the range of 1200-1400 mc and 2600-40,000 mc:

RG-69/U, RG-48/U, RG-49/U, RG-50/U, RG-51/U, RG-52/U, RG-91/U, RG-53/U

Available with fluorescent or inert gas (argon or neon) tubes. Noise output fluorescent tubes 15.8 db ±.25db • Noise output argon gas tubes 15.2 db ±.1 db. • Noise output neon tubes 18.0 db ± .5 db • Noise output of inert gas tubes, independent of operating temperature.

WRITE FOR DETAILED SPECIFICATIONS
Prices $295—$350 Including Power Supplies

KAY ELECTRIC COMPANY
Dept. TT-3 14 Maple Avenue
Pine Brook, New Jersey

B O O T H 3 9

portable **FREQUENCY COUNTER**
STRAIGHT (Batch) COUNTER
TACHOMETER

direct reading MODEL
DS-6100 FREQUENCY COUNTER

INPUT
.1 Volts RMS
FREQUENCY RANGE
20 to 100,000 CPS
GATE TIME
1 second (.1 and 10 sec. available)
STABILITY
Short Term — 1 part in 10^5 (10^6 with crystal oven)
ACCURACY
Inherent ± 1 Event
TIME BASE
100 KC Crystal Oscillator (Oven Available)

MULTI-SAMPLING
3 to 60 second manual
MANUAL RESET
Display until reset
AUTOMATIC RESET
Display .5 to 6 sec. variable
READ-OUT
direct in events per sec. to 100,000
SIZE and WEIGHT
14¼" W x 7½" H x 13½" D — approx. 28 pounds

COMPUTER-MEASUREMENTS DIVISION OF THE **Detectron CORP.**

IRE SHOW
Kingsbridge Palace, N.Y.C.
Dept. 89-B—5528 Vineland Ave., North Hollywood, Calif.

Visit
PRECISION PAPER TUBE COMPANY
at the Radio Engineering Show
1955 IRE National Convention . New York City, March 21-24

BOOTH 791
Kingsbridge Armory, Airborne Ave.

DIELECTRIC KRAFT • FISH PAPER • CELLULOSE ACETATE COMBINATIONS • PHENOL IMPREGNATED

Round, square, rectangular, triangular, any shape, any size—Precision Paper Tube Co. can provide *all* your paper tubing needs. Your specifications are met to the most exacting tolerances.

The only complete coil form service available. Get full information at our booth.

Representatives in:

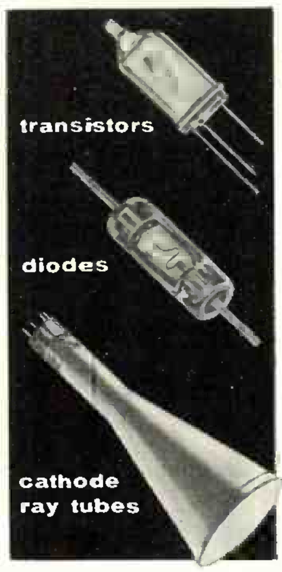
New England:
Framingham, Mass., Framingham 7091
New York, New Jersey:
Jersey City, New Jersey, Journal Square 4-3574
Upstate New York:
Syracuse, N.Y., Syracuse 76-8056
Maryland:
Baltimore, Maryland, Plaza 2-3211
Philadelphia:
Philadelphia, Pa., Chestnut Hill 8-0282
Northern Ohio, Western Pennsylvania:
Cleveland, Ohio, Atlantic 1-1060
Indiana, Southern Ohio:
Logansport, Indiana, Logansport 2555
Missouri, Southern Illinois, Iowa:
St. Louis, Missouri, Sterling 2318
California:
Pasadena, California, Sycamore 8-3919
Canada: Montreal, Quebec, Canada, Walnut 2715

PRECISION PAPER TUBE CO.
2057 W. CHARLESTON ST. CHICAGO 47, ILL.
Plant No. 2: 79 Chapel St., Hartford, Conn.

for modern, profitable automatic production...

...call on KAHLE

...world's leading exclusive manufacturer of production machinery for the electronics field



Write for information on special experimental and research services offered by Kahle.

If you're making (or plan to make) *diodes, transistors, sub-miniature, miniature, cathode ray tubes, or other electronic tubes or component parts,* take full advantage of Kahle's invaluable experience.

With Kahle methods and "know-how" you're sure of getting exactly the right machinery to produce exactly what you want ... accurately, dependably, profitably.

For more than a quarter of a century the leaders in the electronics field have relied on Kahle for production machinery. Typical production steps automatically performed by Kahle equipment include sealing, bulb making, stem making, exhausting, grid winding, filament coil winding, lead wire welding.

Write today for additional details, equipment specifications, production data, and quotations.

Kahle ENGINEERING COMPANY
1310 SEVENTH STREET • NORTH BERGEN, N. J.

Color Television

(*Continued from page 186*)

ing amplifier mounted in the control console has incorporated many space saving features. For instance, a monitor auxiliary circuit as part of the processing amplifier provides for precise electronic switching of the video signals to be monitored on the TM-6C. The processing amplifier performs a great number of functions previously requiring several other units. Integration of these electrical functions in a single unit results in a simple, space-conserving, low cost system. Use of this design allows set-up time to be substantially reduced and requires fewer video operators and control room engineers for programming. Hence considerable savings in operating costs can be realized. A large reduction in power required as well as increased tube life due to extremely conservative operation of tubes further reduce costs, at the same time improving performance and overall quality.

Fig. 12: Master console, including camera control panel and processing amplifier units

The basic circuit elements in the processing amplifier are three plug-in video amplifiers which perform the following functions: cable compensation, video amplification, blanking insertion, shading insertion, feedback clamping, linear clipping, gamma correction and output amplification.

A fourth plug-in unit serves as the video section of an electronic switcher which is an integral part of the main chassis. The switcher, used with master monitor, TM-6C, provides an individual or combined presentation of red, blue and green video.

Rack equipment—all the units normally housed in the master console—master monitor, control panel and processing amplifier may be

Color Television

(*Continued from page* 189)

rack mounted. To complete the camera chain, a colorplexer, an aperture compensator, and a set of power supplies (two WP-33B's and three 580-D's) also mount in standard 84-inch cabinet racks. A color monitor is also included in the chain and can be rack mounted or placed in a cabinet at a convenient location.

3-V MULTIPLEXER

3-vidicon multiplexer—this multiplexer, TP-12, provides the optical system required to project a number of film sources into a single 3-vidicon camera input. Using mirrors, the multiplexer provides for two film projectors (16mm or 35mm) and a single 2 x 2″ dual-disc slide projector. Selection of any of the film sources can be remotely controlled. Each of the two mirrors in the multiplexer is hinged so that they will fold out of the way as required (see the block diagram on these pages). The movement is electrically activated so that the proper operating combination can be obtained by projector controls. The image from any of the projectors can thus be relayed to the field lens in 3-vidicon camera.

Film and slide projectors—in color film reproduction the TK-26A 3-vidicon film camera system utilizes the excellent storage characteristic of the vidicon tube. This allows operation with intermittent type film projectors with which most television operators are already familiar. Use of the intermittent type projector means that, while the sync generator is phased from the color subcarrier crystal as required in a color system, the projectors can operate directly from the power line and be synchronized with it. It is necessary, however, to modify these projectors for long application. The RCA TP-6BC professional projectors, however, can be used in the 3-vidicon system without modification since the long application feature has been incorporated in its design.

Monitors—A color and a monochrome monitor are furnished in plan #2 equipment for monitoring the Vidicon film and slide camera operation. The master monitor is necessary in order to properly set the separate R, G, and B channels. The TM-10B color monitor is, of course, essential in checking the output of the system.

PART THREE WILL APPEAR
IN THE APRIL ISSUE

VECTROHM POTENTIOMETERS

PRECISION — WIRE WOUND

"Standard Units" "From Stock"

48 STANDARD UNITS

Now available . . . with more to come

- **Standard Components** . . . from stock.
- **Standard Quality** . . . to meet all usual precision requirements.
- **Standard Prices** . . . from our published price list.
- **Standard Specifications**

Sizes: 7/8", 1 1/16", 2" diameters **Rotation:** 320° and 350°
Linearity: from ...... 1/4% **Bearings:** Sleeve and ball
Overall Resistances: 10 to 100,000 ohms in 16 values for each diameter
Temperature Coefficients of Resistance Wire: 0.0002 parts per °C
Starting Torque: from 1 inch-ounce

NEW VECTRON VFS 250
Variable Frequency Power Supply

FOR TESTING
Airborne Electronic Equipment
Airborne Electrical Systems
Servo Amplifiers and Equipment
Synchro and Selsyn Systems
Transformers and Inductors
Export and Foreign Equipment

FOR POWERING
Vibration Shakers
Choppers and Vibrators
Magnetic Amplifiers

FOR CONTROLLING
Synchronous Motors
Processing Equipment

- **Full negative feedback networks for instantaneous voltage control.**
- **Built-in two range stabilized frequency generator.**
- **Grounded output with polarized receptacle for maximum safety.**
- **Compact, semi-portable package for bench use.**

Output Power at 100 to 130 V	250VA continuous 300VA intermittent
Output Frequency	45-2,000 cycles
Output Voltage	0-130 Volts
Output Regulation zero to full load	± 1% to 1,000 cycles ± 2% to 2,000 cycles
Line Regulation at 250VA	± 1% maximum change for 105-125V input

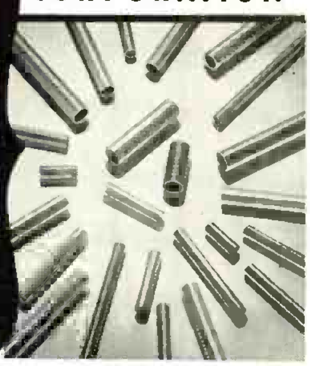
Send for bulletin and price list TODAY

VECTRON, inc.
Electronic and Electro-Mechanical Equipment
408 MAIN STREET WALTHAM 54 · MASSACHUSETTS

Send for Bulletin VFS 250 TODAY

RESINITE CORPORATION

invites you to visit
BOOTH No. 791*
AT THE
Radio Engineering Show
1955 IRE NATIONAL CONVENTION
New York City... March 21-24
*Kingsbridge Armory, Airborne Avenue



The coil form with the highest resistivity of any resinated product. Custom fabrication to your exact specification assures correct dimensions to within the most critical tolerances.

We will furnish—without charge—a pilot production run of custom-made embossed forms to fit your particular application.

Get full information on Use of Threaded Tubes, Threaded Iron Cores VS. Torque Control.

RESINITE CORPORATION

Sales Representatives in:

New England: Framingham, Mass., Framingham 7091
New York, New Jersey: Jersey City, New Jersey, Journal Square 4-3574
Upstate New York: Syracuse, N.Y., Syracuse 76-8056
Maryland: Baltimore, Maryland, Plaza 2-3211
Philadelphia: Philadelphia, Pa., Chestnut Hill 8-0282
Northern Ohio, Western Pennsylvania: Cleveland, Ohio, Atlantic 1-1060
Indiana, Southern Ohio: Logansport, Indiana, Logansport 2555
Missouri, Southern Illinois, Iowa: St. Louis, Missouri, Sterling 2318
California: Pasadena, California, Sycamore 8-3919
Canada: Montreal, Quebec, Canada, Walnut 2715

Division of **PRECISION PAPER TUBE COMPANY**
2035L W. CHARLESTON ST. · CHICAGO 47, ILLINOIS

The Sign of precision engineered
TRANSFORMERS
for greater DEPENDABILITY
QUALITY
CONSTRUCTION

AUDIO - POWER - PULSE
Transformers and Inductors
High Temperature—Miniaturized Encapsulated Units.

SEE US AT THE I R E SHOW
Kingsbridge Palace
Booth #31

INDUSTRIAL TRANSFORMER Corporation
GOULDSBORO PENNSYLVANIA

INDUSTRY NEWS

Howard S. Gleason has been appointed Mgr. of Automation Research at Stromberg-Carlson Co., Rochester, N.Y. The Automation Research Group is a newly formed one for research in the field of automation.

Kimball A. Reyher has been named Radio Merchandise Mgr. of Westinghouse TV-Radio Div. in Metuchen, N.J.

Lawrence LaPatka has become Division Mgr. of Burroughs Corp. Electronic Instruments Div., Philadelphia, Pa. He was previously division sales manager.

L. LaPatka

G. Dean

Gordon Dean, former Chairman of the U. S. Atomic Energy Commission, has been elected to the board of directors of Ketay Instrument Corp. Mr. Dean is Chairman of the Board of Nuclear Science and Engineering Corp., a Ketay affiliate.

New appointments at Philco Corp. include that of **Joseph A. Lagore** to the post of Vice-Pres., Mfg. and **James D. McLean** to Vice Pres., Sales of the Govt. and Industrial Div. Mr. Lagore was formerly Gen. Mgr. in charge of Operations and Mr. McLean was General Sales Mgr. at this division.

J. A. Lagore

J. D. McLean

Robert C. Scott, who has been a member of the Du Mont organization since 1948, has been made general sales manager of the Cathode-ray Tube Div., of Allen B. Du Mont Labs., Clifton, N. J. He will have complete responsibility for the sale and merchandising of TV picture tubes.

(*Continued on page* 194)

TELE-TECH ADVERTISERS — MARCH, 1955

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

(Continued from page 194)

Charles M. Green has succeeded to the presidency of Sperry Gyroscope Co. Div. of Sperry Corp., following retirement of **Preston R. Bassett** who will continue as vice president of the parent company. Mr. Green has been executive v.p. and general manager since 1945.

C. M. Green

P. R. Bassett

Harold M. Zimmerman has been named director of CBS-Columbia, TV, radio and electronics apparatus division of Columbia Broadcasting System. He will report to **Mr. Will James**, director of operations. Previously, Mr. Zimmerman was in charge of procurement for engineering products at Radio Corp. of America.

Milton Binstock has been appointed vice-president and director of sales at Sheldon Electric Co., division of Allied Electric Products Inc., Irvington, N. J. **Frank Ferdinand** has been made sales manager.

Dr. **Anthony Moos,** general manager of the Patterson-Moos Division, Jamaica, N. Y., has been made vice-president of Universal Winding Co., Providence, R. I. Universal acquired the division in July 1954.

New appointments at Permoflux Corp., Chicago, Ill., include **R. S. Fenton**, V. Pres. in charge of sales and engineering; **Frank Newberg**, Mgr. of Manufacturing, and **Edward Watermulder**, administrative mgr.

Robert G. Lynch has been promoted to the newly-created position of assistant regional mgr. for equipment sales in the Eastern Region for Sylvania Electric Products Inc. He will be located at the company's regional office in Chicago, Ill.

David W. Potter has been named sales manager of the Components Div. of Federal Telephone & Radio Co., Clifton, N. J., division of I.T. & T.

R. J. Studders has been appointed manager of magnetic products engineering at Carboloy Dept. of General Electric.

Do you want more information about PRODUCTS *advertised in* TELE-TECH & ELECTRONIC INDUSTRIES

LEADING MANUFACTURERS

are using space in this issue to acquaint you with their products. Perhaps you want more information on some of them—on one or two, or possibly a score. You can cover all of your needs with the cards below. They are convenient and postfree.

Use the convenient postage-free cards below to get information quickly about products listed here—all advertised in this issue

701 Acme Electric Corp.—Miniature pulse transformers
702 Adams & Westlake Co.—Mercury relays
703 Aerovox Corp.—Molded Tubular Paper capacitors
704 Airdesign, Inc.—Industrial & military transformers
705 Aircraft Radio Corp.—Aircraft course checkers, signal generators
706 Aircraft transformer Corp.—Hermetically sealed transformers
707 Alden Products Co.—Plug-in components; recording equipment
708 Alford Mfg. Co., Inc.—Antenna systems, navigation aids
709 Allen-Bradley Co.—Molded resistors, ferrite cores
710 Altec Lansing Corp.—Microphones
711 American Electrical Heater Co.—Soldering irons
712 American Elite, Inc.—Microphones
713 American Lava Corp.—Pressed ceramics
714 American Microphone Co.—Microphones, phone cartridges
715 Amperite Co.—Delay relays & ballast regulators
716 Ampex Corp.—Magnetic tape recorders
717 Arnold Engineering Co.—Magnetic materials
718 Artos Engineering Co.—Wire cutting & stripping machines
719 Atlas Sound Corp.—Microphone boom
720 Audio Devices, Inc.—Mylar recording tape
721 Audio Instrument Co., Inc.—Audio reverberation units
722 Bell Telephone Labs.—Dial system
723 Bendix Aviation Corp., Red Bank Div.—"Reliable" double triode
724 Berlant Associates—Tape recorders
725 Berndt-Bach, Inc.—Sound-on-film equipment
726 Bird Electronic Corp.—Coaxial load resistors
727 Blaw-Knox Co.—TV antenna towers
728 Bradley Labs., Inc.—Selenium rectifiers
729 Bruno-New York Industries Corp.—Laboratory standard DC Voltmeters
730 Burke & James, Inc.—TV camera lenses
731 Burnell & Co., Inc.—Telemetering filters
732 Bussmann Mfg. Co.—Fuses, fuse clips & holders
733 California Institute of Technology, Jet Propulsion Lab.—Engineering personnel
734 Cannon Electric Co.—Audio cord connectors
735 Carter Motor Co.—Generators; dynamotors; alternators
736 Century Lighting Co.—Lighting equipment & controls
737 Chester Cable Corp.—Wire & cable
738 Chicago Condenser Corp.—Upright capacitors for printed circuits
739 Chicago Telephone Supply Corp.—Volume controls for color TV
740 Cinch Mfg. Corp.—Molded connectors, sockets
741 Cinema Engineering Co.—Attenuators for control consoles
742 Cleveland Container Co.—Laminated paper base phenolic tubing
743 Columbian Carbon Co.—Red ferric oxides
744 Collins Radio Co.—Broadcast equipment
745 Communication Accessories Co.—Aircraft transformers & magamps
746 Cornell-Dubilier Electric Corp.—Miniature & H V capacitors
747 Corning Glass Works—Metallized glass enclosures
748 Crosby Labs, Inc.—Wideband oscilloscopes
749 Cunningham, Son & Co., Inc.—Crossbar switches
750 Dage Electric Co.—Coaxial cable connectors
751 Dale Products, Inc.—Miniature power resistors
752 Daven Co.—Microwave transmission measuring set
753 DeMornay-Bonardi—Test instruments up to 90 KMC
754 Detectron Corp.—Tachometer frequency counter
755 Diamond Microwave Corp.—Microwave components, mixers
756 DuMont Labs., Inc., Allen B.—Color film scanners
757 Eisler Engineering Co., Inc.—Indexing turntables
758 Eitel-McCullough, Inc.—Amplifier klystrons
759 Electra Mfg. Co.—Deposited carbon resistors
760 Electrical Industries—Hermetically sealed terminations & closures
761 Electro Motive Mfg. Co.—Miniature dipped mica capacitors
762 Electro-Voice, Inc.—Cardioid dynamic microphones
763 Electronic Engineering Co. of California—Engineering personnel
764 Engineering Co.—Precision metal stampings
765 Fairchild Camera & Instrument Corp.—Miniature precision potentiometers
766 Fairchild Recording Equipment—Transcription tables
767 Federal Telecommunication Labs.—Engineering personnel
768 Filtors, Inc.—Subminiature relay
769 Ford Instrument Corp.—Gyroscopes
770 F-R Machine Works, Inc.—Microwave test equipment
771 Freed Transformer Co., Inc.—Megohmmeters
772 Garde Mfg. Co.—Stand-offs, headers, coil forms
773 Gates Radio Co.—Inductors, cabinets, control desks
774 General Communications Co.—Switches, test equipment, beacons
775 General Electric Co.—Germanium junction rectifier
776 General Electric Co.—Portable broadcast amplifier
777 General Precision Lab., Inc.—Film chain, color TV equip.
778 General Radio Co.—900 to 2000 Mc oscillator
780 Gertsch Products, Inc.—Frequency meter, frequency divider
781 Giannini & Co., Inc., G. M.—Precision potentiometers
782 Globe Industries, Inc.—Small motors, servos
783 Good-All Electric Mfg. Co.—Mylar dielectric capacitors
784 Graphite Metallizing Corp.—Brushes, contacts, slip rings
785 Gudebrod Bros. Silk Co., Inc.—Braided nylon lacing tape
786 Helipot Corp.—Potentiometer technical paper

Listings continued on next page

Use these postage-free cards to get further information

Write in boxes the code numbers of products for which you want information. See list above and on next page.

Your company ....
Company address ....
....
Your name ....
Your title ....

TELE-TECH—MARCH 1955

CALDWELL-CLEMENTS, INC., 480 Lexington Avenue, New York 17

Not good after May 1, 1955

...QUIRY CARD

Write in boxes the code numbers of products for which you want information. See list above and on next page.

Your company ....
Company address ....
....
Your name ....
Your title ....

TELE-TECH—MARCH 1955

CALDWELL-CLEMENTS, INC., 480 Lexington Avenue, New York 17

PRODUCT INFORMATION?

If that is what you need, use the cards below to get it quickly, through . . . **TELE-TECH** & ELECTRONIC INDUSTRIES

Listings continued from preceding page

787 Heppner Manufacturing Co.—Speakers, ion traps
788 Hermetic Seal Products Co.—Transistor housing bases
789 Houston Fearless Corp.—Remotely controlled parabola
790 Hudson Radio & TV Corp.—Electronic & tube supplies
791 Hughes Aircraft Co.—Semiconductors
792 Hughes Research & Dev. Labs.—Engineering personnel
793 Hughey & Phillips—Tower lighting control units
794 Hycon Manufacturing Co.—Missile test instrumentation
795 Hycon Manufacturing Co.—Digital VTVM, oscilloscopes
796 Hycor Co., Inc.—Variable attenuators
797 Ilsco Corp.—Connectors, terminal blocks
798 Industrial Hardware Mfg. Co., Inc.—Sockets, stampings, assemblies
799 Industrial Transformer Corp.—Transformers & inductors
800 Institute of Radio Engineers—Radio engineering show
801 I-T-E Circuit Breaker Co.—Potted resistors
802 International Rectifier Corp.—Selenium rectifiers
803 JFD Manufacturing Co.—Piston capacitors
804 Johnson Co., E. F.—Tube sockets
805 Jones Div., Howard B. Cinch Mfg. Corp.—Plugs & sockets
806 Kahle Engineering Co.—Tube & diode production machines
807 Kanthal Corp.—Resistance wire
808 Kay Electric Co.—Microwave noise measuring equip.
809 Kearfott Co., Inc.—K_u band test set
810 Kester Solder Co.—Flux-core solders
811 Keystone Electronics Co.—Miniature quartz crystals
812 Klein & Sons, Mathias—Pliers, cutting, slim & chain nose
813 Kulka Electric—Terminal blocks, switches
814 Kurz-Kasch, Inc.—Instrument & control knobs
815 Lavoie Laboratories—Manufacturers' representatives
816 Lockheed Aircraft Corp.—Engineering personnel
817 Lomasney & Co., D. A.—Shares of capital stock
818 Loral Electronics Corp.—Airborne, radar & test equip.
819 Machlett Laboratories—Coax terminal power triodes
820 Mallory & Co., Inc., P. R.—Multiple unit carbon controls
821 Measurements Corp.—Crystal calibrator
822 Melpar, Inc.—Engineering personnel
823 Methode Manufacturing Corp.—Printed circuits
824 Microdot Div., Felts Corp.—Microminiature coax connectors
825 Minnesota Mining & Mfg. Co.—Extra play magnetic tape
826 Motorola, Inc.—Engineering personnel
827 National Vulcanized Fibre Co.—Copper-clad plastics
828 Norris Thermador Corp.—Transformers
829 North Electric Mfg. Co.—Rotary armature relays
830 NRK Mfg. & Engineering Co.—Microwave assemblies, radar components
831 Onan & Sons, Inc., D. W.—Standby electric plants
832 Oster Mfg. Co., John—Motors, servos, blowers
833 Phaostron Co.—Multimeters
834 Philco Corp.—Crystal diodes
835 Polarad Electronics Corp.—EHF signal generators & analyzers
836 Polarad Electronics Corp.—Direct reading spectrum analyzer
837 Polarad Electronics Corp.—Microwave multi-pulse spectrum selector
838 Potter Co.—Capacitors, filters
839 Precision Paper Tube Co.—Paper tubes, phenol impregnated
840 Presto Recording Corp.—Recording discs
841 Prodelin, Inc.—Microwave antenna systems
842 Pyramid Electric Co.—Radio-TV components
843 Radio Corp. of America—Color TV broadcast equipment
844 Radio Corp. of America—Industrial receiving type tubes
845 Radio Materials Corp.—Capacitors for printed circuits
846 Raytheon Manufacturing Co.—Filamentary subminiature tubes
847 Raytheon Manufacturing Co.—Microwave relays, radomes
848 Raytheon Manufacturing Co.—Magnetrons; klystrons
849 Relay Sales—Relays
850 Republic Steel Corp.—Antenna towers
851 Resinite Corp.—Resinated coil forms
852 Royal Metal Mfg. Co.—Chairs, stools
853 Sanders Associates—Microwave attenuator
854 Scherr Co., Inc., George—Projectors, comparator charts
855 Sensitive Research Instrument Corp.—Panel instruments
856 Shallcross Mfg. Co.—Encapsulated resistors
857 Specific Products Co.—WWV receivers
858 Sprague Electric Co.—Miniaturized axial-lead wire wound resistor
859 Sprague Electric Co.—Electrolytic capacitors
860 Stackpole Carbon Co.—Resistors, capacitors, cores, switches
861 Stainless, Inc.—Antenna towers
862 Standard Electronics Corp.—TV transmitters & amplifiers
863 Stephens Manufacturing Co.—Condenser microphones
864 Stoddart Aircraft Radio Co.—Radio interference & field intensity equip.
865 Struthers-Dun, Inc.—Hermetically sealed relays
866 Sylvania Electric Products Co.—Series string TV tubes
867 Sylvania Electric Products Co.—Power transistors
868 Sylvania Electric Products, Inc.—Engineering personnel
869 Synthane Corp.—Laminated plastics
870 Syntronic Instruments, Inc.—Yokes, focus coils
871 Telechrome, Inc.—Color TV broadcast equip.
872 Texas Instruments, Inc.—Silicon & germanium transistors
873 Tinnerman Products, Inc.—Fastenings
874 Transradio Ltd.—Low attenuation cable
875 Triad Transformer Corp.—Isolation transformers
876 United Transformer Corp.—Miniature transformers, toroids, filters
877 Varian Associates—High-power klystrons
878 Vectron, Inc.—Potentiometers, power supplies
879 Waterman Products Co.—Oscilloscopes
880 Weckesser Co.—Cable clips
881 White Dental Mfg. Co., S. S.—Negative coefficient resistors
882 White Dental Mfg. Co., S. S.—Air abrasive units
883 Williams & Co., Inc., C. K.—Ferric oxides
884 Zero Manufacturing Co.—Aluminum instrument cases

TELE-TECH
& ELECTRONIC INDUSTRIES
480 Lexington Avenue, New York 17, N. Y.

MAIL CARD TODAY

NOT GOOD AFTER MAY 1, 1955

FIRST CLASS
PERMIT No. 22273
(Sec. 34.9, P.L.&R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

TELE-TECH
& ELECTRONIC INDUSTRIES
480 LEXINGTON AVENUE
NEW YORK 17, N. Y.
Caldwell-Clements, Inc.

FIRST CLASS
PERMIT No. 22273
(Sec. 34.9, P.L.&R.)
NEW YORK, N.Y.

BUSINESS REPLY CARD
NO POSTAGE STAMP NECESSARY IF MAILED IN UNITED STATES

POSTAGE WILL BE PAID BY

TELE-TECH
& ELECTRONIC INDUSTRIES
480 LEXINGTON AVENUE
NEW YORK 17, N. Y.
Caldwell-Clements, Inc.

Three-in-one—Easily Portable

DAVEN TRANSMISSION MEASURING SET TYPE 12-A

For Measuring the Characteristics of Microwave Relay Systems

See Daven's Booth at the I.R.E. Show
543 & 545 Components Avenue

This unit provides the necessary information on transmission character istics for the installation of terminal equipment, for the maintenance of termi nal equipment, and for the field service of transmission lines and termina equipment for microwave relay systems.

In one portable unit for efficient field use are combined the function which normally would be performed by a separate Vacuum Tube Voltmeter Audio Oscillator and Equalization Filters.

This unit has filters for providing response curves for accurate indicatio of 144, F1A or flat transmission lines. The 12-A also has provision for measure ment of harmonic distortion and has its own self-contained low distortio 1000 cycle oscillator with variable amplitude.

The amplifier of the 12-A provides range levels from plus 20 to minu 80 DBM in calibrated steps of 10 Db. The associated meter is calibrated i 0.5 Db steps. The dynamic characteristics of the indicating meter are suc that its response approximates the speed of appreciation of sounds by the ea

This unit has line blocking capacitors for use across central batter and dial telephone lines.

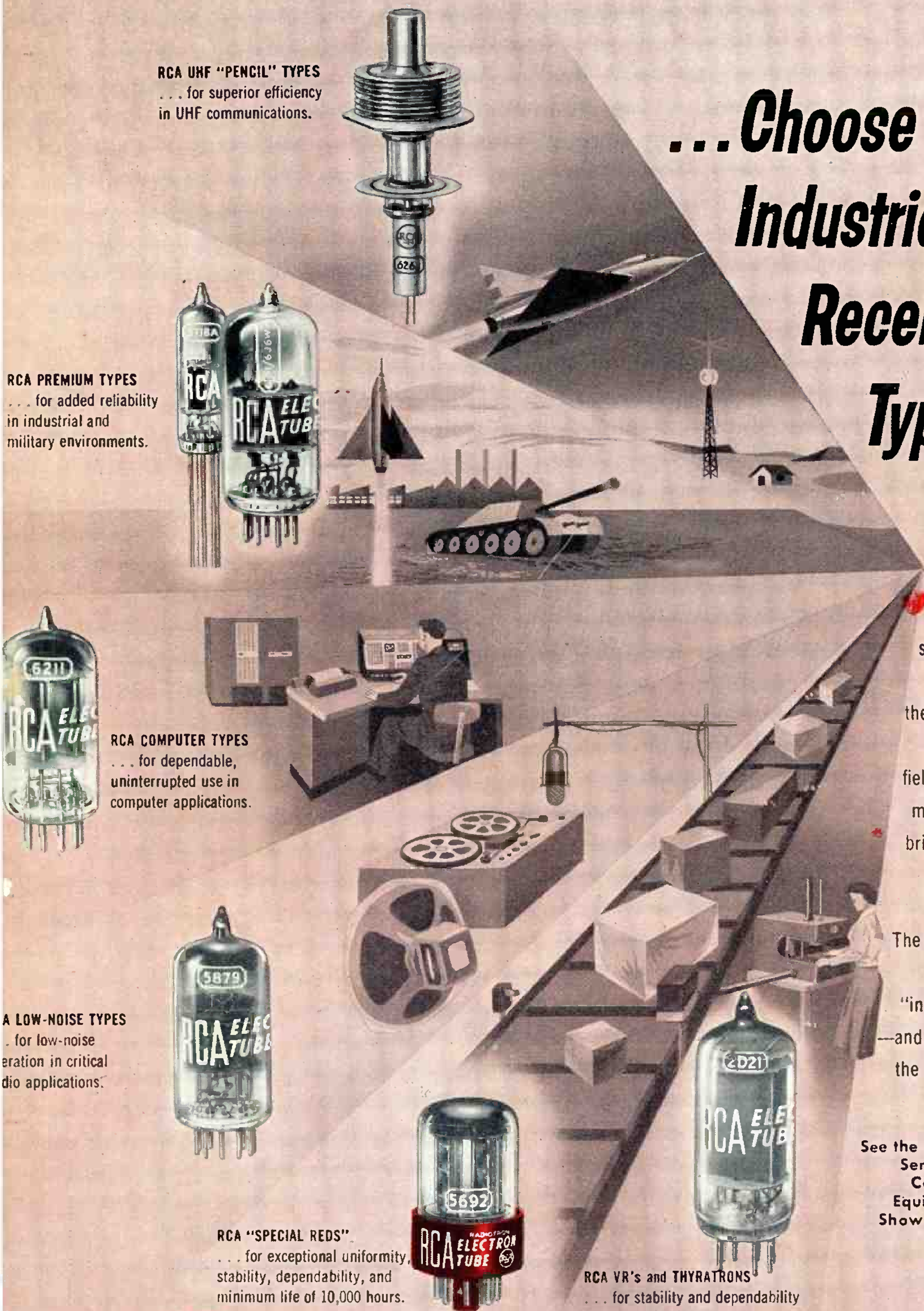
Write for additional specific information and for catalog materia

THE DAVEN CO.
179 Central Avenue
Newark 4, New Jersey

WORLD'S LARGEST MANUFACTURERS OF ATTENUATORS

EEP AHEAD WITH YOUR EQUIPMENT DESIGNS

...Choose RCA Industrial Receiving-Type Tubes



RCA UHF "PENCIL" TYPES
. . . for superior efficiency in UHF communications.

RCA PREMIUM TYPES
. . . for added reliability in industrial and military environments.

RCA COMPUTER TYPES
. . . for dependable, uninterrupted use in computer applications.

A LOW-NOISE TYPES
. for low-noise eration in critical dio applications.

RCA "SPECIAL REDS"
. . . for exceptional uniformity, stability, dependability, and minimum life of 10,000 hours.

RCA VR's and THYRATRONS
. . . for stability and dependability in control circuits.

To help get your share of the enormous market potential in the expanding industrial and communications fields, RCA research and manufacturing facilities bring you this important family of industrial receiving-type tubes. The line offers you a wide latitude in designing "industrial type" circuits—and, of course, offers you the famous RCA standard of performance.

See the array of RCA Tubes, Semiconductor Devices, Components, and Test Equipment . . . at the IRE Show—Booths 151 to 155

RADIO CORPORATION of AMERICA
ELECTRON TUBES HARRISON, N.J.