INDUSTRIES & ELECTRONICS

TELE-TECH

A Caldwell-Clements Publication

DECEMBER, 1953

FRONT COVER: PRINTED CIRCUITS SPEED ELECTRONIC PRODUCTION—Dip soldering technique plays vital role in manufacturing printed circuits. Here the panel receives its second dip in the double pot method at Methode Manufacturing Corp. Its purpose is to reflow any solder that may have bridged across the circuit pattern, and to cover the panel with a moisture and fungus resistant coating. Details are given in article starting on page 62.

Totals: TV Income, Engineer Salaries, Government Contract Awards		3
As We Go To Press		11
Federal Administration Problems of National Telecommunications		59
Printed Wiring Multiple Soldering Methods	Morris Weinberg and L. J. Martin	62
Guided Missile Data Distribution	James B. Wynn, Jr. and Sam L. Ackerman	65
Transistor I-F Amplifiers	J. R. Nelson	68
Embossed Wiring for Printed Circuits	O. I. Steigerwalt	70
Paste Solder Cuts Assembly Costs		71
New Hand Carried Transmitter-Receiver	Stanley Cutler and George Brownstein	72
Magnetic Alloy Shields for Color TV Tubes	Robert D. Teasdale	74
Preventing Acoustic Feedback	Benjamin Wolfe	77
The Economics of Printed Wiring	Robert L. Swiggett and James F. Carberry	78
1954 Directory of Printed-Circuit Product Manufacturers		81
Cues for Broadcasters		82
Encapsulated Test Prods	Rudolph L. Kuehn	84
An Experimental Television Receiver		86
Protective Coatings for Etched Circuits	Morris Weinberg and L. J. Martin	88
New 10-KW Air-Cooled Tetrode	M. B. Shrader	90
Application of FM/FM Telemetering—Part One	W. J. Mayo-Wells	91

DEPARTMENTS

Coming Events	18	Washington News Letter	102
Letters	36	News of Manufacturers' Reps	125
Tele-Tips	48	Books	173
Radarscope	60	Personal	180
New Equipment	94	Bulletins	184

News of Industry 189

TELE-TECH*, Vol. 12, No. 12. Published monthly by Caldwell-Clements, Inc. M. Clements, President; Orestes H. Caldwell, Treasurer. Acceptance under Section 34.64 Postal Laws and Regulations authorized at Bristol, Conn., February 8, 1952 with additional entry at New York, N. Y. 75c a copy. Annual Subscription Rates: United States and Possessions: $7.00; Canada: $8.00; All Other Countries: $10.00. Please give title, position and company connection when subscribing.

CALDWELL-CLEMENTS, Inc.

Publication Office, Bristol, Conn.

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

Publishers also of MART and TECHNICIAN

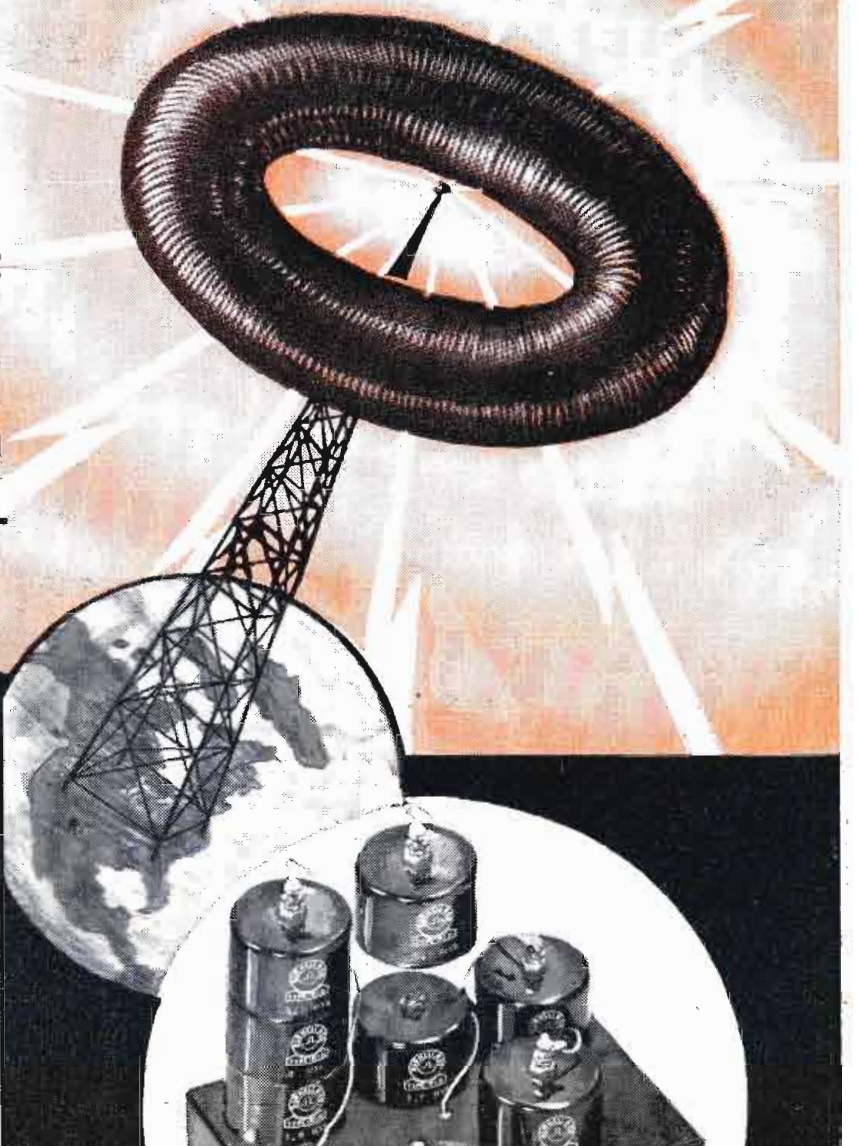
* Reg. U. S. Pat. Off.

TELE-TECH'S CIRCULATION, 21,000

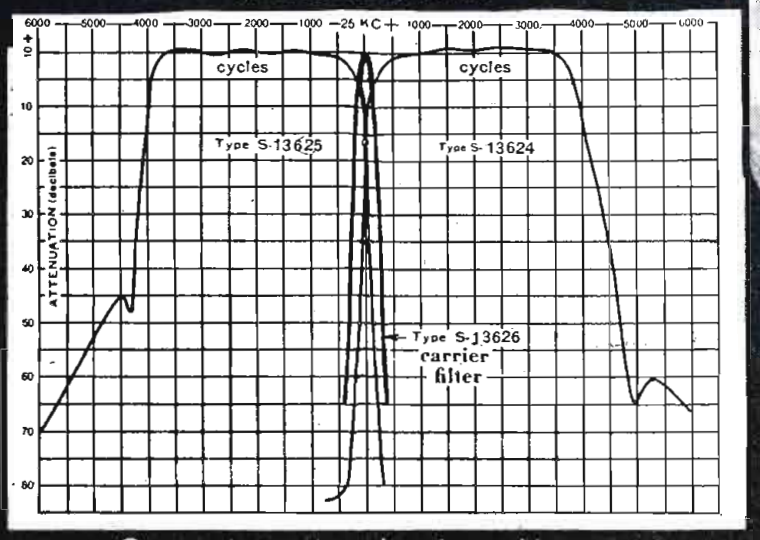
Because of increases in circulation which obviously cannot be shown in current audited statements, advertisers should disregard any comparison based on a previous period or any that fails to show TELE-TECH'S guaranteed circulation of 21,000.

RIGHT ON TOP

Burnell records a few of it's most recent engineering achievements in Toroids and Filter Networks.

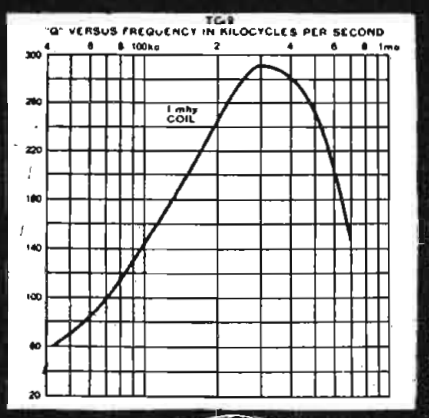


SIDE BAND FILTERS



Our most recent engineering achievement in communications filters has already stirred the interest of the leading receiver manufacturers in the country.

Our new side band filters which eliminate, for most applications, the necessity for expensive crystal filters are expected to accelerate the advancement of single side band communications.



SUB MINIATURE TOROIDS

Toroids for intermediate frequencies of 100KC to 1 megacycle. A wide variety of coils ranging in size from ½ inch provides high Q in the frequency range between audio and RF.

The tiny toroid about the size of a dime has been welcomed by designers of sub miniature electronic equipment for the transistor, guided missile and printed circuit field.

PLUG IN DECADES

An entirely new development in inductance decades eliminating disadvantages of switch boxes. Inductance units plugged together in various combinations providing decade steps of inductance with minimum number of units required.

MINIATURE TELEMETERING FILTERS

In recognizing the need for miniaturization of the presently bulky telemetering equipment, our engineering staff has succeeded in reducing the size of telemetering filters to as little as 25 to 50% of the original volume.

BURNELL & COMPANY is very pleased to announce that it now has available a 12 page catalog which includes valuable and complete information on toroids, high quality coils, and various audio filter networks.

The catalog includes complete descriptions, attenuation and Q curves that will prove valuable for equipment design engineers.

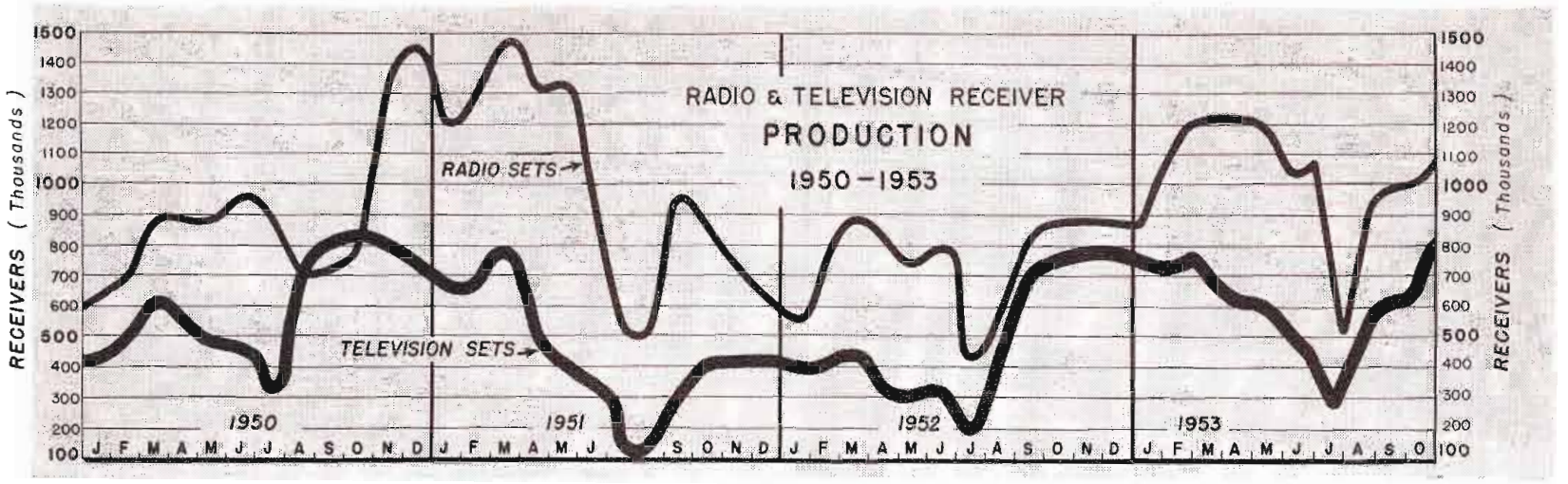
Write for Catalog 101-A.

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

Exclusive Manufacturers of Communications Network Components

Facts and Figures Round-Up
December, 1953

ELECTRONIC INDUSTRIES TOTALS



Broadcast Stations in U.S.

	AM	FM	TV
Stations on Air	2401	555	204 VHF 98 UHF
Under Construction (CPs)	128	65	84 VHF 164 UHF
Applications Pending	235	10	330 VHF 114 UHF

Radio & TV Receiver Production

	TV	Radio	
October, 1953		Home	450,000
		Battery	160,000
		Auto	280,000
		Clock	180,000
Total	800,000		1,070,000
Ten months, 1953 Jan.-Oct. Inclusive		Home	3,600,000
		Battery	1,600,000
		Auto	4,500,000
		Clock	1,800,000
Total	6,300,000		11,500,000

$324,200,000 TV Income Last Year

Supplanting the preliminary figures released earlier this year, the Federal Communications Commission has released financial data covering the operations of the television broadcast industry.

Total broadcast revenues of the TV industry in 1952 were $324.2 million or 38 percent above 1951. Networks, including 15 owned and operated TV stations, reported 1952 TV revenues of $180.2 million, expenses of $170.3 million and income of $9.9 million.

The year 1952 marked the first time in which TV network time sales surpassed radio network time sales. TV networks reported total time sales of $137.7 million, approximately 41 percent above 1951.

Magnet Requirements for TV, Radios, etc.

R. S. Fenton, Chairman of the Speaker Section, RTMA Parts Division, gives a revised estimate of the needs for Alnico 5 magnet material during the current year:

"Our revised estimate of magnet requirements is 23,500,000 units," Mr. Fenton said, adding, or "approximately 2,203,750 pounds of Alnico 5 Magnets."

The revision was based on the following production estimates:

Type of Set	*1952 Production*	*Est. '53 Prod.*
Television	6,096,279	7,000,000
Radio	10,934,872	11,500,000
Phonographs	1,000,000	2,500,000
Replacement & Misc.	2,000,000	2,500,000
	20,031,151	23,500,000

Engineers Starting Salaries, 1929-53

Average starting salary of the non-experienced June engineering graduate of Illinois Institute of Technology reached in 1953 an all-time high of $362. This was a jump of $20 over the February class average of $342. While the starting salary of engineers has steadily increased, the ratio between non-experienced and experienced engineers has been appreciably narrowed, points out *Council Compass*. The table below shows the Western Electric pattern for non-supervisory engineers in the last 24 years.

Years	*Starting Salary (Per Month)*	*Top Salary (Per Month)*	*Ratio*
1929-37	$100	$360	3.60
1938-40	$130	$425	3.27
1941-42	$160	$485	3.03
1943-45	$185	$550	2.97
1946-48	$230	$640	2.78
1949	$265	$675	2.55
1950	$305	$725	2.38
1951	$325	$750	2.30
1952	$345	$780	2.26
1953	$365	$850	2.33

What It Has Cost To Run The FCC—1942 To Date

1952	$6,505,550
1951	6,600,000
1950	6,729,345
1949	6,717,000
1948	6,240,000
1947	6,236,900
1946	5,954,900
1945	6,312,343
1944	7,884,914
1943	7,777,135
1942	5,655,924

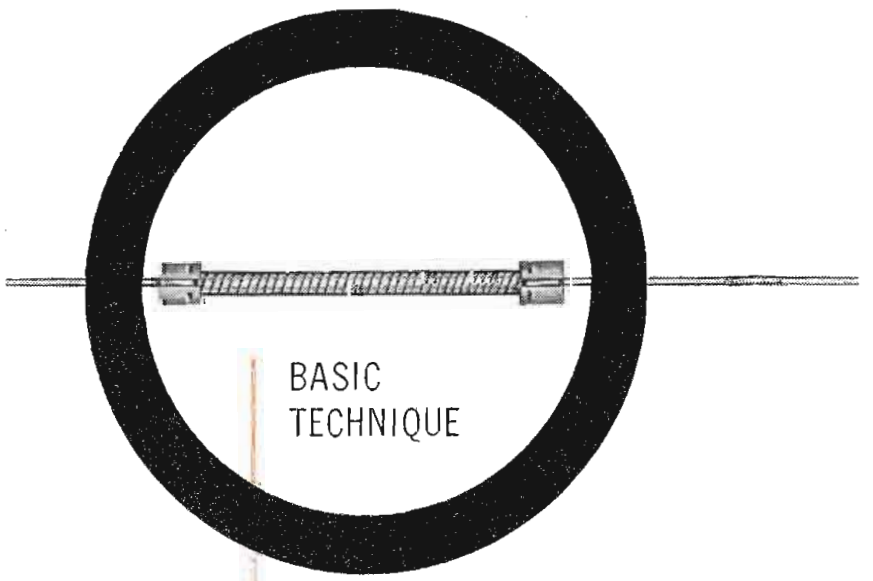
GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in October 1953

Actuators	$998,125	Inspection Units	82,735	Regulator Assys	28,242
Amplifiers	2,239,274	Instrument Landing System	44,684	Resistors	72,441
Amplifier Assys, motor	130,454	Insulators	92,400	Rotor Assys	53,360
Antenna Feed	43,572	Intervalometers	275,869	Rotary Couplers	46,414
Batteries	2,703,752	Jacks, telephone	55,250	Radio Telephones	42,460
Cable	319,976	Loudspeakers	48,796	Spectrophotometers	20,225
Circuit Breakers	159,862	Meters, frequency	75,438	Switches	128,804
Connectors and Cords	29,937	Motors	58,582	Switchboards	39,924
Contacts, female	37,050	Oscilloscopes	140,140	Switchgear Assys	157,088
Cores	37,170	Plotting Board, vertical	69,600	Telemetering Equipment	104,062
Core Mounts	35,264	Potentiometers	30,433	Testers, high voltage	31,317
Demagnetizers	8,976	Radio Compasses	147,328	Tracking Systems, 3-D	101,122
Generators	1,017,340	Radio Phonographs	26,164	Transformers	63,020
Handsets	164,424	Radio Receivers	2,075,363	Tubes, electronic	1,073,551
Indicators	228,758	Receptacles	60,381	Welders, electric	98,767

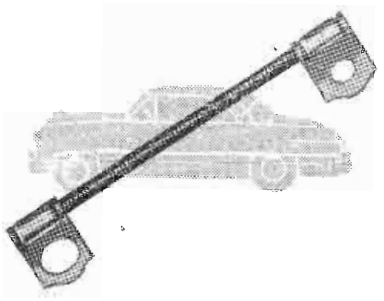
Precision, high-speed winding equipment for IRC elements

ONLY IRC WINDING SKILL OFFERS



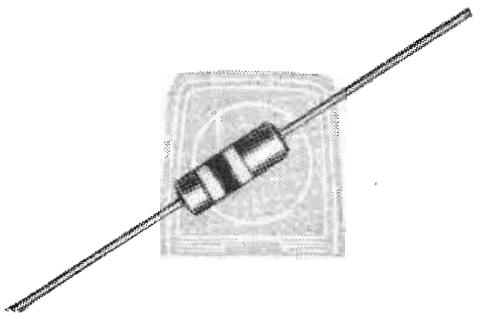
Wire element is uniformly and tightly wound on an insulated core. Axial leads or other terminations are secured to element by automatic machinery. Insulated housing may be used or omitted.

If you seek savings in component costs, IRC's winding skill may serve your need. IRC's mastery of winding wire elements dates back more than 25 years. Today, it provides a wide variety of unique units that offer realistic possibilities for savings. Cost-conscious IRC engineers will glady analyze your requirements.



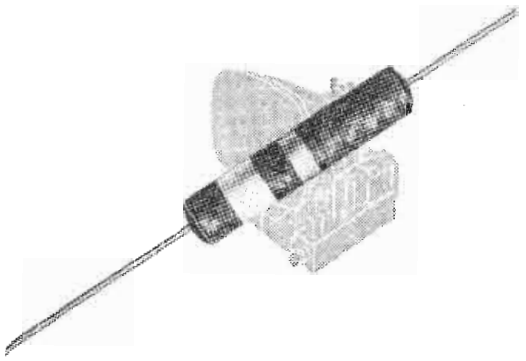
14c savings per car

Type AW Wire Wound resistors save automobile manufacturers an average of 14c per car. For quantity requirements, these low-cost windings can be made specially to suit individual designs. This adaptability has proved profitable to numerous appliance manufacturers.



low cost—low wattage

Type BW insulated wire wounds offer excellent stability in low ranges—at low prices. Leading instrument manufacturers attest to their superiority. ½, 1 and 2 watt sizes are equivalent to Jan types RU-3, RU-4 and RU-6.



50% savings

IRC Insulated Chokes offer savings up to 50% over ordinary types. Available in two sizes, they are fully protected against humidity, abrasion, assembly damage and danger of shorting to chassis. A favorite source of savings for TV and radio set manufacturers.

THESE SAVINGS

inexpensive solution

4-watt Insulated Power Wire Wounds with axial leads can save several cents over conventional power resistors. Inorganic core and high-temperature plastic housing allow safe operation up to 165° C. Widely used in toys, juke boxes and amusement devices.

NEW *specifications*

MIL-R-93A AMENDMENT 1

Government specifications for precision wire wound resistors have been revised. MIL-R-93A Amendment 1 is the new rigid standard.

IRC PRECISION WIRE WOUNDS

meet and beat these new specifications. They are equivalent to Mil types RB-15 through 19.

MAXIMUM STABILITY

Temperature cycling even beyond Mil requirements has only negligible effect. Send for new technical bulletin.

Boron & Deposited Carbon Precistors • Power Resistors • Voltmeter Multipliers • Low Wattage Wire Wounds • Insulated Composition Resistors • Volume Controls •

Wherever the Circuit Says—

Precision Wire Wounds • Ultra HF and Hi-Voltage Resistors • Low Value Capacitors • Selenium Rectifiers • Insulated Chokes • Hermetic Sealing Terminals •

IRC

INTERNATIONAL RESISTANCE CO.

407 N. Broad St., Philadelphia 8, Pa.

In Canada: International Resistance Co., Ltd., Toronto, Licensee

Send me technical data on: ☐ Precision Wire Wounds; ☐ Insulated Chokes; ☐ BW Resistors; ☐ 4-Watt Power Resistors

Name_____

Title_____

Company_____

Address_____

City_____ State_____

TELE-TECH

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

BERNARD F. OSBAHR, *Executive Editor* — DR. A. F. MURRAY, *Consulting Editor*

ALBERT FORMAN, *Associate Editor* — HARRY D. WULFORST, *Associate Editor*

JOHN H. BATTISON, *Contributing Editor* — B. V. SPINETTA, *Directory Editor*

CARL THOMAS, *Assistant Editor*
R. C. DAVIES, *Washington News Editor*
CHARLES F. DREYER, *Art Director*
GAIL CARLSON, *Editorial Secretary*
Lt. Col. STANLEY GERSTIN, *Consulting Editor*
(Vice Pres. & Gen. Mgr., Caldwell-Clements Manuals Corp.)

BUSINESS DEPARTMENT

M. H. NEWTON, *Business Manager*
HOWARD A. REED, *General Sales Manager*
HAROLD PRINCE, *Sales Promotion Manager*
JOSEPH DRUCKER, *District Manager*
JAMES S. COLEMAN, *Asst. Sales Manager*
N. McALLISTER, *Asst. Business Manager*
A. SHILLIN, *Production Manager*
480 Lexington Ave., New York 17, N. Y.
Telephone Plaza 9-7880

S. M. GASKINS, *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
1355 Market St., San Francisco 8, Colif.
Telephone KLondike 2-2311, Ext. 579

WARREN S. BROWN, *Circulation Manager*
M. GROENING, *Asst. Circulation Manager*
JOHN J. BORGHI, *Controller*

CIRCULATION 21,000

Because of increases in circulation which obviously cannot be shown in current audited statements, advertisers should disregard any comparison based on a previous period or any that fails to show TELE-TECH's guaranteed circulation of 21,000.

TELE-TECH* & ELECTRONIC INDUSTRIES is edited for top-level engineers and executives throughout the electronic industries. It gives the busy engineering executive authoritative information and interpretation of the latest developments and new products, with emphasis on subjects of engineering import and timeliness. Special attention is given to:

MANUFACTURING

—Electronic equipment, communications, broadcasting, microwave relay, instrumentation, telemetering, computing.
—Military equipment including radar, sonar, guided missiles, fire controls.
—TV-FM-AM receivers, phonographs, recorders, reproducers.

OPERATION

—Fixed, mobile and airborne communications in commercial, municipal, aviation and government services.
—Broadcasting, video and audio recording, records, audio and sound systems, motion picture production.
—Military, civilian and scientific electronic computing and control systems.
*Reg. U. S. Pat. Off.

THE ELECTRONIC INDUSTRIES DIRECTORY

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

As We Go To Press...

FCC to Impose Licensing Fees

The FCC is one of a number of federal agencies affected by the recent order of the Budget Bureau directing that "It shall be the policy of federal agencies engaged in licensing activities to provide a system of fair and equitable fees which, taking account of the value to the recipient and the public policy or interest served, shall recover, to the full extent possible, the aggregate cost incurred in the conduct of those activities." The proposed schedule of fees, subject to comments by interested parties, will be made public by Feb. 1, 1954. Its object is to reduce to the general taxpayer the costs of services which provide a special benefit to limited groups.

Unlike other agencies, the FCC will not be required to seek special legislation to implement the new fee system. Rate regulation and enforcement activities are exempted, as are local governments, foreign countries, and charitable non-profit groups. At the discretion of the agency head, other exceptions to cost recovery may be made.

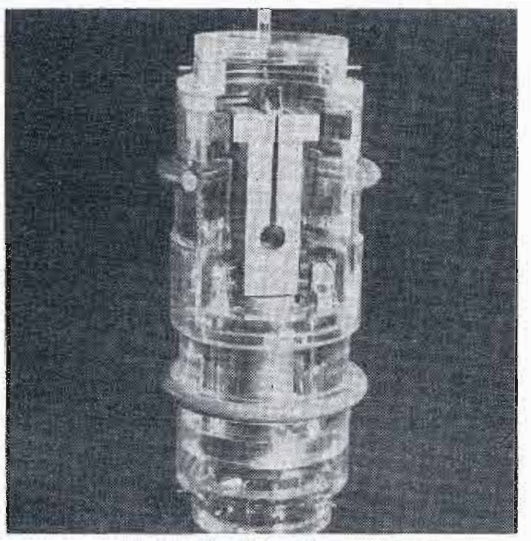
First Transcontinental Color TV Demonstration

The first coast-to-coast demonstration of compatible color TV was made on Nov. 3 by the National Broadcasting Co. The program, originating in New York and transmitted to Hollywood over Bell System facilities, employed RCA equipment operating on NTSC signal specifications. An interesting feature of the broadcast was the use of color film as well as live pick-up.

Military Procurement Money Available

Over $2.5 billion is being made available by the Department of Defense for procurement of electronic equipment during fiscal year 1954. Although new allocations have been cut to $500 million less than last year, the carryover of almost $1 billion from 1953 makes up the total of $2.5 billion.

Vibratory Gyroscope Developed for Navy



Heart of vibratory gyro (l) are U-shaped prongs at center of cutaway instrument. It sings like tuning fork, and is analogous to spinning wheel that operates conventional gyroscopes. Experimental automatic pilot (r) based on new vibratory gyro gets ground test before flight check

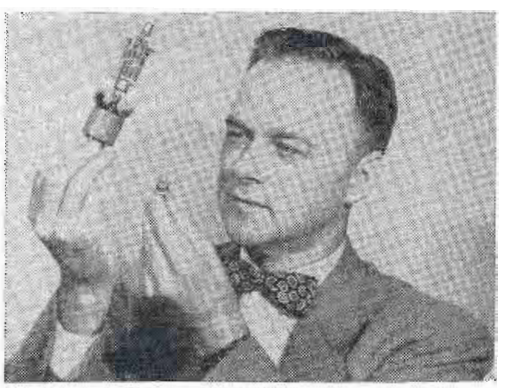
A new and different kind of gyroscope was recently disclosed by the Navy. The instrument is analogous to the "halteres" or gyratory sense organs found on the common house fly. These are club-shaped vibrating rods behind the fly's wings which give the fly his sense of balance. The fundamental principle of the vibratory gyroscope, discovered at Sperry Gyroscope, indicates a promising range of applications. Its development, however, is still in the experimental stage.

The principle of operation is based on a device similar to a tuning fork. When the aircraft turns, it twists the equivalent of the tuning fork handle. This sets up a vibratory pattern in the tines which is translated into electrical signals by torsion pickup coils. The signals are compared with a reference in a phase detector and applied to a rate of turn indicator.

Experimental vibratory gyroscopes, until now a classified project at Sperry for the Navy's Bureau of Aeronautics, consist of small electrically-driven tuning forks which are sensitive to extremely small as well as large turning motions. The experimental units can measure rates as slow as the earth's rotation, to more than 100 rpm. A new automatic pilot based on experimental vibratory gyroscopes is currently undergoing flight experiments in a Navy airplane. Interest in the new vibratory gyro results from its remarkable freedom from friction effects.

20-Watt Power Transistor Produced

A thimble-size transistor that is 100 times as powerful as present commercially available types has been developed in the research laboratories of Minneapolis-Honeywell Regulator Co. Dr. Finn J. Larsen, research director, reports that the new power unit has an output of 20 watts. A prototype aircraft electronic fuel gauge making use of the new transistor already has been built by the company. The transistor is not yet in commercial production, but is being built on a pilot-line basis.



Dr. Finn J. Larsen, research director at Minneapolis-Honeywell, compares new 20-watt transistor with standard power tube. High output enables unit to operate motors and relays

MORE NEWS on page 14

Names that mean outstanding quality

Capehart

SYLVANIA

Motorola

Sentinel

RAYTHEON

. . . RELY ON Midland CRYSTALS

Manufacturers with front-rank reputations make sure of every component that goes into their products. Such reputations can be maintained only through constant vigilance and selection of suppliers who also have proud reputations to uphold.

Names of distinction in every field of communications depend on Midland Crystals for reliable frequency control in their products. That's tribute enough to the kind of performance Midland Quality Control has built into millions of crystals faithfully doing a first-class job on land, sea, and in the air.

Whatever your Crystal need, conventional or highly specialized
When it has to be exactly right, contact

Midland MANUFACTURING COMPANY, INC.
3155 Fiberglas Road, Kansas City, Kansas

WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS

Tantalum Capacitors For Extreme Temperatures

−55°C to +175°C

New Standard 7/8 Inch Case Size

Saves up to 20% in Weight . . . 16% in Volume

When the Tantalum Capacitor was introduced by Mallory, it provided the first answer to dependable operation in the extremely high ambients such as result from miniaturization of electronic equipment.

Now, Mallory has reduced the higher capacity 1⅛″ Tantalum Capacitors to ⅞″, thereby establishing a single standard case diameter. This refinement not only simplifies installation and mounting hardware; it will also produce substantial reductions in the weight and size of high capacity units.

Be sure and look into the advantages of Mallory Tantalum Capacitors for your equipment. Our engineers will be glad to talk over any problem you may have in the application of capacitors, the development of special types, or the simplification of related circuits.

FOR MORE INFORMATION...

Write for your copy of the new Technical Bulletin on Mallory Tantalum Capacitors. It contains complete mechanical and electrical data and performance characteristics.

Expect more ... Get more from P.R. MALLORY & CO. Inc. MALLORY

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

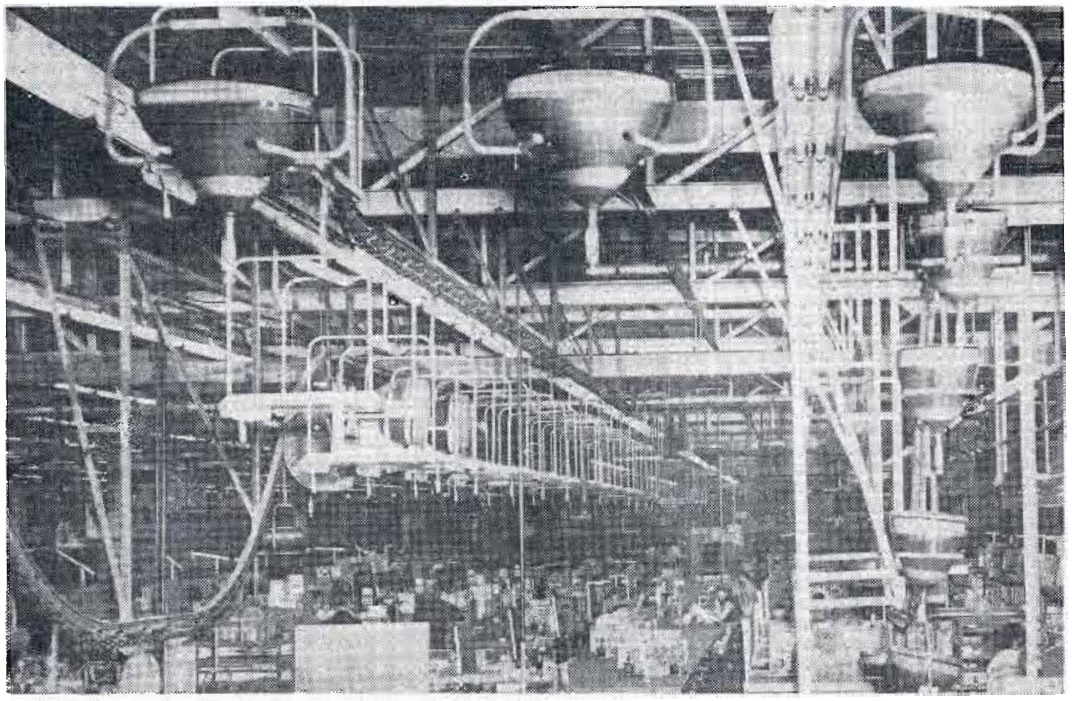
P.R. MALLORY & CO. Inc.
MALLORY

SERVING INDUSTRY WITH THESE PRODUCTS:
Electromechanical — Resistors • Switches • Television Tuners • Vibrators
Electrochemical — Capacitors • Rectifiers • Mercury Batteries
Metallurgical — Contacts • Special Metals and Ceramics • Welding Materials

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

As We Go To Press . . . (Continued)

TV PLANT SWINGS INTO PRODUCTION



The 450,000-sq. ft. Westinghouse plant in Metuchen, N. J., said to be one of the first of its size build specifically to assemble TV receivers, has stepped up set production. More than 2200 people are employed here. Civilian production, started earlier this year, occupies half of the plant space; government production occupies the other half. Picture tubes move along overhead conveyor.

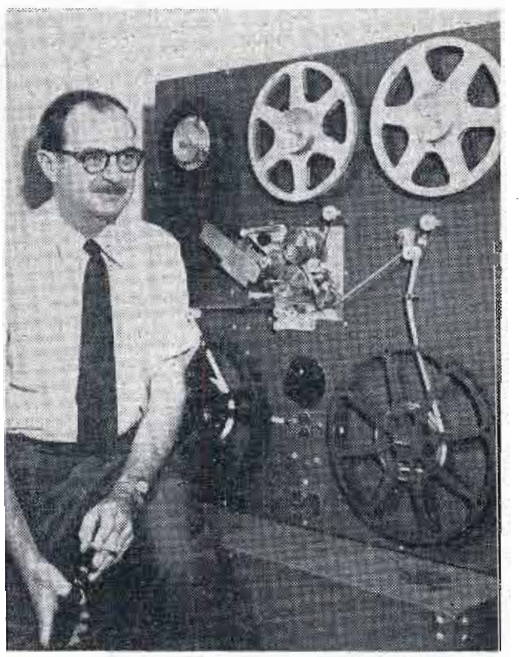
U.S. Pulls Out of Ocean Station Program

The U. S. has notified the International Civil Aviation Organization (ICAO) that it would withdraw from participation in the North Atlantic Ocean Weather Stations program at the expiration of the present agreement on June 30, 1954. This project maintains 25 ships needed to man 10 floating weather stations in the North Atlantic.

The stations provide meteorological and navigational aids to aircraft and serve as rescue bases. They are supported by 15 nations whose territories ring the North Atlantic. The reason given for the U. S. position is that the services provided are no longer required and that the benefits derived are no longer commensurate with the cost.

Award Given for Magnetic Tape Developments

Dr. Wilfred W. Wetzel, Technical Director of the Magnetic Recording Div. of Minnesota Mining & Mfg., has been presented the Samuel L. Warner Memorial Award by the SMPTE for his contributions to magnetic tape development. Two advances revealed by Dr. Wetzel are a new process for applying multiple magnetic sound tracks to 35-mm film, and a long-life playback head for motion picture sound reproduction. The developments are expected to find widespread use in stereophonic sound applications. The system for applying magnetic sound tracks to film, called the "Scotch-Track" laminate film process, is made possible by an applicator machine which automatically bonds the tape to the film at the rate of 125 ft. per minute.



Dr. Wetzel and tape applicator for film

TV Color Film Systems Shown

Three methods for telecasting film in color were recently demonstrated by the RCA Victor Div. Significant among the new projection equipment under development is a system which utilizes three vidicon tubes, which, by employing dichroic mirrors, can pick up and reproduce color film projected by standard black-and-white 16-mm film projectors. In addition to the vidicon system, RCA also disclosed another method—now in commercial production—which utilizes a special 16-mm fast pulldown projector with a flying spot scanner. The third system, which like the three-vidicon system, is still under development, is a continuous film projector for 35-mm film, also used in conjunction with a flying spot scanner.

Germanium Extraction from Coal Impractical

Two companies interested in obtaining germanium from coal have come to the reluctant conclusion that such extraction is impractical. This finding is the outgrowth of a joint research program conducted by the Eagle-Picher Co. and Pennsylvania Coal and Coke Corp. to find a plentiful source for the expensive metal widely used in transistors and diodes. The negative conclusion sharply contradicts overly optimistic opinions voiced in recent months. However, the Bureau of Mines is continuing its hunt for germanium from coal in a program to assist the Signal Corps.

Among the reasons given for the "pessimistic attitude" are:

Not all coals contain germanium.

Germanium concentrations in coal seams are erratic.

Germanium content is very low, and in best coals rarely exceed 0.002 % or 0.003 %.

Because of the low germanium content, it is economically necessary that the coal be burned in a separate operation and the germanium recovered as a byproduct. Such extraction is expensive. Also the germanium distributes itself unevenly over the various products of combustion.

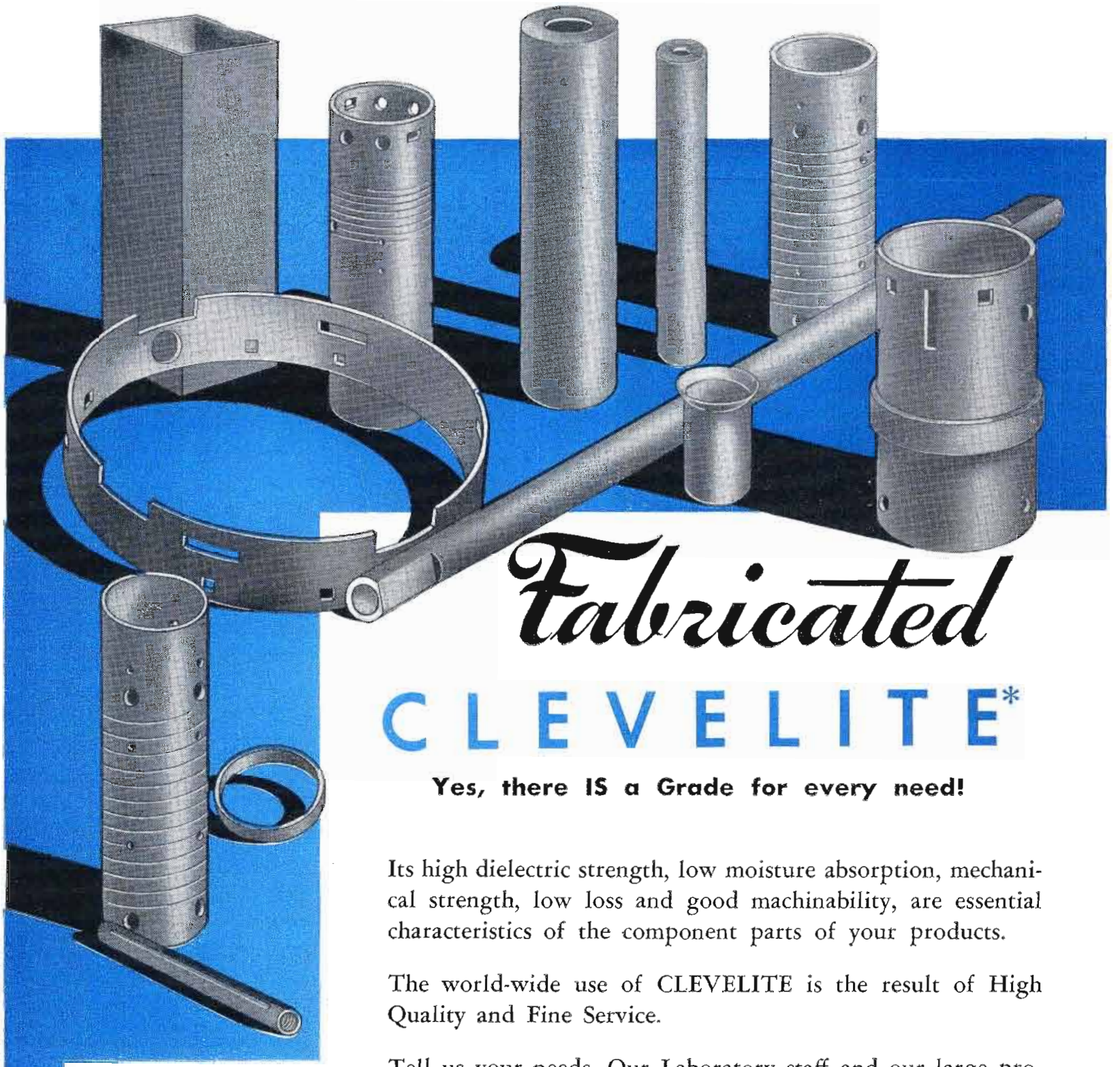
The germanium market is reportedly unstable.

Annual Index

of all articles published in TELE-TECH & ELECTRONIC INDUSTRIES during 1953, classified according to subjects, may be obtained free of charge by writing to:

The Editors
TELE-TECH & ELECTRONIC INDUSTRIES
480 Lexington Ave., New York 17, N. Y.

MORE NEWS on page 18



Fabricated

CLEVELITE*

Yes, there IS a Grade for every need!

Its high dielectric strength, low moisture absorption, mechanical strength, low loss and good machinability, are essential characteristics of the component parts of your products.

The world-wide use of CLEVELITE is the result of High Quality and Fine Service.

Tell us your needs. Our Laboratory staff and our large production facilities are at your disposal.

Send for our new folder with complete details on the SEVEN GRADES of CLEVELITE and their applications.

CLEVELITE MEANS HIGH QUALITY!

* Reg. U. S. Pat. Off.

Each day sees some new problem solved by the outstanding electrical and physical properties of CLEVELITE.

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

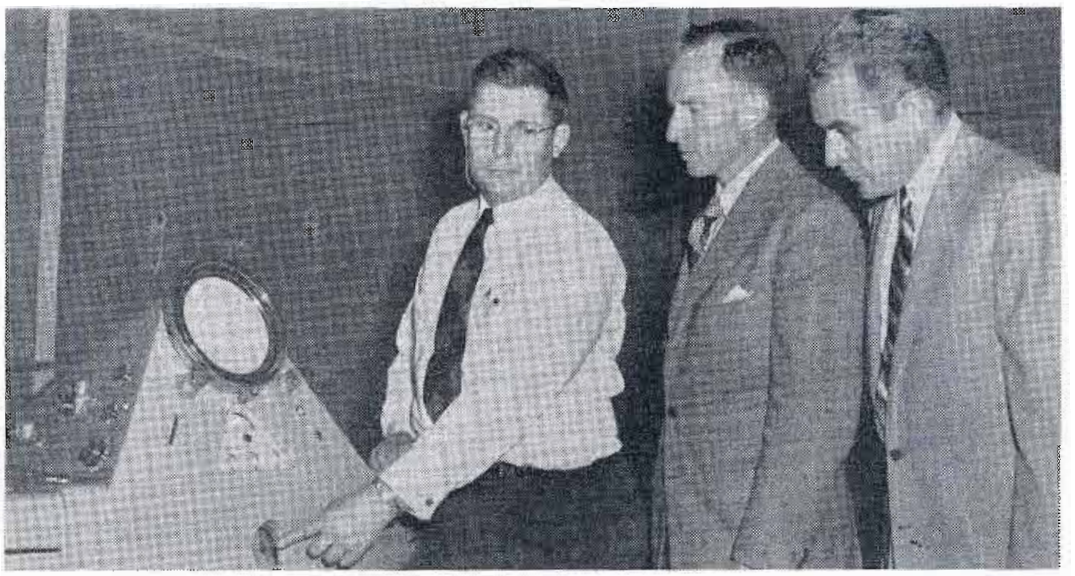
PLANTS AND SALES OFFICES at Chicago, Detroit, Memphis, Plymouth, Wisc., Ogdensburg, N. Y., Jamesburg, N. J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

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
WEST COAST IRV. M. COCHRANE CO., 408 S. ALVARADO ST., LOS ANGELES

As We Go To Press . . . *(Continued)*

ELECTRON MICROSCOPE ON TV



(l to r) Thomas Turnbill, microscope expert at North American Philips, Dr. Norman D. Newell, curator of American Museum of Natural History, and CBS commentator Charles Collingwood examine electron microscope which showed virus and bacteria specimens magnified 20,000 to 60,000 times for first time to 21-station national TV audience on CBS "Adventure" show

Bell System TV Service Extended

The interconnection of TV station WIFE, Dayton, Ohio, with the Bell Telephone System's nationwide network facilities was announced by the Long Lines Dept. of AT & T. With this addition, network TV service is now available to 210 stations in 132 cities in the U. S.

Starting Salaries

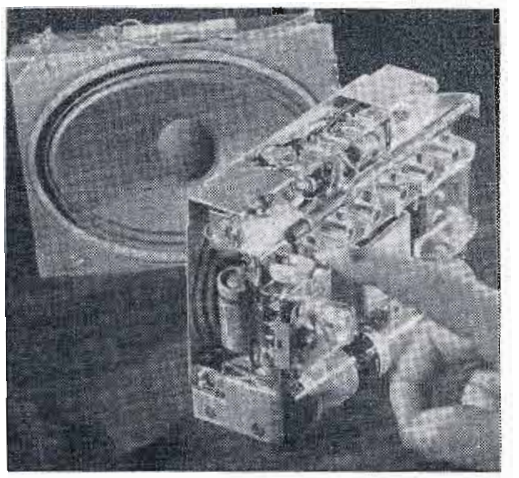
Engineering graduates of NYU had an average starting salary of $345 per month in 1953, a 5% rise over 1952. About 71% took jobs in private industry.

Crosley to Manufacture Lawrence Tube

Leonard F. Cramer, (l) vice-president of Avco Mfg. Corp. and general manager of Crosley radio and TV, and Richard Hodgson, (r) president of Chromatic TV Labs., hold production model of Chromatron, or Lawrence tube, which Crosley has recently been licensed to manufacture

TELE-TIPS
Begin on Page 58

Transistorized Portable Radio



Lab model of portable radio designed by Loy E. Barton of RCA. It uses six new r-f junction transistors, three transistors for audio, and a junction diode. Six flashlight cells operate 500 hours with power drain only one-ninth of comparable set. Audio power from 4 x 6 in. speaker is twice that of tube set

"Microstrip" Licensing Policy Announced

Latest developments in Microstrip, a printed circuit replacement for waveguide, were revealed on Nov. 4 to representatives of over 60 electronic manufacturers and the armed forces. Licensing policy based on 1% royalty, $1000 per year minimum, and no requirement for back-licensing for improvements, were revealed. Experimental kits are available at costs of about $350 and $500.

COMING EVENTS

1953

Dec. 8-10—AIEE-ACM-IRE, Eastern Computer Conference, Statler Hotel, Washington, D.C.

Dec. 14-16—Second Signal Corps-Industry Wire Cable Symposium, Berkeley Carteret Hotel, Asbury Park, N.J.

1954

Jan. 18-22—AIEE Winter General Meeting, Hotel Statler, New York, N.Y.

Jan. 25-27—Plant Maintenance & Engineering Conference, Hotel Conrad Hilton, Chicago, Ill.

Jan. 25-28—Plant Maintenance & Engineering Show, International Amphitheatre, Chicago, Ill.

Jan. 27-29—Tenth Annual Technical Conference of the Society of Plastics Engineers, Royal York Hotel, Toronto, Can.

Feb. 4-6—IRE Sixth Annual Conference and Electronics Show, Hotel Tulsa, Tulsa, Okla.

Feb. 4-6—1954 Audio Engineering Society Audio Fair, Alexandria Hotel, Los Angeles, Calif.

Feb. 11-12—AIEE-IRE-ACM West Coast Computer Conference, Ambassador Hotel, Asbury Park, N.J.

Feb. 18-19—AIEE-IRE Conference on Transistor Circuits, Philadelphia, Pa.

Mar. 15-19—NACE Tenth Annual Conference and Exhibition, Kansas City.

March 22-25—IRE National Convention, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

April 24—Eight Annual Spring Technical Conference, IRE Cincinnati Section.

April 26-30—Tenth Biennial ASTE Industrial Exposition, Philadelphia Convention Center, Phila., Pa.

May 4-6—RETMA Fifth Government-Industry Conference, U.S. Department of Interior Auditorium, Washington, D.C.

May 4-7—1954 AWS National Spring Technical Meeting, Hotel Statler, Buffalo, N.Y.

May 5-7—AIEE Northeastern District Meeting, Schenectady, N.Y.

May 5-8—1954 Welding and Allied Industry Exposition, Memorial Auditorium, Buffalo, N.Y.

May 7-8—IRE North Atlantic Region New England Radio Engineering Meeting, Sheraton Plaza Hotel, Boston, Mass.

May 7-9—AFCA National Convention, Shoreham Hotel, Washington, D.C.

May 17-20—1954 Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

May 23, week of—NARTB Convention, Palmer House, Chicago, Ill.

June 15-17—RETMA Convention, Palmer House, Chicago, Ill.

June 21-25—AIEE Summer General and Pacific Meeting, Hotel Biltmore, Los Angeles, Calif.

July 13-15—Plant Maintenance Show, Pan Pacific Auditorium, Los Angeles, Calif.

AFCA: Armed Forces Communications Ass'n.
AIEE: American Institute of Electrical Engineers.
ASTE: American Society of Tool Engineers.
AWS: American Welding Society
IRE: Institute of Radio Engineers
NACE: National Association Corrosion Engineers.
NARTB: National Association of Radio and TV Broadcasters.
RETMA: Radio-TV Manufacturing Association.

Never

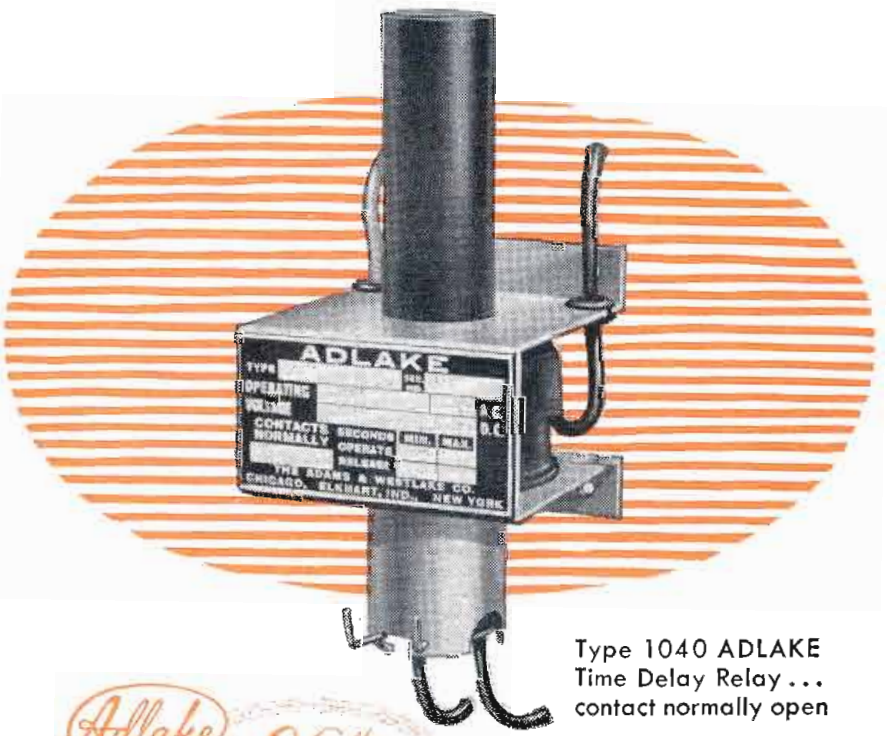
any Maintenance required with Adlake Mercury Relays!

Yes, thanks to their positive, leak-proof sealing . . . their sure-fire mercury-to-mercury contact . . . their immunity to normal vibrations and temperature changes . . . thousands of satisfied users in every branch of industry can testify that ADLAKE Relays literally require no maintenance whatever!

ADLAKE Relays have won their place by *proven dependability*—year in and year out—in jobs that conventional relays can do in an uncertain manner at best! For every ADLAKE Relay is tested—and guaranteed—to meet specifications!

Yes, in chick incubators or diesel locomotives—wherever sensitivity and dependability are required—you can always count on ADLAKE! Send for complete Relay catalog today . . . write The Adams & Westlake Company, 1175 N. Michigan, Elkhart, Indiana. In Canada, write Powerlite Devices, Ltd., Toronto.

Every ADLAKE Relay is tested... *and guaranteed*...to meet specifications!



Type 1040 ADLAKE Time Delay Relay . . . contact normally open

Adlake 96th year of serving the transportation and building industries

THE Adams & Westlake COMPANY

Established 1857 • ELKHART, INDIANA • New York • Chicago

Manufacturers of ADLAKE Hermetically Sealed Mercury Relays

TELE-TIPS

AT RADIO FALL MEETING in Canada, the speaker (RCA) had some uneasy moments as transistorized "personal-type" receiver he was demonstrating persisted in giving out with squeals, squawks, and sputters. The quality of reception improved immeasurably when previous speaker (GE) rose and quietly turned off TV receiver left running with audio turned down. (Ed. note—Some still say it was sabotage.)

BEAT THE CLOCK—the radar auto-speed clocking meters, that is. In a little over a year, about 2000 speeding convictions have been obtained with the radar timer, in spite of numerous attempts to foul up the system. The methods attempted include: 1. Steel marbles in hub caps; 2. Tinfoil shielding; 3. Dragging steel chains; 4. Lead radiator shields. Many of the would-be deceivers are ex-GI's who remember how the enemy dropped metal foil to confuse Allied radar. However, these attempts are ineffectual. The radar systems, now in more than 40 states, can only be jammed by an unauthorized transmitter in the car—and the FCC takes a dim view of such shenanigans.

TEST TUBE HANDS, the laboratory equivalent of milady's dishpan hands, may be a thing of the past. The Labwasher, manufactured by Westinghouse for the Chemical Rubber Co. is designed to accommodate over 90% of the most-used lab glassware thereby freeing skilled scientists from the time-consuming chore.

THE FOUR R's are coming into prominence in American schools. In addition to the classical trio—readin', 'ritin', and 'rithmetic—recordin' has been playing a growing role as an educational aid. This year schools will buy more than 50,000 magnetic tape recorders at a total cost of over $10,000,000.

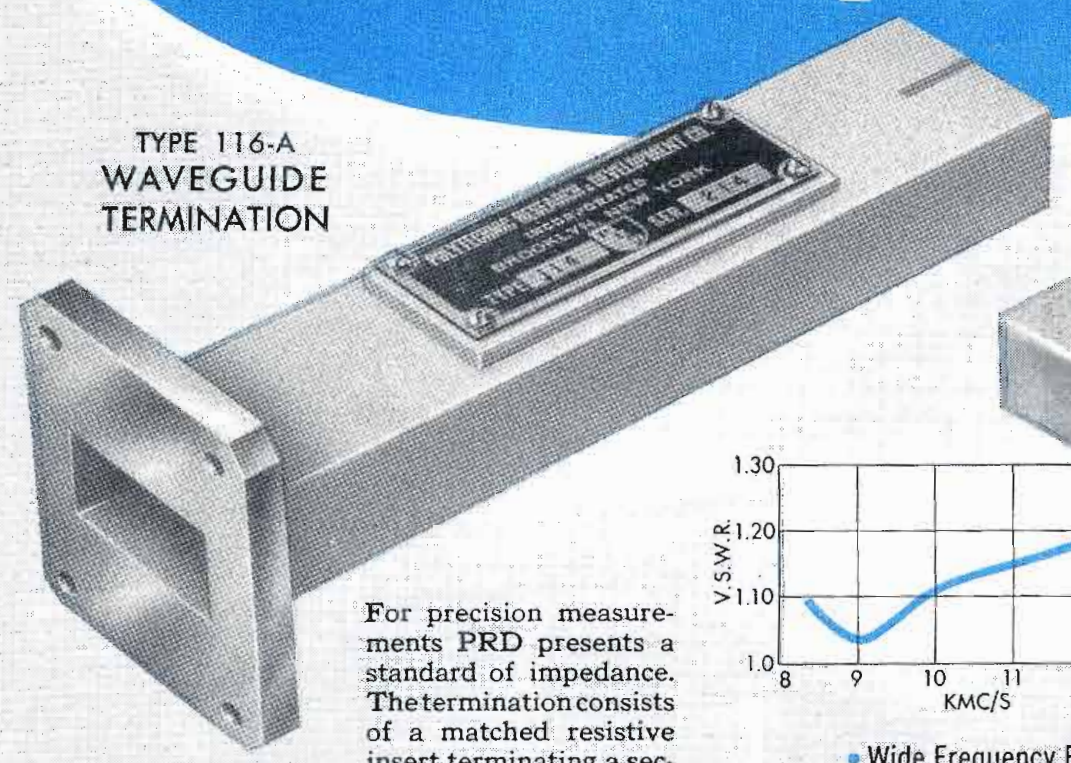
RADIOACTIVE isotopes are cutting down the time lag of electron tubes. This effect, similar to the delay that occurs before a fluorescent tube lights, is quite critical in radar operation. By placing a drop of radioactive cobalt solution prepared by Tracerlab on the tube electrodes, tubes have been found to fire immediately and consistently.

(*Continued on page* 52)

Precision Designed for LOWEST VSWR!

PRD microwave TRANSMISSION LINE components

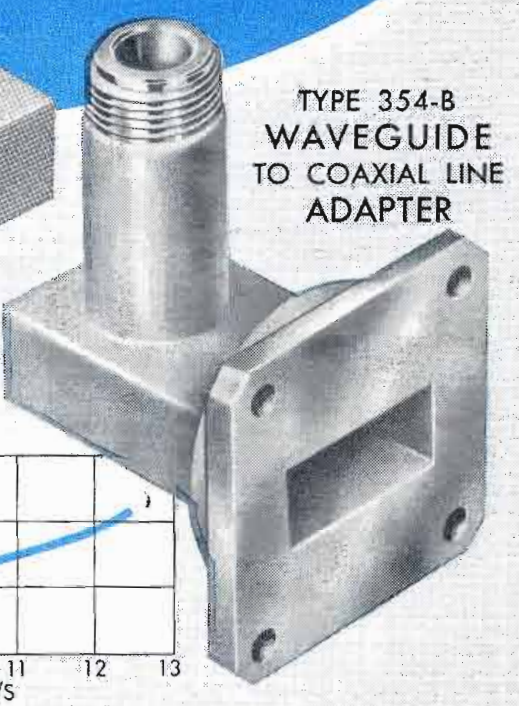
TYPE 116-A
WAVEGUIDE
TERMINATION



- Frequency Range: 8.2 to 12.4 kmc/s
- Very Low VSWR: Less than 1.015
- Stable Characteristics
- Rugged
- Waveguide Type: RG-52/U
- Flange Type: UG-39/U

For precision measurements PRD presents a standard of impedance. The termination consists of a matched resistive insert terminating a section of RG-52/U waveguide. Each insert is tested to insure that its VSWR is less than 1.01. Dimensions are maintained so that its characteristic impedance is within 0.5 percent of nominal. Flange faces are milled flat and the screw holes are referenced to the center line of the waveguide.

TYPE 354-B
WAVEGUIDE
TO COAXIAL LINE
ADAPTER



- Wide Frequency Range: 8.2 to 12.4 kmc/s
- Low VSWR: (See curve)
- Waveguide Type: RG-52/U
- Flange Type: UG-39/U
- Coaxial Connector: Mates with UG-21B/U or equivalent

The Type 354-B Adapter is designed for making minimum reflection connections between waveguide and coaxial line. Typical VSWR is shown in the curve. The low VSWR assures least disturbance of the electrical properties of mating components.

CHECK WITH PRD FOR QUALITY-BUILT TEST EQUIPMENT

The components shown are typical of the very complete PRD line of precision-built Microwave Test Components. Standard items available include Attenuators, Terminations, Impedance Measurement and Transformation, Transmission Line Components, Frequency Measuring Devices, Detection and Power Measurement, Signal Sources and Receivers, etc. Write today for the PRD illustrated catalog. Address Dept. T-12.

Polytechnic **RESEARCH & DEVELOPMENT COMPANY·Inc**

55 JOHNSON STREET, BROOKLYN 1, NEW YORK

WESTERN SALES OFFICE:
741½ North Seward St.
Hollywood 38, California

TELE-TIPS

(*Continued from page* 48)

MEDICAL MEN are heaping praise on the TV industry for bringing medical information to the public. The appeal of such programs as "Health Talks," "From the Cradle to Maturity," and "What to Do Until the Doctor Arrives" have been cited by the American Medical Association. The AMA has learned that 77% of the county medical societies and 91% of the state societies are using some form of radio and TV.

COMICS are being utilized with notable success to introduce young people to the engineering profession. General Electric has issued 13 comic books since 1945, each with press runs of 500,000 to 3,000,000, for a grand total of 35,000,000 copies. These books, widely used in schools, carry such titles as "Adventures in Jet Power," and "Adventure Into the Future"—the latter showing Johnny, the main character, how to become an engineer and what the opportunities are in the field.

SOMEWHAT SIMILAR approach for school and industrial illustration has been developed by R. L. Switzen, Dr. H. L. Zorbaugh of NYU, and Pictorial Media, Inc. Called "Viseodrama," this system employs eight cartoon characters which take advantage of the readers' "role-playing" to aid idea communication. Set of eight rubber dies are available for $1 from Reilly Plastictype Div., Dept. E, 5221 S. Soto St., Los Angeles 48, Calif. Comic program information may be obtained from R. L. Switzen, P. O. Box 322, Santa Monica, Calif.

TV SNOOPER used by the British Post Office to ferret out TV set owners who have neglected to pay the annual £2 ($5.60) tax has impressive psychological impact on recalcitrants. In the university town of Cambridge, the announcement of the arrival of the detector truck produced 900 license applications before it ever appeared on the streets. The situation is confused by the fact that while some quarter-million British TV owners without licenses have hidden antennas, a goodly number of people who try to keep up with the Joneses have antennas, but no receivers.

TELE-TECH
& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

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

Federal Administration Problems of

NATIONAL TELECOMMUNICATIONS

There has long been need within the Federal Government for a better means for handling telecommunication problems. Heretofore we have had few clean-cut established national policies in this field for the guidance of executives and administrators. In fact, there has been no specific mechanism whereby policy could be established and maintained.

The need for regulating the use of radio for communication purposes resulted in the Radio Act of 1927. This was replaced by the Communications Act of 1934 which included all forms of electrical communication. A Federal Communications Commission is provided, which administers to the regulation of all non-Federal telecommunications. The President of the United States is empowered to deal with many aspects of Federal Government telecommunications. Experience has disclosed weaknesses which may be stated as:

1. Each government department or agency itself determines what kind of and how much telecommunications it needs. There is no higher authority charged with providing coordination and long-term policy nor preventing duplication.
2. The assignment of radio frequencies to government stations is done by an interdepartmental committee and confirmed by Presidential Executive Orders. Each representative on this committee strives to secure satisfaction of his boss's stated needs. The blocking out of radio frequency assignments generally must be worked out on a compromise basis between the Commission and the various government agencies.
3. International telecommunication policies are arrived at through international conferences which result in treaties. Frequently, basic differences of opinion arise between various units of the government which, being unresolved, make the task of the State Department's delegation more difficult.
4. The State Department attempted to deal with policy in recent years by establishing a Telecommunications Coordinating Committee, but as this committee lacked authority it could only reach conclusions that were unanimously acceptable to the member agencies. Unresolved problems remained unsettled.
5. Private industry cannot realistically participate in decision making because it is regulated by the Federal Government.

Telecommunications Advisor Abolished

These conditions caused the President to appoint an eminent Board in 1950 to make recommendations. After a year of effort it recommended a permanent Board, or an individual, to be advisory to the President. President Truman thereupon appointed a Telecommunications Advisor in 1951. After twenty months, this office was abolished by President Eisenhower and its functions transferred to the Director of Defense Mobilization who has now appointed an Assistant Director to deal with them.

Experience has shown that forward progress beyond that attainable by voluntary acceptance by the many government agencies can be achieved by the process of an Executive Order only if the President and his immediate agency heads will put their weight behind the effort and promulgate decisions. This is because decisions intended for the general national welfare are not likely to be equally acceptable to all agencies. The President and his lieutenants cannot be expected to administer to such a specialized field, as a normal and continuing matter.

Under the present law there is dual responsibility. The law's provisions are not administered similarly. Private industry must plead and justify its every action before a Federal Commission and the law contemplates this. A government agency is not required to conform to a similar pattern and there is no way whereby its decisions can be appealed by an objector, unless the President wants to intervene. Under the existing arrangement the Director of Defense Mobilization has no authority over the Federal Communications Commission nor has the Commission any over the Executive Branch, therefore there is no way provided to resolve differences that might arise between the Commission and other government agencies.

A National Radio-Frequency Administrator Needed

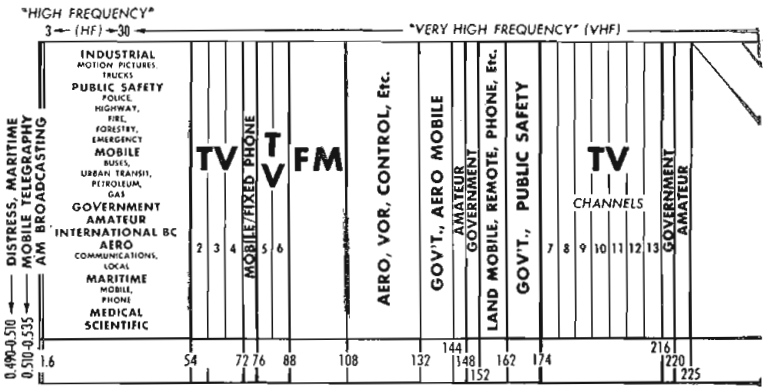
The proposed HR 6819 to establish a Telecommunications Planning Committee would do no more than give legal sanction to the sort of organization now operating. Its Committee could only make plans and recommend them, as well as suggest legislation to Congress. The Director of Defense Mobilization can do both of these now.

Legislation is needed to place both authority and responsibility. All radio-frequency granting and supervision of use should reside in a National Radio Frequency Administrator. Government agencies should be required to justify their requirements formally. The law should also provide for a coordinated control, within the Executive Branch, of all government communication facilities. Such control should prevent the growth of gov-

(*Continued on page* 146)

RADARSCOPE

Revealing Important Advances Throughout the Spectrum of Radio, TV and Tele Communications



RESEARCH

PUBLIC SUPPORT FOR BASIC SCIENCE—Realignment of present division of research responsibilities is recommended by Julius A. Stratton, vice-president and provost at Massachusetts Institute of Technology, Cambridge, Mass. "Traditionally, we have looked to the universities for the advancement of knowledge, and we depend upon them largely for all research into the fundamentals of science. To industry falls the task of applying new knowledge to useful ends and of furthering research and development focused on new materials, processes, and products. . . . Government encourages research of all kinds with a view to development of new weapons and supports a variety of investigations in such fields as agriculture and public health. But all this chain of obligations hangs upon fundamental research, and the future vitality of countless enterprises depends upon the soundness of our national effort in this domain. The responsibility for the support of basic science cannot be delegated wholly to the university; it must be shared by industry and government, by business and by the public at large."

GOVERNMENT

PAY-AS-YOU-GO licenses for broadcasters apparently are on the horizon. Several government agencies, including the FCC, have recently been asked to review their operational structure and to develop a licensing program which would make them effectively "self-supporting" agencies. By this means the administration would be placing the support burden on the actual users of the facility rather than on the taxpayers. The current annual budget for the FCC is approximately $7 million.

TRANSISTORS

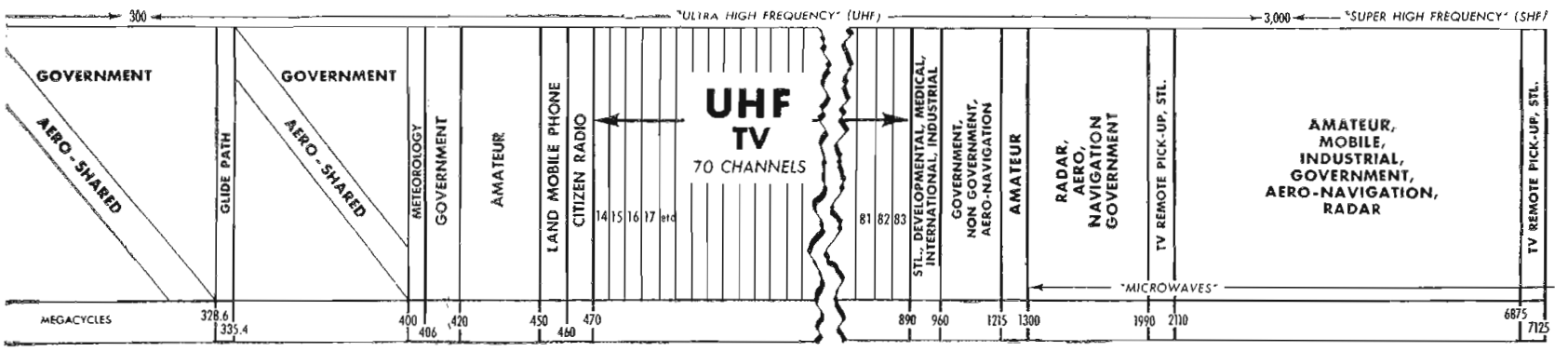
JUNCTION AND POINT-CONTACT types are combined in an experimental transistor developed at Bell Telephone Laboratories. The structure utilizes a p-n junction as a collector and a point-contact on the "n" material as an emitter. The base is connected to the "n" side, and the collector to the "p" side. This device has possible advantages over either of the current types since the fabrication requires only a p-n junction to which a point emitter is added, thus simplifying the crystal preparation. If further investigation shows good performance characteristics, the unit might prove most welcome to transistor manufacturers who are constantly on the watch for new ways to eliminate production headaches.

PRODUCTION

A WIDELY USED TOOL on TV and electronic assembly lines is the "airgun" screwdriver, which is used to mount parts on chassis and cabinets. This semi-automatic assembling method is a significant advance over hand-driving techniques, but one shortcoming of this device is its ability to hold only one screw at a time. In several operations observed by the editors, it took only two to three seconds to drive a screw, but it took from three to ten seconds to hand-feed the screw into the airgun's mouth and reposition it on the work. Several TV-electronic manufacturers have indicated their desire to buy automatic airguns with continuous screw feeding—if performance and price are right. The total number of such screws used in all industries runs into several billion per year. Here's a challenge for manufacturers to come up with an inexpensive time-saver, and enter a market that is waiting with open arms.

Beware the BS in EE!

Verily I say unto you, marry not an engineer, for the engineer is a strange being and possessed of many devils.
Yea, he speaketh eternally in parables which he calleth electronic "formulae"
And he wieldeth a big stick which he calleth a slide rule, and he hath one Bible—a Hand Book.
He talketh always of printed circuits and computers and without end of gory chokes and bleeders.
He showeth always a serious aspect and seemeth not to know how to smile.
And he picketh his seat in the car by the springs thereof and not by the damsel beside him.
Neither does he know a waterfall except by its power, nor a damsel except for her heat dissipation.
Always he carrieth his books with him and he entertaineth his maiden with circuit Schematics.
Verily though she expecteth chocolates when he calleth, she opens the package to disclose samples of transistors.
Yea, though he holdeth his damsel's hand but only to measure the friction, and he kisses only to test the servo action.
For in his eyes shineth a faraway look which is neither love nor longing, but a vain attempt to recall a formula.
There is one key dear to his heart, and that is an Eta Kappa Nu key, and he yearneth for the love of a hot cathode.
And when to his damsel he writeth of love and signeth with x's mistake not these symbols for kisses, but for unknown quantities.
When a boy, he pulleth a comb through a girl's hair to generate a spark, but as a man he discovers different devices.
For he would count the vibrations of her heart beat and he reckoneth her dielectric strength of materials.
For he seeketh ever to pursue the scientific investigation, even his heart flutterings he counteth as a vision of beauty, and inscribeth his passion in a formula.
And his marriage is a simultaneous equation, involving two unknowns and yielding diverse answers. —*Adapted*



RADAR

25,000-FT. SURVEILLANCE—Observation by radar is going far aloft with the production of high-altitude reconnaissance planes that will carry observation to a new height, at least 25,000 ft. Lockheed Aircraft Corporation is building for the Air Force and the Navy "magic spyglasses" in the form of "picket planes." These bulge with electronic detection apparatus and are designed to carry the military services' most powerful search radar to high altitude where radar beams attain their maximum effectiveness in spotting surface targets and objects in the air. The main purpose of the craft will be to afford earlier warning in the event of an attack.

When used by the Navy the radar transports will be known as WV-2's and will serve to direct carrier-based fighters beyond the radar reach of surface "combat information center ships." The Air Force versions will be known as RC-121C's and will be equipped to carry as many as thirty-one crew members.

CANADIAN-TV

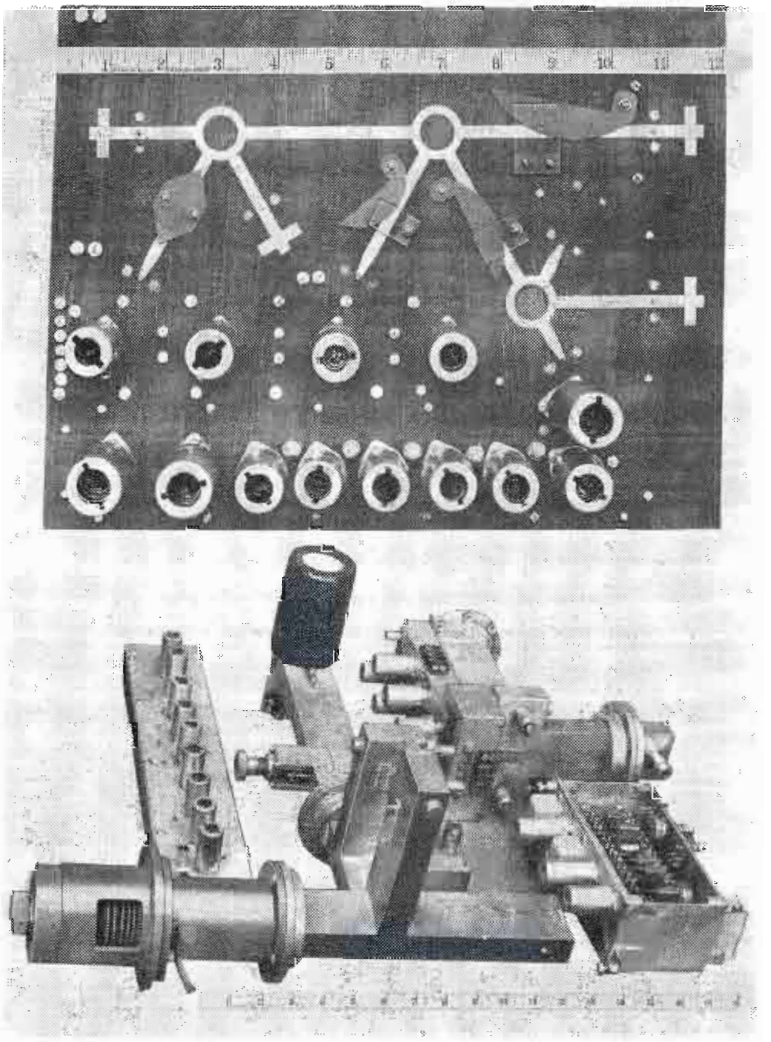
CANADIAN MANUFACTURERS are at a loss to understand why more American TV set manufacturers continue to build subsidiary plants in Canada. When interviewed at the (Silver Anniversary) Radio Fall Meeting, they pointed out that present Canadian population of 14 million reduces to an extremely small number of potential sales when figured on the basis of the number of persons per family; their location with regard to broadcasting installations; language differences in the different areas. Summing up their estimate for the next three years: Perhaps six Canadian TV stations on-the-air; there are 4.2 members in English-speaking families and 6.2 French-speaking members per family; the average purchaser has about 50% less income than U.S. These figures indicate a market of somewhat over ½ million. Since there are now 18 U. S. set manufacturers in Canada—and if each one got a proportionate share—this would boil down to about 10,000 receivers per plant per year!

MANUFACTURING

MILITARY WASTES are touched on pretty sharply in a letter received from an engineer who four years ago emigrated to the Pacific Coast and now wants to get back East. He writes: "You are probably wondering why I do not take some position locally and stay here. There are really only two types of activities here—the military, and the aircraft companies. The former means civil service and the latter is just about the equivalent. Some years ago, I thought I could take civil service. But I must have paid too much in taxes in my day, for it makes my blood boil to see how the taxpayers' money is wasted day after day. Right here in the —— Lab. I know several hundred people who have not done a nickel's worth of work in over three years. Nobody can fire them, and they know it. Now that the bosses have a real opportunity to weed out the deadwood under the President's economy program, one would expect that it would be done. But instead management elects to reduce by attrition which only means that they will lose chiefly their productive people."

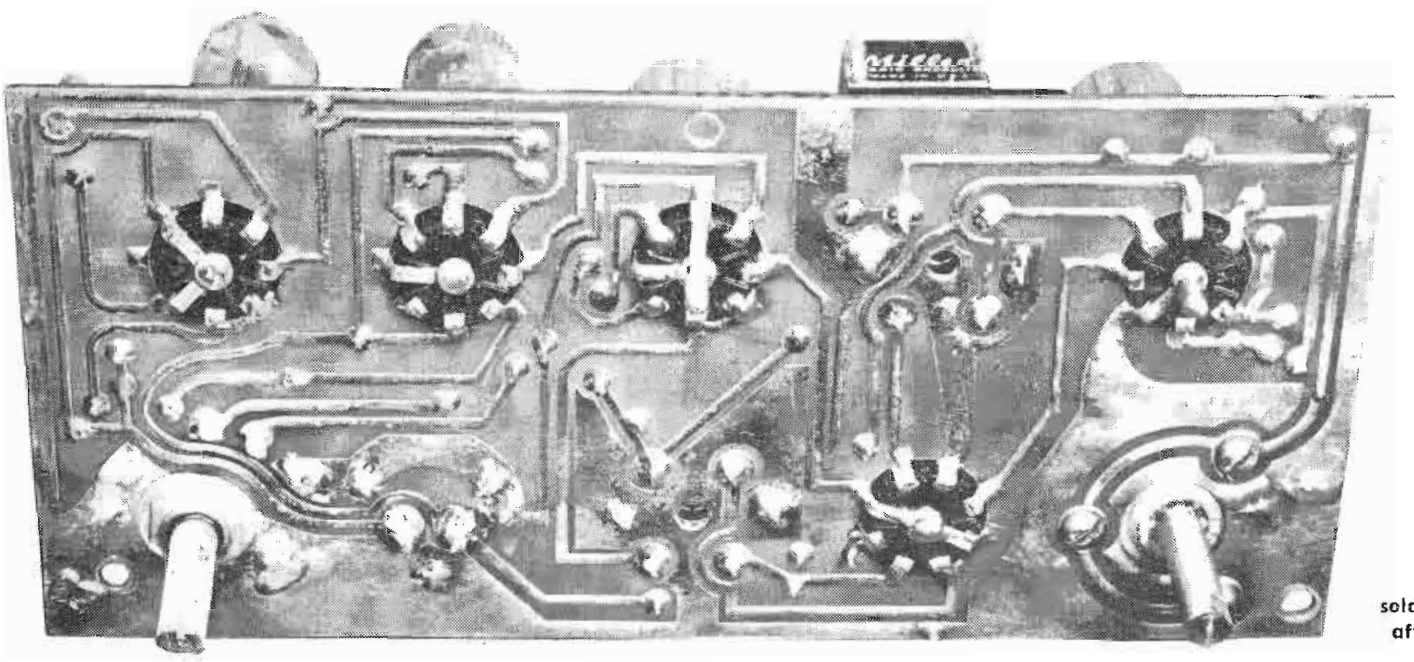
Annual Index

of all articles published in TELE-TECH & ELECTRONIC INDUSTRIES during 1953, classified according to subjects, may be obtained free of charge by writing to: The Editors, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y.



Microstrip receiver (top) developed by the Federal Telecommunication Laboratories, an IT&T Div., offers considerable savings in cost, weight, and size. It measures 12 by 9½ inches. Shown below is a microwave receiver constructed with standard microwave "plumbing." The entire unit weighs 32 lbs., as compared with only 5 for its microstrip equivalent.

Printed-Wiring Multiple



Typical dip soldered chassis after assembly

By ALVIN E. STONES
Methode Manufacturing Corp.
2021 W. Churchill St., Chicago 47, Ill.

THE use of printed wiring as applied to high volume production of commercial units has exposed many potential manufacturing economies, such as miniaturization, unitization, automatic assembly, etc. The greatest potential for manufacturing cost advantage exists, however, in the application of multiple solder techniques.

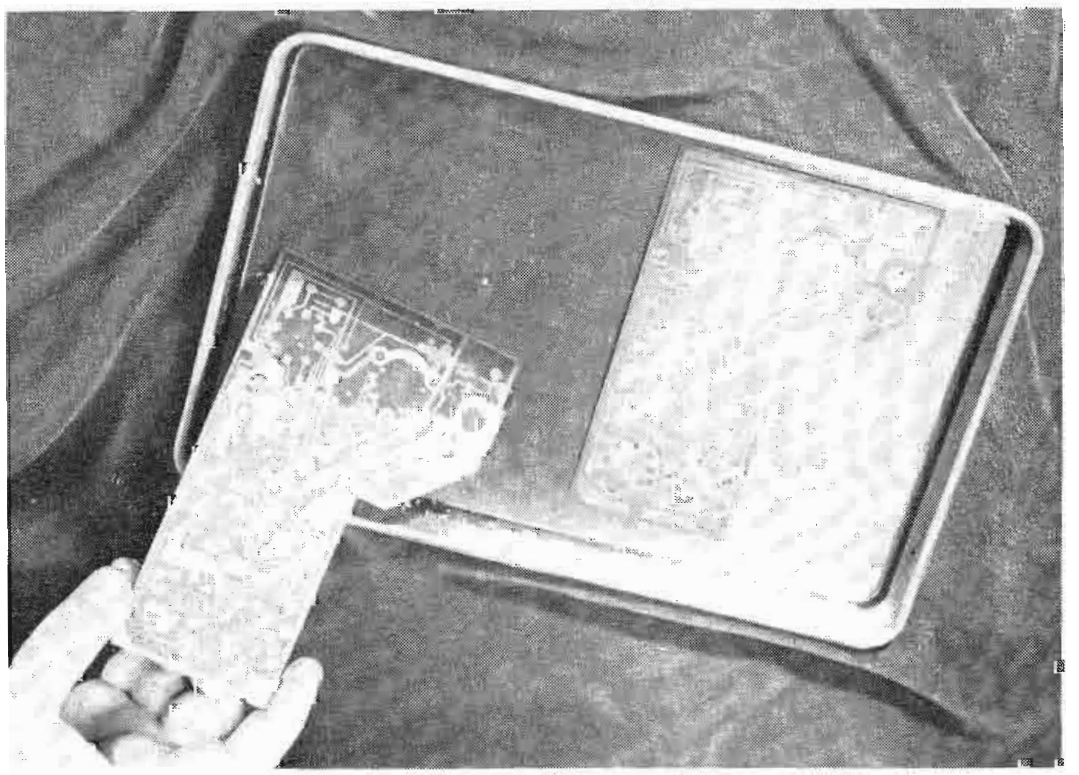
Successful performance of multiple soldering techniques requires particularly that the surface to be soldered be oxide free or otherwise prepared with a surface soldering aid. If the surface of the circuit pattern is bare of any soldering aid finish, it must be prepared immediately prior to the components assembly operation by an oxide removing treatment. See Fig. 1. A bath of aniline hydrochloride, acid bright dip (Table I), cyanide cleaner, or any mild reactivator may be used for this purpose, but pieces so prepared must be used without great delay otherwise an oxide film will again form. Rinsing and drying of the board is required previous to application of components. Drying by exposure to a mild heat source is recommended to aid in driving off any chemicals or moisture that may have been absorbed into the pores of the base material.

Many soldering aid finishes are commercially available which obviate performing this oxide removing treatment immediately prior to your assembly operations and provide you with greater stock versatility. Some of the available soldering aid finishes are water lacquer, rosin base coating, hot solder (Fig. 2), electro-plated solder, electro-tin plating, immersion tin plating, electro-silver plating and immersion silver plating. Shelf life of the boards provided with a metal plated soldering aid is appreciably improved by packing the boards in a sealed carton into which has been placed a very small quantity of napthalene crystals.

Selection of Materials

Fluxes, flux removers, and solders must be selected very discriminately. Boards having bare copper conductors usually require a more active fluxing agent than boards having conductors prepared with a soldering aid finish, but in either case your fluxing agent must contain a minimum of corrosive elements. For bare conductors a mildly

Fig. 1: Oxide removing bath prepares surface. Rinsing, drying and soldering operations follow



Soldering Methods

Modified double-pot and single-pot dip processes provide low circuit board reject rate. How to select materials and prevent warpage, blistering and bridging

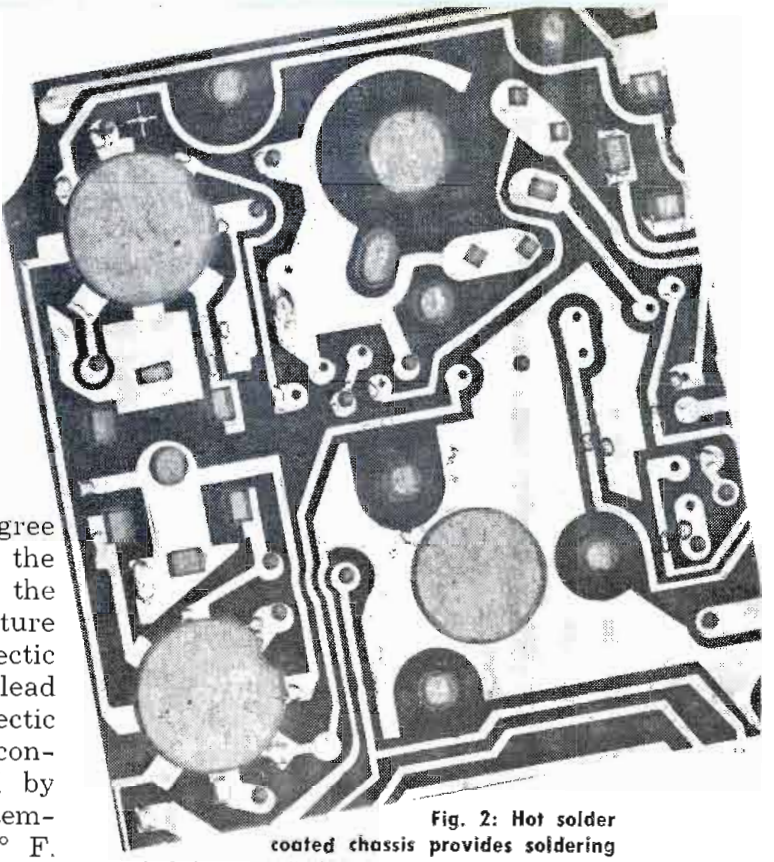


Fig. 2: Hot solder coated chassis provides soldering aid finish to eliminate oxide removing bath

activated alcohol-rosin flux is recommended, and for conductors prepared with a soldering aid finish a non-activated alcohol-rosin flux is usually successful. The electrical properties of these mild alcohol-rosin fluxes are such that in many instances removal of the flux subsequent to the soldering operation is not necessary. Where appearance is important or where ease and comfort of handling is required or where the performance of the unit would be adversely affected by the flux residue, a removing operation becomes necessary. The flux removing operation can be made very facile by gradually decreasing the percent of solids in the flux by addition of thinner to the minimum point where successful soldering is still accomplished. This permits most of the flux solids to be consumed during the soldering operation and decreases the amount of residue remaining.

TABLE I
Acid Bright Dip Formula

H_2SO_4	4 gallons
H_2NO_3	2 gallons
H_2O	1 gallon
H Cl	2 ounces

In selecting the flux remover, close attention should be given to such properties as toxicity, ill affect on human hands, odor, and solvency. Any toxicity or ill affect on human hands are, of course, taboo, but most odors can be pleasantly masked. The solvency properties of the flux remover must be bridled to such extent as to make the solution harmless to the board, mounted components, hardware, and plastic forms.

Heat application

In most cases the item to be soldered to will be some form of metallic circuit pattern affixed to a paper base phenolic resin filled laminate. This phenolic laminate has definite limitations as to the degree and duration of heat application that it can withstand before becoming damaged. Inasmuch as the progress of deterioration is somewhat directly proportioned to the degree and duration of heat application, the objective would be to reduce to the minimum the soldering temperature and period. The selection of eutectic or low melting temperature tin lead solder accomplishes this. Eutectic tin-lead solder is a solder alloy containing 63% tin and 37% lead by weight which has a melting temperature of approximately 370° F. While eutectic tin-lead solder embodies the most ideal possible characteristics for multiple soldering techniques as applied to printed wiring on phenolic laminate, successful soldering has been accomplished using tin-lead solder grades as low as 50 tin and 50% lead.

Principles and Methods

The best proved multiple soldering methods are slight ramifications of basic dip soldering operation. The actual soldering operation, while intrinsically simple, does require close control of working conditions and adherence to some unique principles. One such principle is the opposing coefficients of expansion between the metallic circuit and the phenolic laminate. In dip soldering a metal-clad laminate, a crawling and blistering of the metal at large area locations and warpage of the entire panel is the evidence of the incident of thermal shock as governed by these coefficients of expansion. This effect is minimized by use of the low melting temperature solder and by designing thermal barriers into the circuit pattern. One form of a thermal barrier (Fig. 3) is to shape all large area shielding planes into closely spaced colonnades joined at each end by a cross member much like a picket fence. Warpage alone can be further controlled by mounting the panel in a jig which holds the piece rigid and flat during the soldering operation and through the cooling period.

Two multiple soldering methods have been developed for use with printed wiring panels using the basic dip soldering procedures. One will be termed the single pot method, the other will be termed the double pot method.

Single Pot Method: In the single pot method (Fig. 4) the assembled circuit board is first mounted in the jig, then fluxed freely by either surface dipping into a flux misture bath or by painting the flux mixture on with a brush. In either procedure care must be taken to prevent excessive flux from getting on the back of the panel and flooding the components. After fluxing, the

Fig. 3: "Picket fence" acts as a thermal barrier to minimize warpage and blistering at large areas

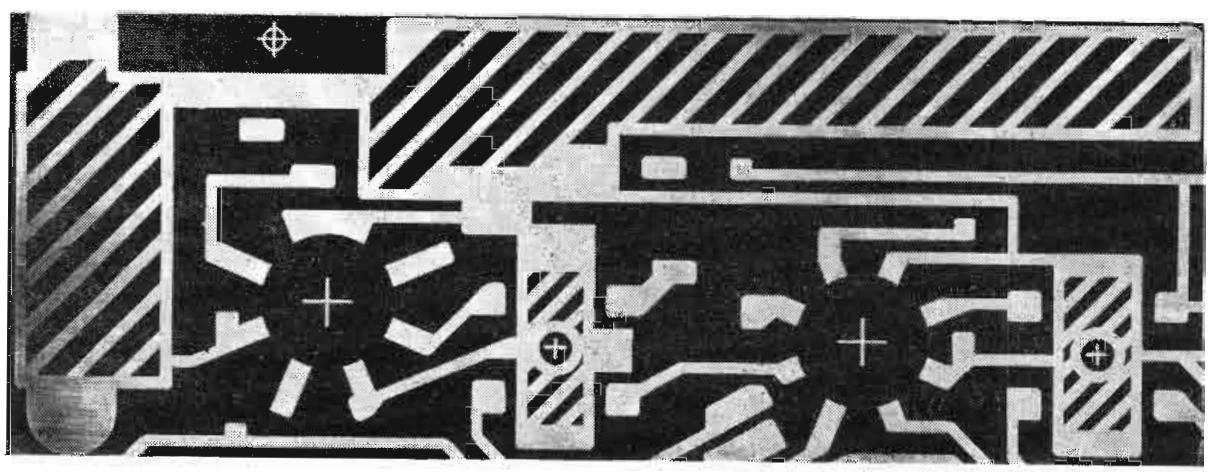


Fig. 4: Soldering dip with spring jig in single pot method

Fig. 5: Solder dip in first of two pots in double pot method

board is brought into surface contact with the cleaned surface of the molten eutectic solder maintained at an operating temperature of approximately 425° F. The solder bath may be kept clean by occasionally wiping a piece of cardboard across the surface in a unidirectional motion. After a five to eight second dip with a slight to and fro motion to insure an even flow of solder, the piece is lifted from the top of the solder by removing one edge first using the other as a fulcrom. This allows the solder to flow away from areas free of circuit and helps to prevent smears and bridging.

If desired the flux residue can now be removed while the panel is still hot by dipping and brushing through the flux remover. It is considerably more difficult to remove the flux residue if you allow the panel to cool first. In this single pot method some bridging of solder across adjacent conductors will be encountered, however, one operator with a pencil iron can easily correct in production any bridging you will experience.

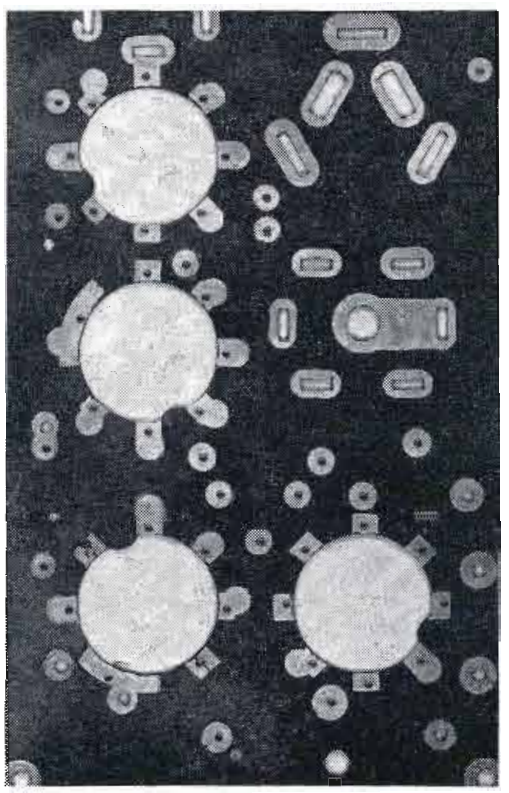
Double Pot Method: In the double pot method the assembled circuit board is first mounted in the jig then fluxed freely before being brought into surface contact with the cleaned surface of the molten eutectic solder in pot number one maintained at an operating temperature of approximately 42° F. See Fig. 5. After a five to eight second dip with a slight to and fro motion the board is lifted from the top of the solder by removing one edge first using the other as a fulcrum. The panel, still mounted in the jig, should be allowed to cool for three to five minutes.

In order to reflow any solder that may have bridged across the circuit pattern, and to cover the panel with a moisture and fungus resitant coating, the piece is then brought into surface contact with the surface of the molten eutectic solder in pot number two which is also maintained at an operating temperature of approximately 425° F, but which has a thin layer of high temperature rosin-impregnated wax floating on its surface. See front cover. A four to seven second dip with a slight to and fro motion is usually sufficient. Removal of the board from the surface of pot number two should be accomplished in the same manner as pot number one. Under proper conditions, no removal of wax deposits is required as they provide the moisture and fungus resistant coating desired, and the wax will have dissolved away those flux ingredients which would tend to interfere with the electrical characteristics of the circuit.

Extremes: Successful dip soldering periods as short as three seconds with solder bath temperatures as high as 550° F and periods as long as twelve seconds with solder bath temperatures as low as 390° F have been reported, however, the procedures outlined here have yielded the fewest number rejections and do not tax the thermal limitations of paper base phenolic

(*Continued on page* 160)

Fig. 6: Selective soldering achieved through use of screened-on heat resistant coating



Guided Missile Data Distribution

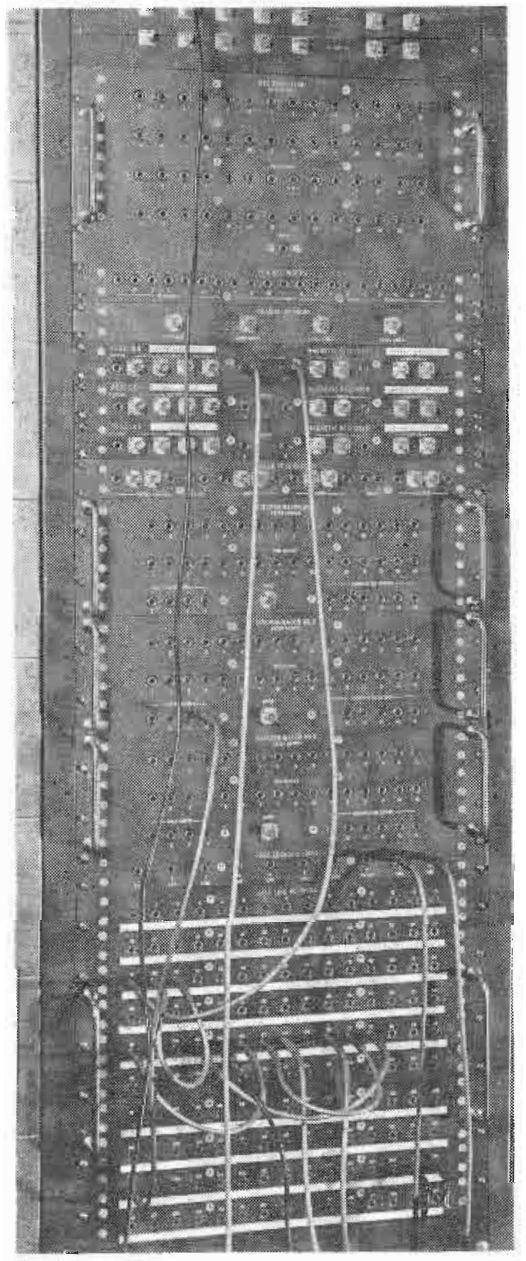


Fig. 1: Lines distribution rack has separate patch panels for each telemetry station assembly (upper portion) and 150-jack patch panel for tie-in with local land lines (lower portion)

Air Force installation handles radio telemetered information through flexible patching arrangement. Standardized stations developed

*By JAMES B. WYNN, Jr.** *Technical Director* *and* *SAM L. ACKERMAN** *General Manager*
Wynack Associates, 224 Strawbridge Ave., Melbourne, Fla.

THE U.S. guided missile program has shown tremendous advancements in the past few years. This has been mainly due to fact that continued efforts on the part of foresighted leadership in the armed forces is now at a stage where research and development is progressing rapidly from the laboratory to field testing stages. Unfortunately though, in the earlier days too few persons recognized the potentialities and necessity of electronic instrumentation to provide a means of remote measurement of the phenomena occuring in the supersonic missiles of today's design.

The missile performance data obtained through means of radio telemetry constitutes the majority of flight information collected. It is possible to radio-telemeter nearly any of the internal functions of a missile or pilotless aircraft. The data may be presented, stored, and recorded in a variety of methods.

Of the total data gathered from any flights where internal missile performance is desired, the radio-telemetering systems normally provide about 80% to 90% of the total information. In some of the instrumented flights, where more than one radio-telemetry system is used, over 95% of the data will be provided via telemetry. In sharp contrast to its importance, telemetry systems approved for use on the test ranges by the Research and Development Board, and in use today, have cost the government relatively little in development compared to the other instrumentation systems such as radar or theodolites, and are satisfactory for the large majority of instrumentation problems.

Florida Facilities

The radio-telemetry facilities at the Florida Missile Test Range are designed for continuous coverage over the first 1,200 miles of flight, with data simultaneously available for local and range distribution. This presents many problems analogous to any of our national radio networks. Information must be remoted locally over land lines and to or through the various instrumentation sites equivalent to a large networks, over coaxial submarine cables. While it is not possible at this time to discuss to any detail the elaborate land lines and submarine cables required for this vast program, it is necessary to consider their importance in the telemetry installation design criteria for this installation.

None of the commercially available radio-telemetry receiving stations lend themselves to easy integration into receiving facilities satisfying these requirements of data distribution. The equipment commercially manufactured today and on the market is either in the form of units, such as receivers, subcarrier discriminators, power supplies, or else as complete stations. No one manufacturer produces a line of equipment that will fully equip a telemetry site for receiving telemetered data for magnetic tape recording, demodulating, and recording data for precision analytical analysis. With this in mind, it is easier to understand why the radio-telemetry equipment producers are reluctant to commercialize on "package installations" when their net interest is not too great a factor.

This is not meant to imply that it is impossible to purchase all equipment and service through one buyer, but it is a small percentage of the overall sales. It is necessary to patch data in and out of the stations and in addition to cross-patch between stations at instrumentation sites for maximum flexibility or "back-up." The compatibility between the frequency-modulated and pulse-width data intelligence telemetry systems provides additional requirements for utilizing common equipment for a dual purpose. At present these two telemetry systems are the only ones approved for general use at the missile test ranges by the Research and Development Board.

Constructional Techniques

The equipment discussed in detail points out the design objectives and criteria established to provide a satisfactory means of furnishing adequate facilities of patching telemetry data and other range functions. It has been fabricated, installed and is a necessary item of adjunct equipment at any of the telemetry sites. The constructional techniques should

* *Mr. Wynn was formerly Chief, Telemetry Section, and Mr. Ackerman was Chief, Internal Electronic Engineering Branch, Technical Systems Lab., Air Force Missile Test Center, Air Research & Development Command, Patrick AF Base, Fla.*

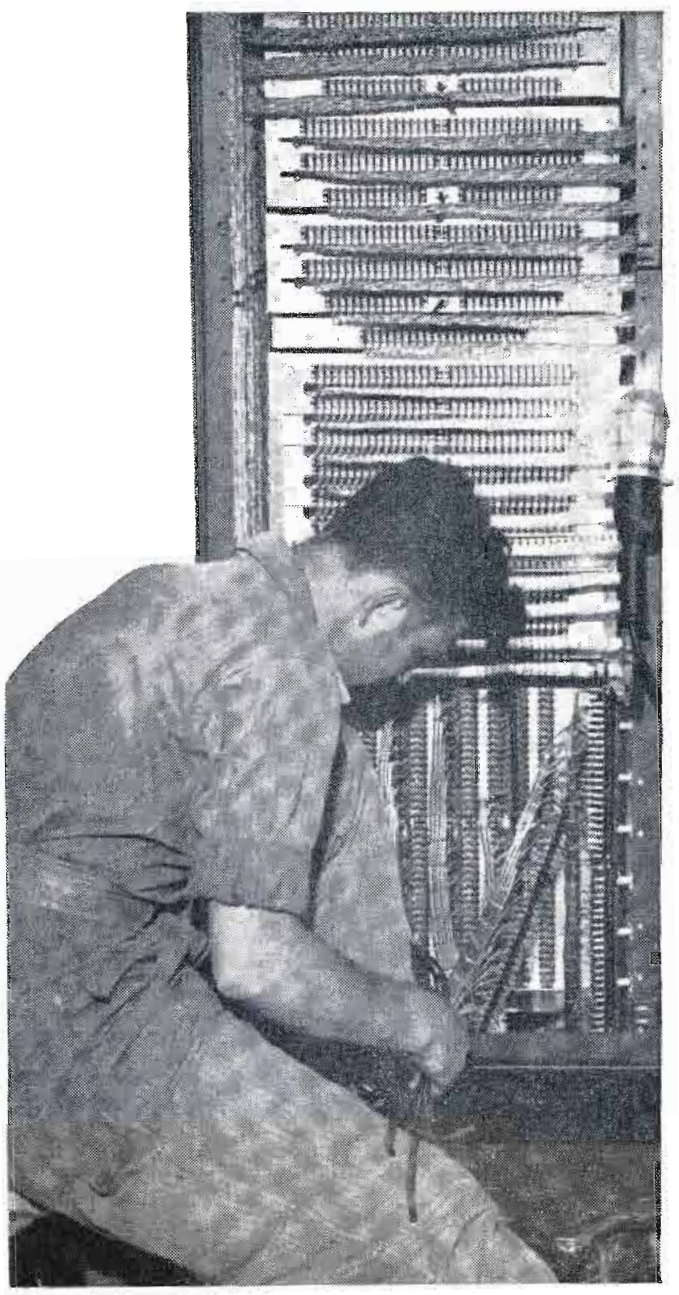


Fig. 2: Accessibility of all patch panel terminal strips in rack shown during installation

be of general interest and be applicable to most of the electronics instrumentation field.

The "Lines Distribution Rack" (Figs. 1 and 2), as the rack containing all the patching facilities has been named, has evolved from the basic design of the engineers of the Air Force Missile Test Center over two years ago. By the end of 1950 the final design had been frozen and a development and fabrication contract AF 33(038)-24898 was awarded to the Spar Engineering and Development, Inc., Wyncote, Pa. In the latter part of 1951, a prototype had been completed and application testing commenced. It is worthwhile to consider in detail, at this point, the layout and application of such equipment.

A relay rack, RCA type MI-30962 or equivalent, was selected to house all the patch panels (Fig. 3) and cable harnesses. This rack provides for the use of standard 19-in. panels, so the equipment or any portions desired may be incorporated into other equipment systems and mounted in any other standard radio relay rack of the users choice. Mounting holes conform to the Western Electric spacing. Selection of this rack was made at AFMTC because of uniformity with other equipment at the telemetry receiving sites. The extra height of these racks provides a useful panel space of 77 in. since the rack itself is 84 in. high. All panels are of ⅛-in. steel and finished in Onslo gray hammeroid. Title lettering on all the panels is engraved to provide neat and permanent identification.

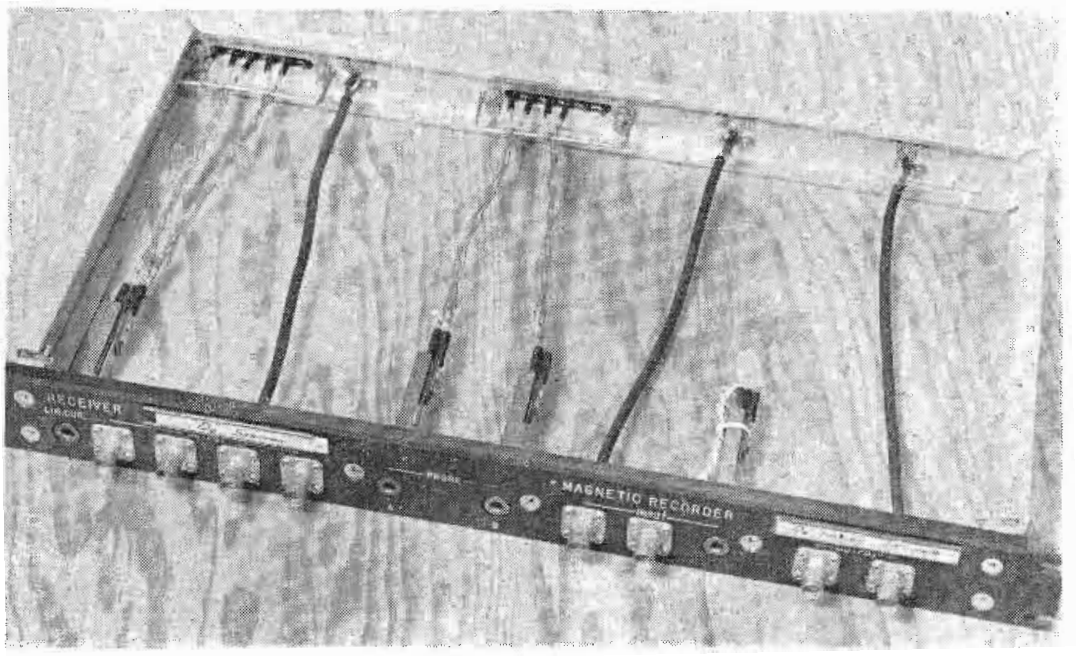
Separate Panels

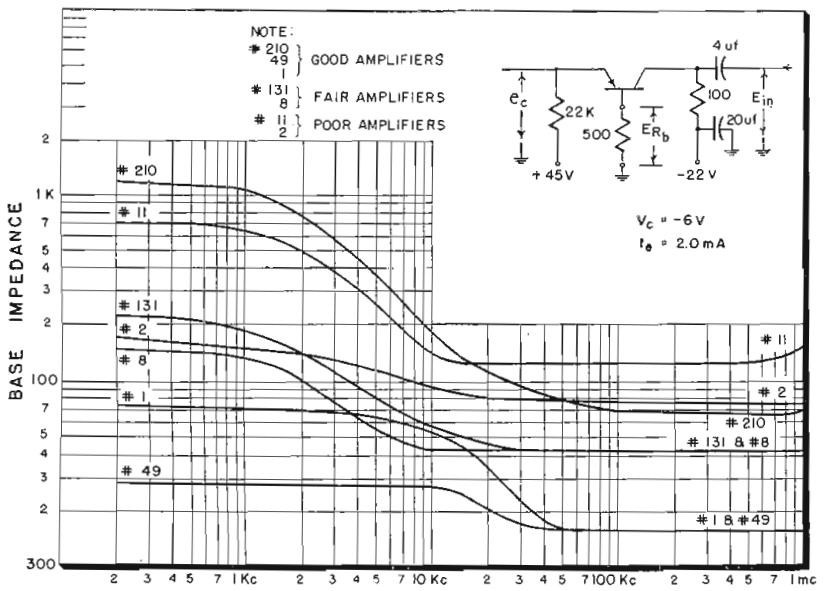
A separate panel was designed for each group of equipment in a telemetry receiving station. A salient point of the engineering design that will become more obvious through the article is the basic breakdown of requirements and system units vs. construction. The telemetry system for example is divided into receiving, recording, discriminators, and decommutation. The logical breakdown centers around conventional operating techniques and combined with the installation design provides a minimum of patching for ordinary operations so that maximum flexibility is available wighout undue complexity. To clarify a few of these points we will discuss in detail the FM/FM class "A" telemetry station.

The class "A" station has the basic units necessary for the receiving of data via a radio link and continuous storage on magnetic tape recorders. In addition, 16 data discriminators are available for simultaneous separation of 16 subcarrier frequencies. Two racks of electronic decommutation or decoding equipment permits simultaneous separation of 27 bits of data commutated in the missile and carried on any one of the subcarriers capable of being commutated. For reproduction and playback of magnetic tape records, electronic error correcting or "wow" and "flutter" compensation equipment is included. The equipment comprising the class "A" station may be used to a limited extent at times or in its entirity or on some occasions supplemented by additional units. The most extensive use for the "Lines Distribution Rack" comes under the category of patching out data from the telemetry station for remote use and supplementing a station with other station components.

In considering a complex electronic installation of this type, one is almost always confronted with the problem and decision as to whether the installation should be made in package (complete) units, or whether it is desirable to place all like components in single locations. This would mean, then, that all receivers, for example, would be housed in one rack and all tape recorders would be housed in one bay of racks and all timing equipment would be housed in another bay, etc. Following the above, then, elaborate patching facilities would be required to set up for a given mission. Experience to date, especially in the broadcast industry has demonstrated that it is this elaborate patching problem which has caused as many operational and equipment failures as the basic equipment itself. Shorting plugs, open jacks, long lines and consequent line amplifiers are all extra items which weaken the chain. An-

Fig. 3: Receiving station patch panel employs phone jacks for all circuits which do not have frequencies exceeding 20 KC. Coaxial fittings are used for circuits in 20 KC to 100 KC range





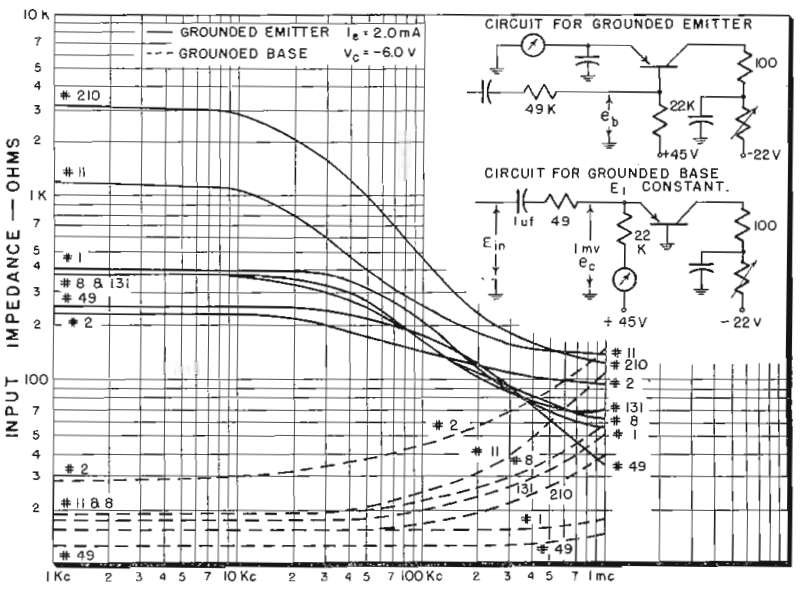


Fig. 3: (l) Variation of base impedance with frequency. Fig. 4: (r) Input impedance characteristics for grounded base and grounded emitter

I-F Amplifiers

operating below 500 kc. Grounded employing junction transistors analyzed

Fig. 5: Collector capacity base return

$$R_{input} = \frac{e_g}{i_1} = \frac{r_e + (r_b + R_g)(1 - \alpha)}{1 - \alpha} \quad (8)$$

An examination of Eqs. (3) and (7) shows that the feedback element in either connection is the base. In the grounded base connection the generator impedance is placed in the emitter and acts like an unbypassed cathode resistance. In the grounded emitter connection the generator impedance is placed in the base and has very little effect. If we wish to degenerate the grounded emitter connection we have to use a resistance in the emitter lead.

In the grounded base connection the resistance R_g is in the emitter lead and reduces the g_m. Eq. 3 shows that if a large value of R_g is used the value of g_m approaches α/R_g so that α cutoff may be determined by using the grounded base connection and a large value of R_g. In the grounded emitter stage a large value of R_g causes the value of g_m to approach $\alpha/R_g\ (1-\alpha)$ provided that

$$R_g\ (1 - \alpha) \gg r_e.$$

If we assume that R_g is made zero in either Eq. (3) or Eq. (7) and ignore signs e_g becomes v_i in the input and

$$g_m = \frac{i_c}{v_i} = \frac{\alpha}{r_e + r_b\ (1 - \alpha)} = \quad (9)$$

$$\frac{\alpha}{(r_e + r_b\left[1 - \frac{\alpha\, r_b}{r_e + r_b}\right]}$$

If α is very nearly equal to 1

$$g_m \cong 1/r_e \quad (10)$$

It has been shown that

$$1/r_e \text{ equals } eI_\Sigma/KT$$

where e is the charge on an electron, K is Boltzmann's constant $= 1.38 \times 10^{-23}$ and T is the absolute temperature. The ratio of

$$\frac{eI_\Sigma}{KT}/I_\Sigma \text{ is thus } g_m/I_\Sigma$$

equal to 38.6 and the g_m is 38,600 micromhos per ma. In junction transistors, values of 10,000 to 38,000 μmho/ma are realized.

The input resistance of the grounded base connection for the approximations made for Eqs. 3 and 4 is

$$R_{in} = r_e + r_b\ (1 - \alpha) \quad (11)$$

The input resistance of the grounded emitter connection for the approximations made for Eqs. (7) and (8) is

(*Continued on page 166*)

Fig. 6: Grounded base circuit has tuning capacitor connected to transistor input

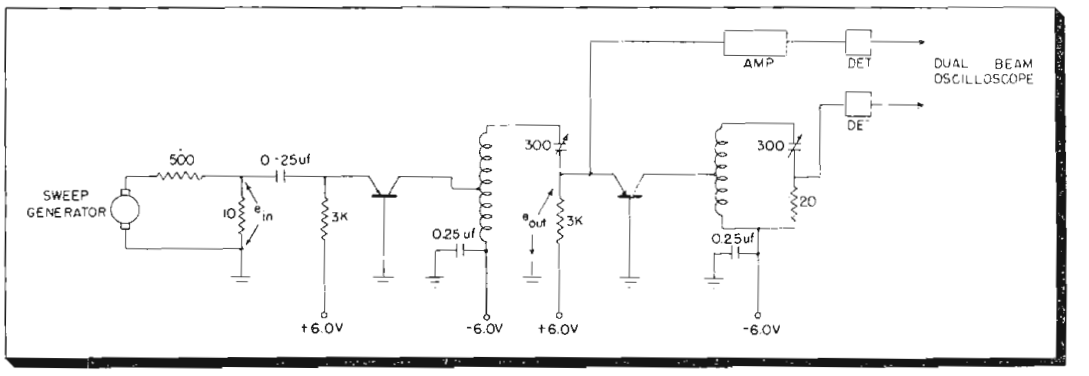
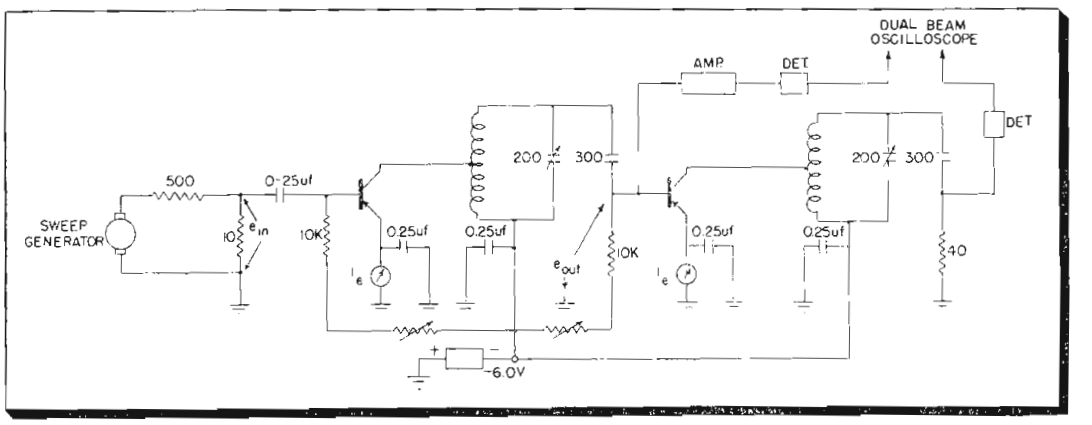


Fig. 7: Grounded emitter circuit has 60% of tuning capacitor in series with base input



Embossed Wiring for

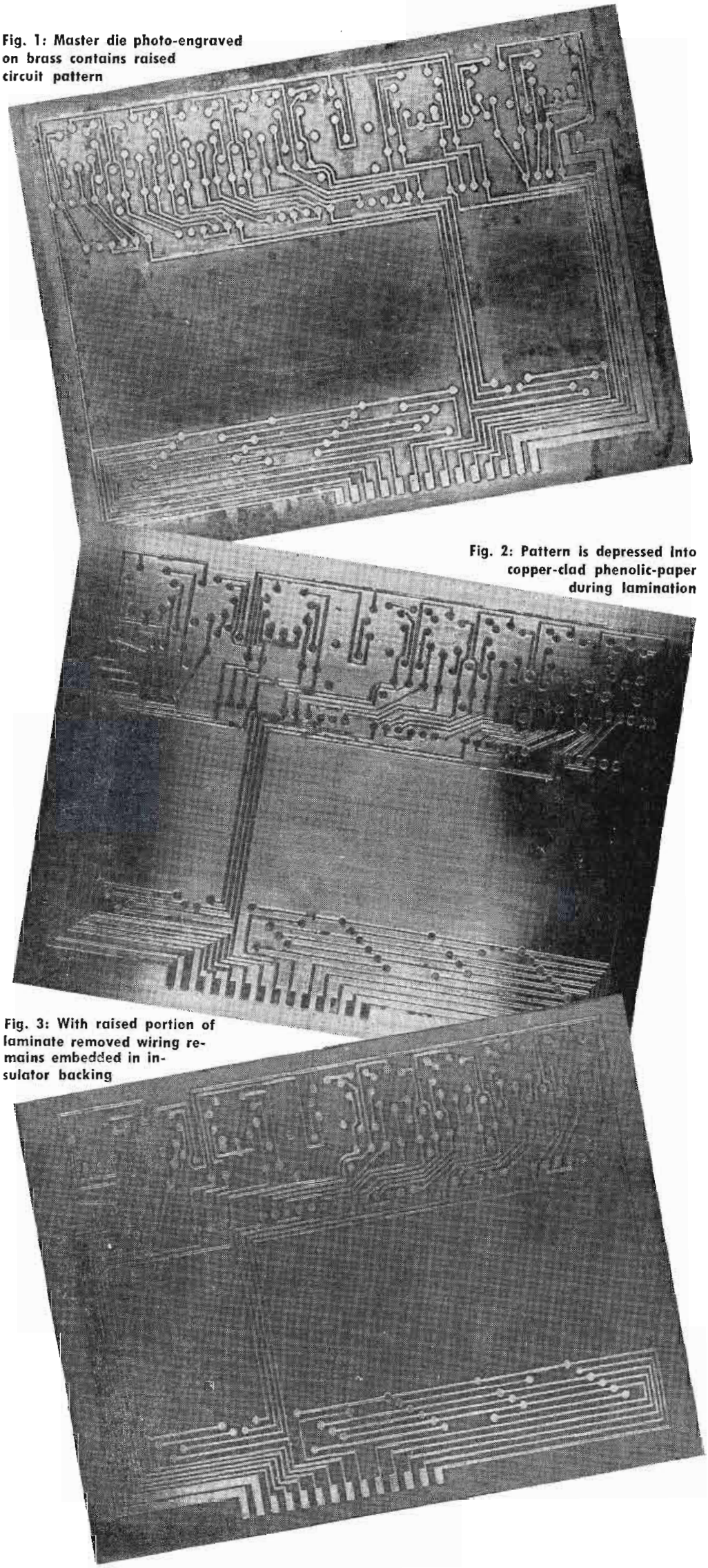


Fig. 1: Master die photo-engraved on brass contains raised circuit pattern

Fig. 2: Pattern is depressed into copper-clad phenolic-paper during lamination

Fig. 3: With raised portion of laminate removed wiring remains embedded in insulator backing

By O. I. STEIGERWALT
Erie Resistor Corporation
644 W. 12 St., Erie 6, Penna.

THE volume of radio and TV production using printed wiring partially or throughout the chassis has been steadily increasing in the last two years. Although most production is still hand-wired, the trend toward printed wiring is apparent—most manufacturers are either producing or designing chassis based on some form of printed wiring.

Some of the deterrents to more widespread use of this development are inertial in character: components such as i-f transformers, tube sockets and the like are more expensive in printed wiring designs because production to date has been insufficient to pay tooling costs; questions of relative costs have led to caution on the manufacturer's part in converting too rapidly to printed wiring; and the printed conductor pattern itself is too new a component to be available generally to the industry in low cost, dependable form.

This situation has kept the printed wiring field in a state of vigorous development and has led to the announcement of several new processes during recent years. The Embossed Wiring technique was developed by the Erie Resistor Corp. to meet the objectives of process simplification and elimination of electrolytes in contact with the insulating material.

Embossed Wiring Process

The basic steps of the embossing process consist of first forming a copper-foil-clad laminate in a hydraulic press similar to the foil-clad laminate generally supplied for circuit etching. A circuit pattern is depressed into the surface by means of photo-etched metal dies during laminating, as shown schematically in Fig. 4A.

At this point, the laminating step has accomplished three things: The backing material has been cured to its optimum qualities, copper foil has been bonded to one or both surfaces of the laminate, and a latent circuit pattern has been indented into the foil-clad surface of the laminate.

The second step of the embossing

point is that some components not, without extensive precautions, be grouped together. The receivers fall within this category.

This represents but two of the reasons why the engineers at AFMTC went to the station modular package installations. Basically, under this scheme, all the various major components are made up as a single station physically grouped together, to receive, record, demodulate and separate all of the information received. The outputs of the discriminators, and/or the decommutators are fed via the patching arrangement to be discussed to remote meters for real time display, to real time recorders or to the data reduction system.

Failure Protection

Not only does this provide for a simplified system, but it permits the establishment of battle station points for operations with a reduction in the required personnel and confusion. In the event of failure, all components are so arranged that it is a simple matter to remove and plug-in a defective unit prior to launching. Sufficient back-up is provided so that in the event of failure during the actual missile firing, a secondary system is immediately available for the recording and reception of the same signal. This is done continuously and is not dependent on the noting of a particular failure. This occurs for example when a missile installation has more than one commutated channel on an r-f link. For this condition an additional set of electronic decommutation equipment which is installed in another telemetry station would be patched in to supplement the standard installation. An important but little used feature of the patching is the ability to cut in additional units in the event of failures.

Even though it might sound as if a complex set up procedure would be required all the circuitry of the various classes of stations are "normalled thru" for standard operations. In other words and in accordance with the basic philosophy, no patching is required other than selecting the channel requiring decommutation in any station operation. The "normalled thru" jack panels are a part of each station and facilitate testing and maintenance. All appropriate units have inputs and outputs paralleled on the "Lines Distribution Rack" for centralized distribution.

All land lines between the telemetry site and remote points which

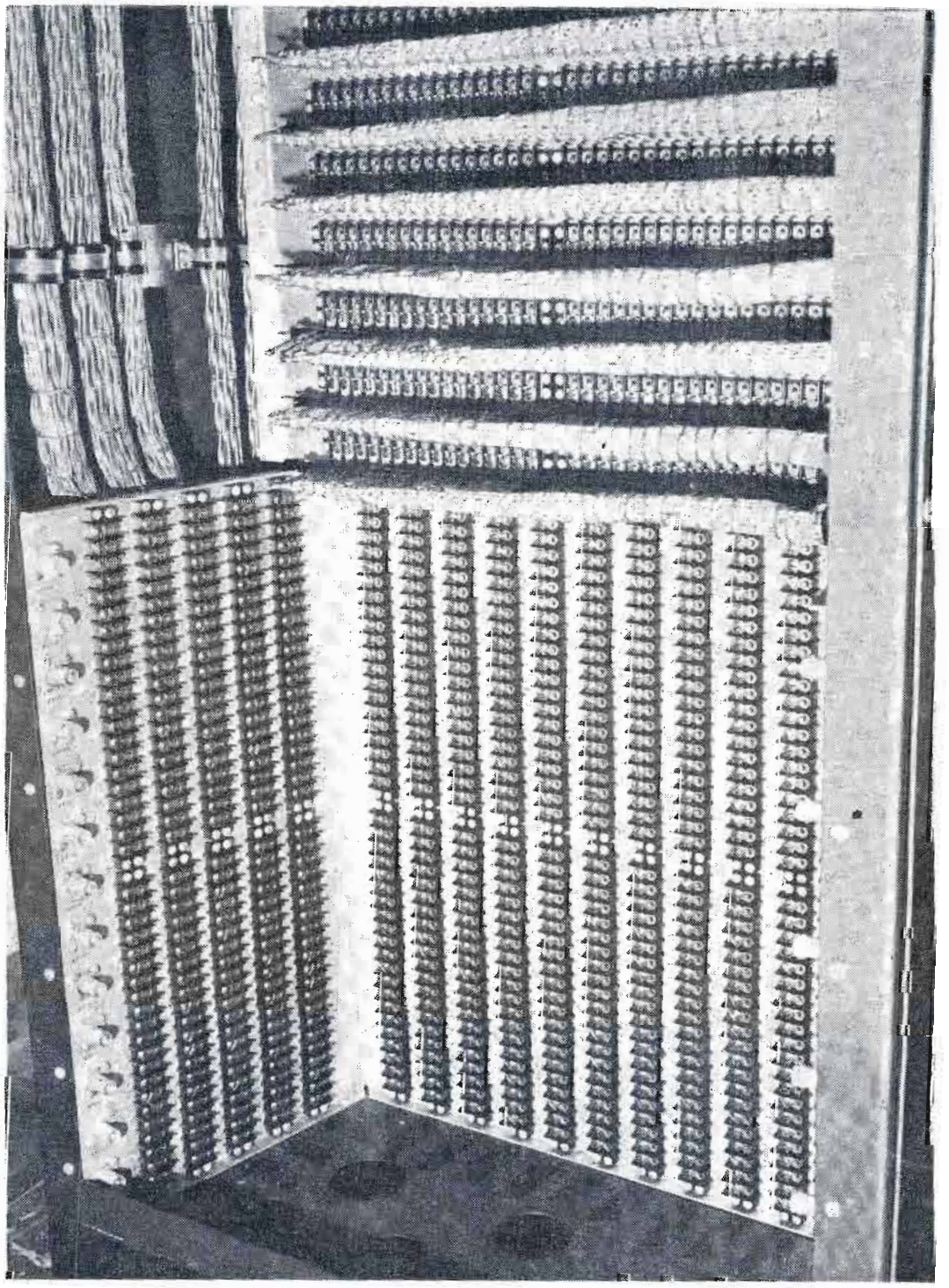


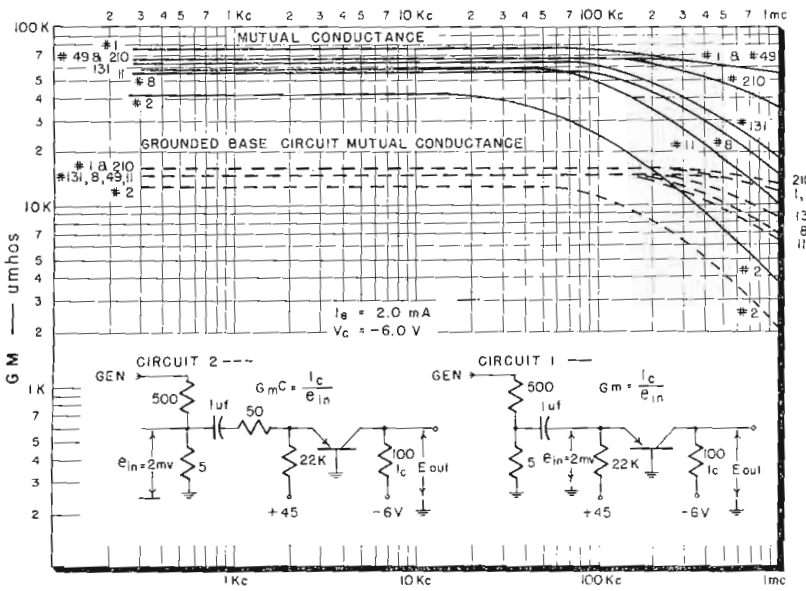
Fig. 4: Close-up view of rack harness terminations in base of lines distribution rack

are used for the transmission of any telemetry data terminate on a panel on the "Lines Distribution Rack" an all test equipment required in routine pre-flight testing set-up or calibration is racked adjacent. This permits standard test and calibration procedures to be easily adhered to so that performance is determined by controllable techniques especially in reference to cabling and points of injecting signals or taking readings. This prevents some of the questionable conditions that sometimes causes one to wonder whether the equipment is erratic or just the methods employed at the time.

The construction of the jack or coaxial patch panels is slightly improved over the conventional design. In order to keep the panel height to a minimum and still use terminal strips on the back of each panel so that it would be easy to remove or install panels, the terminals were mounted on an aluminum extrusion bracket. The extrusion extends across the back and secures to the front panel at both ends. The Western Electric type 246-A jacks are recess mounted on a phenolic strip behind the ⅛-in. metal front panel and coaxial receptacles are flush mounted on the front. All the wiring from the jacks or receptacles is self-supporting and feeds directly to the respective terminals across the back. By having the bracket across the back of each panel 14 in. deep, all the terminals securing to the rack harness are close to the back of the rack which from an operational standpoint is more desirable for ease of installation and inspection. Fig. 4 shows the rack harness terminations.

The feature of standardization was a prime consideration in the design

(*Continued on page* 148)



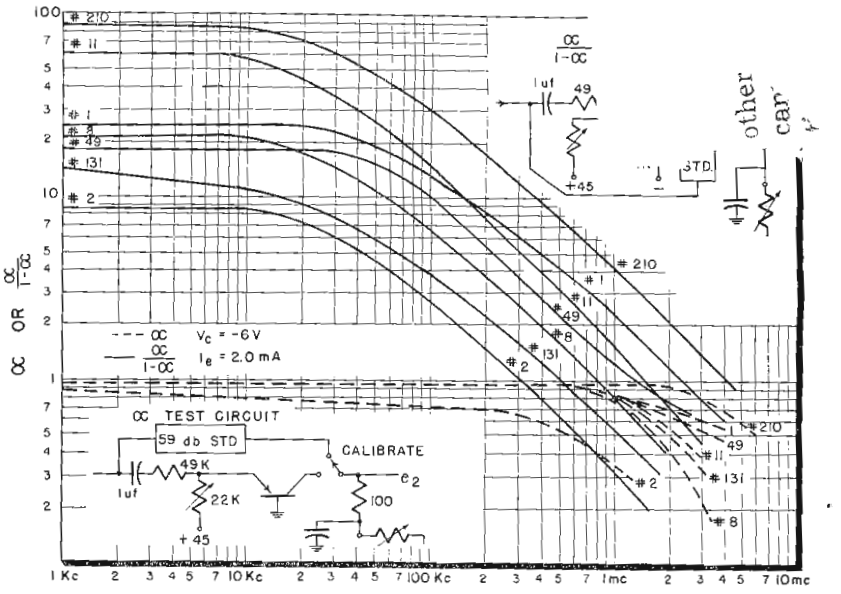


Fig. 1: (l) Variation of mutual conductance with frequency. Fig. 2: (r) Variation of alpha with frequency. Note flatness compared with g_m curves

Transistor

Practical design criteria for circuits emitter and grounded base types

By J. R. NELSON, Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass.

AS is well known, there are two types of transistors commonly available, the junction and the point-contact. Although the operation of the junction type is better understood than that of the point-contact type, its operation at frequencies above the audio range is quite complex due to large junction areas resulting in high capacities, variable widths of base thickness and spreading of the barrier layer due to collector voltage and variations of life time, diffusion length, etc. in the semiconductor used.

In the junction type, α, the current gain, is less than unity so that the junction type is inherently short circuit stable as the transistor determinant is always positive. This makes it possible to analyze the performance without running into stability problems. The junction transistor has in general lower base and emitter resistances and higher collector and mutual resistances than the point contact type which conditions are favorable for circuit operation. The alloy PNP junction type has been studied here as an i-f amplifier because of the above reasons.

Transistor Connections

For the purpose of this article intermediate frequencies are considered to be frequencies below 500 kc. Fortunately, it was found possible to explain the experimental results obtained by analysis using readily measured transistor characteristics so that it was not necessary to study the physics of the junction transistor to explain the operation. Three connections of the transistor are possible, namely the grounded base, grounded emitter and the grounded collector. Only the first two are considered here as they are the most useful ones.

The transistor is usually considered as a current operated device. For our purpose we also consider the junction transistor as a voltage operated device so that its performance may be studied as we vary the frequency. Two g_m values may be derived, namely true g_m obtained by measuring i_c, the collector current, in terms of the input voltage v_i, and circuit g_m, g_{mc} obtained by measuring i_c in terms of the input generator e_g with an internal resistance R_g.

The equations for the grounded base connection are:

$$e_g = (r_e + r_b + R_g)\, i_e + r_b\, i_c \quad (1)$$
$$= R_e\, i_e + r_b\, i_c$$

$$0 = (r_m + r_b)\, i_e + (r_b + r_c + R_L)\, i_c \quad (2)$$

Where: r_e = Emitter Resistance
r_b = Base Resistance
r_c = Collector Resistance
r_m = Mutual Resistance
R_g = Generator Resistance
R_L = Load Resistance
$\alpha \cong r_m/r_c$

If we assume $r_c \gg R_L$, $r_c \gg r_b$ and $r_m \gg r_b$

$$g_{mc} = \frac{i_c}{e_g} = \frac{\alpha}{r_e + R_g + r_b\,(1-\alpha)} \quad (3)$$
$$= \frac{\alpha}{R_e\left[1 - \frac{\alpha r_b}{R_e}\right]}$$

$$R_{input} = \frac{e_g}{i_e} = r_e + R_g + r_b\,(1-\alpha) \quad (4)$$

The equations for the grounded emitter are:

$$e_g = R_e\, i_1 + r_e\, i_c \quad (5)$$

$$0 = (r_c - r_m)\, i_1 + (r_e + r_c + R_L - r_m)\, i_c \quad (6)$$

If we assume $(r_c - r_m) \gg R_L$, $(r_c - r_m) \gg r_e$ and $r_m \gg r_e$

$$g_{mc} = \frac{i_c}{e_g} = \frac{\alpha}{r_e + (R_g + r_b)\,(1-\alpha)} \quad (7)$$
$$= \frac{\alpha}{R_e\left[1 - \frac{\alpha\,(r_b + R_g)}{R_e}\right]}$$

TABLE I: I-F MEASUREMENTS WITH TYPICALLY SELECTED TRANSISTORS IN SECOND STAGE

Transistor Number	α	GROUNDED BASE Ein Mv	Eo Mv	Gain	Collector Mv	Coil Mv	GROUNDED EMITTER Ein Mv	Eo Mv	Gain	Collector Mv	Coil Mv
1	0.960	1.65	18.00	10.90	190	580	0.90	12.5	13.90	63.0	250
49	0.950	1.35	13.50	10.00	145	420	0.94	9.0	9.60	50.0	230
210	0.986	1.45	12.00	8.30	125	400	0.92	10.0	10.80	55.0	220
131	0.933	1.50	8.50	5.66	85	265	0.88	6.2	7.05	34.0	140
8	0.955	1.55	6.80	4.40	70	220	0.89	4.7	5.50	27.5	120
11	0.985	1.55	5.00	3.23	50	165	0.98	3.8	3.88	21.0	100
2	0.900	1.50	2.55	1.70	255	78	0.95	1.6	1.66	9.0	34
1 with #131 used in Computations		1.70	18.50	10.90	210	600	0.87	14.0	16.10	75.0	225
		r_o = 12800 ohms			Q at 2nd Emitter = 43.8		r_o = 6300 ohms			Q at 2nd Emitter = 24.6	

V_c = -6.0 Volts I_e = 2.0 Ma.

Printed Circuits

Use of brass dies to impress circuit pattern on copper-clad phenolic-paper eliminates need for electrolytes. Method excellent for mass production

process involves removal of the raised portion of the embossed laminate by mechanical means to leave conductors embedded in an insulating backer as shown in Fig. 4B.

A typical circuit is shown in Figs. 1, 2, and 3 in various stages of the process. A master die photo-engraved on brass is shown in Fig. 1. The die is pressed into material XXXP grade phenolic-paper laminate with conductors of 0.0013 in. copper foil. The depressed circuit is shown in Fig. 2. Various adhesives have been used to bond the foil to the laminate and have been chosen to match the chemical makeup of the phenolic impregnated paper received from a particular source.

The size of the circuit illustrated in Fig 3 is about 8 by 10 in. The smallest conductors are about 1/32 in. wide.

A standard multiple-platen laminating press is used to produce embossed circuit patterns in quantity. The succeeding steps of surface removal and blanking out individual patterns complete the production process. Economical production of sheets of this size can only be carried out for fairly high production rates, although flexibility in the production rate can be achieved by pressing both standard flat-surfaced laminates and embossed patterns in the same press. Typical laminating presses provide six openings wide enough to hold several 1/16-in. sheets per opening. By varying the number of flat and embossed sheets in each press load, the production rate of each type of material can be adjusted to schedule with the press always operating at full capacity.

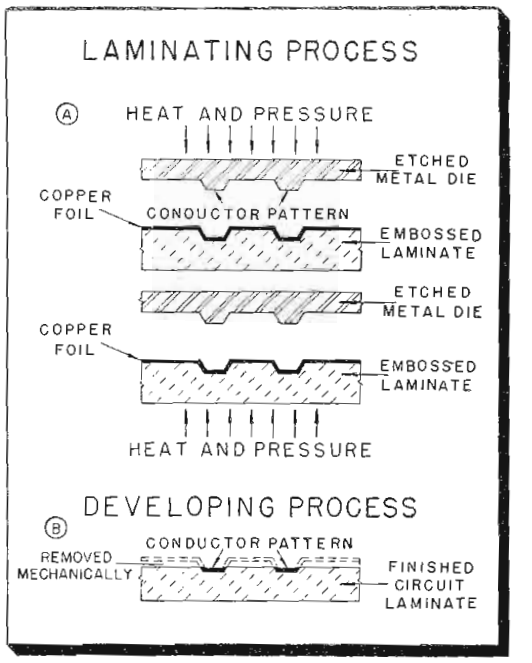


Fig. 4: (A) Pattern is depressed into foil-clad laminate by metal die. (B) Removal of raised portion leaves embedded conductors

Characteristics of Process

This new process has the advantage over other forms of producing foil wiring without using any electrolyte in contact with the insulating material, hence there is no etchant removal problem, and the insulating qualities of the laminate are uniform and unimpaired after processing. Detail obtainable is equivalent to silk screen standards, adequate for practically all applications.

The inherent simplicity of embossing and especially the fact that the process is nearly complete after the laminating step makes production a rather uncomplicated and economical operation, and it is in this respect that the process appears most attractive.

Paste Solder Cuts Assembly Costs

A substantial increase in output is reported to result from the use of flux-containing paste solder which permits separate assembly and heating operations. One illustration is the reduced fabricating costs of Alnico pole piece subassemblies in meters.

Automatic locking relay-type meters for process and heat control, a development of Assembly Products, Inc., Chagrin Falls, Ohio, afford low-cost accurate industrial instrumentation. The heart of the contact meter is an 8-oz. Alnico Type III or IV permanent magnet with 1-in. sintered iron pole pieces soldered to the magnet ends. The signal winding of the floating indicator pivots in a 1/2-in. diameter circular opening formed between the cast iron pole pieces.

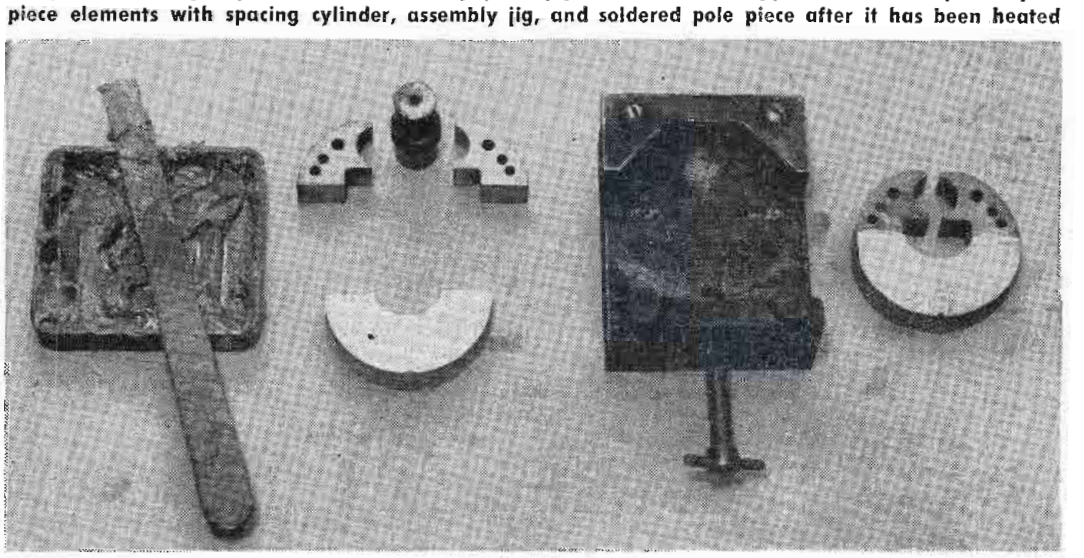
The three parts are fabricated in a bench operation set up to complete the assembly and soldering in two basic operations. Flat steel jigs 4 x 5 in. are used for parts assembly. A cylindrical template fits into the signal winding opening and locks the three parts in position.

Originally the company employed a wire type solder which required a separate fluxing operation. It was necessary to heat the assembly, then apply the flux and finally to apply the wire solder along the joints of the loosely formed assembly. This required a high degree of manual dexterity and required a re-heat, if time was lost in assembly. Due to variance in capillary flow, joint penetration was uncertain.

The company, in seeking cost reduction methods, developed a paste soldering technique which permitted Fusion paste solder to be applied cold to magnet ends prior to assem-

(Continued on page 150)

Complete soldering sequence is illustrated by (l to r) paste solder with applicator, three separate pole piece elements with spacing cylinder, assembly jig, and soldered pole piece after it has been heated



A New Hand

Hand held unit for emergency, Civil Defense, and industrial two-way communications weighs only 3¼ lbs. with batteries. 250 mw power output and 15 μv receiver sensitivity give 1 mile service range. Printed circuitry is used

Fig. 1: Hand held transmitter in operation

By STANLEY CUTLER
Director of Engineering
and
GEORGE BROWNSTEIN
Development Engineer
Pacific Mercury Television Mfg. Corp.
5955 Van Nuys Blvd., Van Nuys, Calif.

An analysis of currently available equipment suitable for low power two-way communications has indicated that these items are often bulky and costly, although the performance of many units are more than adequate for short range service. Consideration of the most desirable characteristics for equipment suitable for emergency use has led to the adoption of the following design objectives.

1. The unit should be light in weight, and small enough that it can be held and operated easily in one hand.

2. The package should be completely self-contained requiring no external power or connections of any kind.

3. Its mechanical design should be such as to provide easy access to all parts for servicing, and should allow almost instant replacement of tubes and batteries.

4. Because it is pointed primarily at the emergency communications field and other short range applications, the unit should use readily available components. In particular tubes and batteries should be types which can easily be obtained in times of emergency from the stock shelves of local radio parts jobbers or servicing dealers.

5. The unit should be capable of being mass-produced to sell for considerably less than existing equipment.

6. The design should provide the maximum possible degree of reliability consistent with low cost.

The Pacific Mercury Model PM-1 portable transmitter-receiver represents a satisfactory approach to these objectives. See Figs. 1, 2, 4 and 5. This unit is completely self-contained, including battery power supply, and is small enough to be carried in and operated by one hand. The design of the case and operating controls is such that it can be operated comfortably in either the right or left hand. It operates in the frequency range of 142-162 MC, and uses a collapsible whip antenna which telescopes into the case when not in use. It can be operated while held in the hand by a push-to-talk transmit-receive switch actuated with finger pressure, or by the unique arrangement of an extension cable with plunger action operated from a remote position. For the latter operation an external speaker/microphone may be plugged in, thus allowing the unit to be completely operated while strapped to the back, or when placed atop a ledge or post to take advantage of height for longer distance communication. Power is furnished by conventional flashlight cells and 67.5 volt portable radio "B" batteries contained within the case. The entire unit measures 8¼ x 4-1/16 x 2¼ in. and weighs 3¼ lbs. complete with batteries.

Crystal Control Used

At the outset of this development considerable thought was given to the choice of tube types, and to the basic circuit arrangement for the transmitting and receiving portions. To satisfy the objectives of reliability and to conform with FCC stability requirements. it was decided to use crystal control to establish transmitter carrier frequency. The requirements of simplicity and low cost dictated the choice of AM (with crystal controlled oscillator). and also ruled out the use of a multitube superheterodyne receiver. The superregenerative detector presented itself as the only practical form of receiver combining high sensitivity performance with a minimum of tube envelopes. Further conservation of tubes was achieved by the use of common tubes for the audio portions of both receiver and transmitter.

The use of harmonic mode crystals in the range of 35 to 40 MC allows the transmitting frequency to be most easily developed with a total of only three stages using cascaded doublers following the crystal oscillator. Audio gain and power output requirements for both transmitter modulation and receiver are provided by one pentode voltage amplifier and one pentode power output stage. The circuit arrangement may be seen readily from the block diagram of Fig. 3.

The available tube types for battery filament operation with physical dimensions suited to this unit are restricted to the conventional miniature types and the round and flat press subminiatures. While some of the latter type subminiatures are presently stocked by some jobbers, they are still restricted to one manufacturer and distribution is limited, while the suitable miniature types are made by several tube manufacturers and are quite generally available. This factor led to the choice of the miniature types even though good performance in many cases can be obtained more easily and at lower power requirements with the subminiatures. This penalty and increased space requirement for the miniatures has been accepted in the interest of the objectives of easy maintenance in times of emergency and of low cost.

The choice of miniature tubes restricted considerably the types which were suitable for the transmitter output stage and the superregenerative detector. Pentodes such as the 3V4, 3S4, 3Q4 and 3A4 were tried for the transmitter output doubler, but these proved to be extremely inefficient due to tube losses and the relatively low impedance tank circuits which were obtained as a result of the large tube output

Carried Transmitter-Receiver

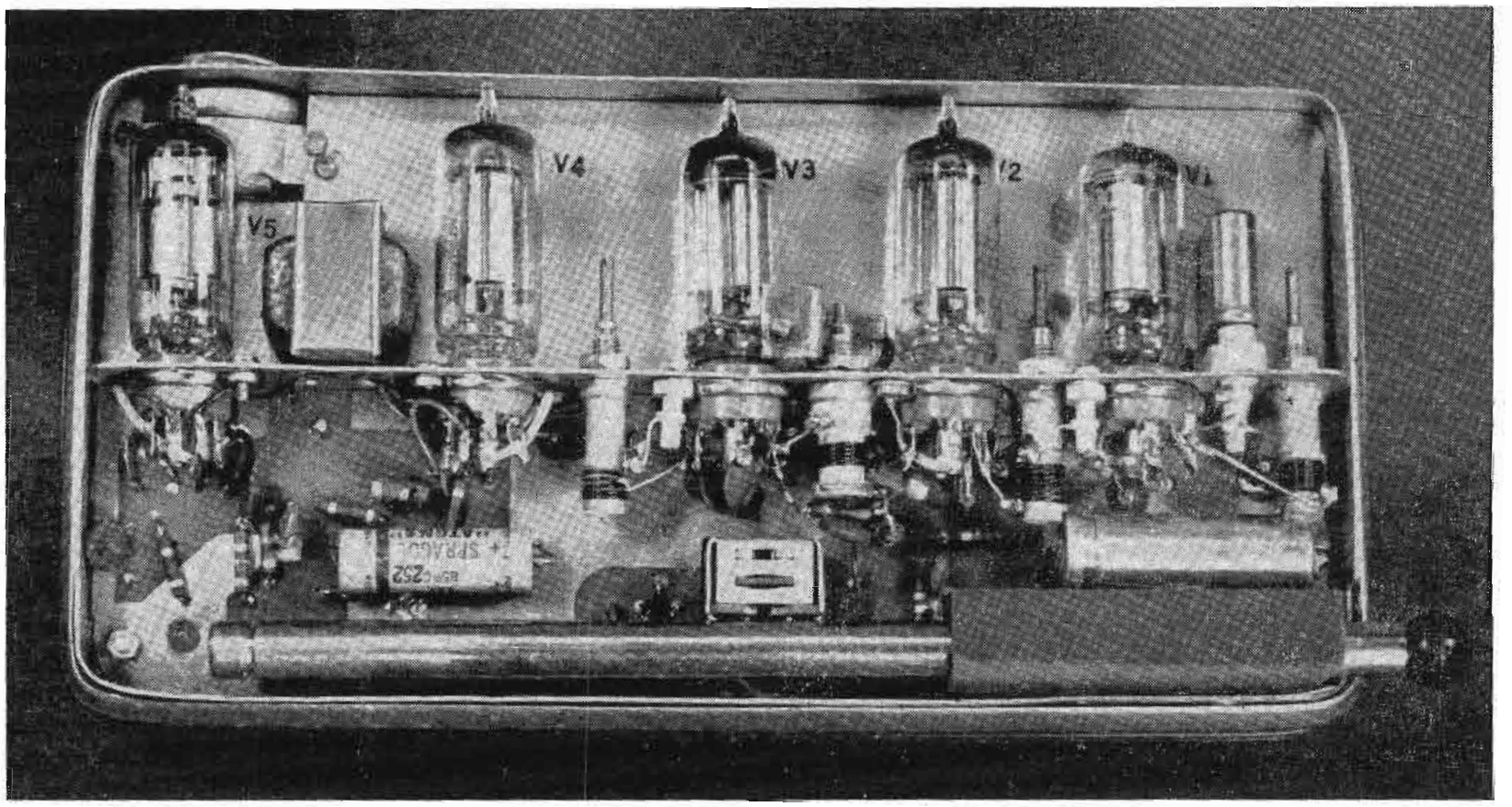


Fig. 2: Transmitter-receiver's tube and components. Collapsible whip antenna is in unoperative position. Unit covers 142-162 MC frequency range

capacitances. The type 3A5 dual triode proved to be the best solution as a combination transmitter output and superregenerative detector. Independent filament connections for the two sections contribute to "A" battery economy since only one section is used at a time.

The oscillator of the transmitter uses a triode connected type 3Q4, and is frequency controlled by a 3rd overtone crystal operating in a series feedback circuit. A serious problem which arose was that of oscillator reliability vs. filament voltage. It was found in early development work that the crystal oscillator would cease operating when the "A" batteries dropped in voltage only 10%. In order for a unit of this type to be practical in the field it is important that it continue to operate over a minimum of a 30% drop in "A" battery voltage, and about a 50% drop in "B" battery voltage. The "A" battery voltage is the more critical of the two since it governs the G_m of the tube to a greater degree. Investigation into this problem showed that three conditions are necessary to accomplish continued performance of the oscillator over a relatively large drop in "A" battery voltage.

1. Crystals of reasonably high activity must be used.

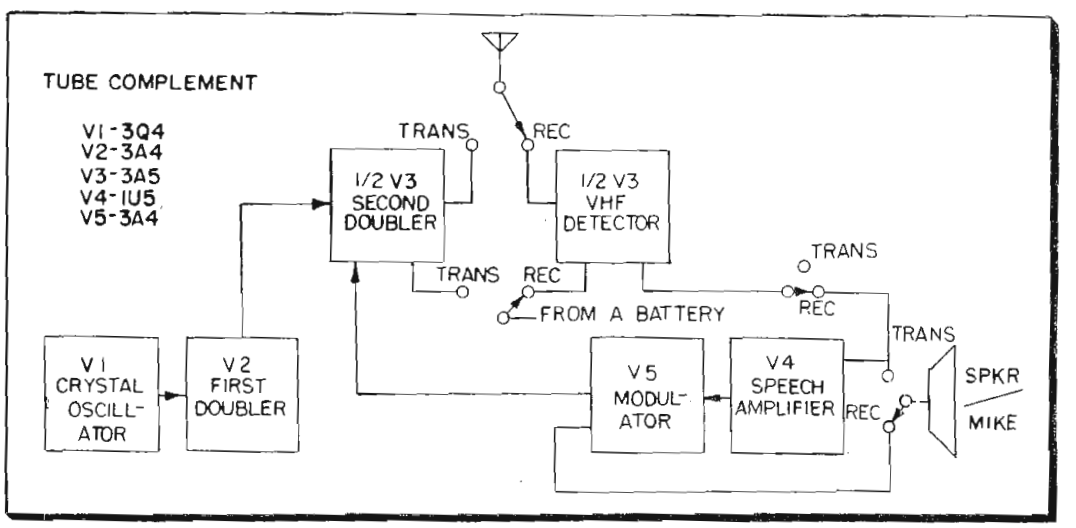
2. The feedback coil of the oscillator circuit must be designed carefully. If the feedback is too great the circuit will oscillate at frequencies other than that of the crystal and with the crystal removed; if it is not enough the circuit will not oscillate at low filament voltages even when an active crystal is used. Therefore, the oscillator coil was designed to provide reliable operation using low filament voltage.

3. The drop from the maximum "A" voltage to the end life voltage should be as slow as possible under load conditions. Fortunately at the time this development was taking place National Carbon Co. marketed their Eveready D 99 1.5 volt dry cell which has considerably greater ampere-hour capacity than ordinary dry cells. This dry cell is available commercially and is recommended for use with this unit. Other "A" battery equivalents will do, but at the expense of somewhat shorter operating life.

The first doubler stage using a type 3A4 pentode is coupled capacitively to the crystal oscillator. The output of this stage is doubled again in the final power amplifier which uses one-half of the 3A5. The second

(*Continued on page* 158)

Fig. 3: Block diagram of PM-1 portable transmitter-receiver. 35 to 40 MC crystals are used



Magnetic Alloy Shields for

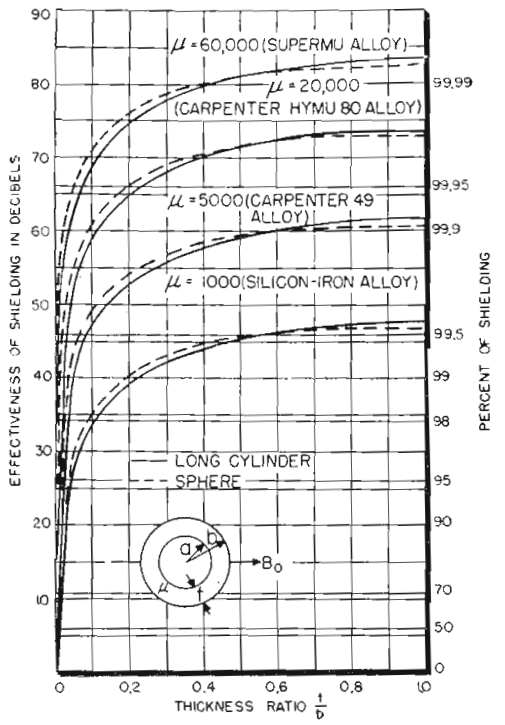


Fig. 1: Effectiveness of cylindrical and spherical shields. Note thickness limit

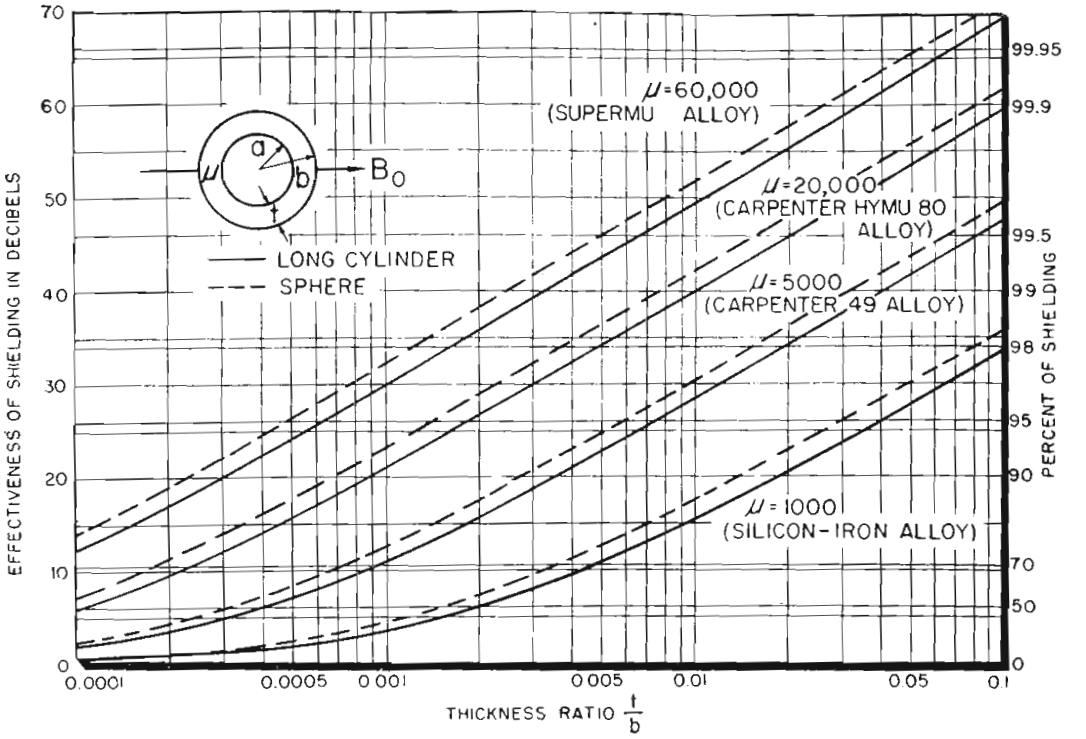


Fig. 2: Shielding effectiveness of cylindrical and spherical shells

By ***ROBERT D. TEASDALE***
Magnetic Metals Co.
Hayes Ave. at 21 St.
Camden 1, N. J.

MAGNETIC shields are needed in many electronic components to contain or to exclude fields for many purposes, such as the isolating of transformers and the input stages of high gain amplifiers, and the shielding of cathode ray tubes and magnetic recording heads. However, relatively little information is available on the actual effectiveness of magnetic shielding for commercially obtainable alloys.

If a uniform magnetic field B_o exists in space and a magnetic shield is then introduced, the magnetic field inside the shield drops to a value B_{in}. Several authors have computed the value of B_{in} for various shield geometries.[1, 2, 3, 4]

For a long cylinder of outer radius b, wall thickness t, and permeability μ, placed in a uniform transverse magnetic field B_o, the shielding equation can be put in the form:

$$\frac{B_o}{B_{in}} = 1 + \frac{\frac{t}{b}\left(2 - \frac{t}{b}\right)}{\left(\frac{\mu + 1}{\mu - 1}\right)^2 - 1} \approx 1 + \frac{\mu}{4}\frac{t}{b}\left(2 - \frac{t}{b}\right) \quad (1)$$

For a sphere of outer radius b, wall thickness t, and permeability μ, placed in a uniform magnetic field B_o, the corresponding shielding equation is:

$$\frac{B_o}{B_{in}} = 1 + \frac{\frac{t}{b}\left[3 - 3\frac{t}{b} + \frac{t^2}{b^2}\right]}{\frac{(\mu + 2)(2\mu + 1)}{2(\mu - 1)^2} - 1} \approx 1 + \frac{\mu}{4.5}\frac{t}{b}\left[3 - 3\frac{t}{b} + \frac{t^2}{b^2}\right] \quad (2)$$

The approximation in the second form of (1) and (2) gives a maximum error of less than 0.8% for a permeability μ of 200. For higher values of permeability, the maximum error is much less.

It is useful to define the shielding efficiency (S. E.) in decibels as

$$\text{S.E.} = 20 \log_{10} (B_o/B_{in}) \quad (3)$$

The higher the ratio of B_o/B_{in}, the higher is the shielding efficiency, and the better the shield. Fig. 1 shows curves of shielding efficiency plotted against the thickness ratio t/b for long cylinders and spheres, for several values of initial permeability:

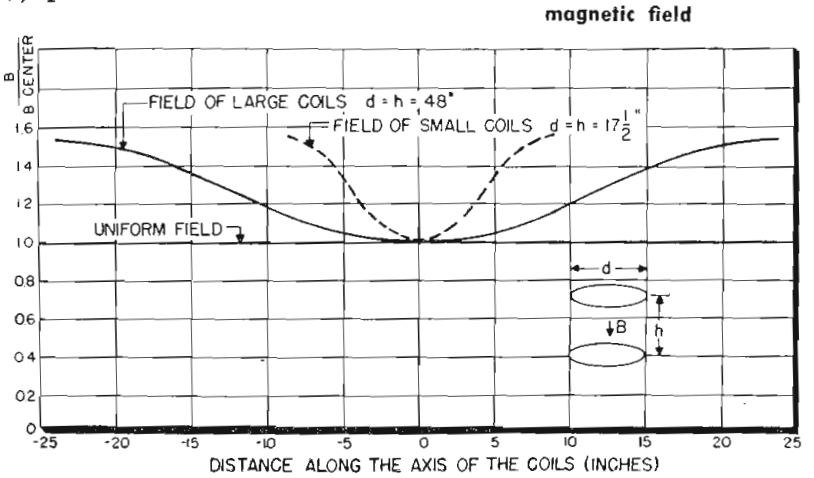
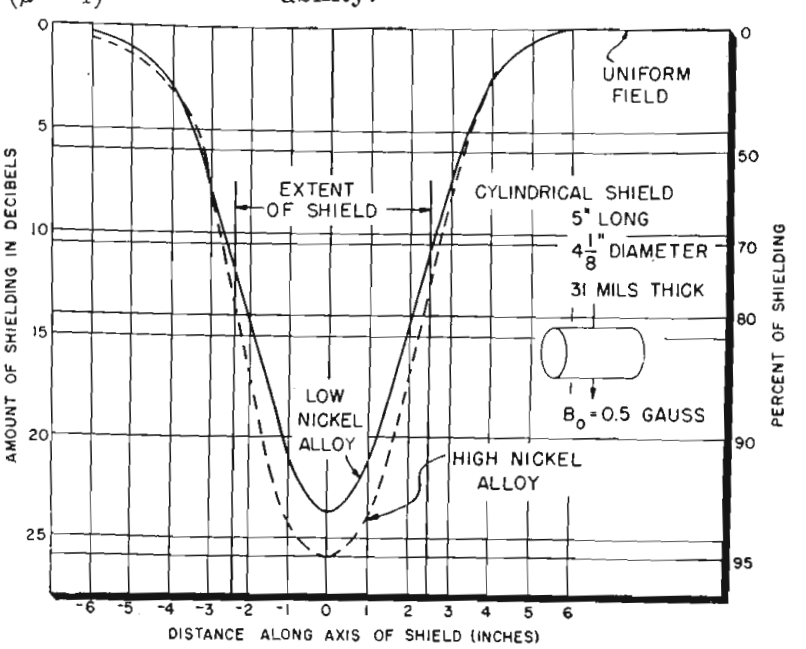


Fig. 3: (l) Uniformity of magnetic field produced by Helmholtz coils. Fig. 4: (r) Cylindrical shield in 0.5 gauss transverse magnetic field



Color TV Tubes

Highly revealing results of analytical and experimental studies show actual effectiveness of commercial alloys. Effect of shape and thickness of conical shielding structures given for transverse and axial magnetic fields

Table I: Ultimate Shielding Efficiency for Several Magnetic Alloys

Alloy	Nominal Initial Permeability	Ultimate Shielding Efficiency for Long Cylindrical Shields	Ultimate Shielding Efficiency for Spherical Shields
Silicon-Iron	1,000	48 db.	47 db.
Low Nickel	5,000	62 db.	61 db.
High Nickel	20,000	74 db.	73 db.
SuperMu	60,000	83.5 db.	82.5 db.

Note: For double shields these ultimate values should be doubled. For triple shields these ultimate values should be tripled.

Table II: Shielding Efficiency of Cylindrical Shields

Material	Length (Inches)	Thickness t	Outer Radius b	t/b	Measured Value: Axial Field db	Measured Value: Transverse Field db	Read from Fig. 2 db
Silicon	6	.025	1	.025	26.6	28.6	22.3
Double Silicon Spaced 1/4"	6	.025	1	.025	29.8	35.6	*
Low Nickel	4.87	.031	2.06	.015	15.2	23.8	32.0
High Nickel	4.87	.031	2.06	.015	16.8	26.0	43.5
High Nickel	6	.025	1	.025	39.5	51.0	48.0
High Nickel	6	.031	1	.031	42.5	52.0	49.5
High Nickel	6	.062	1	.062	50.0	53.0	55.3

*28 db. for a single shield of thickness 0.050 inch, no spacing

- μ = 1,000, corresponding to 4% silicon-iron alloy
- μ = 5,000, corresponding to 50% nickel alloys, such as Carpenter 49 alloy
- μ = 20,000, corresponding to 77-79% nickel alloys, such as Carpenter HyMu 80 alloy
- μ = 60,000, corresponding to 79% nickel. 5% molybdenum alloy, such as Supermu alloy

There is an ultimate limit to the amount of shielding which can be achieved—a value which can not be improved no matter how thick the shield is made. This limit depends only upon the permeability μ of the shield. From (1) this limit for long cylindrical shields is:

$$\left(\frac{B_o}{B_{in}}\right)_{max} = \frac{(\mu+1)^2}{4\mu} \approx 0.25\,\mu \qquad (4)$$

From (2) the corresponding limit for spherical shields is:

$$\left(\frac{B_o}{B_{in}}\right)_{max} = \frac{(\mu+2)\,(2\mu+1)}{9\mu} \approx 0.222\,\mu \qquad (5)$$

These ultimate values of shielding efficiency for several magnetic alloys are given in Table I. They can also be read from the curves of Fig. 1. (If even higher values of shielding efficiency are needed, multiple shields must be used. For double shields, these ultimate values should be doubled. For triple shields, these ultimate values should be tripled.[5]) Further, the curves of Fig. 1 show that this shielding effectiveness is approached for intermediate values of shield thickness. Very little improvement in shielding efficiency is obtained by increasing the thickness beyond 0.4 of the outer radius for single shields.

In Fig. 2 the lower portions of the

Fig. 5: (l) Shielding by cylindrical shield in 0.5 gauss axial magnetic field.

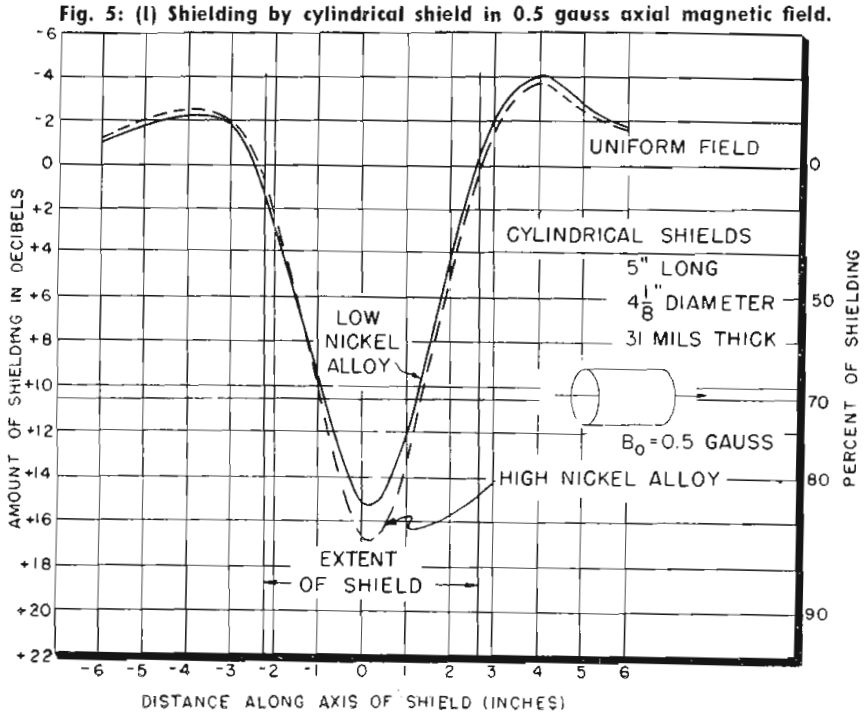
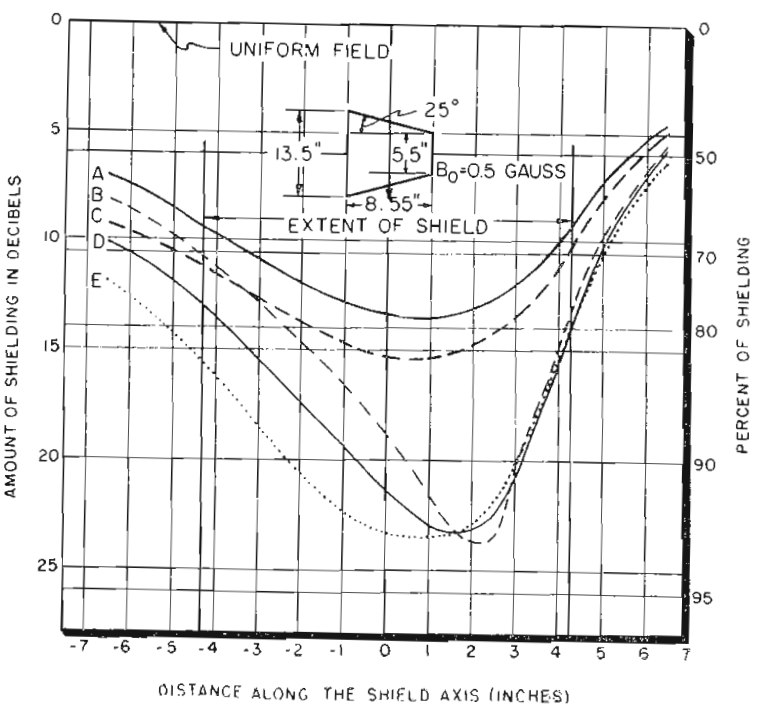
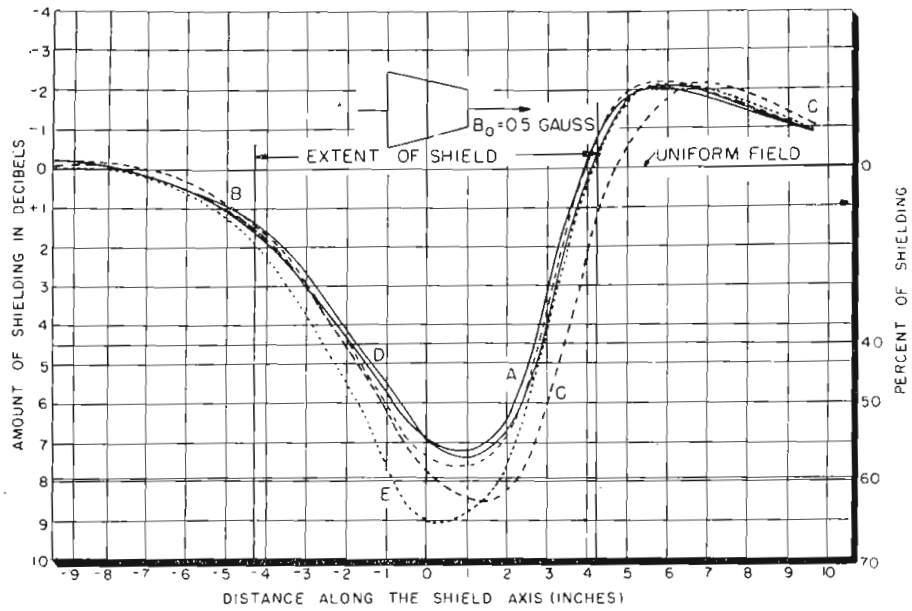


Fig. 6: (r) Truncated conical shield in transverse magnetic field.





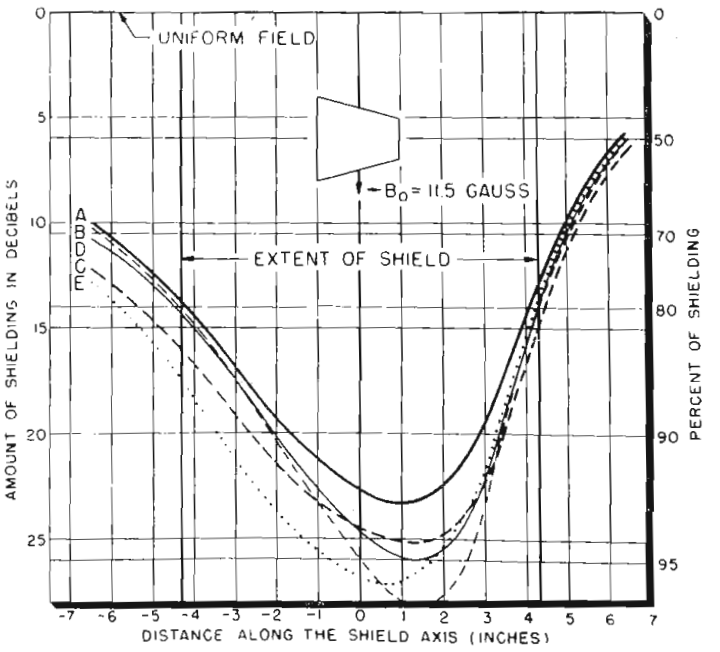


Fig. 7: (l) Shielding by truncated conical shield in 0.5 gauss axial field. Fig. 8: (r) Truncated conical shield in 11.5 gauss transverse field

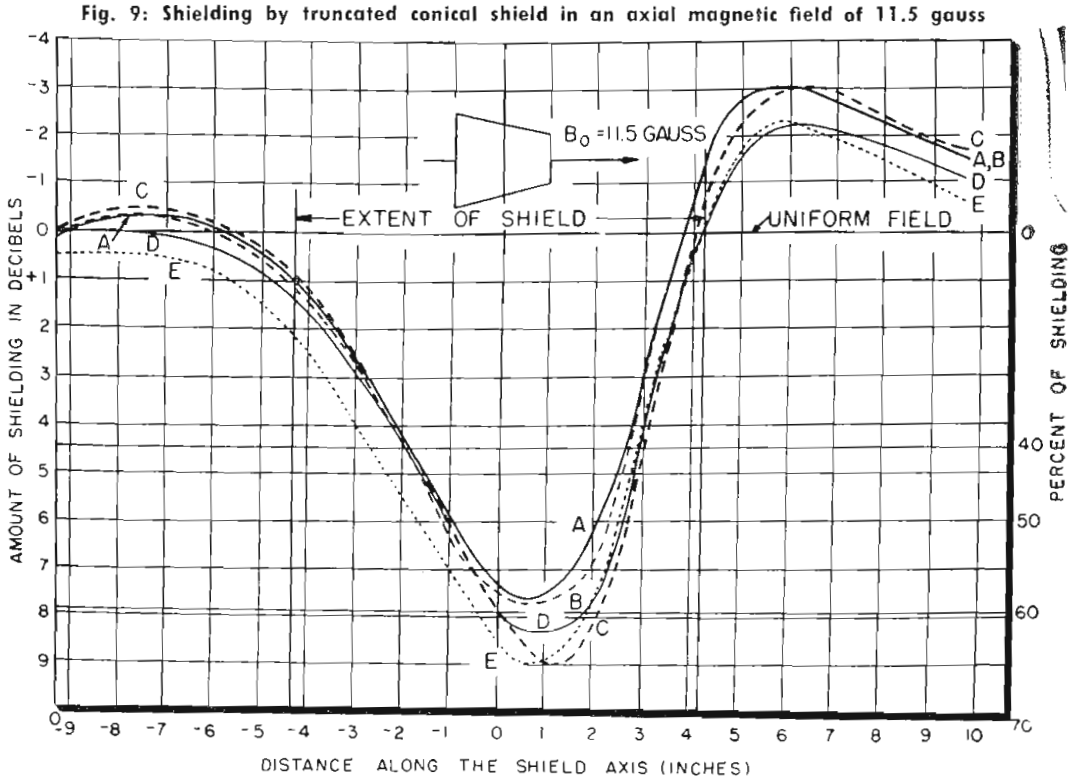
curves of Fig. 1 are expanded to show the shielding effectiveness of cylindrical and spherical shells. For most practical shields the t/b ratio is below 0.1. In this range the curves of Fig. 2 show how effective additional wall thickness and higher permeability can be.

The shielding efficiency increases rapidly with even slight increases in thickness. For example, for a cylindrical shield of high-nickel alloy of 1-in. outer diameter, the shielding effectiveness increases by 6 db (from 46 to 52 db) if the shield thickness is changed from 10 mils to 20 mils.

Note that, for a given material, the amount of shielding depends only upon the ratio of t/b and not upon t or b alone. Thus, if the outer diameter of the shield is doubled, the shield thickness must be doubled also to keep the same amount of shielding. Also, for a shield of a fixed thickness, the maximum amount of shielding is obtained by making the shield diameter as small as possible. For long cylinders and spheres of the same material, same wall thickness, and same radius, the shielding effectiveness is essentially the same. For thin shields, a sphere is slightly better than a long cylinder of the same radius, thickness and permeability. For very thick shields, the long cylinder is slightly superior to the sphere.

Actually, the curves of Fig. 1 and 2 could be shown as a band to include the fact that the actual permeability varies over a range of values due to differences in production and to normal variation. However, except for the Supermu, the permeability figures used represent reasonable values obtainable in commercial production. Fig. 1 and 2 give an upper limit to the amount of shielding to be expected at the center of a cylindrical shield. For actual cylindrical shields of finite length, the shielding is somewhat less than the value read from Figs. 1 and 2, but as the cylindrical shields get longer, the actual values approach those given by the curves. Also these curves allow us to predict the improvement in shielding caused by a change of shield thickness, shield radius, or shield permeability. The curves for spherical shells give a good estimate as to the amount of shielding possible in a completely enclosed shielding structure.

Fig. 9: Shielding by truncated conical shield in an axial magnetic field of 11.5 gauss



Experimental Equipment

Parallel circular loops of wire, commonly called Helmholtz coils, were used to produce a uniform field for experimental purposes. In the smaller set each coil of 55 turns was 17½ in. in diameter, and the two parallel coils were spaced by 17½ in. Also, a larger pair of coils was wound and mounted to produce an essentially uniform field over a larger region. In the larger set, each coil of 100 turns was 48 in. in diameter, and the two coils were spaced by 48 in. See Fig. 10.

In making the measurements a pair of coils was used to produce a reasonably uniform applied field, and a high sensitivity search coil of 10,000 turns was connected to a Ballantine No. 300 voltmeter for relative magnetic field strength measurements at 60 cycles. Two search coils were used, one for axial fields and

(*Continued on page* 138)

Preventing Acoustic Feedback

Simple circuit allows speaker to be near microphone in multi-channel communication system without causing oscillation. Only 3 db loss introduced

By BENJAMIN WOLFE
Director of Engineering
WAAM-TV
3725 Malden Ave., Baltimore 11, Md.

IT is frequently desired to transmit recorded music or speech from a studio turntable along with "live" accompaniment produced in the studio. In order that the "live" aspects of the program may be properly correlated with the recorded aspects, it is desirable for the recorded intelligence to be played into the studio over a loudspeaker. Since the audio output of the loudspeaker may be in close proximity to the live microphone, and since both parts of the program are simultaneously conveyed over a multi-channel preamp communication system to a single program amplifier, oscillation and feedback frequently can occur.

Hybrid Coil System

One method of preventing this feedback that has been commonly used is the hybrid coil system. This system requires that the impedance of the hybrid coils be maintained constant over the 30 to 15,000 cycle audio frequency spectrum. Should the impedance of any of the three hybrid coils used vary somewhat due to common coupling, there is a tendency for the hybrid coil system to create excessive hum, and if the impedance variation is sufficient, "feedback" will result. A bridge resistor system that is used to prevent "feedback" requires perfectly matched resistors. Another system employs a resistor network which when used imposes a 6 db loss. In the method to be described the loss is limited to 3 db. High levels of audio may be fed into the studio loudspeaker and the loudspeaker may be placed as close as desired to the microphone without obtaining howling or singing feedback effects.

Fig. 1 shows two preamps coupled through a common transformer to a program amplifier. While only two preamps are shown on the diagram for discussion purposes, normally a radio broadcasting console may employ from five to ten preamp circuits. The acoustic intelligence picked up by the microphone channel is fed through preamp tube V1. the resultant amplified output is applied to the common input transformer T4 to the line program amplifier. In the turntable channel the transmission path to the common transformer T4 thru preamp tube V2 differs from the foregoing preamp channel, in that the cathode follower network is provided for applying the output of the turntable to a loudspeaker in the broadcasting studio.

Cathode Circuit

In preamp V2's cathode circuit a low impedance transformer is inserted, 600 ohm/600 ohm. The output of this transformer drives the studio loudspeaker amplifier through its associated ladder type attenuator. The feedback voltage obtained from acoustic coupling of the loudspeaker into the studio microphone is developed on the plate of V2. Sustained oscillations in the combination of preamp V1 and V2 can only result from the microphone feedback path if the voltage reaching the cathode or preamp V2 from preamp V1 is large compared to the voltage produced in preamp V2 by the turntable input voltage. The return signal voltage from the plate of preamp V1 to the plate of preamp V2 is attenuated sufficiently at the cathode of preamp V2 by cathode degeneration to prevent any possibility of oscillations under normal operating conditions. Thus the circuit provides a simple and economic means of preventing feedback (howling or singing) and provides a stability which is not dependent upon exact adjustment.

Degenerative Loss

The loss brought about by the degenerative effect of transformer T3 is found by the following calculations to be approximately 3 db:

G = gain of preamplifier V2 without feedback.

G' = gain of preamplifier V2 with feedback.

Preamplifier V2 is a 6J7 triode connected.

μ = 20 amplification factor.

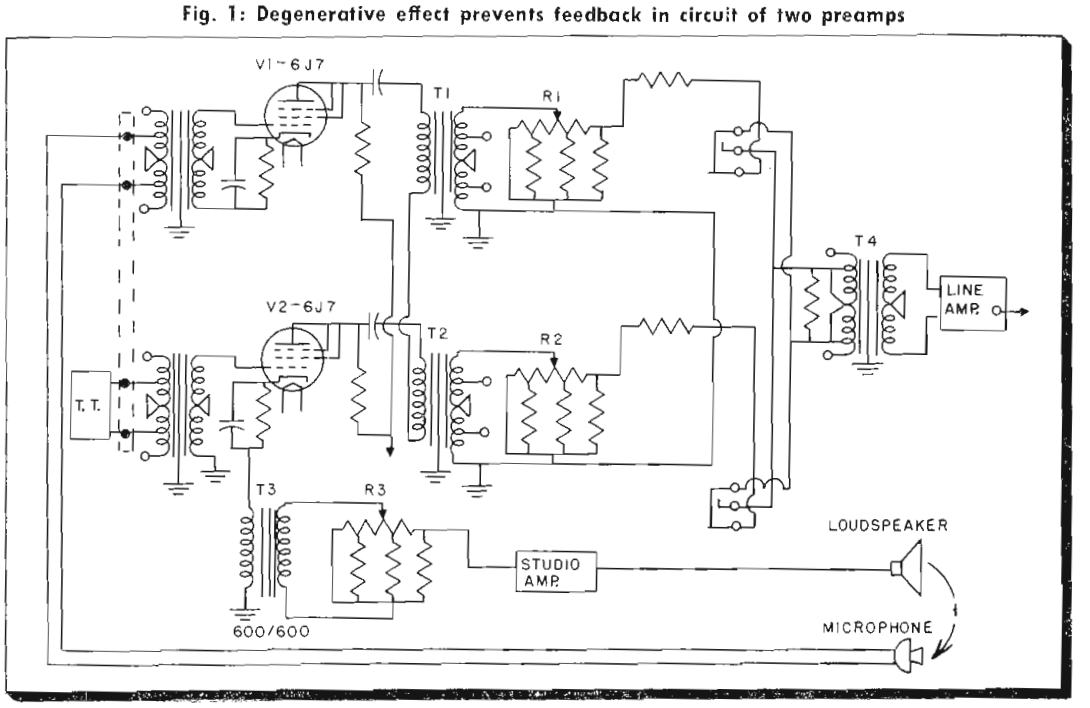
R_L = 22,000 ohms primary impedance of T2.

R_p = 11,000 ohms plate resistance of T2.

R_c = 600 ohms Zp primary impedance of T3.

(*Continued on page* 133)

Fig. 1: Degenerative effect prevents feedback in circuit of two preamps



The Economics of

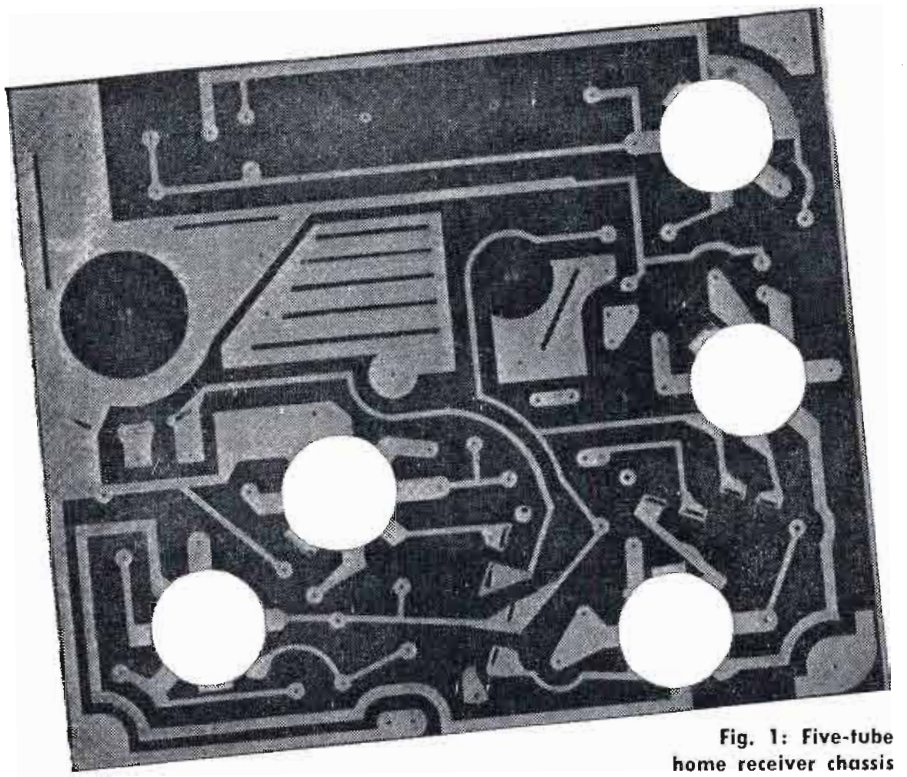


Fig. 1: Five-tube home receiver chassis

By ROBERT L. SWIGGETT & JAMES F. CARBERRY
Photocircuits Corp.
Glen Cove, N.Y.

MUCH has been written about printed wiring, primarily concerning the techniques used in its manufacture and its application; but little has been said concerning its cost. We will explore the various cost factors involved in using printed wiring in an attempt to answer the question most asked of a printed wiring manufacturers, "What will it cost and how much will it save?"

Our discussion is limited to the type of printed wiring or printed circuitry which produces a metal conductor pattern on an insulator, usually a laminated plastic, by the process of etching or electro-plating. It does not concern the type of printed circuits made by printing on ceramic wafers with silver paints and resistor inks to form small R-C networks or similar sub-assemblies.

One of the reasons why much has not been written concerning the economics of printed wiring is that only in the last year or so has the volume of its production and use become large enough to establish a base for a reliable comparison between the costs of doing a job by printed wiring and doing it with conventional wiring methods. Until mid 1952 most of the work done was on prototypes and preproduction runs, but since then there has been a sizeable amount of production in a variety of fields. Sample and prototype work is continuing at an ever increasing pace indicating the rapid growth of interest in printed wiring. But the significant fact is that a high percentage of the projects initiated with samples eventually get into production. This shows that printed wiring is proving in economically. RETMA established a Printed Wiring Committee in March of 1953 with the view of setting up methods for determining standards for printed wiring. This is a further indication of a general acceptance of the technique.

An etched conductor pattern is made by printing the desired pattern with an acid resist on the surface of a sheet of laminated plastics which has been clad on one or both sides with a sheet of thin metal foil, usually copper. The unwanted metal is then etched away leaving the conductor pattern on the surface.

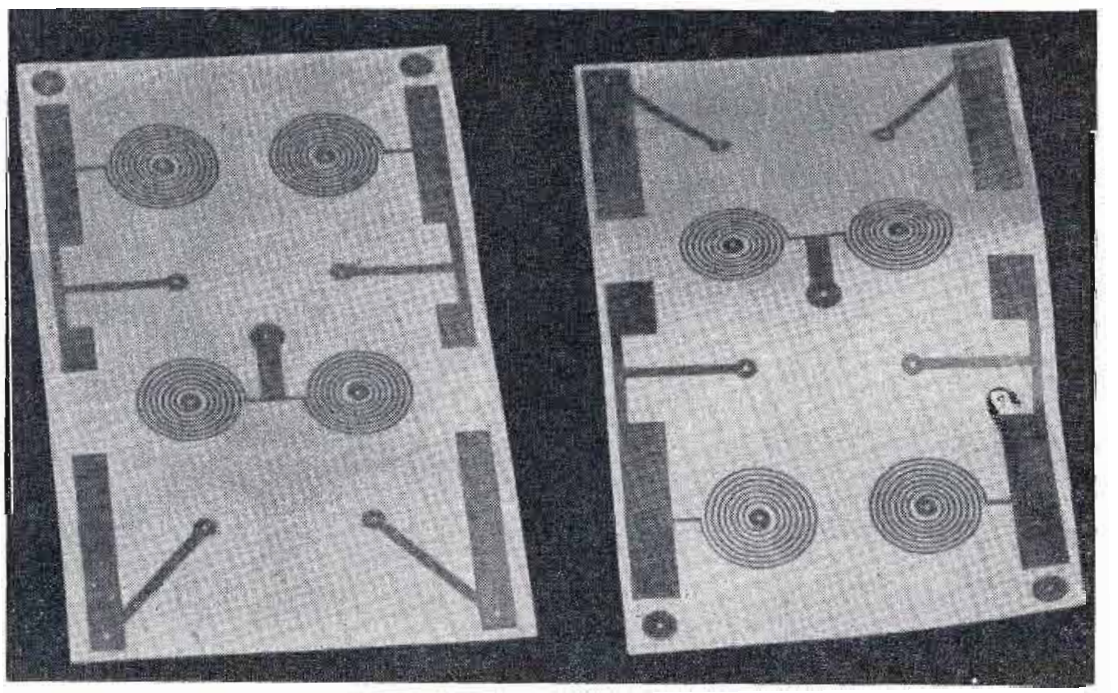
A variation on this process is to print the negative or reverse image of the pattern on the copper clad plastic sheet with a plating resist. The area left uncovered is electro-plated with solder or silver or other metals; and after the plating resist has been removed, the unwanted copper is etched away with a solution which does not attack solder or silver plating. This process yields conductor patterns which have been plated for corrosion resistance, easier soldering, use as a wiping switch or contact, or some other special purpose.

A completely plated circuit is made by depositing an extremely thin metallic film on the surface of the insulator, printing the negative of the required pattern with a plating resist, building up the pattern by electro-plating, then removing the resist and the thin metallic film.

Resist Printing

The resist printing is carried out photographically, with screen printing, or by offset printing. Regardless of the method, the starting point in the process is a photographic negative usually made by photographing an enlarged black-and-white master drawing of the pattern. Normally the circuit forming operations are done on large sheets containing many in-

Fig. 2: High-pass filter printed on both sides of 0.006-in. thick flexible glass cloth



Printed Wiring

An answer to question most often asked: "What will it cost and how much will it save?"

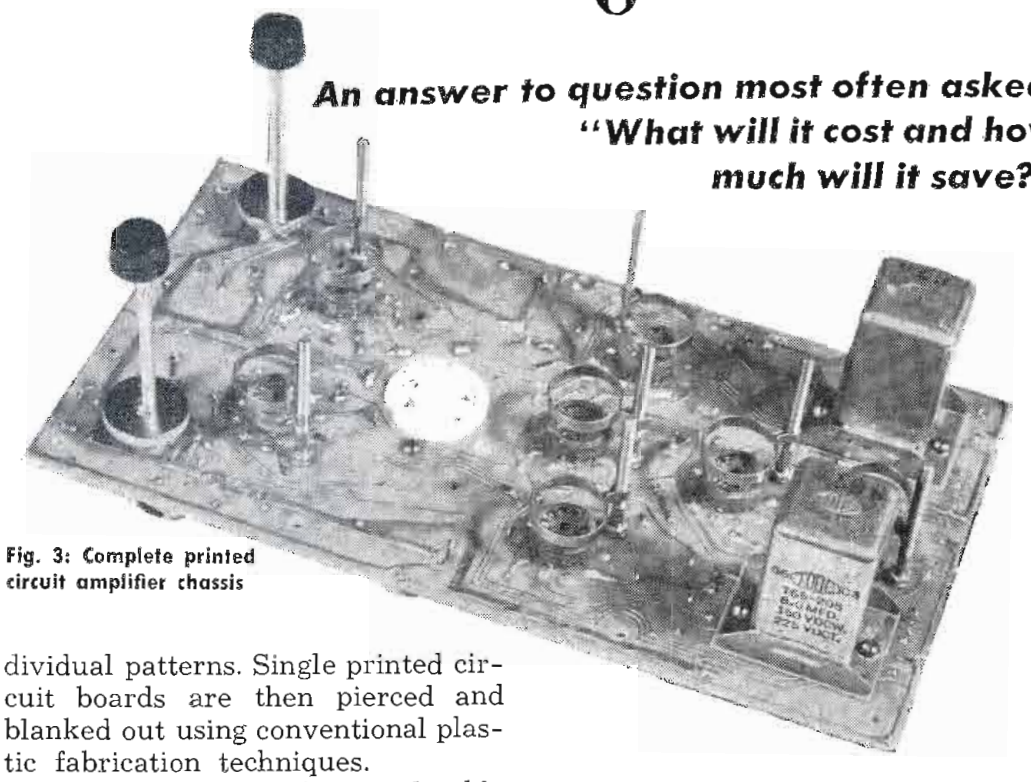


Fig. 3: Complete printed circuit amplifier chassis

dividual patterns. Single printed circuit boards are then pierced and blanked out using conventional plastic fabrication techniques.

A development of considerable economic importance is the system of making through connections from one side of the board to the other by electro-plating. This is accomplished by piercing or drilling the holes to be plated through and making the interior of the holes conductive before going through the plating and etching operation described above. This eliminates the necessity of using eyelets or rivets for through connections and makes dip soldering easier and more reliable.

Several other methods for forming conductors on plastics have been proposed and are in various stages of development, but the above briefly mentioned methods are those used for virtually all printed wiring being produced at this time. They are very flexible. The large number of combinations of types of plastics, metals, and platings available make it possible to establish designs that fit a wide variety of requirements. The ultimate in cost reducing production techniques has, of course, not been reached; but the art has now advanced to the point where it makes possible the realization of considerable cost savings in many types of work.

Cost Elements

Before discussing specific applications we should list the elements of the cost of a printed wiring assembly.

A. Design Costs—Includes engineering, layout, design, drafting, master drawing.

B. Tooling and Setup—Consists of photographic plates, printing plates or other printing setups, and plastics fabrication tools such as drill jigs, piercing and blanking tools.

C. Material—Laminated plastics usually copper clad.

D. Labor—1. Circuit forming operations including printing, etching, plating. 2. Machining, piercing and blanking. 3. Assembly of components, hardware, etc. 4. Test and inspection.

Several typical printed wiring applications will be discussed with reference to the cost elements listed above.

A radio receiver is typical of a long run high production job. Another similar part would be a TV i-f strip. Fig. 1 shows a printed circuit for a standard five tube superhet receiver. The base plastic is 1/16-in. paper base phenolic with 0.00135-in. copper, one side solder plated. The area of the part is approximately 20 in. square.

The quantities produced would usually exceed 10,000 units. A tool for piercing the holes and slots and blanking the part would be constructed at a cost somewhere between $1000.00 and $1500.00. No other tooling would be required.

The receiver manufacturer would purchase the fabricated part for a price probably between $.25 and $.45 depending on the size of the order, thickness and type of plate required, etc. A two-sided circuit with plated through holes interconnections would be somewhat higher. The breakdown on this selling price is approximately as follows: Material, including etching and plating chemicals 67%; labor including inspection 33%. This is indicative that material is the major cost item in the long run printed wiring application.

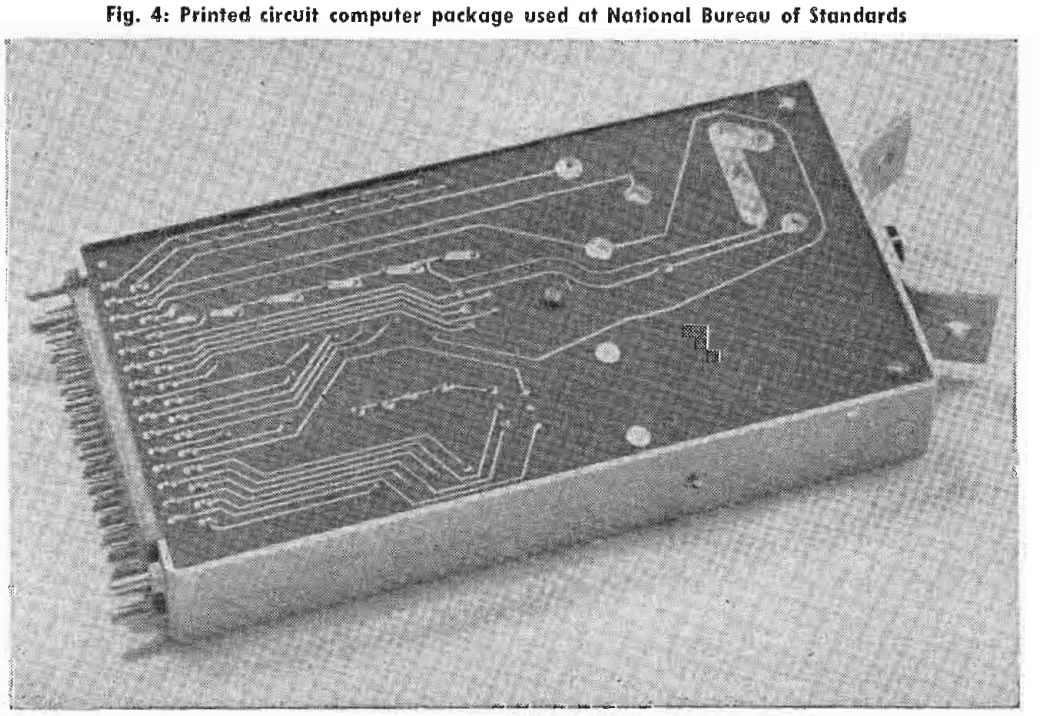
When queried as to why they are using a printed chassis radio manufacturers offer the following reasons:

1. Savings in assembly costs since the components can be dropped into place and dip soldered in one shot.
2. Shorter production line, space saved.
3. Savings in inspection and trouble shooting time.
4. Since this is the first step toward completely automatic assembly, manufacturers desire to familiarize themselves with the use of prefabricated wiring.

Interference Filter

The high pass filter shown in Fig. 2 is representative of another type of long run application. The filter with an area of about 5 sq. in. consists of eight coils and six capacitors which are printed on both sides of

Fig. 4: Printed circuit computer package used at National Bureau of Standards



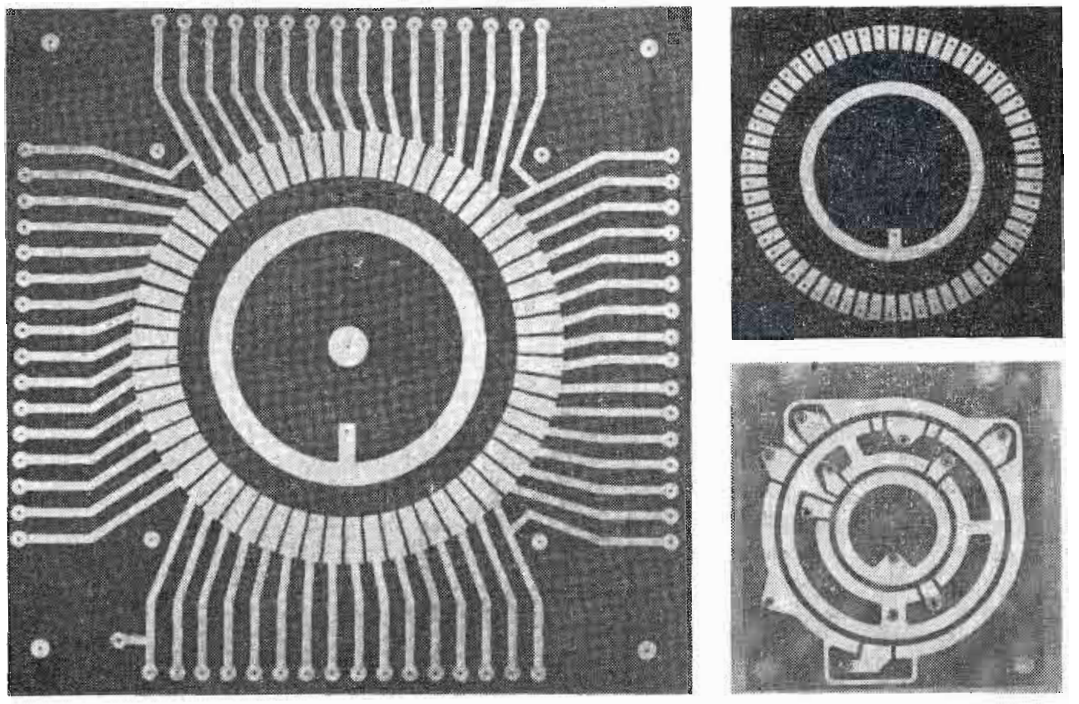


Fig. 5: Rhodium plated switch patterns

flexible glass cloth 0.006 in. thick. Tooling would be $250.00 to $400.00 for a piercing and blanking tool. The material cost represents about 55% of the selling price and labor about 45%.

A startling fact is that the selling price is considerably less than the purchase price of eight wire wound coils and six standard capacitors, to say nothing of the cost of mounting and assembling the coils and capactors. The electrical properties are comparable to filters made with conventional components, and that are more closely reproducible in manufacturing. Very substantial savings in cost are possible with printed filters.

Short Run Assemblies

Short run complex production units such as test equipment, custom-made amplifiers, or complex computer units where the quantities are usually under 500, are another field where printed wiring justifies itself economically. Actually the cost savings, percentagewise, are normally greater with this type of thing than with the long run type such as the five tube receiver previously discussed. The primary reason for this is that it is difficult or impossible to train operators and set up an efficient short run production line for complex hand wired assemblies. Home receiver assembly lines, on the other hand, even though they use conventional wiring and soldering techniques, are very efficient.

Using printed wiring boards it is possible to set up a smooth running production line to handle short runs since operator training problems are minimized. With large scale drawings or partially assembled parts before them as models, assemblers rapidly attain speed in dropping components into the proper holes in the printed wiring board. The laying out and lacing of wiring harnesses is eliminated. Inspection and trouble shooting time is greatly reduced.

A typical unit is shown in Fig. 3. It has an area of about 60 sq. in. and is ⅛ in. thick with plated through holes. Tooling and set-up charges including drill jigs, cutting templates, master drawings, photography, etc., would be under $500.00. Engineering and design costs would be additional and would be roughly comparable to the engineering and design costs for the unit if it were assembled in the conventional manner.

The major cost in manufacturing this unit is the labor required in drilling the holes, cutting to size, punching slots, etc. The plastics fabrication labor is considerably greater than the circuit forming labor. In estimating the total labor cost of a complex, short run printed wiring board, a rough rule of thumb might be to estimate the plastics machining costs in the usual manner, then increase it by something between 20% and 70% to allow for printing, etching, plating, inspection, etc. The same considerations apply to smaller printed wiring boards such as those used in the computer package shown in Fig. 4.

The unit price decreases considerably when the quantity becomes great enough to justify the use of a piercing and blanking tool to fabricate the part. This usually occurs when the quantity required exceeds a number somewhere between 400 and 1500.

A system often employed to reduce costs is to design several different circuit patterns around a standard shape and hole pattern. A single fabrication tool can then be used for several circuits. This idea is particularly useful in computers which employ a standard plug-in package.

When comparing printed wiring with conventional wiring, considerations other than cost are brought to light, such as reliability, reproducibility and miniaturization. Not only are the printed wiring units identical in every detail but are admittedly superior in appearance. In printed wiring you obtain desired reliability without paying the usual premium for it. Printed wiring is ideal for miniaturization as in computer applications where the circuit may be folded or stacked to obtain maximum utilization of available space. In many cases where printed wiring may not justify itself costwise, these other factors will dictate its use.

Switches and Commutators

A surprisingly large number of successful applications of the printed circuit technique are in the switch and commutator field. The main reason being that very complex rotary and sliding switch configurations can be made up at a cost far below that possible with any other system of manufacture. In printing a pattern the complexity does not add to production or tooling costs. If the patterns pictured in Fig. 5 were made by stamping or machining metal parts and mounting them on insulating wafers, or by inserting them in a molded plastic piece, the tooling and production costs would be astronomical. When made by the etched or plated pattern method the only setup costs are for a master drawing and photographic negative on short runs and, additionally, on longer runs whatever plastics fabricating tools are needed.

Cost Advantage

Another cost advantage of printed switches is that they may often be incorporated in a printed wiring board containing the rest of the associated circuitry and components. Or in the case of switches where the elements must be interconnected in a complicated fashion, the necessary jumpers are printed at no extra cost. The cost of wiring in these jumpers by hand often throws the

balance in favor of the printed switch over a conventional type even though the conventional type may be a completely tooled standard production model. A recent printed design for a stacked switch with six wafers, 27 contacts to the wafer, saved about 40% over the cost of the same switch with conventional contacts and hand wired jumpers. This was primarily due to the fact that printing the jumpers did not increase the cost of the wafers.

Binary Code Discs

Binary code discs or complex commutators as appear in Fig. 6 can, as we have said before, be made economically only by printed circuit methods. The use of such code discs with appropriate contact fingers appears to be the least expensive

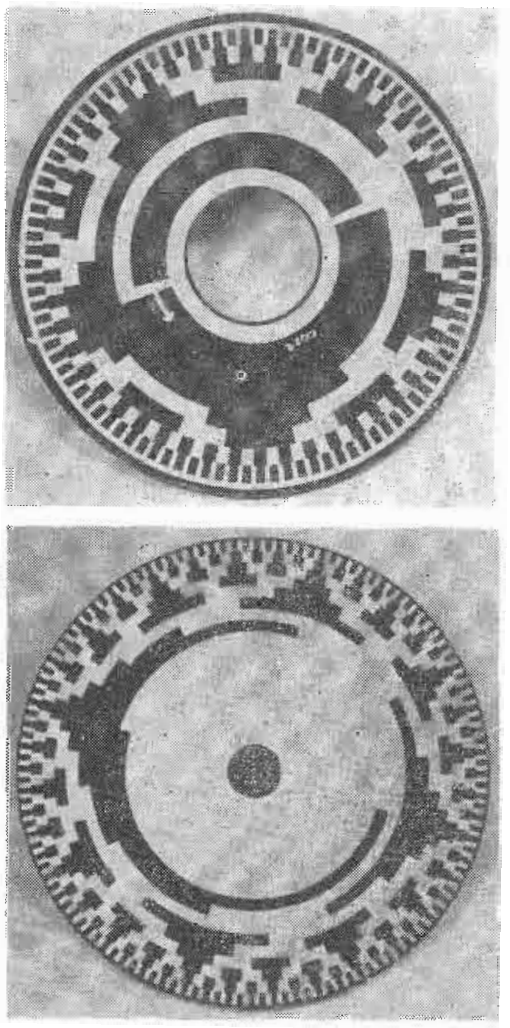
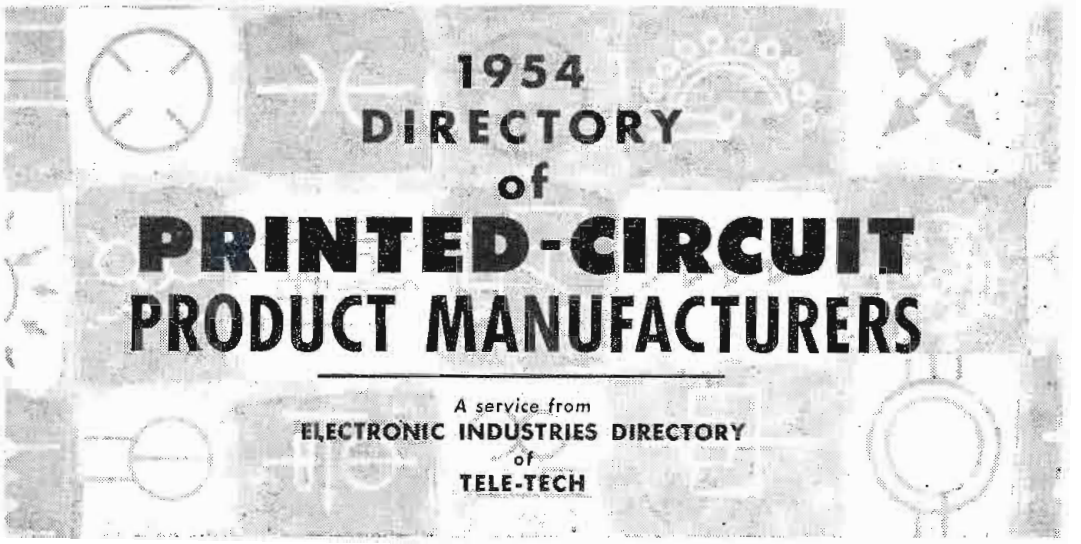


Fig. 6: Code discs

method of converting rotary shaft position to a binary code output. Many of the new shaft position reading or controlling devices using digital computer principles have been built around printed code discs.

Reliability and wear resistance are more or less proportional to cost. Switches with a life expectancy in the hundred thousands or low millions of operations can simply be silver plated, thereby not increasing

(*Continued on page 177*)



Aerovox Corp., 740 Belleville Ave., New Bedford, Mass., A. E. Quick, 4-9961 Printed Circuit Components
Airflyte Electronics Co., 21 Cottage St., Bayonne, S. J., M. Feinman, HE 6-2230 Printed Circuits
Alden Products Co., 117 No. Main St., Brockton, Mass., G. Morrison, Brockton 160, Terminal Card Mounting
Allied Photo Engravers Inc., 153 W. Huron St., Chicago, Ill. Michigan 2-6410 Printed Circuits
Alpha Metals Co., 58 Water St., Jersey City 4, N. J., Harold Herzog, HE 4-6778 Printed Circuit Bar Solder
American Metaseal Corp., 3337 Lincoln Ave., Franklin Park, Ill., R. F. Curd, Jr. 5-5650, Printed Circuit Plastics
American Smelting & Refining Co., Federated Metals Division, 120 Broadway, New York, N. Y., Emile Rimbault, Jr., Rector 2-9740, Printed Circuit Bar Solder
Bendix Aviation Corp., Pacific Div., 11600 Sherman Way, No. Hollywood, Calif., R. M. Combes, ST 7-2651, Printed Circuits
Bogart Manufacturing Co., 315 Seigel St., Brooklyn 6, N. Y., L. N. Blatt, HY 7-4972, Printed Circuits
Bristol Engineering Corp., Lincoln & Pond Sts., Bristol, Pa., R. J. Zeigler, Bristol 6739, Printed Circuits
Brubaker Mfg. Co., 9151 Exposition Dr., Los Angeles 34, Calif., S. F. Arn, TE 0-6441, Printed Circuits
Centralab, 900 East Keefe Ave., Milwaukee 1, Wisc., W. G. Tuscany, Woodruff 2-9200, Printed Circuits
Centronics Co., 21-04 122 St., College Pt., N. Y., Norman Friedman, FI 3-7390, Printed Circuits
Chicago Telephone Supply Corp., 1142 W. Beardsley Ave., Elkhart, Ind., B. S. Turner, Elkhart 3-0310 Variable resistors for printed circuits
Cinch Mfg. Corp., 1026 S. Homan Ave., Chicago, Ill., S. Pfannstiehl, Nevada 2-2000 Ext. 207, Printed Circuitry Components
Circuit Corp., 2448 N. Cicero Ave., Chicago, Ill., Eugene Proch, Berkshire 7-9866, Printed Circuits
Circuitron, Inc., 155 W. Main St., Rockville, Conn., Paul Anderson, Rockville 5-4706, Etched & plated Printed Circuits
Citation Products Co., 233 E. 146 St., New York 51, N. Y., H. F. Meola, MO 5-0742, Printed Circuits
Colorvision Plastics Inc., 247 Atlantic Ave., Boston, Mass., J. J. Donovan, HA 6-9851 Printed Circuits
Corning Glass Works, Corning, N. Y., Geo. Norman, 6-3721, Printed Circuits
Communication Measurements Laboratory, Inc., 350 Leland Ave., Plainfield, N.J., D. A. Griffin, PL 4-5502, Printed Circuits
Continental Diamond Fibre Products, Newark, Delaware, Frank Cooper, Newark 531 Laminated Plastics for Printed Circuit Use
Davelle Laboratories, 145-68 228th St., Springfield Gardens 13, N. Y., Printed Circuits, Stamped & Etched
Daven Co., 191 Central Ave., Newark 4, N. J., Edward L. Grayson, Mitchell 2-6555, Printed Circuits & Rotary Switches
Dietz Co., Henry G., 12–16 Astoria Blvd., L.I.C. 2, N. Y., H. Dietz, Ravenswood 6-3347, Printed Circuits
Digital Products, Inc., 7643 Fay Ave., LaJolla, Calif., G. S. MacDonnell, Glencove 5-7216, Etched Circuits, Components
Drakenfield Co., B. F., 45 Park Place, New York, N. Y., I. Zieler, BA 7-6809, Silver Paste for Printed Circuit
Dynakon Corp., 9623 Clinton, Cleveland, Ohio, Harry Raech, Jr., AT 1-2881, Printed Circuits
Eby Inc., Hugh H., 4700 Stenton Ave., Philadelphia, Pa., George Mohr, Davenport 4-7000, Printed Circuit Connectors
Elco Corp., 190 W. Glenwood Ave., Philadelphia 40, Pa., Leo Kagan, Garfield 6-6620, Printed Circuit Binding Posts
Electralab, Inc., 105 First St., Cambridge, Mass., A. R. Hughes, Elliot 4-3662, Etched, Printed, Plated Circuits
Electronic Mechanics Inc., 101 Clifton Blvd., Clifton, N. J., F. B. DuVall, Gregory 3-4108 Printed Circuits
Electron-Radar Products, 1041 N. Pulaski Road, Chicago 51, Ill., J. J. Bailey, Dickens 2-5885 Printed Circuits
El Mec Laboratories, 380 Hillside Ave., Hillside, N. J., C. M. Osburn, Waverly 3-2935, Custom Printed Circuits
Elm Laboratories, 18 S. Broadway, Dobbs Ferry, N. Y., M. Brownshield, DO 3-4058, Printed Circuits
Engineering Research & Development Co., Addison, Ill., J. S. Bogen, Elmhurst 1849, Printed Circuits
Erie Resistor Corp., 644 West 12th St., Erie, Pa., A. K. Shenk, 21481, Printed Circuits
Etched Products Corp., 39-01 Queens Blvd., Long Island City, N. Y., Theodore Nieremberg, ST 4-5900, Printed Circuits
Federal Telecommunication Laboratories, Div. of International Telephone & Telegraph Corp., 500 Washington Ave., Nutley 10, N. J., H. Engelmann, Nutley 2-3600, Printed Microwave Circuitry
Glenco Corp., 212 Durham Ave., Metuchen, N. J., H. Abrams, Metuchen 6-2800, Printed Circuits
Gurley, W. & L. E., 514 Fulton St., Troy, N. Y., J. M. Klaasse, Ashley 2-6300, Printed Circuits
Herlec Corp., Grafton, Wisc., E. Pionkowski, Grafton 817, Printed Circuits
Intereleetronies Corp., 2432 Grand Concourse, New York 58, N. Y., M. L. Lewis, Ludlow 4-6200, Printed Circuits
Javex, P.O. Box 646, Redlands, Calif., C. J. Reimuller, Redlands 4-5752, Printed Circuit Components
Jowil Electronies, Inc., Belfield Ave. & Wister St., Philadelphia, Pa., J. F. Griffin, MI 4-9580, Printed Circuit Amplifiers
Kalbfell Laboratories, Inc., 1090 Morena Blvd., San Diego 10, Calif., Richard T. Silberman, Woodcrest 6359, Custom Etched Circuits
Maida Development Co., 214 Academy St., Hampton, Va., S. H. Thompson, Hampton 4385, Printed Circuits
Magnex Corp., 90-28 Van Wyck Expressway, Jamaica 18, N. Y., G. R. Eulo, AXtel 7-4400, Printed Circuits
Methode Mfg. Corp., 2021 W. Churchill St., Chicago 47, Ill., W. J. McGinley, Brunswick 8-0334, Printed Wiring Panels
Micro-Circuits Co., New Buffalo, Mich., Robert F. Bradley, 272W1, Printed Circuit Paints
Minn. Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn., D. E. Denham, Cedar 3071, Printed Circuits
Mycalex Corp. of America, 125 Clifton Blvd., Clifton, N. J., Jerome Taishoff Prescott 9-8866, Printed Circuits
National Vulcanized Fibre Products Co., Wilmington, Delaware, J. D. Otis, Wilmington 5-6371, Laminated Plasties for Printed Circuit Use.
North American Model Products, Inc., 9802 Warwich Rd., Warwich, Va., C. J. Dietrich, Newport News 2-0923, Custom Printed Circuits
PCA Electronics Inc., 2180 Colo. Ave., Santa Monica, Calif., Harvey Smith, TE 0-6716, Printed Circuits
Photocircuits Corp., P.O. Drawer 151, Glen Cove, N. Y., William W. Tewell, Glen Cove 4-4000, Printed & Plated Circuits & Subassemblies
Plastics & Electronics Corp., 272 Northland Ave., Buffalo 8, N. Y., Thos. L. Robinson, Summer 1630, Subminiature Printed Circuits
Radio Corp. of America, RCA Victor Division, 415 South Fifth St., Harrison, N. J., Humboldt 5-3900, Printed Cir. IF Transformers, Coils and Traps
Ray-Par Corp., 7810 W. Addison St., Chicago, Ill. Pat D'Orio. Tuxedo 9-3700, Printed Circuits
Raytheon Mfg. Co., 55 Chapel St., Newton, Mass., C. W. Martel, BI 4-7500, Printed Circuits
Richardson Co., Lockland, Cincinnati, 15, Ohio, James Richardson, Printed Circuits
Sanders Associates, 137 Canal St., Nashua, N. H., H. W. Pope, Printed Circuit Ceramics
Sickles Div., F. W., Gen. Instrument Corp., P.O. Box 330, Chicopee, Mass., H. W. Lamothe, Springfield 36621, Printed Circuit I.F.'s
Solar Mfg. Corp., 2660 E. 46th St., Los Angeles 58, Calif., Dorr Wagner, Logan 8-2124, Printed Circuits
Sprague Electric Co., 97 Marshall St., North Adams, Mass., Gilbert Devey, North Adams 423, Printed Circuits
Standard Coil Products Co., Inc., 2329 N. Pulaski Rd., Chicago 39, Ill., Louis Martin, CA 7-2500, Printed Circuits
Stupakoff Ceramic & Mfg. Co., Latrobe, Pa., D. E. Albert, Latrobe 1400, Printed Circuit Ceramics
Sylvania Electric Products Co., 1740 Broadway, New York, N. Y., Ernest Ulm, JU 6-2424, Printed Circuits
Synthane Corp., Oaks, Pa., H. W. Widdop, Laminated Plastics for Printed Circuits Use.
Technograph Printed Electronics, 191 Main St., Tarrytown, N. Y., H. Shortt 4-4300 Printed Circuits
Telectro Industries Corp., 35-16 37th St., Long Island City, N. Y., Stanley Rosenberg, Astoria 4-2125, Printed Circuits
Telex, Inc., Telex Park, St. Paul 1, Minn., J. R. Anderson, Nestor 7211, Custom Circuits, Printed
Thompson Clock Co., H. C., 38 Federal St., Bristol, Conn., J. J. McHugh, 2-5151 Printed Circuits
Tri-Dex Electronics, P.O. Box 1207, Lindsay, Calif., K. B. Howard, 2-4051, Etched Circuitry
U. S. Gasket Co., 602 N. 10th St., Camden 1, N. J., H. S Stott, Woodlawn 4-0370, Printed Circuits
Visart Inc, 2634 Park Ave., New York 51, N. Y., Murray Safit, MO 5-0796, Printed Circuits
Vokar Corp., Dexter, Mich., W. F. Cairns, Dexter 5000, Circuits
Wadsworth Manufacturing Associates, 509 Balsam St., Liverpool, N. Y., H. M. Wadsworth, 69-7043, Printed Circuits
Wheaton Co., T. C., Millville, N. J., Edward Miller, Millville 1400, Printed Circuits
White Mfg. Co., S. S., Industrial Div., 10 E. 40 St., New York, N. Y., Thomas Latimer, Murrayhill 3-3015, Air Abrasive Unit
Winchester Electronies, Inc., 15 Crescent St., Glenbrook, Conn., R. S. Kempton, Stamford 4-4127, Printed Circuit Receptacles

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Speaker Switching and Talkback Circuit

HARRY J. SIMMINGTON, Chief Engineer, WPWA, Chester, Pa.

TALKBACK facilities of most consoles require use of the monitoring amplifier. This has certain disadvantages, one of which is the interruption of program monitoring in all studios and control rooms while the talkback is used.

The talkback system used at WPWA operators through a separate amplifier fed from the audition bus of the console for cueing. The control room talkback microphone is fed into the cueing amplifier and a three pole-double-throw relay switches selected studio monitor speakers from program to cue amplifier output.

Unused remote line input keys are used to eliminate talkback into any studio. By placing the remote line key in the up position, program may be heard in the studio. When the talkback key is operated, the studio speaker is switched to the cue amplifier output. When the remote line key is down, program is fed directly to the studio speaker and talkback cannot be heard. Silencing a speaker is accomplished by putting the key in neutral position, thereby eliminating the need of putting on a faded down microphone with its "On the Air" or "Audition" light burning.

A Raytheon RC11 console is used at WPWA. Remote lines input keys 7, 8 & 9 were disconnected from the remote cue circuit pad and wired directly to the monitor output. Speaker output terminals were carried over to the remote line input terminals and the leads to the remote mixer input carried to the talkback relay. A loading resistor value can be found which will sufficiently load the output so that there is no noticeable change in volume or quality when speakers are removed from the monitor output.

Novel CONELRAD Alarm

J. S. TOWNSEND, Chief Engineer, WMPM, Smithfield, N.C.

ALL that is needed for this CONELRAD system are two tubes, two relays and an AM receiver. (It may work with an FM receiver; we haven't tried it.) B plus, filament voltage and AVC come from the receiver, and the plus fifteen volts DC from the cathode of the audio output tube in the receiver which is usually connected to ground through a resistor.

The time delay circuit is built around the filament warm up time for the 5Y3, and can be adjusted from ½ second to 20 seconds through the series control. The pot in the cathode circuit of the 6J7 adjusts the sensitive relay which trips the system. The relay in the plate circuit of the 5Y3 is not critical, provided the resistance is high enough for the tube to conduct current to pull it. We used a rewound pin ball machine relay, and the resistance in series with it is just enough to close the relay in operation.

An added advantage is that lightning cannot trip this system, and nothing but the carrier of the monitored station leaving the air will cause it to go off. We have it mounted under the console table and a small control box on the console contains a buzzer, pilot light and reset switch. The system draws only heater current for the 6J7 while not in operation.

Channel Mixer

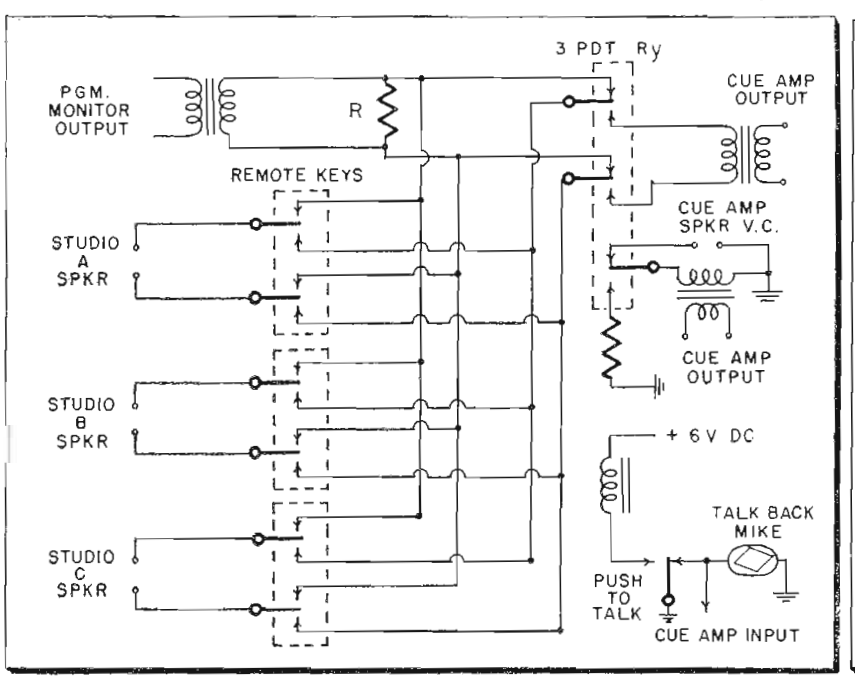
F. A. SCOTT, Chief Engineer, WNDB, Daytona Beach, Fla.

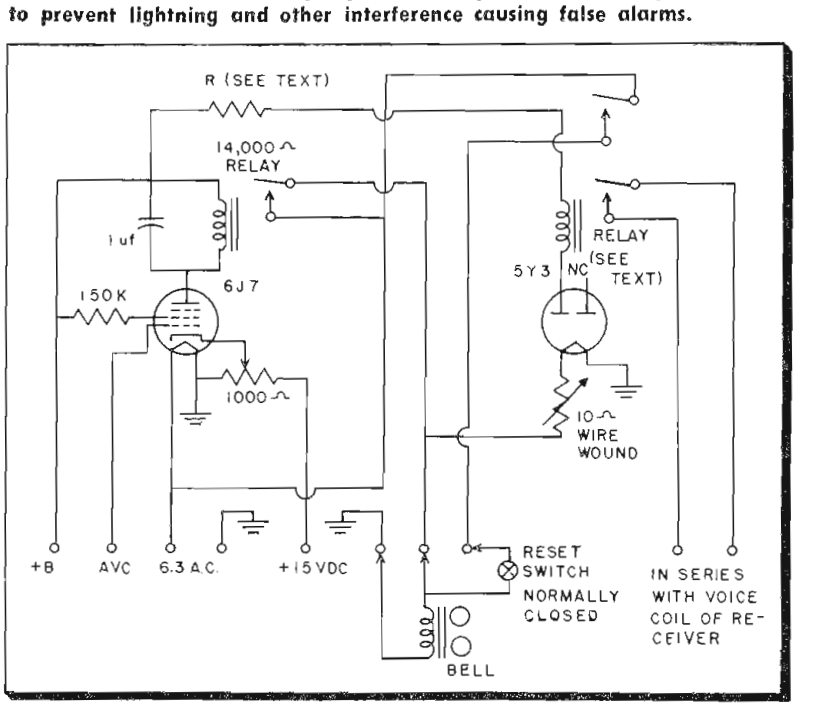
MOST stations have several pieces of single channel remote equipment and perhaps one multichannel unit which is in use much of the time. Most tape recording units in use have single microphone input. Occasions frequently arise where one is called upon to do a special multiple mike pickup from a remote point where a single channel unit is normally installed.

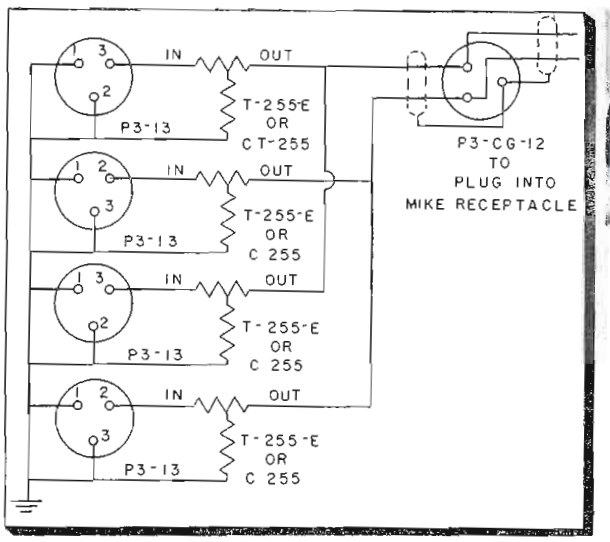
To solve this problem, we built a portable four-channel mixer which can easily be taken to remotes and which will work into all of our microphone receptacles, including studio, tape, disc, and auditioning equipment inputs, with a minimum of insertion loss.

The mixer case can easily be made

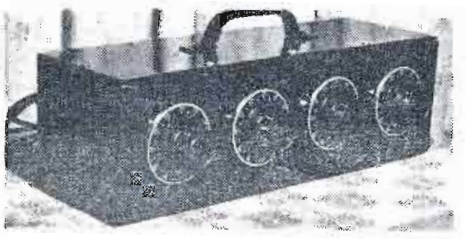
Left: Separate talkback amplifier provides adequate talkback facilities for studios without disrupting monitoring operations. Right: Filament warmup time of 5Y3 rectifier determines delay in operation to prevent lightning and other interference causing false alarms.







Portable four channel mixer works into any type of input with minimum insertion loss



Front view of four channel portable mixer at WNDB

be a sheet metal shop for a few dollars. The removable top and bottom are attached with sheet metal screws. A carrying handle is fastened to the top lid for ease in handling. Your type microphone plug is attached to the mixer output cord which is of sufficient length to allow convenience in reaching your normal amplifier microphone receptacle. Four microphone receptacles are mounted on the rear of the case directly behind their corresponding attenuators. Rubber feet are placed on the bottom corners of the case to prevent slippage and table scratching.

Parts needed are:

Cabinet—4½" high x 5" deep x 16" long.
4—250/250 ohm (Daven T-255E) or 50/50 ohm (Daven 255).
Tee attenuator, tapered, 20 steps, 2 db per step (designed for minimum insertion loss).
4—P-3-13 Cannon microphone receptacles or the corresponding type used at your station.
1—P3-GG-12 Cannon microphone plugs or the corresponding type used at your station.

Disc Equalizer

VERN YEICH, Chief Engineer, WWSO, Springfield, Ohio

THE accompanying diagram shows a simple disc recording equalizer used successfully at WWSO for transcribing spot announcements and station breaks. Since it makes use of a ten step line equalizer, the circuit permits approximate equalization for various recording diameters as well as slow or fast turntable speeds where intelligibility is the main consideration.

The line equalizer used is the RCA type 56-E. A capacitor, "C," may be added in parallel with the capacitor of the resonant circuit to lower the resonant frequency to correspond to the high frequency cut off of the cutter head. For the Presto 1-C cutter head, .06 μf is used with the type 56-E line equalizer.

Motor Tuning Modification for CONELRAD

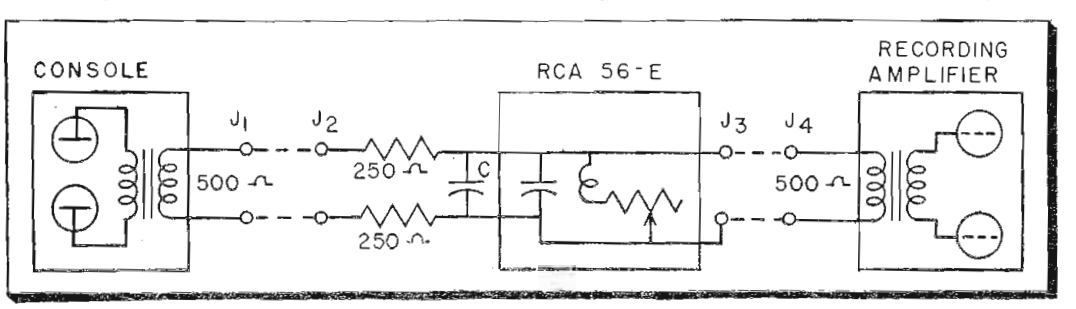
C. W. WHITE, Chief Engineer, WMCK, McKeesport, Pa.

A CONSIDERABLE number of broadcast transmitters employ motor tuning controls operated by push-buttons or switches located on the front panel of the transmitter. While this system lends itself to optimum placement of electrical components within the cabinet, it presents a disadvantage when a lone operator must make major tuning adjustments since the angular position of the capacitors and coupling coils is unknown.

When a CONELRAD test is run at WMCK it is necessary to retune four motor operated tank circuits in addition to making other adjustments—all in less than five minutes. The problem was solved (on a Raytheon RA-1000 transmitter) by connecting eight single-pole single-throw push-button switches in parallel with the front panel push-button controls, one for each. These are mounted in a small metal box just inside the rear doors. The rotating shaft of each tank capacitor has a pointer attached. The correct position of the pointer for each frequency is clearly marked by a paint dot.

It is now possible for one operator to retune the transmitter from the rear of the cabinet in less than a minute without plate voltage being applied. Differently colored paint dots are used to indicate the correct settings for the regular broadcast frequency facilitating a rapid return to the air after a CONELRAD test.

Simple disc equalizer makes possible use of multispeed recordings and maximum clarity



Plastic Reel Design

R. A. VON BEHREN, Magnetic Tape Div., Minnesota Mining & Mfg. Co., St. Paul 6, Minn.

IN recent years, improved magnetic recorders and tapes have made possible the attainment of high quality recordings at tape speeds of 7.5 ips. The natural result of this has been a trend toward increased professional use of the 1200-foot length of magnetic tape mounted on a 7-in. reel, sufficient for a 30-minute recording at this speed.

However this trend has focused considerable attention on some of the limitations of present design of the popular 7-in. reel. Recognizing the problems imposed by these limitations a new plastic 7-in. reel has been designed by Minnesota Mining & Mfg. Co. and adopted as the standard reel for 1200-foot lengths of "Scotch" No. 111 and No. 120 "High Output" magnetic tape.

Among the recording problems involved are:

(1) Timing errors—it is most essential that the running time of recorded radio programs be accurate.

(2) Warpage—"wandering" of the tape across the heads can cause poor frequency response due to misalignment at the play gap.

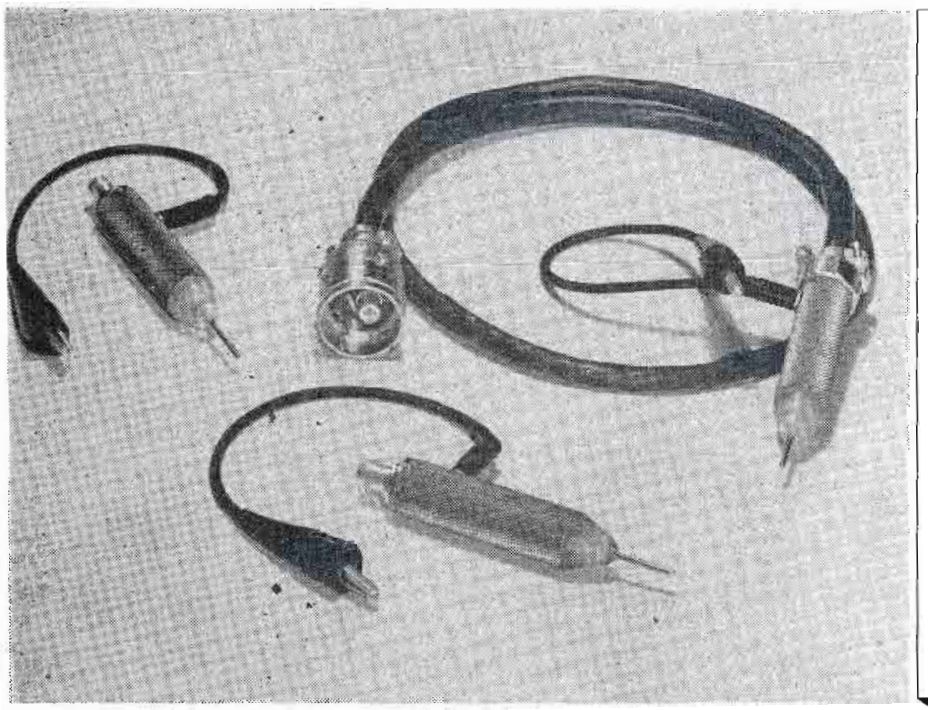
(3) Uneven winding—this leaves unprotected turns of tape protruding from the roll resulting in nicked edges and possible tape breakage.

(4) Labeling space—studio experience indicates that the most desirable place for labeling a tape with information about the material recorded on it is on the reel rather than on the box or a separate sheet.

(5) Threading—difficulties in fast threading of the tape on the reel make desirable a faster, more positive method of threading that would save valuable time in "cueing up".

The timing error problem is perhaps the most serious consideration. Recorders tend to speed up at the beginning of a reel because of high tension on the take-up side, and slow down at the end because of

(*Continued on page* 110)



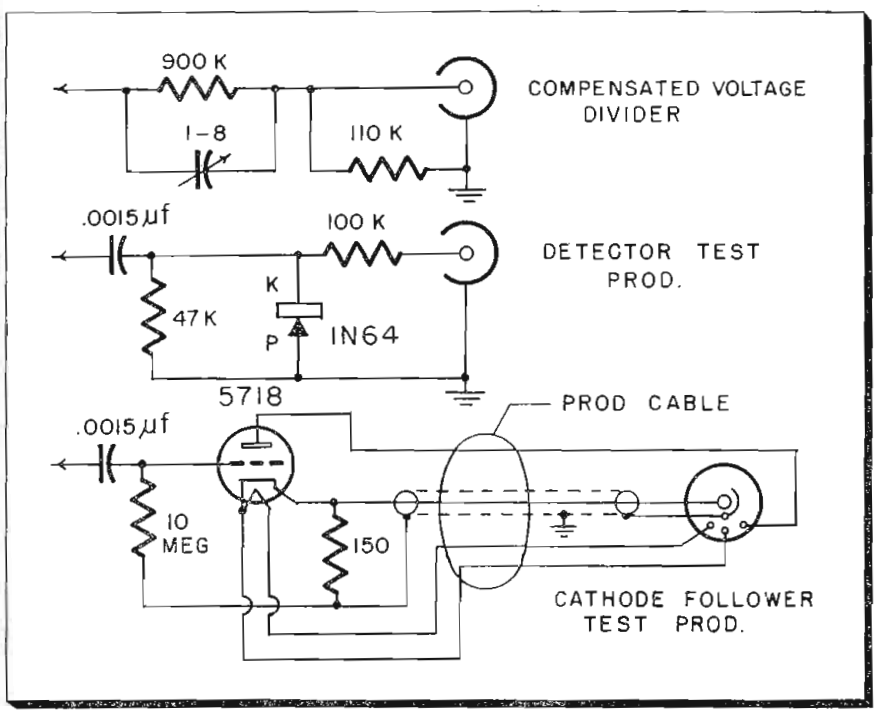


Fig. 1: (l) Three test prods for use with oscillosynchroscope. Fig. 2: (r) Circuitry of voltage divider, detector and cathode follower test prods

Encapsulated

Resin embedment, as aid to unitized concircuit reliability. Casting methods and

IN recent years two growing trends in electronic packaging have manifested themselves: (A) Subminiaturization, and (B) unitized construction. Both have served to increase the interest in encapsulation or embedment of electronic assemblies. Military demand for smaller, lighter, more rugged, and easily serviced equipment has been an added impetus towards development of resins readily handled in production.

In Fig. 1 are three test prods being fabricated as accessories for a high precision oscillosynchroscope. Fig. 2 shows the individual circuitry embedded in each prod, and Fig. 3

By RUDOLPH L. KUEHN
Project Engineer
Industrial Television, Inc.
369 Lexington Ave., Clifton, N.J.

illustrates a typical internal structure. Note the absence of any mechanical support other than the casting resin itself. Functionally the three test prods are (A) 10 to 1 voltage divider, (B) crystal detector, and (C) low capacity or cathode follower. Each of the three presented a unique problem in embedments in addition to the overall requirement for a production design (see Table I).

Initially it was apparent that the minimum tooling should be identical for the three prods to effect large volume economies. Variations were to be held to just those necessary to achieve the natural differences in performance. Thus, the following basic concepts were reached:

1. The circuitry to be embedded in an aluminum tube acting as both the container and electrical ground.
2. Mechanical support to depend entirely upon the casting resin.
3. Room or low temperature casting to avoid component damage, especially in the case of the germanium diode in the detection prod.
4. All other external structure such as tips, tail bushing, and other screw machine parts to be as nearly identical as possible.

All of the above points were met without sacrificing individual performance. Fig. 3 indicates the accessibility of the voltage divider trimmer. This posed the first serious problem in the casting technique. A trimmer adjustment had to be provided since individual equipments using the test prod and varying cable lengths would necessitate readjustment of the capacitor. Early attempts with ceramic trimmers lying near an access hole in the test prod body posed an extremely difficult pouring problem in casting. It was also problematical as to whether or not the mold release agent sur-

TABLE I: DESIRED SPECIFICATIONS

	VOLTAGE DIVIDER	CATHODE FOLLOWER	DETECTOR
Input Z	1 Megohm Shunted by 10 µµf Maximum	Very High Shunted by 8 µµf Max.	Not Specified
Color Distinction	Green	Yellow	Blue
Overall Size	¾ inch O.D. x 4½ Long	¾ inch O.D. x 4½ Long Exclusive of Integral Cable	¾ inch O.D. x 4½ Long
Unique Requirements	Accessible Trimmer Adjustment	Integral Power and Signal Cable, Good Low Frequency Response	Usable at 10 to 200 MC Carrier

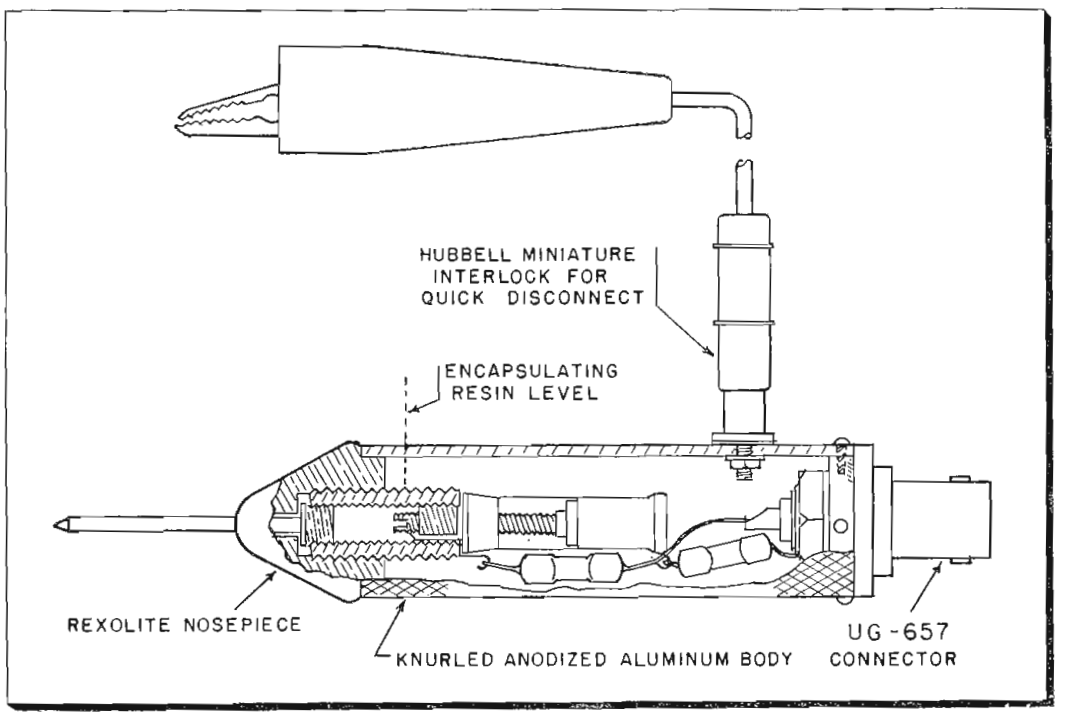


Fig. 3: Cutaway view shows internal structure of attenuator test prod

Test Prods

struction and subminiaturization, improves proper selection of materials described

rounding the trimmer would be sufficient to keep the adjustment from freezing. The final design shown utilizes a piston type glass trimmer whose terminal end is sealed. During assembly the plunger is coated with Dow Corning silicone grease DC-7 to prevent freezing by accidental resin contact. The resin is poured into the tube in a vertical position. A nosepiece of Teflon is screwed down to keep the components positioned correctly. After final curing the Teflon is replaced by a Rexolite nosepiece.

There are many casting resins on the market, most of them presently falling into two major categories, the epoxy resins and the polyesters (see Table II). The choice as to which one to use will depend greatly upon the application. Some are more readily activated and used than others; some require or release more heat in curing then the embedded components can tolerate. Shrinkage of the resin during cure may be critical, especially when the inserts are large relative to the total size of the casting. In many cases, such as circuitry operating at very high frequencies, the dielectric constant and loss factor of the material should be considered.

Principal Difficulties

In the case of the low capacity test prod three major difficulties presented themselves:

A. Input capacitance to be kept extremely small.

B. A subminiature vacuum tube being embedded had to be protected against excessive shrinkage stresses in resin curing and against hot spots due to poor thermal conductivity during operation.

C. The integral cable assembly left fissures through which the poured resin could flash or escape before it gelled.

Importance of Fillers

Many different materials were tried from those listed in Table II. The best results to date have been obtained by using the Scotchcast No. 2 with a crystalline silica filler. Fillers are an important factor in encapsulations and are quite commonly used to improve or alter the natural characteristics of the resin alone. Materials such as aluminum oxide, silica, glass fibres, glass beads, mica, or quartz may be used to reduce shrinkage stresses. It is possible to match the coefficient of expansion of the casting resin to that of the inclusions thus increasing resistance to thermal cycling. The first two mentioned above can more than double the thermal conductivity providing cooler and more

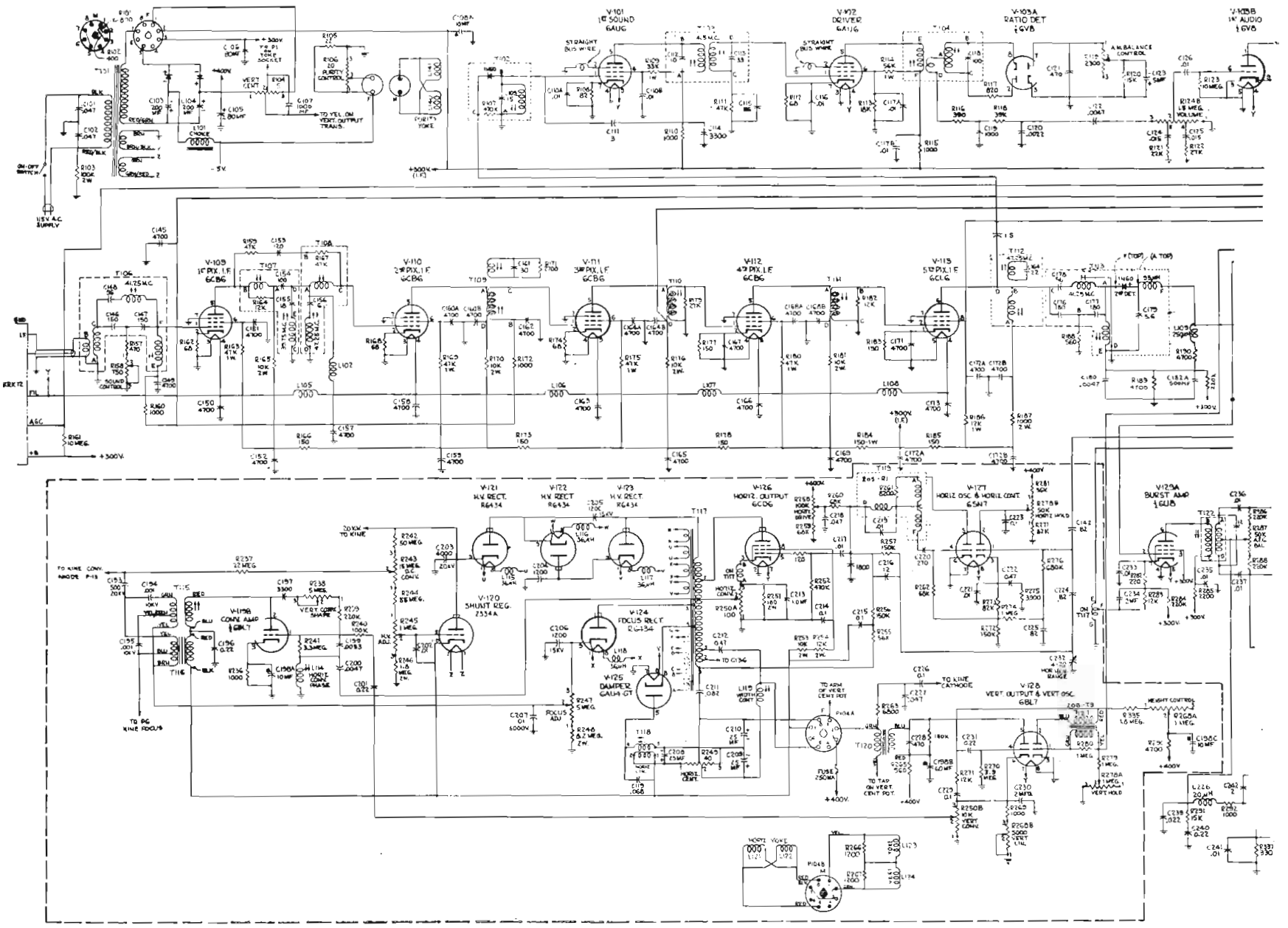
(*Continued on page* 129)

TABLE II: RELATIVE CHARACTERISTICS

RESIN	MANUFACTURER	TYPE	APPROX. COST PER LB. OF CURED RESIN	DIELECTRIC CONSTANT AT 10^6 CYCLES	DIELECTRIC STRENGTH VOLTS/MIL	LINEAR/°C THERMAL COEFFICIENT OF EXPANSION	SPECIFIC GRAVITY
Araldite CN-501	CIBA Co. New York, N. Y.	Epoxy	$1.38	3.62	405 (1/8" Thick)	4.77×10^{-5}	1.23
Scotchcast No. 2	Minnesota Mining & Mfg. Co.	Epoxy	3.57	3.6	1000-1500 (10 Mil)	80×10^{-6}	1.3
Coil Seal No. 17	National Engineering Products, Inc. Washington, D. C.	Epoxy	2.45	—	340	60×10^{-6}	1.56
Laminac 4116	American Cyanamid Co.	Polyester	—	3.00	380 (1/8")	—	1.20
Randac R-4052	Mitchell-Rand Insulation Co.	Epoxy	1.58	3.36	586 (100 Mil)	6.8×10^{-5}	1.17

An Experimental Color-

Schematic diagram depicting recent design affords opportunity for designers



In recent weeks many of our readers have inquired as to the availability of schematic circuit diagrams for color-TV receivers operating on NTSC standards. It should be understood that all of the current designs are experimental in character and have as yet not been engineered for production. The editors of Tele-Tech & Electronic Industries are glad to make above diagram available as a reader service. A detailed explanation of

X-Rays Speed-up Shell Production

An electronic rocket shell inspection device which has made possible a fourfold increase in the number of shells that can be inspected in an eight hour period was demonstrated recently at Standard Electronics Research Corporation, 2 East End Ave., New York City. Development of the inspection instrument was initiated by the Commanding Officer of Picatinny Arsenal for 3.5 in. rocket shells.

Under previously used radiographic inspection methods, the inspection time required for each shell was approximately three minutes. With the new electronic instrument, the time needed is less than a minute.

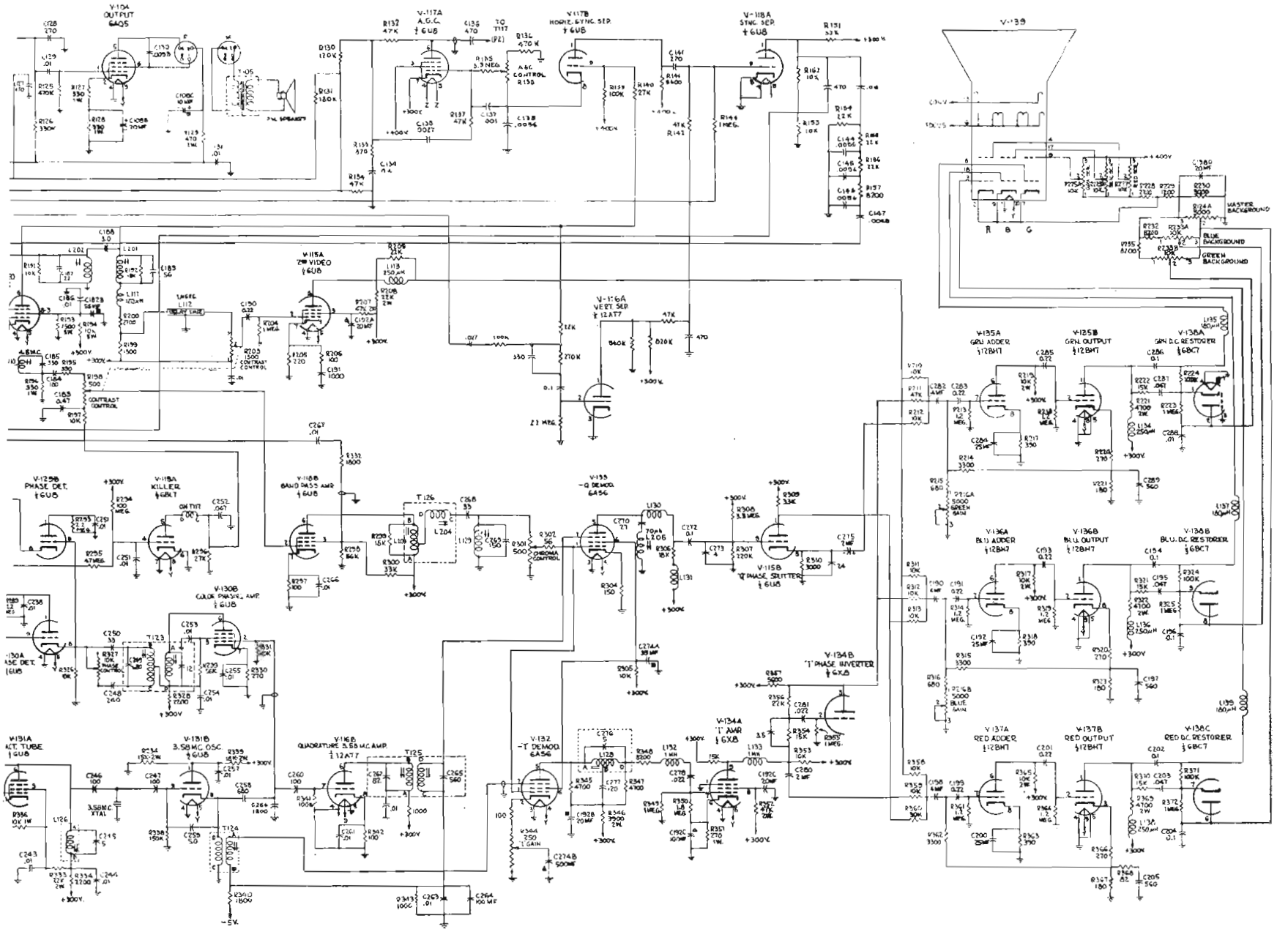
Shells have to be inspected for the presence of voids in the charge. Up until recently they were radiographed and, to be absolutely foolproof, the shell should be radiographed at least from two directions, 90° apart, and better still from three directions, 120° apart. These radiographs are then visually inspected. This is costly and time consuming.

With this new machine, the shell under test is rotated over a very narrow X-ray beam. At the same time, the shell is displaced laterally so that every portion of the shell is inspected. Cavities which may have escaped detection on a film cannot be missed by the new instrument. It is a well-known fact that however transparent the material may be to X-rays, there is always some absorption. The thicker the specimen, the more absorption.

The new electronic system operates on this principle. Any void in the charge, or for that matter any reduction of the shell wall itself, will be detected by an increase in the intensity of X-rays passing through the shell. Ordinary X-ray detectors, however, are not sensitive enough and are too slow to keep pace with modern production requirements.

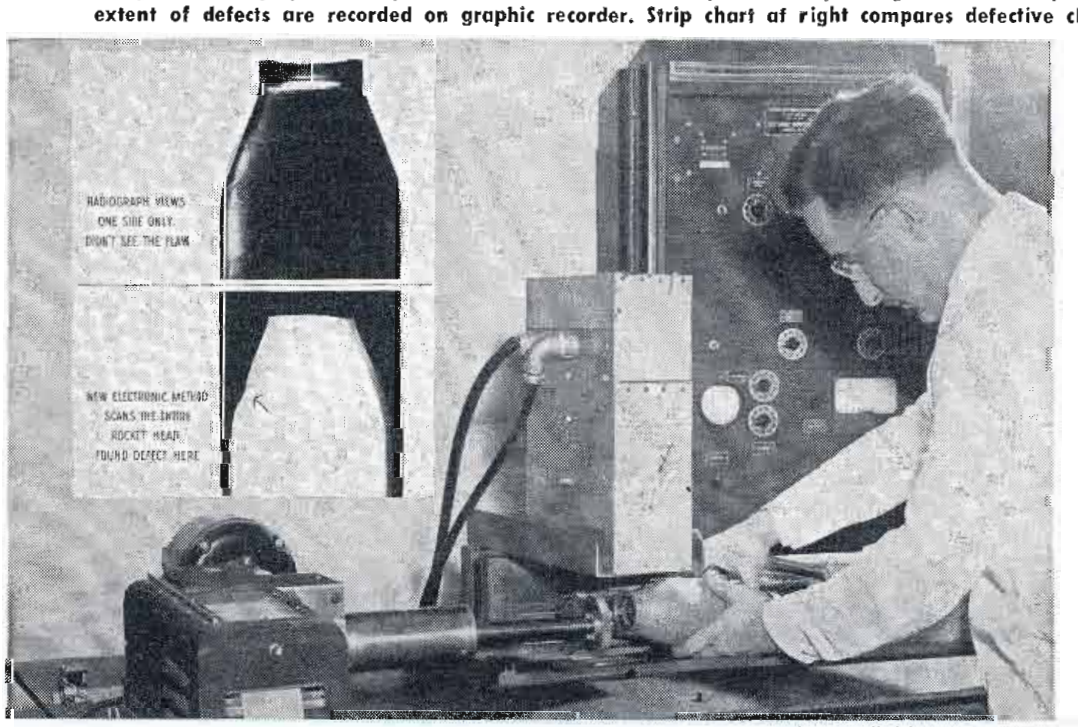
Television Receiver

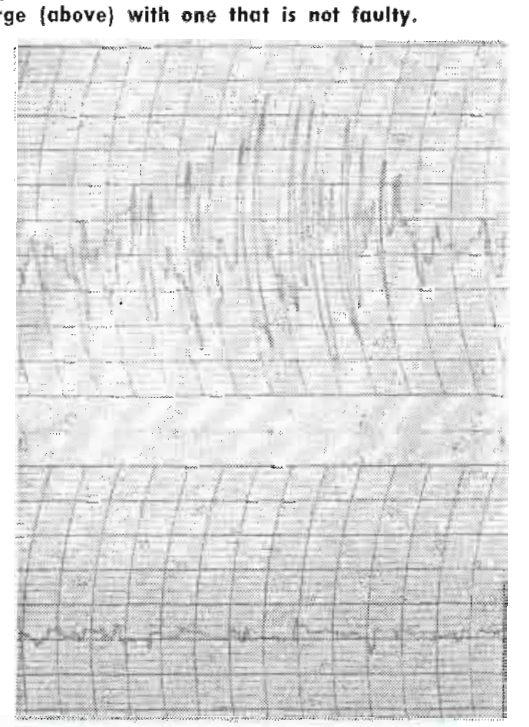
to compare circuit complexity against that of black-and-white sets



receiver design and operation is not possible at the present time. But generaly, . . . 34 tubes excluding the power rectifiers and the three-gun color-picture tube are employed. The picture i-f amplifier operates on 45 MC, and the intercarrier sound I-f of 4.5 MC is obtained from a separate second detector. Most of the circuits peculiar to color-TV are contained in the lower right hand section of the diagram.

(Left) Photo of new X-Ray rocket shell inspection equipment developed by Dr. F. Fua and his associates. Inset compares faulty charge using the radiograph technique and new electronic technique whereby charge is rotated spirally under X-Ray source and number and extent of defects are recorded on graphic recorder. Strip chart at right compares defective charge (above) with one that is not faulty.





Protective Coatings for

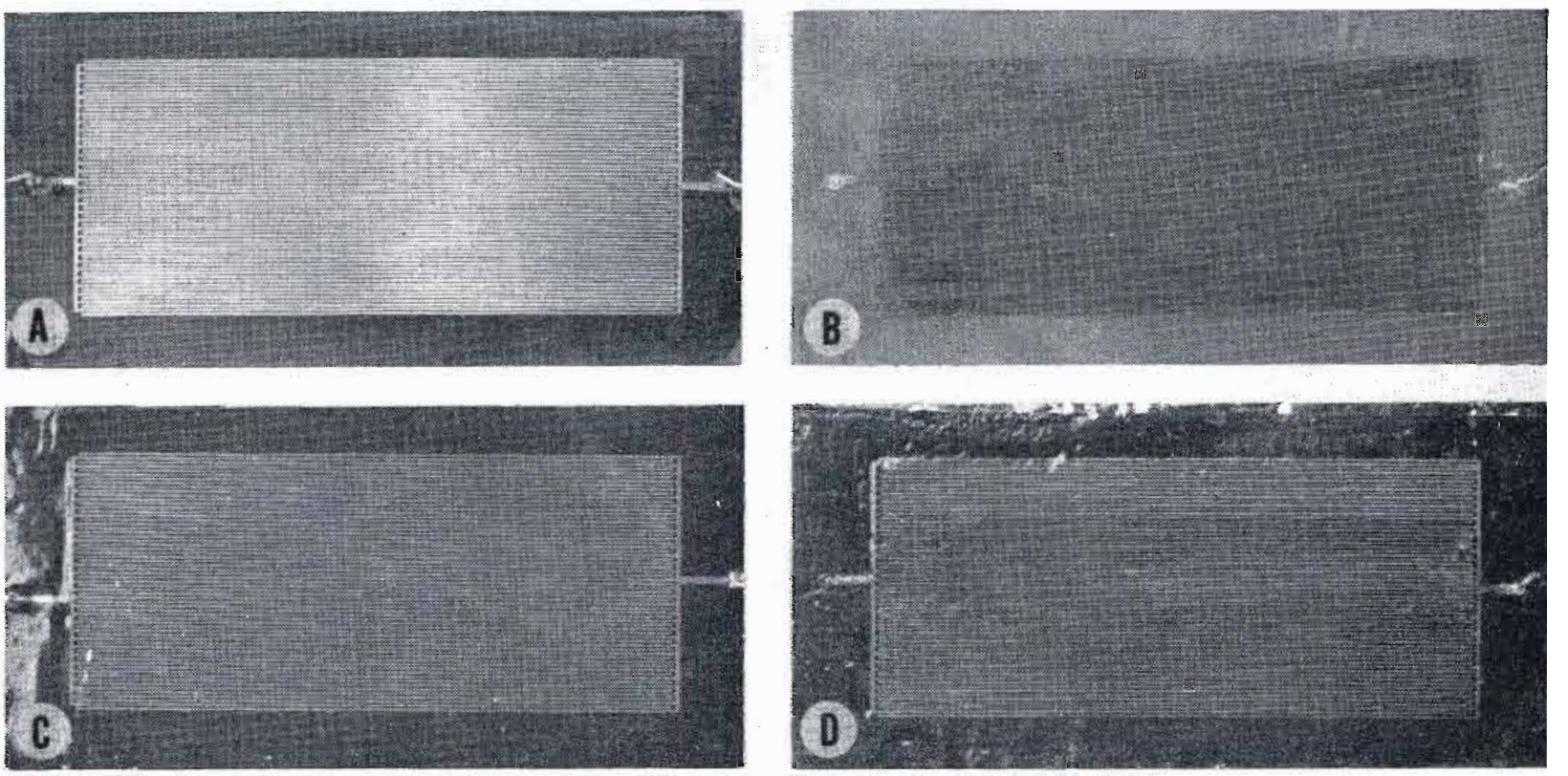


Fig. 1: (a) Test board before exposure to 95% humidity. (b) Test board without coating, after exposure. Note corrosion. (c) Epoxy coated test board after exposure. (d) Test board after exposure, coating material not epoxy. Note discoloration of coating and corrosion of copper

Insulation loss effect under high humidity conditions points up need for moisture-resistant coatings. Tests show resistance, recovery and required thickness for various materials

By MORRIS WEINBERG
Director of Research
PCA Electronics, Inc.
Santa Monica, Calif.

and

L. J. MARTIN
Research Engineer
Hughes Aircraft Co.
Culver City, Calif.

ONE of the major problems in the use of etched wiring is the possible loss of adequate insulation during and following high humidity exposure. This is an especially serious consideration for military applications. One of the important differences between a conventionally wired circuit and one with etched wiring is that the etched circuit pattern of conductors is not surrounded by insulation as is the conventional hook-up wire. Secondly, the etched wire conductors are spaced on a two dimensional insulating surface which gives rise to surface leakage between the uninsulated conductors. Both of these conditions may contribute to moisture failure of the etched circuits.

An obvious, but not always successful, means of improving the moisture resistance of etched wiring is to coat the wire pattern with a film of moisture-resistant material, termed a "protective coating." The primary requirements of a good protective coating for etched circuits are:

1. High moisture resistance consistent with good recovery properties.
2. Adequate electrical properties.
3. Ability to cure or dry at 75° C or less so that the coating can be applied over temperature sensitive components.
4. Good physical properties such as adhesion to board material.
5. Transparent, so that color coding on components can be recognized.
6. Easily applied in the required thickness.

Resistance Measurements

The evaluation of protective coatings started with the measurement of resistance values between two etched parallel conductors 2 in. long, spaced 1/32 in. on XXXP phenolic and coated with various materials which included cellulose acetate, phenolic, silicone, and epoxy resins. Resistance readings were taken after immersing these test boards in a water bath for 24 hours. This type of evaluation did not give the qualitative results desired, since the resistances were exceedingly high and difficult to read, due to the short length of etched lines. Moreover, less deterioration of insulation was caused by this immersion test than by prolonged humidity cycling. However, from the 43 coating materials tested, ten were found to give superior moisture protection.

The next preliminary work consisted of coating a typical etched circuit board, containing holes and eyelets, with these various coating materials and again measuring resistance between the same points on all boards. This time the boards were humidity cycled according to Procedure I, of specification MIL-E-5272A. See Fig. 2. Again, the results were not as consistent as hoped for, except that all the coatings gave relatively low resistance values. Irregularity in readings were thought to be caused by the variation in coating thickness, as caused by the holes and eyelets in the board. The contamination of the board surface was another possible source of variations in readings, the chief offender being ferric chloride from the etching bath.

When components were placed on

Etched Circuits

these etched boards, and the entire assembly coated with materials containing solvents, it was found that these coatings would not dry or cure under the components. "Solvent traps" existed between the component and etched board. As the "air dry" (75° C) coating runs under the components and drying takes place, a skin is formed over the outside or exposed areas, but the solvent does not escape as readily from the interior regions between the component and board material. This results in coatings of poor electrical and humidity resistance.

Standard Test Board

Next, a standard test board (Fig. 1a) was designed which had 63 parallel lines 0.030 in. wide, spaced 0.010 in. apart, and 6 in. long. Alternate lines were connected to terminals at opposite ends of the board. This pattern was the equivalent of two parallel conductors spaced 0.010 in. apart and 186 in. long. Such long and closely spaced conductors would not be found in an etched circuit, but this pattern reduced the leakage resistances to conveniently measurable values and this facilitates studying the effects of high humidity. The test board does not accurately simulate the surface leakage phenomena to be expected with etched wiring because the close spacing of conductors favors volume leakage; especially with coatings thicker than this 10 mil conductor spacing. Since the primary concern was with moisture penetration, there was no immediate need to differentiate between these two types of leakage. The board contained no holes or eyelets which might give uneven coatings. XXXP phenolic board material from one manufacturer was used throughout all tests. The boards were all etched in the same manner with normal washing after etching to remove the ferric chloride.

The boards were dried and resistance measurements taken, then they were subjected to 95% relative humidity at room temperature for 24 hours and resistance readings again were taken. This resistance reading at 95% relative humidity was used to detect the presence of any surface contamination. Previous work on this type of board pattern had shown variation in readings with the same coating material and the same coating thickness. The variations in readings were found to be due to varying amounts of ferric chloride contained on board. This 95% relative humidity test showed contaminations which were unapparent when resistance readings were taken at lower relative humidity and the contamination could not be detected readily by chemical tests. All of the uncoated boards, even contaminated ones, when conditioned at 50% relative humidity, gave resistance readings greater than 50,000 megohms. Upon exposure to 95% relative humidity at 70° F the board resistance varied from 2 megohms to 200 megohms. Chemical spot tests with potassium ferrocyanide capable of detecting 1 part ferric ion in 1 million parts solvent, did not show the presence of ferric chloride. These low reading boards were then immersed in distilled water for 24 hours, but even upon concentration of this wash water, no ferric chloride could be detected. However, by rewashing these low reading boards in water and using a detergent solution, the resistance readings could be brought up to 100-200 megohms at 95% relative humidity.

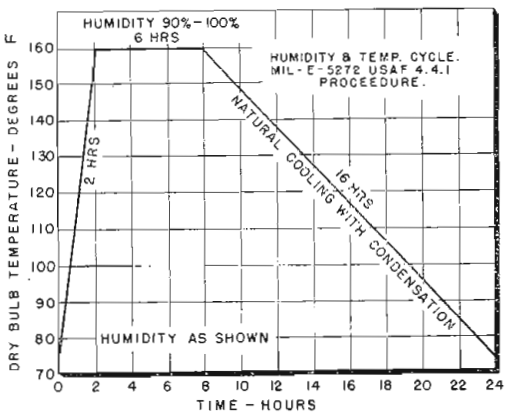


Fig. 2: Humidity cycle to which test boards were subjected to evaluate protective coatings

TABLE I: RESISTANCE READING of TEST BOARD PROTECTED with 5 MIL COATING and EXPOSED to HUMIDITY CYCLE

All coated boards read 50,000 megohms or more before test
All readings in megohms

Material	1 Day	3 Days	5 Days	11 Days	17 Days	Recovery ½ Hr.	Recovery 2 Hrs.	Recovery 24 Hrs.
Epoxy	5000	1100	500	50	5	11	18	20
Epoxy + Solvent	30	12	3	2	1	1	1	1.5
Epoxy + Diluent A	100 Megohms before exposure. Not tested.							
Epoxy + Diluent B	32	26	9	1.5	0.9	1.3	1.6	2.0
Polyester Styrene	30	4.5	1.0	0.2	0.2	0.3	0.6	1.0
Polystyrene + Solvent	2000	1.0	0.1	0.2	0.15	0.5	25	30
Styrene + Dichlorostry	10	0.1	0.2	0.15	0.25	0.3	2.3	
Vinyl + Solvent	200	200	60	12	2.7	4.0	4.0	5.5
Phenolic Varnish A	150		125	17	3.5	6	7	12
Phenolic Varnish B	125	100	35	4	1.5	1.8	2	2.3
Silastic Varnish	2		1.4	0.35	0.4	0.6	0.6	0.6
Cellulose Acetate	33		33	7	2	3	3	3
Wax	10		6		.5	.5	2	3.5

Coating Materials

After thorough cleaning and testing, as described, the boards were again dried at 75° C for 12 hours and then coated with the various coating materials to the desired thickness. The coating materials were selected from the better commercially available materials in each of the various classes of resins, as determined from the previous tests. As shown in Table I, these included solvent and non-solvent materials consisting of epoxys, polyesters, phenolics, silastics, styrene, vinyls, cellulose acetate, and waxes. A 5 mil thickness of these coatings was applied to test boards and subjected to the MIL-E-5272A humidity test Procedure 1, and resistance readings were taken at various time intervals. Resistance readings were taken with a General Radio Model 729A Megohmmeter which reads resistances at 22 volts. Check readings were taken with a General Radio Megohmmeter at test voltage of 500 volts and resistance readings

(*Continued on page* 129)

New 10-KW Air-Cooled Tetrode

Improved power tube for TV and FM service has overall efficiency of 55%. Thoriated tungsten emitter is used

By M. B. SHRADER, Tube Dept., Radio Corporation of America, Lancaster, Pa.

IN recent years, the advent of full-time telecasting schedules and the increasing number of VHF stations being put into operation have pointed up the need for low-cost, air-cooled, high-power VHF tubes. The air-cooled RCA-6166, shown in Fig. 1, has a thoriated-tungsten filament. A single 6166 in the final stage of a VHF TV transmitter can deliver a synchronizing-level power output of more than 10 kw in broadband TV service or 6 kw of FM sound.

Emitter: A study of the results obtained with various emitters led to the selection of thoriated tungsten as the cathode material for use in the 6166. Field performance of thoriated types, such as the RCA-5671 having recorded life of over 30,000 hours in broadcast service, has proved the reliability of thoriated tungsten. Although the 5671 and the 5770 operate at relatively low frequencies, life tests on the thoriated-tungsten type RCA 5762 at 216 MC indicated that no problems would be encountered at VHF. A self-supporting multi-strand filament structure is used in the 6166. This directly heated filament requires only a simple ac filament supply. The size of the active emission area is such that the filament is required to supply a peak emission-current density of slightly more than 1 amp/sq. cm.

Tetrode Structure: A tetrode structure is used in the 6166 to obtain high power gain, ease of video modulation in grid-modulated final amplifiers, and complete shielding between input and output circuits. Although it is desirable that absorption of grid current and screen current be low, other equally important factors must be considered for operation at VHF and under TV conditions. The problem of r-f circuit loss in the input circuit is especially serious because at VHF losses in the input circuit due to high circulating r-f currents can become many

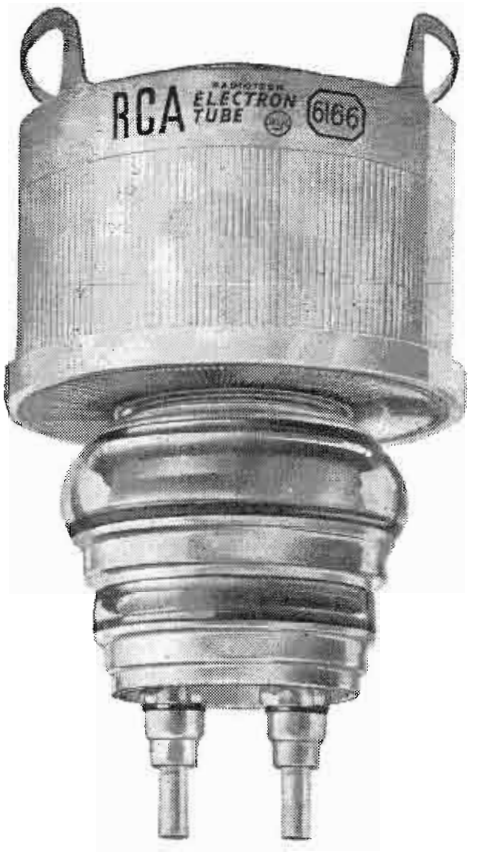
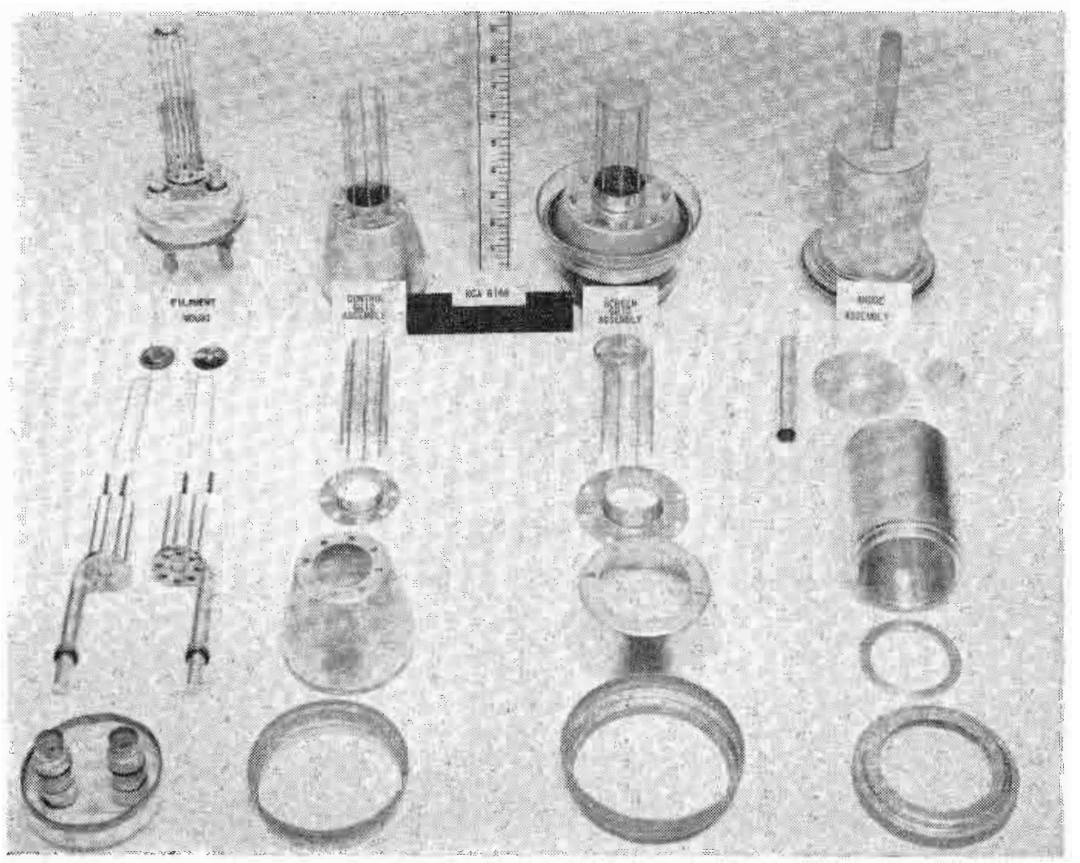


Fig. 1: Type 6166 air-cooled VHF tetrode

times greater than the loss due to electron absorption by the grid. Circuit losses can be minimized at VHF by a reduction of the r-f voltage swing required to drive the tube, and by keeping the input capacitance low.

The 6166 uses helical control and screen grids having a high number of turns per inch, and welded to heavy side-support rods. Platinum-clad molybdenum helix wire is used because of its low grid-emission characteristics and desirable welding properties. The ratio of spacing between turns to the grid-filament spacing is low so that the grid-control characteristic is good and the required r-f grid-voltage swing low.

Fig. 2: Components of (l to r) filament mount, control grid, screen grid and plate assemblies



Grid Supports

Both grid and screen are mounted on heavy copper-clad steel conical supports, as shown in Fig. 2. The copper cladding provides the good conductivity necessary for the high VHF circulating currents; the steel base metal provides rigid support for the control elements. The plate, also shown in Fig. 2, is fabricated from heavy-wall copper tubing.

Seals: Conventional Kovar glass-to-metal seals are used in the 6166 because the dielectric heating losses in glass at 216 MC and at the 10-kilowatt level are not a serious problem provided the glass is adequately cooled. The use of large-diameter high-strength seals reduces displacement-current densities in the seals to a minimum and provides high strength for easy in-

(*Continued on page* 154)

FM/FM TELEMETERING

"Building block" arrangement of standard subassemblies allows versatile use in different installations. High reliability built into measurement systems for rockets

By W. J. MAYO-WELLS
Applied Physics Laboratory
The Johns Hopkins University
8621 Georgia Ave.
Silver Spring, Md.

PART ONE OF TWO PARTS

THE FM/FM telemetering system, which forms the subject of this article, is a radio telemetering system developed specifically for rockets and other airborne machines. For this purpose the primary considerations have been:

1. Reliability
2. Ability to withstand severe physical conditions
3. Weight and size
4. Low power consumption
5. Versatility
6. Accuracy

These requirements have naturally colored the thinking of the designers, and have resulted in a system particularly adapted to its environmental conditions.

Two ways of tackling the problem of developing such a system were open at the start of the programs. One was to build independent complex units for each application, and this would have resulted in nearly a hundred specialized installations. The other plan was to design a set of standard building blocks from which the particular group of component subassemblies could be selected to fulfill the needs of each special installation. The second plan was adopted, and not only satisfied the versatility requirement for the Navy Bureau of Ordnance, but also resulted in a large degree of standardization, which has been followed by the establishment of a standard FM/FM telemetering system for national defense applications.

Basic Principles of FM/FM

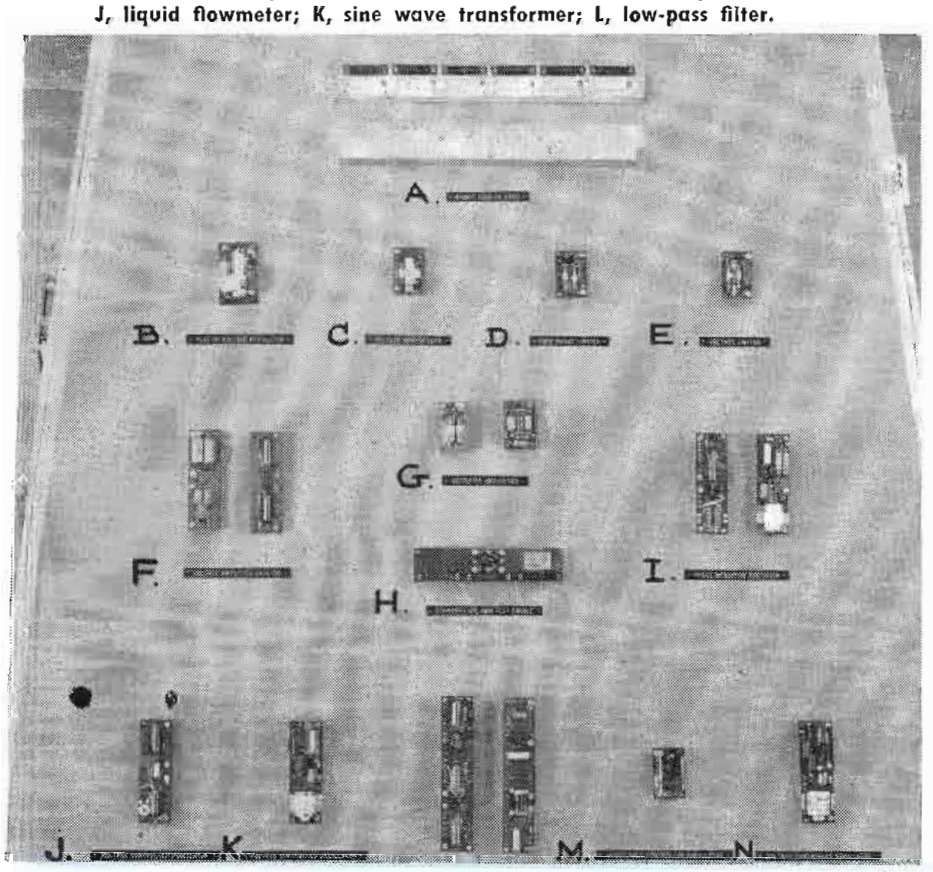
The basic elements of an FM/FM telemetering system channel are well known. The principle of subcommutation of a given band to provide a number of channels is equally common knowledge, and it will suffice to say that in the presently described system such subcommutation is employed and the system becomes a combined FM/FM and PAM/FM/FM system.

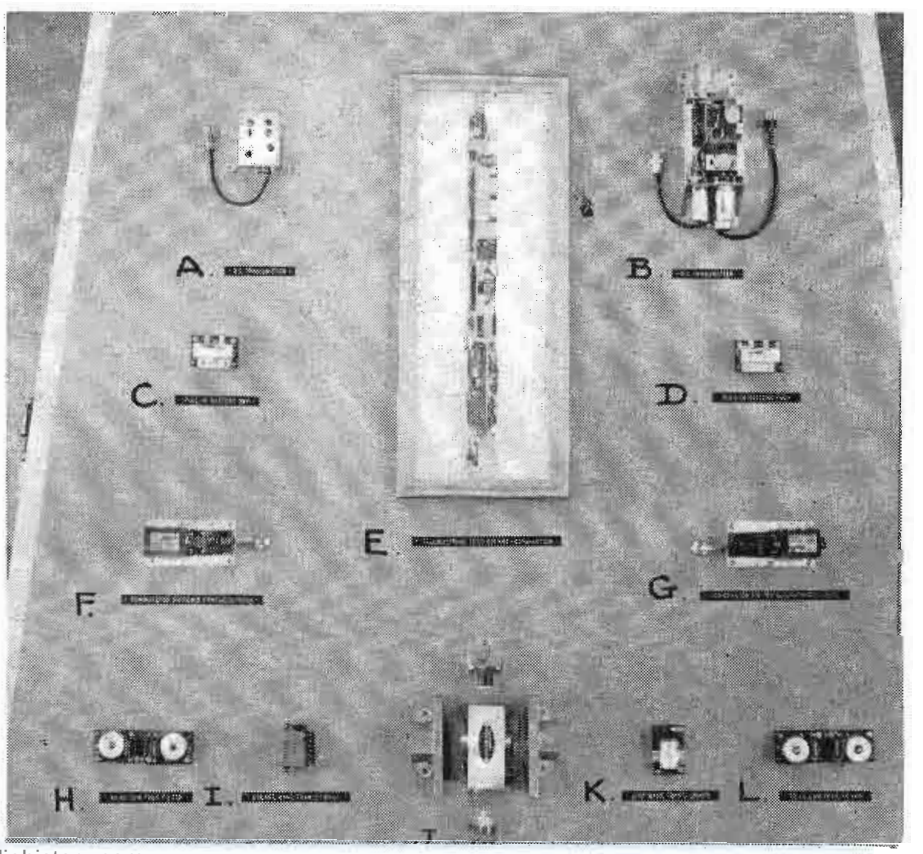
Other types of sub-modulation of the r-f carrier or of modulation of a subcarrier have been considered, such as PWM/FM/FM, but these have not been fully developed although laboratory tests have shown their feasability. The use of a third FM element with no commutation to make the system FM/FM/FM offers considerable possibilities for further expansion, especially when the highest standard subcarrier band of 70 KC is considered.

In the receiving stations, commutated channels are at present recorded in sequence on magnetic recording galvanometers or magnetic tape recorders and the discrimination between samples of a given intelligence channel is done manually along with the complete data reduction. Laboratory equipment has, however, been constructed and demonstrated to provide automatic decommutation more especially of PAM and PWM types of subcarrier modulation. When automatic data reduction machines are in use, automatic decommutation will probably prove a necessary corollary.

The standard FM/FM system may be built up from 18 subcarrier bands ranging from 400 CPS to 70 KC. In the program under discussion a maximum of 11 bands has been used, but other organizations have

Fig. 1: (1) Subcarrier system. A, plug-in strip; B, voltage regulator; C, compressor; D, dual range limited; E, limiter; F, amplifier; G, rectifier and filter; H, standard bridge; I, rectifier; J, K, N, voltage controlled oscillators; L, bridge controlled oscillator; M, inductance controlled oscillator. Fig. 2: (r) R-F and modulator system. A, B, r-f transmitters; C, D, battery; E, rocket installation; F, G, commutator switch; H, low-pass filter; I, square wave transformer; J, liquid flowmeter; K, sine wave transformer; L, low-pass filter.





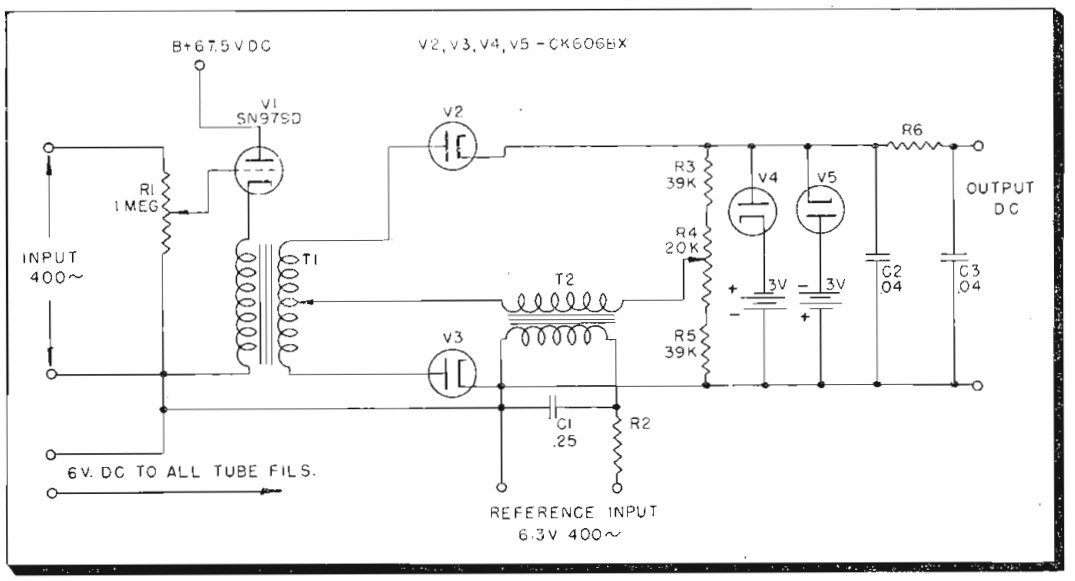


Fig. 5: Circuit of phase sensitive rectifier shown at position 1 on Fig. 1

extended this number to 15. The original four bands were selected to eliminate interference between bands from sum and difference components of fundamentals and harmonics. With a comparatively narrow bandwidth of 15%, this result was practicable for four bands without utilizing an excessive total bandspread. With the extension, first to six, and later to seven, ten, and eleven bands, such elimination was no longer possible within a reasonable bandspread. It was then necessary to improve the linearity of the radio link to such a degree that the interband interference is negligible.

For the lower bands, that is up to and including 14.5 kc, this bandwidth of 15% applies; but for the super-audio bands better results are obtained by increasing the bandwidth to 30%. The standard system quotes both bandwidths, though when the higher is used only a total of 16 bands are named. The increase in bandwidth raises the frequency of the intelligence which for a given system deviation ratio can be satisfactorily recorded. This sytem used a deviation ratio of 5, though in special instances, where the r-f signal strength can be relied upon to remain high during a complete test, this deviation ratio may be lowered to as little as one, maintaining the same bandwidth, to raise still further the frequency of intelligence to be recorded. In the program described, the system deviation ratio is achieved by inserting low-pass filters between the outputs of the subcarrier audio discriminators and the several recording circuits. These filters will be described in greater detail in a later section of this paper.

Airborne System

The airborne components or subassemblies can be divided into six basic groups and a brief description of the more important or characteristic items in each group will be given. The groups are:

1. Pickups
2. Commutator-switches
3. Subcarrier oscillators
4. Auxiliary units: Amplifiers, Filters, Rectifiers, etc.
5. RF transmitters
6. Antenna system

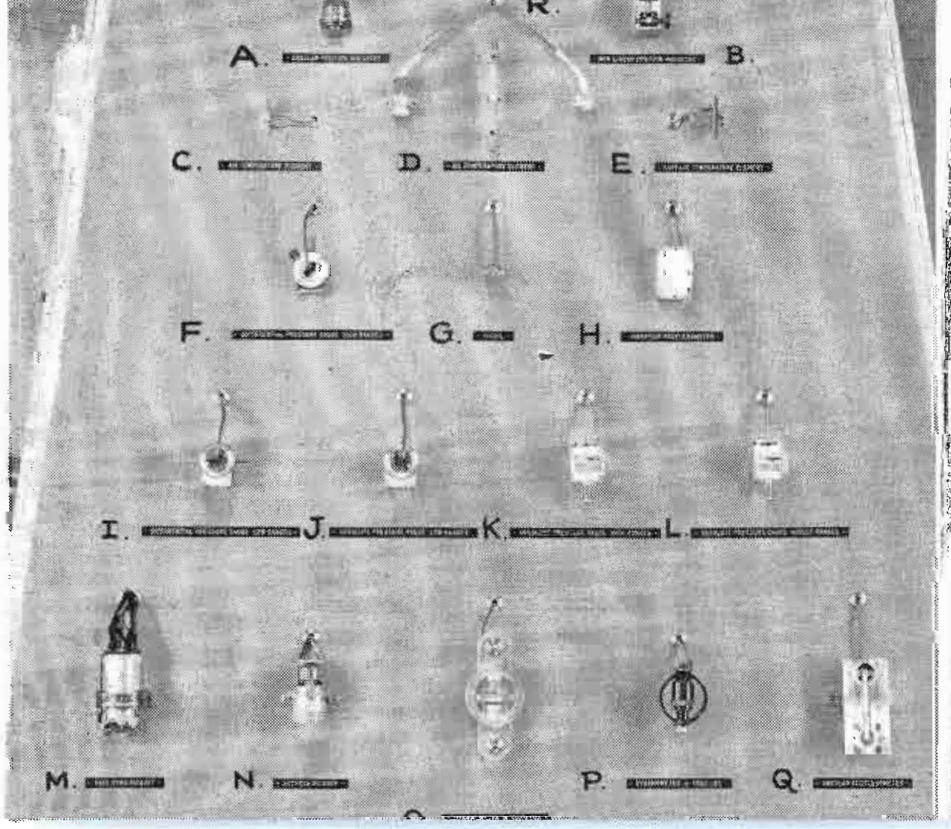
One way of describing the building blocks is by classified groups. An alternative preferred by the author is to describe typical channels according to the nature of the physical quantity or measurand being telemetered. The following types of intelligence will be considered:

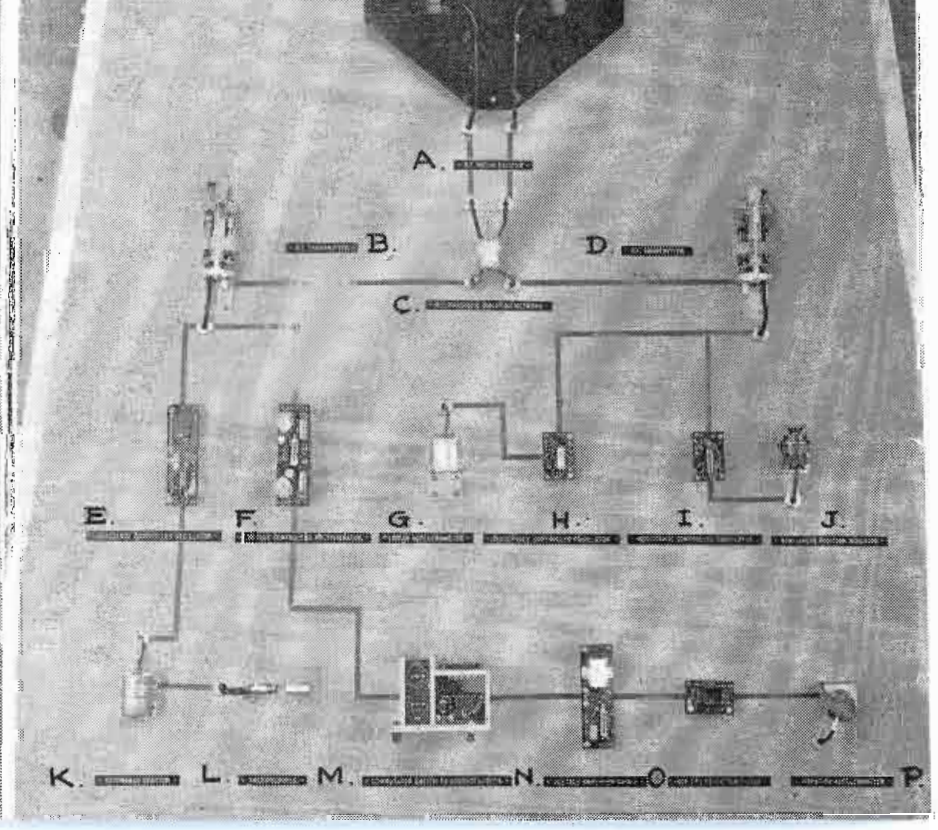
1. Voltage
2. Pressure
3. Linear acceleration
4. Motion
5. Vibration
6. Temperature
7. Strain
8. Others

and the necessary units required to convert the measured quantity into a suitable modulation signal for a transmitter will be explained in turn.

Measurement of Voltage: For this

Fig. 3: (1) Measuring devices. A, B, position indicators; C, D, E, temperature elements; F, I, differential pressure gauge; G, E-coil; H, vibration accelerometer; J, K, L, absolute pressure gauge; M, rate gyro pickoff; N, Autosyn pickoff; O, P, dynamometer; Q, R, accelerometers. Fig. 4: (r) Telemetering transmitting system. A, r-f notch exciter; B, D, r-f transmitter; C, phasing & isolation network; E, reactance controlled oscillator; F, multivibrator; G, linear accelerometer; H, I, inductance controlled oscillator; J, nonlinear position indicator; K, saturable reactor; L, thermocouple; M, commutator switch; N, amplifier; O, rejection filter; P, vibration accelerometer





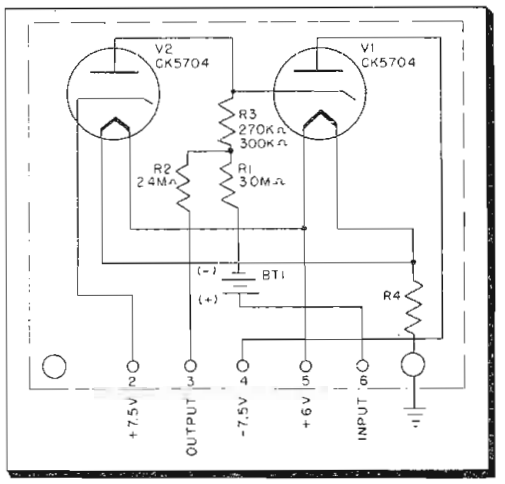


Fig. 6: Voltage compressor (see C of Fig. 1)

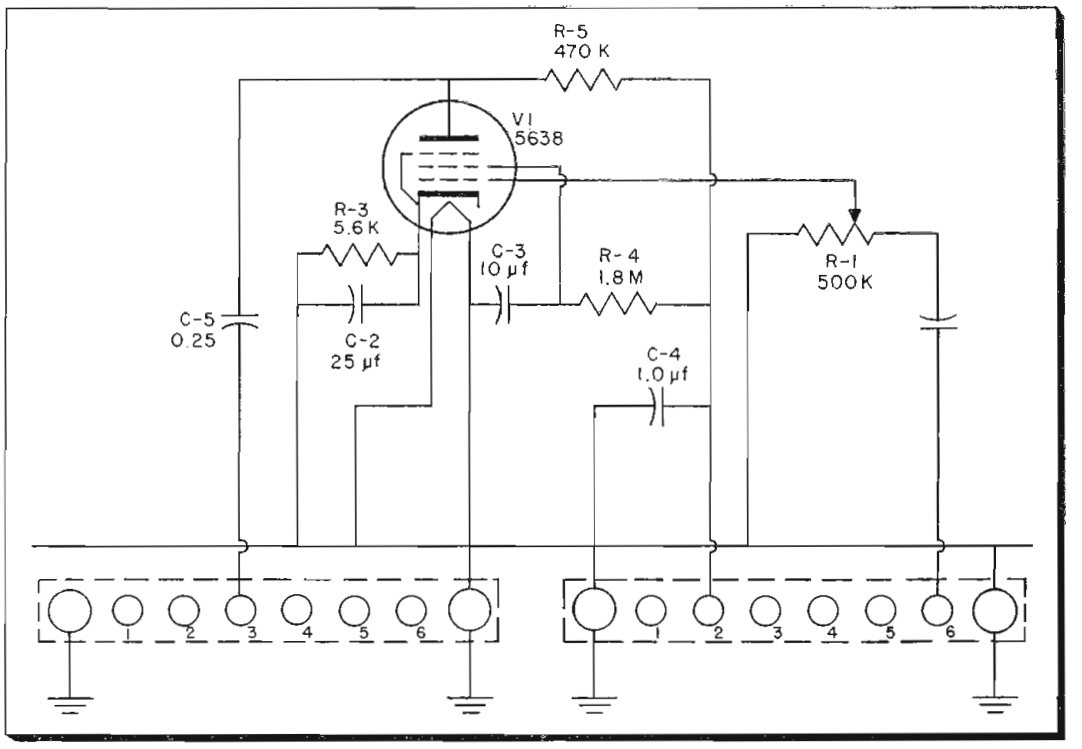


Fig. 7: Low-input voltage amplifier shown at position N on Fig. 4

type of intelligence no pickup is required. The voltage may be dc or ac, and it may be measured in volts or millivolts. If of suitable range, it will require no modification, and can be used directly or through a switch to modulate a subcarried oscillator. Generally some modification is necessary and for this, one or more of the Group 4 devices may be used. If the intelligence is an ac source of which only the amplitude is of interest; the voltage rectifier plug-in unit shown at position (G) on Fig. 1 is used. If the phase is also important the unit shown at Position (I) is used. The circuit diagram is given on Fig. 5.

Limiting DC Voltage

If the source is volts dc, it may require limiting or compressing. Units for this purpose are at positions (C)-(E) on Fig. 1. The circuit for the compressor is given on Fig. 6.

For very low voltages an amplifier, such as shown at position (N) on Fig. 4 is used. Its circuit is given on Fig. 7.

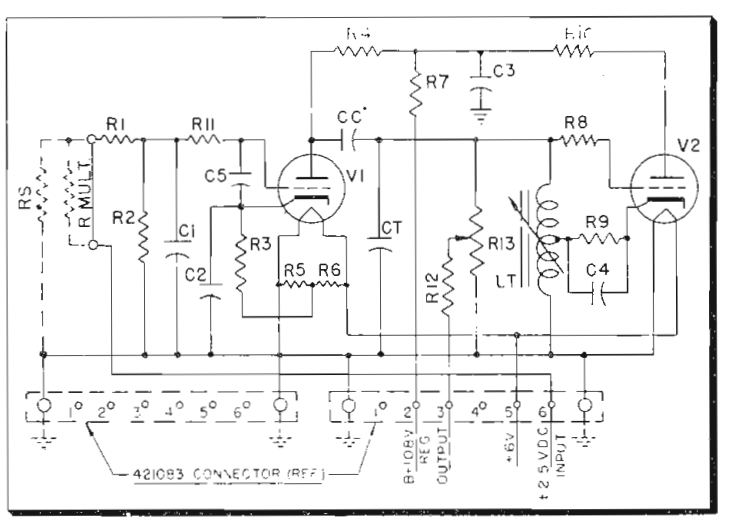
There are two types of subcarrier oscillator modulated by a voltage, and the frequency of the subcarrier determines in general which type is used. For the lower bands, 1.7 to 14.5 kc, a Hartley oscillator circuit, as is shown on Fig. 8, is employed, the modulator tube forming part of the tuning capacitance which accordingly varies with the voltage applied to the grid. This unit is shown at Position (N) on Fig. 1. For higher subcarrier frequencies a multivibrator circuit (see Fig. 9) is used. This unit is shown at Position (J) on Fig. 1.

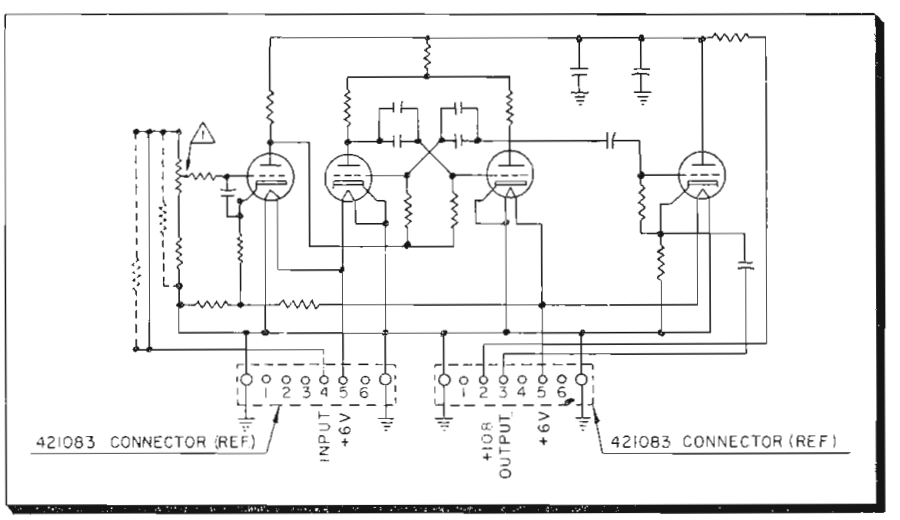
The harmonic content of the output of the Hartley oscillator is low, the total distortion never exceeding 7%. The multivibrator on the other hand gives a nearly square wave output and so filters must be introduced before its output is mixed with that of a higher subcarrier oscillator if harmonic interference is to be prevented. Later it is hoped to redesign the multivibrator to include an output filter; at present the units shown at positions (H) and (L) on Fig. 2 are used. The coils are high-Q torroids and the filters, which have a constant K section followed by an m-derived section, have an insertion loss of less than 6 db over the passband, while providing an attenuation of 30 db to the second harmonic and higher frequencies.

Measurement of Pressure: Three types of pressure pickups are presently known, and one is in common use in this program. One type converts changes in pressure into a variation in inductance, and is the original pickup of the whole telemetering system. The second, which for reasons described in a later section, is only slowly coming to be generally used in this project, converts changes in pressure into a change in the position of a potentiometer arm. This latter type pickup may be used to modulate the Hartley voltage oscillator. A third type employs strain gages but these require a more complex oscillator cir-

(*Continued on page* 174)

Fig. 8: (l) Voltage controlled inducance type oscillator. Fig. 9: (r) Voltage controlled multivibrator type oscillator

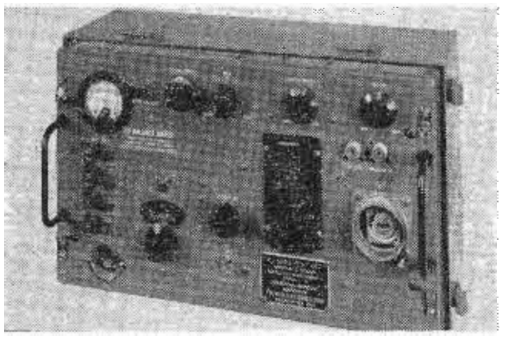




New Test and

SIGNAL GENERATOR

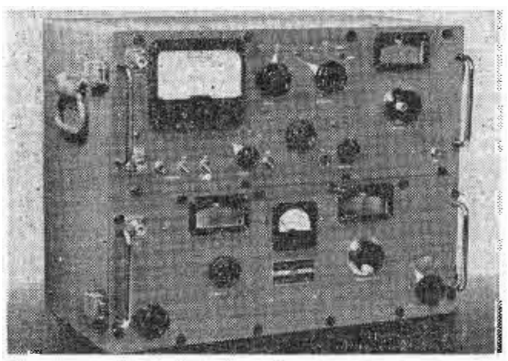
The all-purpose KU band signal generator provides means for testing radar and associated equipment in the 15.75



to 16.25 KMC range. The unit consists of a reflex klystron tube, associated plumbing, attenuating devices, and an absorption type wavemeter. An internal modulation circuitry tube provides pulse and FM modulation of the klystron oscillator, and a temperature-compensated thermistor bridge is incorporated for measuring power output and r-f input for testing transmitters. Power supplies are built into the signal generator. Frequency measurements are accurate to ±10 MCS/secs. Power measurements with correction are accurate to ±1.5 db. Amount of delay is adjusted by a front panel control. **Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TEST UNIT

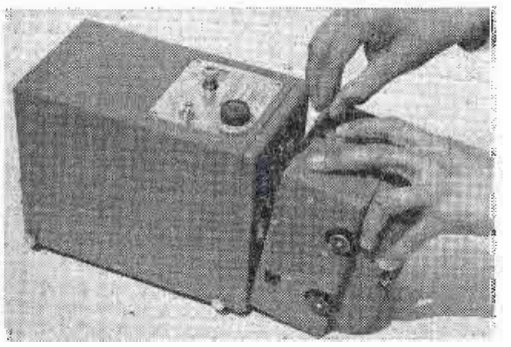
Type BW-7A "three-in-one" test unit is designed for broadcast field intensity measurements and other uses. It com-



bines a field intensity meter, a standard laboratory-quality, signal generator, and a laboratory-quality receiver that is tunable from 54 to 230 MC. Performance specifications call for a field intensity range of 1.5 μv/m to 10 v/m at 54 MC, and 6 μv/m to 10 v/m at 220 MC. Image rejection is not less than 37 db within the tuning range; and l-f frequency is rated at 21.4 MC. The signal generator output is metered and continuously variable from 1.0 μv. to 100, 000 μv. Set operates from a 6 v. battery, or 110 v., 50/60 cps power supply. Complete with carrying case, dipole tripod antennas, and necessary cables. **Radio Corporation of America, RCA Victor Div., Camden, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

OSCILLOGRAPH

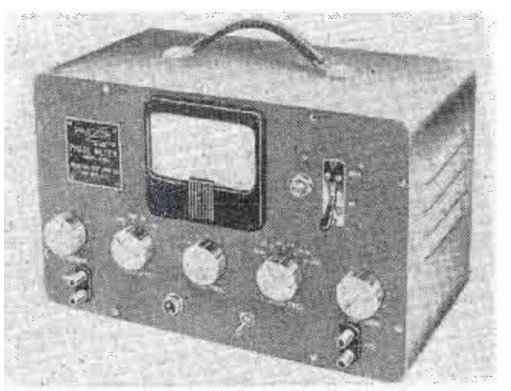
Type 5-117 recording oscillograph records as many as six active channels in the 0-300 cps range simultaneously with positive time correlation. The highly sensitive galvanometers employed make it possible in many instances to conduct tests without use of amplifiers. Easily changed gears provide six discrete record speeds from ¾ to 24 in./sec. Data is photographically recorded. Trace deflection is limited only by the record width. One static reference trace provides a base for record reading. Precision timing lines are recorded every 1/100th sec. A 5-digit counter is advanced at the beginning of each record and photographed. A foot-



age indicator shows how much of the 100 ft. length of 70 mm photographic paper remains. Only 115 v. 60 cps ac power is required. **Consolidated Engineering Corp., 300 N. Sierra Madre Villa, Pasadena 8, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PHASE METER

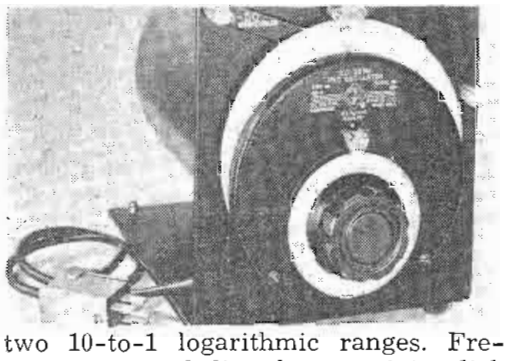
Under certain conditions, phase shifts of the order of 0.01 degrees can be measured by model 200A phase meter. Even though the input signal is complicated by noise and harmonic voltages, the instrument enables accurate phase shift measurements and also in-phase or quadurate voltage components. Self-calibrating, the instrument measures from 0° to 360° and is electronically limited to prevent over-



load. Power input is 105-125 v., 60 cps., 25 w. Dimensions are 9 x 15 x 8 in. **Industrial Test Equipment Co., 55 East 11 St., New York, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

UNIT OSCILLATOR

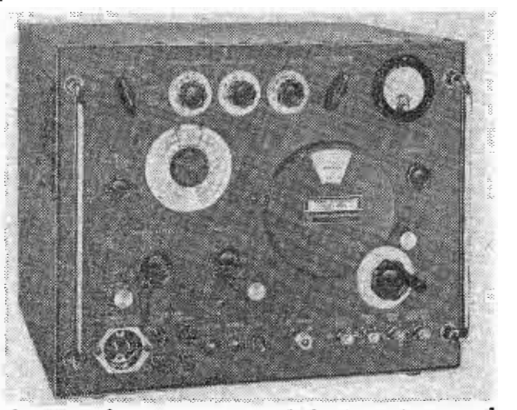
Type 1211-A unit oscillator is the latest addition to the GR line. Its frequency span is 0.5 to 50 MC, covered in



two 10-to-1 logarithmic ranges. Frequency is read directly on a 6-in. dial, with a slow-motion-drive dial indicating frequency increments of 0.2% per division. Output power is well over 1 watt over the 0.5 to 5 MC range and is at least 0.2 watt over the 5 to 50 MC range. The unit provides effective shielding so that it can be used as a power source in bridge measurements. Type 874 coaxial output connector permits extension of the shield to the bridge. The Type 1203-A unit power supply is available for ac operation. **General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SIGNAL GENERATOR

Designed to simplify all SHF measurements, model 620A signal generator provides internal or external pulse mod-

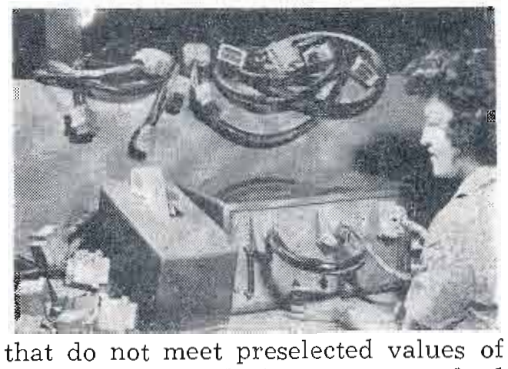


ulation, frequency modulation, internal square wave modulation, frequency modulation, and CW output Pulse output width is variable from 0.5 to 10 μsecs, and repetition rate is 40 to 4,000 pps. For internal FM, the instrument provides a saw-tooth sweep variable between 40 and 4,000 cps. For external FM, capacitive coupling is provided to the repellor of the klystron oscillator. Repeller voltage is tracked automatically. The generator has an output of 0.071 v. to 0.1 μv. into 50 ohms. Frequency calibration accuracy is better than 1%. Attenuator accuracy is better than 2 db. In all measuring operations, frequencies are directly set and read. No charts or interpolations are required. **Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Measuring Equipment

CABLE TESTER

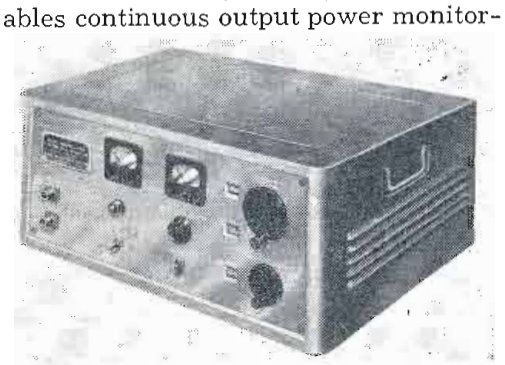
The automatic cable tester, Model 4110, scans multiconductor cables and prints a code number of connections



that do not meet preselected values of continuity and leakage on standard adding machine tape. Leads are rapidly and sequentially scanned by means of stepping switches according to any predetermined pattern. The printed code numbers are then affixed to the cable for record purposes, or as a guide for rework. On continuity test in which the one and two connections are reversed, the digital printer will record 1-1 and 2-2. On the leakage test, a cross check is obtained, for the printed reading will be 1-2, 2-1. By use of adaptor sockets, the unit can be used with a wide variety of cable terminating connectors. **Beckman Instruments, Inc., Berkeley Scientific Div., 2200 Wright Ave., Richmond, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

POWER OSCILLATOR

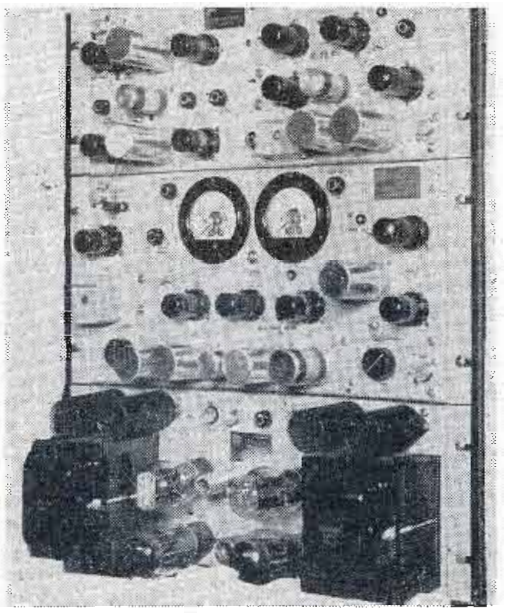
The UHF wide band power oscillator shown covers the entire range from 200 to 2,500 MC. Offering 50 w. at 200 MC to 10 w. at 2,500 MC, the unit enables continuous output power monitor-



ing, external modulation at video and audio frequencies, good calibration accuracy and frequency stability. The unit consists of a grid-separation, dual cavity, coaxial line oscillator, a 2C39A disc-seal triode, and a self-contained rectifier power supply. Plate and grid circuit line lengths are simultaneously set by a single tuning control, with provision made for tuning the grid-cathode line for maximum power output. Power consumption is 200 w. at 115 v., 60 cps, with a minimum modulation power requirement of 5 w. **The W. L. Maxon Corp., 460 West 34th St., New York 1, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CURVE TRACER

Model 1603-AR envelope delay curve tracer consists of two units: model 1603-AR-1 transmitter, and model 1603-AR-2 receiving unit. The function of the tracer is to provide rapid determination of the envelope delay characteristic and the amplitude characteristic of any amplifier or system using conventional sweep techniques. By using two oscilloscopes with a video sweep generator,



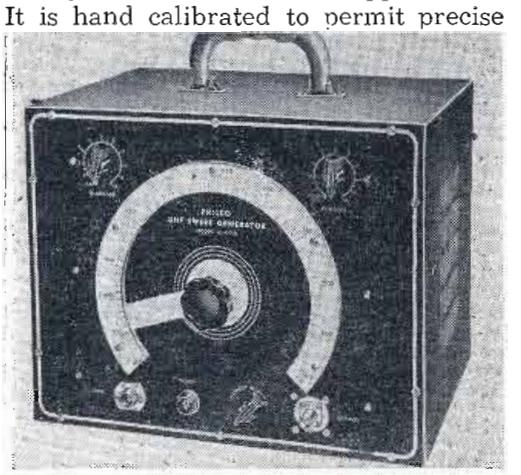
amplitude and envelope phase characteristics can be plotted simultaneously. The transmitter unit can be located at the beginning of a system and the receiver at the end. No auxiliary equipment is necessary for looped operation. **Telechrome, Inc., 88 Merrick Road, Amityville, L.I., N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

VOLTMETER

Model R-1 has decreased drift in the dc millivoltmeter and the dc amplifier to less than 3 mv/hr. through circuit refinement and use of new wirewound resistors. Intended primarily for the precise measurement of dc potentials, the following functions have been included in its design: Distended dc voltage ranges, bucks out 99% of measured voltage and indicates 1% of measured voltage full scale; dc millivolt ranges, 1 mv full scale to 1,000 mv full scale—drift, less than 3 mv/hr. AC volt and millivolt ranges, 1 mv full scale to 1,000 v full scale—frequency range 10 cps to 100 cps. Self-contained standard cell for voltmeter calibration. Ohms ranges, times 1 to times 10^6. Distended ohms ranges, reads bottom half of ohms scale full scale. DC amplifier, will drive 1 ma recorder, has gain of 200 and frequency range of 0 to 100 KC. **Southwestern Industrial Electronics Co., 2831 Post Oak Rd., Houston 19, Texas.**—TELE-TECH & ELECTRONICS INDUSTRIES.

SWEEP GENERATOR

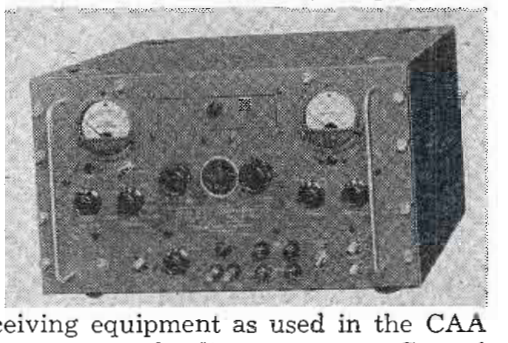
Model G-8010, a new UHF sweep generator, is designed especially for highly accurate industrial applications. It is hand calibrated to permit precise



readings and has a high output—a minimum of 1 v. peak to peak, blanked. An electronic leveling circuit accounts for the extreme flatness of sweep—1 db over the frequency range 470-890 MC. The leveling circuit has been designed to reduce matching errors that might be introduced by the input circuit. **Philco Corp., 4700 Wissahickon Ave., Philadelphia 34, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SIGNAL GENERATOR

Type 232-A glide slope signal generator provides complete testing and calibration facilities for glide slope re-

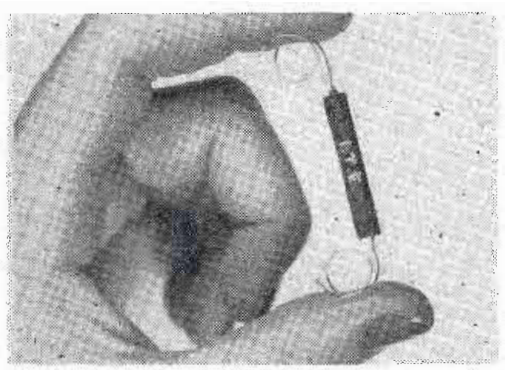


ceiving equipment as used in the CAA instrument landing system. Crystal controlled r-f and i-f signal voltages, coupled through carefully designed piston attenuators, enable accurate study, alignment, and calibration of the system under test. Internal modulation is available for the simulation of on and off-course signals, and for general purpose work. Specifications include an r-f range from 329.3 to 335.0 MC in increments of 0.3 MC. and an i-f frequency of 20.7 MC (15-30 MC by change of crystal) all accurate to $\pm 0.0065\%$. Output voltages are from 1.0 to 200,000 μv., continuously variable, at an impedance of 53 ohms. Internal 1,000 cps and variable-ratio 90/150 cps AM modulation is provided at modulation depths from 0 to 1000%. Input power requirements are 105-125 v., 60 ± 1 cps, 50 w. (electronically regulated.) **Boonton Radio Corp., Intervale Rd., Boonton, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Technical Products for

RESISTOR

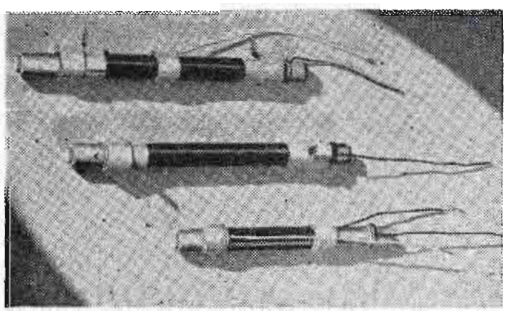
The Type A3606CG hermetically-sealed, sub-miniature resistor measures only 3/16 in. in diam. and 1⅛ in. in



length. Rated at 0.10 w., the unit has a maximum resistance—using Evenohm wire or its equivalent—of 500,000 ohms. Tolerances down to 0.1% are standard. Axial lead wires are 22-gauge tinned copper, 1½ in. long. **I-T-E Circuit Breaker Co., Resistor Div., 1924 Hamilton St., Philadelphia 30, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DELAY LINE

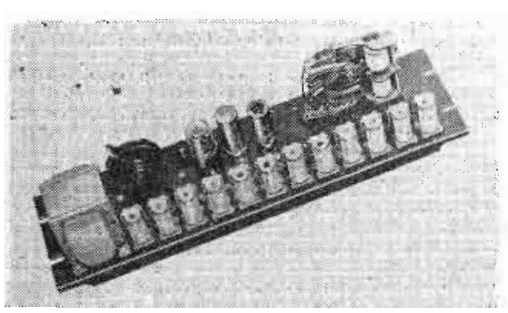
Type D-.25-1-10-R has 0.25 μsec delay one way at 1000 ohms impedance. The rise time does not exceed 0.03 μsec



and the attenuation is less than 0.35 db. It is wound on a metallized ceramic rod that is 3 9/16 in. long with a ⅜ in. dia. maximum overwinding. The unit can be supplied either in hermetically sealed containers or with standard mounting brackets. Special lines of this type can be made to have a top operating range of + 200° C. **Electrometric, Inc., Woodstock, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SWITCHING UNIT

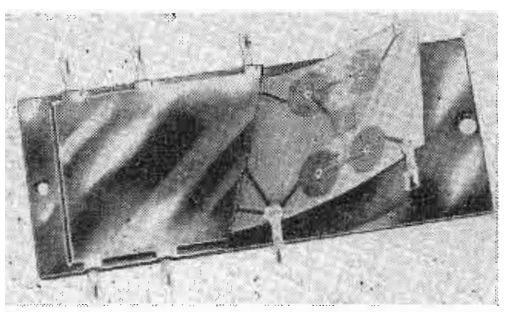
Operated from a telephone type dial at the control center over a transmission medium using either audio tone or dc telegraph signals, the PCU-2 pulse counting unit, is applicable to railroad control and signal operation, utilities,



refineries, pipe lines etc. In a typical application it selects any one of 10 telemetering circuits when only one transmission circuit is available for sending metered information. The PCU-2 selects the metering circuit requested from the control point. It is also suitable for controlling transmitters, receivers, lights, motors, pumps, valves, and other items that can be adapted to electrical control. **Hammarlund Manufacturing Co., Inc., 460 West 34th St., New York 1, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FILTER

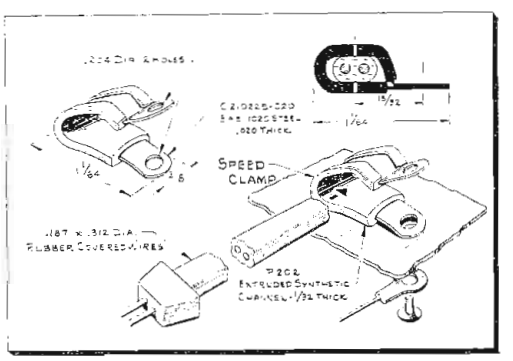
Model UV-3, a new triple-tie cross-over filter, employs a printed circuit to eliminate the need for two down



leads when a UHF and VHF antenna are both in operation. One down lead eliminates interaction between the UHF and VHF systems and simplifies installation. A second UV-3 is installed at the receiver where sets are wired internally for two antenna systems. The unit is moisture and fungus proof. Impregnation before encasement eliminates component drift or shorting. **TV Products Co., 145-68 228 St. 13, Springfield Gardens, New York.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CLAMP

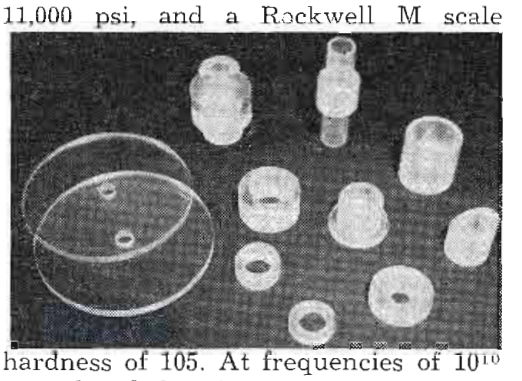
The clamp shown acts as a 15 μf antenna capacitor and a strain relief clip; therefore, reduces materials han-



dling and installation time. Insulated wires are merely slipped into the clamp and a contact terminal is positioned under the panel in alignment with the mounting hole. A single rivet inserted through terminal, panel, and clamp secures the entire unit. **Tinnerman Products, Inc., P.O. Box 6688, Cleveland 1, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SHEET INSULATION

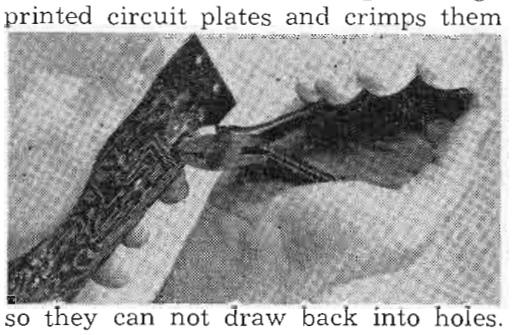
Stycast 0005, a newly developed plastic material, has a tensile strength of 11,000 psi, and a Rockwell M scale



hardness of 105. At frequencies of 10^{10} cps. the dielectric constant is 2.53 to 2.56; dissipation factor is below 0.0005. It will withstand temperatures as low as −70° C. without adverse electrical or physical effects. A thermosetting plastic, Stycast will not flow at temperotures as high as 200° C., though it is recommended that prolonged heating under stress should be limited to 125° C. Rods are available in ¼ in. to 3 in. diameters; sheets from ¼ in. to 1 in. in thickness. **Emerson & Cuming, Inc., 869 Washington St., Canton, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PC PLIER

The No. 052 printed circuit plier cuts lead wire ends extending through printed circuit plates and crimps them



so they can not draw back into holes. The tool was developed especially to enable dip-soldering an entire printed circuit plate. A slight pressure of the plier cuts the wire and the crimped ends hold the loose parts in position for fast, efficient soldering. The plier knives are held at 45° to enable visual control. A replaceable tempered steel spring keeps the plier in the open position for immediate use. **Mathias Klein & Sons, 3200 Belmont Ave., Chicago 18, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

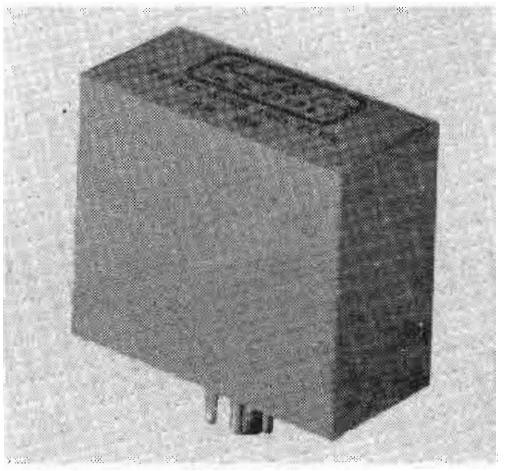
PC WAVE TRAP

A new printed circuit wave trap will block out TV reception interference from local police transmissions. Tuneable over a frequency range of 37 to 50 MC, it can be preset by the TV manufacturer. Soldering terminals are supplied for easy assembly and installation. Overall size is 25/32 x 2¼ x ⅜ in. **Circuitron, Inc., subsidiary of LaPointe Electronics Inc., Rockville, Conn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

the Electronic Industries

BAND PASS FILTERS

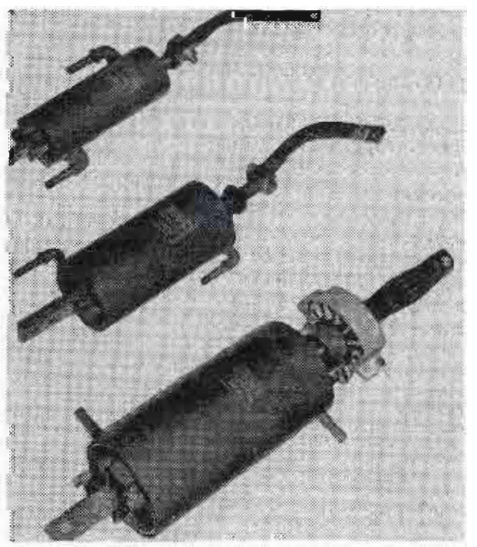
A series of miniaturized telemetering band pass filters have been produced without sacrificing attentuation charac-



teristics. One complete set of 20 telemetering channels occupies 300 cu. in. as compared with the 1,500 cu. in. space of standard size filters. The new series is equipped with octal plug mounting and is hermetically sealed in accordance with government specifications. Another recent addition, the Type S-15000 side band filter, consists of stabilized toroids and other components that will attenuate a 50 kc carrier at 20 db and most of the upper side band 40 db. Audio response through the filter is from 300 to 3,300 cps. **Burnell & Co., 45 Warburton Ave., Yonkers, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

IGNITRONS

Five ignitrons have been added to the Amperex line of industrial tubes. All five are electrically and mechanically



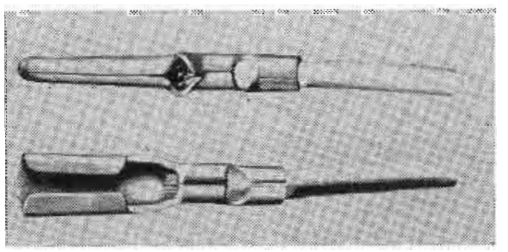
identical and are interchangeable with standard types of the same designation. Types AX-5551, AX-5552, and AX-5555 (the largest) are shown. The detachable braided copper anode lead and long-life ignitor are improvements. **Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L.I., N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TOROIDAL COILS

A new line of toroidal coils is available in a wide range of sizes with varying finished coil dimensions. All have small cross section cores. Coil hole sizes range from 5/16 in. to 8 in. in diameter. An outstanding feature of these toroids is the closeness of the electrical tolerances to which they can be held in production. Units can be wound to ±5% inductance, matched to a standard 0.1% inductance or —1 turn. Finished toroids are available as uncased units, hermetically sealed, or embedded to meet applicable MIL specs. The units can be incorporated in wave filters or networks designed to performance specs, or to the customers design. **General Instrument Corp., F. W. Sickles Div., Chicopee, Mass.**—TELE-TECH & ELETRONIC INDUSTRIES.

TAPER TECHNIQUE

An AMP taper technique that eliminates terminal screws and soldering in electrical circuits has been developed.



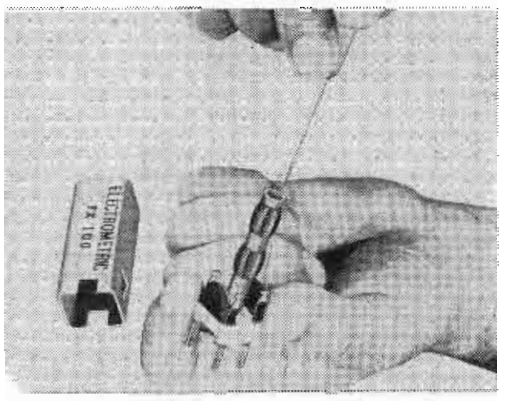
Self-locking terminals, taper pin and mating receptacle, flat taper tab and taper-tab receptacle were designed primarily for the electronics and communications fields. As the taper pins are virtually as small as the insulated diameter of the wire, close termination spacing is enabled without danger of short circuits. An AMP automatic terminator (covered by the terminal purchase price), assures controlled precision crimps over long production runs. The illustration shows the taper pin and taper-tab receptacle and the special sleeve that grips the wire insulation. The overall length of the pin for #26-#22 wire is only 9/16 in. **Aircraft-Marine Products, Inc., Electronics Div., 2100 Paxton St., Harrisburg, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MICROPHONES

Models MC10 and MC11 controlled-reluctance magnetic microphones were designed specifically for use with transistor circuits, but they are also applicable to small compact amplifiers, transmitters, dictating equipment, etc. Both models are 1 in. in diameter and 3/8 in. thick, but MC11 has a "Mu-Metal" shield-ring. **Shure Brothers, Inc., Sales Div., 225 West Huron St., Chicago 10, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

I-F TRANSFORMER

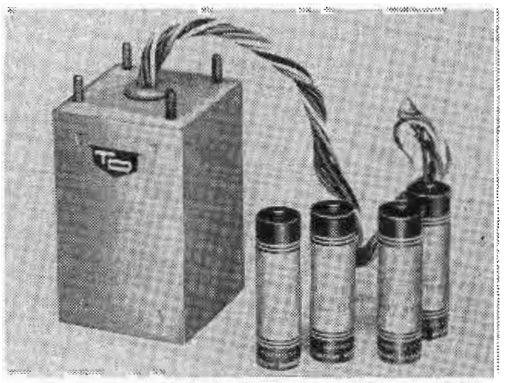
Type TX100 i-f transformer enables tuning both coils either from the top or from the bottom, providing greater



freedom in chassis design and faster set alignment. Terminals are soldered to the capacitors, and coil leads are soldered directly to the tops of the terminals. A higher Q results from a unique delay line type of winding. Temperature-compensated for low drift, the unit delivers constant high performance over a wide temperature range and can be used for any application that requires a 3/4 in. i-f transformer. A wide range of inductances and Q's is available for AM, FM, TV, and military applications. **Electrometric Co., Woodstock, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

POWER SUPPLY

Models PS-1 and PS-2 of a sub-miniature, transistorized, high-voltage power supply with voltage regulated to

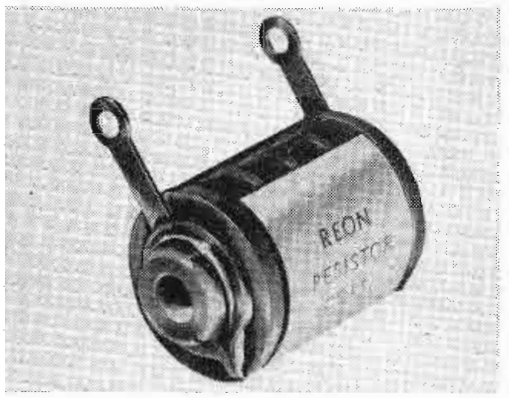


15 v., at 700 v. and 900 v., respectively, measure 2 3/4 x 1 3/4 x 1 7/8 in. and weigh only 7 1/2 oz. Battery operated (4 penlite cells can be used), dc energy conversion efficiency ranges from 30% to 50%, depending on the operating point and input voltage. Input can be connected to operate on from 3 v. to 22.5 v. There are no moving parts; no thermionic tubes. The conversion unit uses hermetically sealed junction transistors. Both models have a maximum current output of 50 μa and an ac ripple voltage of mv. **Technical Operations Inc., 6 Schouler Court, Arlington, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Technical Products

RESISTORS

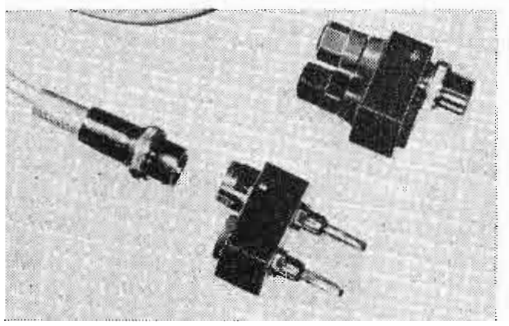
The RB series of precision wire-wound resistors are made in tolerances up to 0.02%. Ratings of ¼, ⅓, ½, and 1 watt are provided in resistances



ranging from 0.1 ohm to 3 megohms that are stable mechanically from −55° C. to +155° C. The units are fitted with brass lug terminals for resiliency and strength, and show less than 0.05% change in resistance after MIL-R93A tests. **Reon Resistor Corp., 117 Stanley Ave., Yonkers, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CONVERSION PLUGS

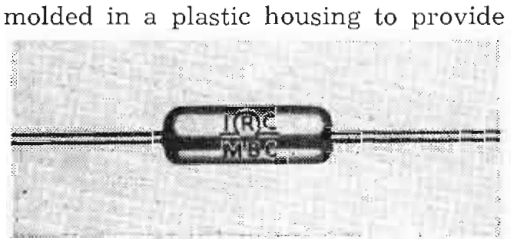
To simplify interconnecting electronic instruments and equipment having old style ¾ in. spaced banana plugs, or corresponding jack type terminals, with



instruments having new style concentric "Amphenol" terminals and plugs, two new "conversion plugs" have been announced. CP-122 is used for amphenol to spaced jacks, CP-221 for spaced plugs to amphenol. Their use enables plugging new meters and scopes into old equipment. The shield clip lead, CL-101, is used with old equipment having spaced terminals. **Millivac Instrument Corp., 444 Second St., Schenectady, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RESISTOR

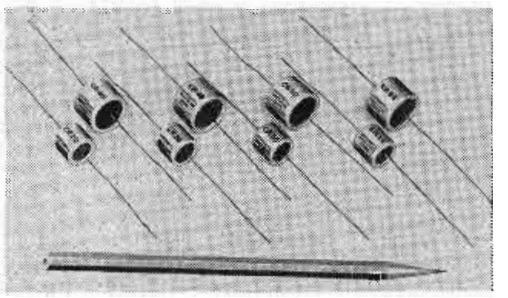
Type MBC molded boron carbon resistor is rated at ½ watt. The unit is molded in a plastic housing to provide



mechanical protection. Its body length is 9/16 in. ± 1/32. Its body diameter is 5/32 in. ± 1/32. Its lead length is 1½ in. ± ⅛. Its lead diameter is 0.032 in. minimum. Therefore, its size is the equivalent of a 1 watt composition resistor. The new resistor excels the characteristics outlined in Signal Corps specs., MIL-R-10509A. **International Resistance Co., 401 North Broad St., Philadelphia 8, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SELENIUM RECTIFIERS

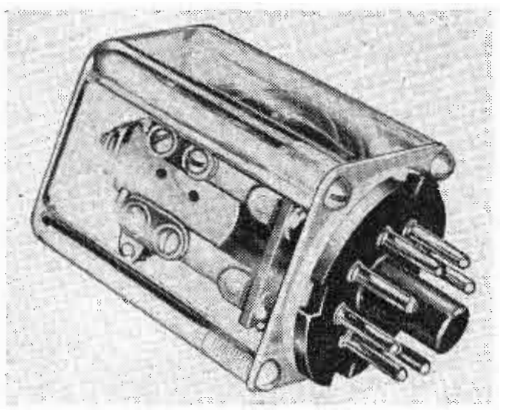
The CR series of TV booster and UHF converter type miniaturized selenium rectifiers consist of a number of cells



assembled within a cylindrical aluminum tube with pigtail copper leads. The smallest unit, Type CR-15, is 0.5 in. in diameter and 0.6 in. long. The largest is 0.75 in. in diameter and 0.6 in. long. The series is rated for maximum RMS input voltages of 130 and 160 v. for operation into a capacitive load. **International Rectifier Corp., 1521 E. Grand, El Segundo, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RELAY

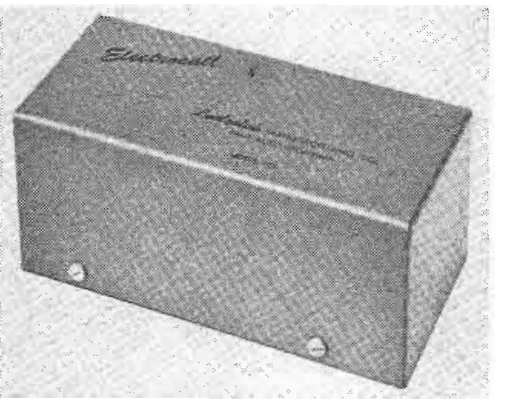
The "KCP," a new plate circuit, current-actuated, plug-in relay, enclosed in a clear polystyrene dust cover, is



intended for use in original equipment using photo-electric cell control, or similar electronically operated circuitry. Contact rating is 2 amps, 115 v., ac non-conductive load. Operating coil power is 125 mw per movable pole. Contact pressure, approximately 10 grams. The new relay is available in a range of switch poles and throws, and nominal pull-in values. **Potter & Brumfield, Princeton, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FLEET CONTROL

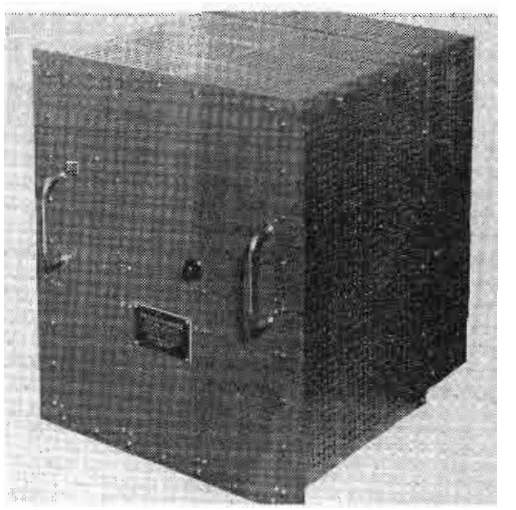
The "Electrocall" unit puts fleet radio systems on a direct call basis when one is installed in each fleet receiver and a



fully automatic coding unit is installed in the base-station transmitter. The unit energizes the output circuits of the receivers on receipt of the coded signal from the fleet transmitter, making it unnecessary for the vehicle operators to listen to all the transmission in the frequency band. An operational advantage is gained through a per vehicle battery drain of 14%. **Lectrolab Manufacturing Co., 2995-C Middlefield Rd., Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FREQUENCY CHANGER

The output frequency voltage of the model 2261 frequency changer is 400 ± 0.1% cps regardless of transients in the

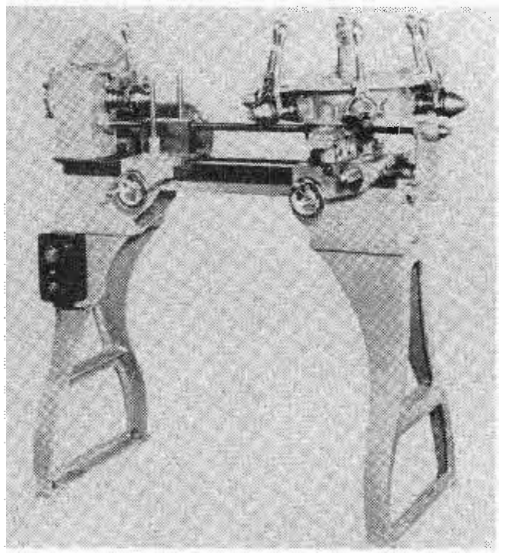


input voltage and load fluctuations. The output voltage waveform has a maximum harmonic content of 8%. Input power is rectified and filtered. This dc voltage is used to operate an electronic inverter which consists of two thyratrons alternately fired in push-pull fashion by an electrically-driven tuning fork. Frequency of the output voltage is determined by the tuning fork frequency. A saturable reactor, with appropriate circuits, controls the output voltage. **Varo Manufacturing Co., Inc., 1801 Walnut St., Garland, Texas.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Lab and Plant Equipment

TURRET LATHE

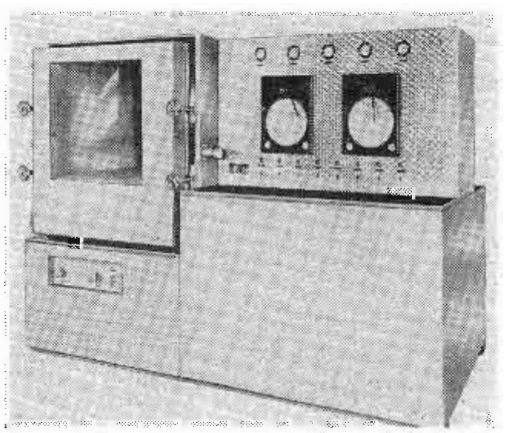
Model 2326 (patented) glass turret lathe facilitates the addition of successive pieces, or any combination of pieces



and operations, to be made continuously. This precludes the work cooling between steps and the necessity to rechuck. Consequently, absolute concentricity around the same axis is assured. Annealing becomes a part of the operation. Only the chuck in operation rotates. Chucks can be loaded at any time. The entire turret moves back and forth like the tool post of a machine lathe. The burner carriage can be moved in the same way. Burners are controlled by a foot-operated economizer. Rotating speeds are adjustable. The turret chucks can be loaded with glass, other pieces, or with various forming tools. Air can be admitted through the operating chucks. **Kahle Engineering Co., 1307 7 St., North Bergen, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

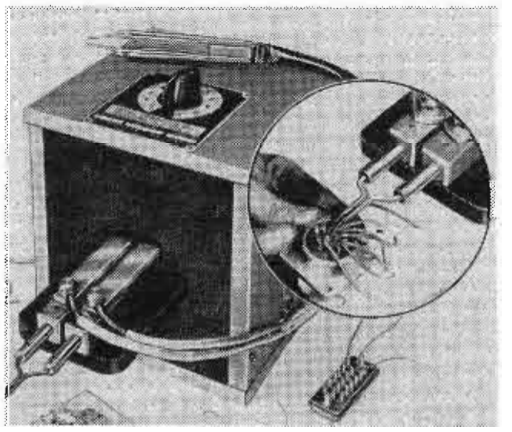
ALTITUDE CHAMBERS

Model SC100-8, 8 cu. ft. high-altitude testing chamber, shown, is designed for operation from +200° F. to −100° F. Capable of carrying a 200 watt "live" load, the chamber also provides humidity control between 20% and 95%, and pressure control from atmospheric to 8 mm Hg absolute, the equivalent of 100,000 ft. The unit is completely self-contained and requires relatively simple utility connections for operation. The multi-stage refrigeration system, vacuum pump, and other operating machinery are vibration-isolated from the main frame and enclosed by removable panels. The control panel is adjacent to the test chamber and incorporates separate electronic, thermocouple-type recording-controlling instruments for the dry and wet bulb functions. **Refrigeration Systems, Inc., 646 W. Washington Blvd., Chicago 6, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.



SOLDERING MACHINE

A new 250 w. AN connector soldering machine equipped with air-cooled fiberglass insulated soldering tweezers as well as with regular electrodes, is said to provide soldering versatility for small parts production. The electrodes are interchangeable and can be replaced at low cost after an average life of about three months. Moreover, they can be shaped to fit any type of operation. In use, the operator merely sets the heat



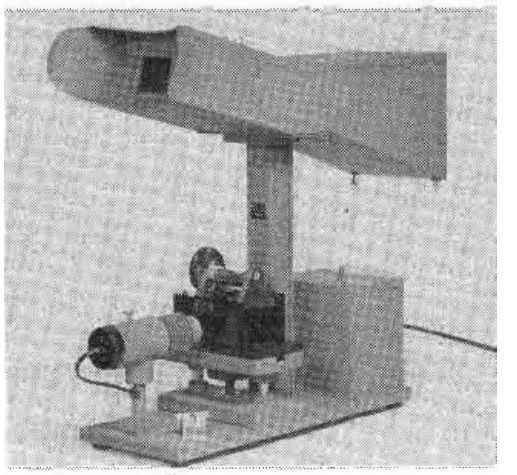
and the solder, presents the work, and presses a foot switch. Other fixed electrodes can solder from 2 to 30 or more on AN connectors. The unit can be used also on terminal boards, printed circuits, and military equipment with lugs solder-crimped to government specifications. **Joyal Products, Inc., 115 Edison Place, Newark 5, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

DC ARC WELDER

A new type direct current arc welder consists essentially of two parts; a selenium rectifier which converts ac to dc current, and a Transactor unit which controls voltage and current. Because aluminum, instead of copper, is used in the construction of the Transactor unit coils, the new welder is about 110 lbs. lighter than previous models. Virtually all the parts of the new unit, with the exception of the Transactor, are interchangeable for welders of similar models but different ratings. Little maintenance is required because of the almost complete absence of moving parts. **Westinghouse Electric Corp., Motor and Control Div., Buffalo, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

OPTICAL PROJECTOR

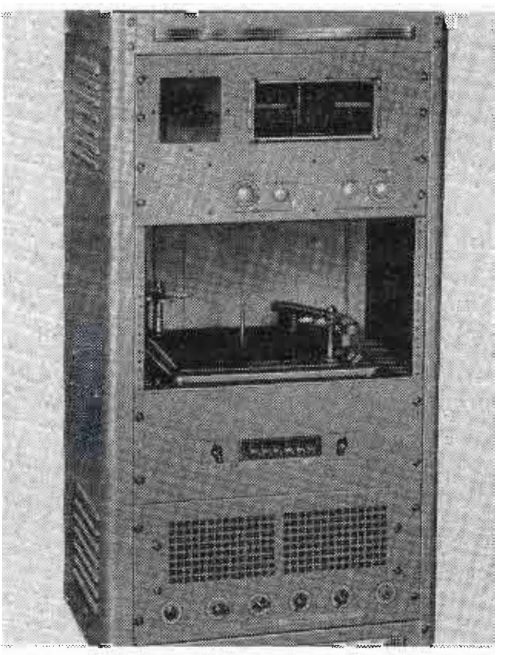
Model 66 horizontal contour projector, with staging fixture and chart, is designed for use by crystal diode



manufacturers to test quality. Set at the factory for 35X magnification, the instrument checks overall length of whisker from point to mount; the concentricity of the whisker and its point in relation to the mount; the configuration of the whisker dimensionally; and, the shape of the whisker point. No hood is required to keep out excess light from the screen. **Stocker & Yale, Inc., Marblehead, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SOUND BROADCASTER

A new sound broadcaster, rated at 60 watts, class AB-1 at less than 5% distortion, has peak power of 80 watts.

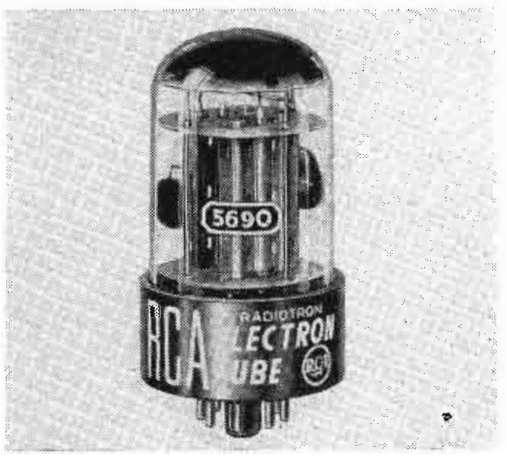


Frequency response is ±2 db, 50 to 10,000 cps. The unit has a built-in three-speed automatic record changer, an AM/FM tuner, and three separate inputs enabling it to transmit sound from record, radio, or directly from microphone to any or all of six zones. **Mark Simpson Mfg. Co., 32-28 49th St., Long Island City 3, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Power Supply Accessories

FULL-WAVE RECTIFIER

The RCA-5690 full-wave rectifier tube has two separate diode units of the indirectly-heated cathode type, and is conservatively rated to withstand a



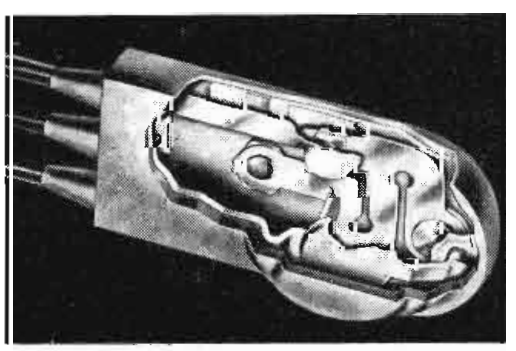
max. peak inverse plate voltage of 1120 v., at a max. peak per plate current of 375 ma. and a max. per plate dc output current of 75 ma. When operated within maximum ratings, the unit has a minimum life of 10,000 hrs., and it is capable of withstanding continuous vibration of 2.5 G at a frequency of approx. 25 cps for hundreds of hours at max. rated voltage. At the same voltage, it will withstand impact shocks of 500 G for short periods. **Tube Dept., Radio Corporation of America, Harrison, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

POWER RHEOSTAT

A new Type K, 25-watt, vitreous, wire-wound, power rheostat has a resistance range of one to 2,500 ohms, and is equipped with a patented arm that assures constant contact pressure. The unit is 1⅜ in. deep and 1 1/16 in. in. diam. The addition of the new item makes available a line of rheostats ranging from 25 to 500 watts. **P. R. Mallory & Co., Inc., 3029 E. Washington St., Indianapolis 6, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES.

WATERPROOF SWITCH

Designed in accordance with U. S. Army specification 60-977-2 Class B, covering waterproof and corrosion resistance, the new CPI S.P.D.T., three-wire, miniature switch has a snap action mechanism that is built around a beryllium-copper, sine-curved spring. The switch mechanism is enclosed and



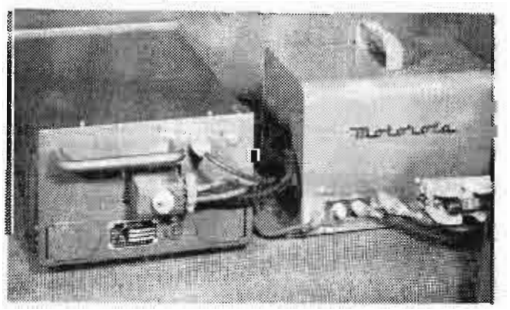
will operate without damage in temperatures in the range −65°F to +165°F. Electrical capacity is 20 amps dc resistive 28 v. dc, 10 amps. resistive 110 v. AC. **Control Products, Inc., Sussex St., Harrison, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

VIBRATOR CONVERTER

Model 3494 vibrator converter is capable of delivering continuous duty power up to 350 w. at 115 v., 60 cps, from an input of 48 v. dc. Primarily, the unit is used as a reserve source of ac power during commercial power outages and can be actuated by an external voltage-sensing circuit. After the start relay is energized, the converter picks up full load at approx. 50 μsecs. When the service vibrator fails, automatic transfer is made to the auxiliary vibrator within 3 seconds, and the transfer is indicated by a change in pilot lights. A four-position tap switch supplied in the output accommodates various load conditions so that automatic regulation can operate from the most desirable voltage value. **Cornell-Dubilier Electric Corp., South Plainfield, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

VOLTAGE CONVERTERS

Two small 12 v. dc to 6 v. dc converter units have been designed to prevent the obsolescence of 6 v. mobile two-way radio units caused by the

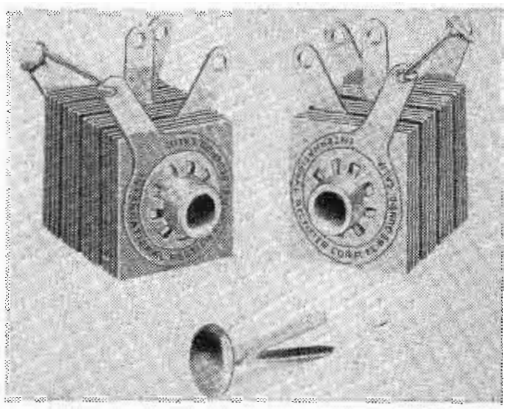


trend toward 12 v. automotive electrical systems. One can supply from 10 to 50 amps., the other from 10 to 30 amps. Both units utilize a special transformer-vibrator circuit with a conversion efficiency of better than 80%. The converters can be used with any mobile unit that operates within the given amperage limits. They are mounted under the instrument panel or in the automobile trunk. **Motorola, Inc., Communications & Electronics Div., 4545 W. Augusta Blvd., Chicago, Ill.**—TELE-TECH & ELECTRONICS INDUSTRIES.

See NEW PRODUCTS
for the
Electronic Industries
on pages 104, 106, 108, 112, 114, 116, 118, 120, 122, 124, 130, 131

RECTIFIER

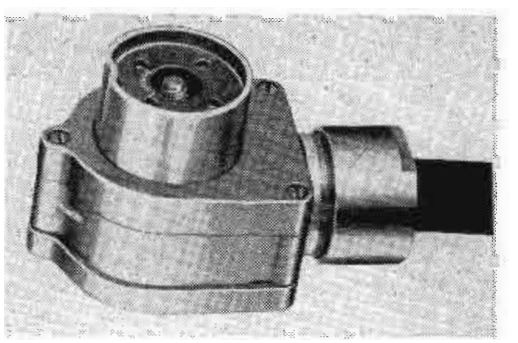
The single phase bridge rectifier, Type D-3575, is designed for direct use from 117 v. ac systems and rated to



deliver an output of 9 w. at 90 v. dc, continuous duty, to operate magnetic devices such as relays, solenoids, and electric counters. With a 3 μf or larger filter capacitor, the rectifier will deliver 117 v. dc. Thereby, in conjunction with this rectifier, the magnetic device can operate directly from the conventional 117 v. line. Mounting and terminal dimensions require a total space requirement of 1 1/16 x 1 1/16 x 1¼ in. **International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

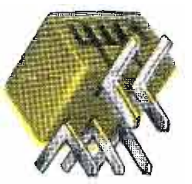
POWER CONNECTORS

A new series of sealed power connectors, manufactured to Signal Corps specifications and designated by Corps identifications ranging from U-112U to U-117/U, are now available for



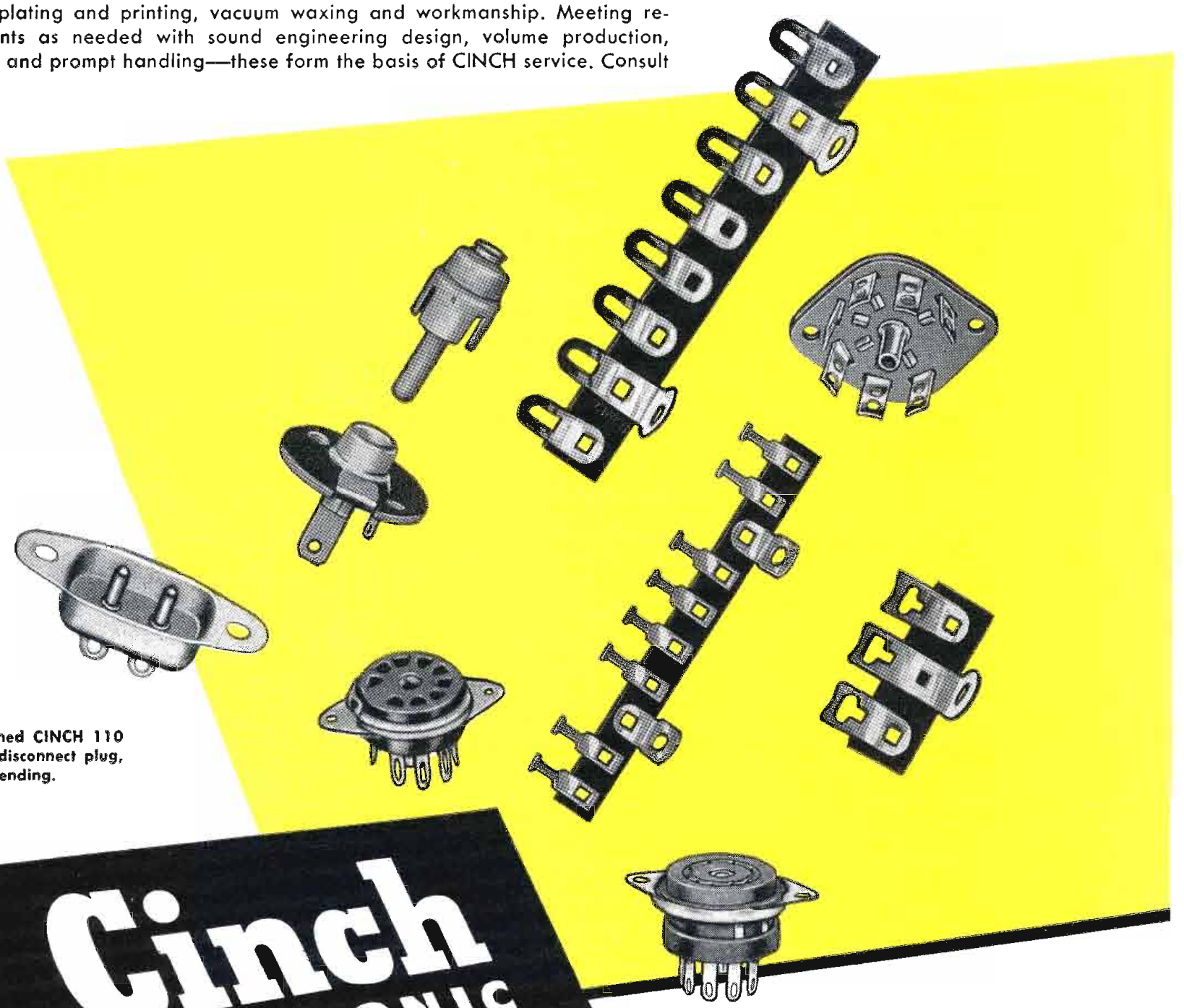
power units of audio equipment. Plugs are of the 90° angle type with a wing blade handle that operates a screw which easily engages or disengages under conditions that require the operator's hand to be gloved. Receptacles are round, with a lock ring for panel mounting. Contact arrangements are 4-No. 16, 12-No. 16, and 29-No. 16 contacts having 2,500 v. ac rms flash-over values. Contact engagement is extra long. Socket contacts are of the "closed entry" type. Finish is cadmium plate and olive drab chromate treatment. **Cannon Electric Catalog Dept., 420 West Avenue 33, Los Angeles 31, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

"FIRST" IN METAL PLASTIC ENGINEERING... STANDARD IN USE



The CINCH "original", or "first" numbers many types of components designed for varied purposes . . . and many now standard in use.

And the performance of these and all CINCH components has proven them to be of the utmost in quality, of insulation and other materials, tooling fabrication, plating and printing, vacuum waxing and workmanship. Meeting requirements as needed with sound engineering design, volume production, efficient and prompt handling—these form the basis of CINCH service. Consult CINCH.



Re-designed CINCH 110 Volt TV disconnect plug, patent pending.

CINCH-ERIE Plexicon Socket, a joint development of Erie Resistor Corp. and CINCH.

Cinch ELECTRONIC COMPONENTS

CINCH components are available at leading electronic jobbers—*everywhere*

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

WASHINGTON
News Letter

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

TACKLE OTHER TV PROBLEMS—After its assured sanction of compatible color television, now likely during the month of November, the FCC will tackle several other television issues of great importance. They are subscription TV, community antenna TV and booster and satellite video stations. Because major questions of FCC policy and the scope of the Communications Act over these new fields of television will be involved and must be determined, there is the definite outlook that a comprehensive hearing will be staged. The FCC recognizes that it has to present Congress with affirmative and complete information for any future legislation or for its own decisions on these issues.

NEW FM MULTIPLEXING SYSTEM—The undisputed "Father of AM and FM Radio," Major Edwin H. Armstrong has presented the FCC through the mid-October demonstration his FM multiplexing system which will permit the simultaneous broadcast of two different programs within a standard FM band and has great commercial potentialities of adding other radio services. Since Major Armstrong has forecast his new system is "only the beginning," this development brings into the controversy between FM broadcasting and industrial mobile radio services most important ammunition against "invasion" of the FM bands by the latter. Inventions by Maj. Armstrong have always been outstanding in the blazing of the progress of radio.

CONGRESSIONAL DEMANDS—Leaders in Congress, both the Senate and the House, are convinced that the standards blueprinted by the National Television System Committee for compatible color television are so undisputable to effectuate that new video services are completely in the public interest. As a result, this Congressional leadership has impressed the FCC Commissioners that no delay must ensue in the adoption of the color television standards. Color television broadcast equipment has already been geared for delivery in December to nearly 60 video stations throughout the nation by RCA and this epitomizes the desire of the public to have this new improved video service launched immediately.

SUPERSONIC AIR ELECTRONICS—Completely automatic communications-electronics systems with full reliability of performance are imperative for the supersonic jet aircraft, both for military and civilian aviation, Dr. W. R. G. Baker, Vice President and General Manager in charge of electronics of the General Electric Company, emphasized to the Radio Technical Commission for Aeronautics at its recent semi-annual meeting in Washington. Dr. Baker proposed that jet aircraft electronics systems must be integrated completely and predicted the integration of capacitors, resistors and transistors into a single crystal. He warned "we have not started early enough," because of having lagged in basic research, "in our attempts to devise the electronic tools needed to carry out the tasks which must be performed ten years or twenty years from now."

ENGINEERS MUST RECOMMEND—The importance to top management of using electronic engineers to make the recommendations and to formulate the plans for advancements in the use of electronics and radio was emphasized by the Association of American Railroads Communications Section's Chairman, General Communications Superintendent of the Rock Island Railroad, C. O. Ellis, in the keynote address at that body's recent annual meeting. He cited that the busy top executives are not going to plan the communications-electronics work for railroads so it is the job of the engineers in that field to recommend. He stressed "let us not be negligent in our duty to do so." Two-way radio and electronic systems for the operation of railroads are not only expanding, he said, but are "rapidly becoming a definite necessity."

REDUCE INTERFERENCE—Spurious radiations now causing a great deal of harmful interference to important radio communications services from radiobroadcast and television receivers should be given the most careful consideration by set manufacturers for their elimination to the fullest extent, FCC Commissioner George E. Sterling stressed to the Radio Fall Meeting in Toronto, Canada. There are other sources of interference which the FCC is studying intensively such as the operations of community antenna systems, campus broadcasting systems, ignition systems and electrically operated apparatus, he cited. Receiver manufacturers must take greater preventive measures to provide better selectivity and to suppress oscillator radiation and this is especially pertinent in UHF TV receivers and converters, he advised.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington, Editor

GET COMPLETE INFORMATION ON

PHILCO BROADCAST PRODUCTS

- Television Studio Equipment
- Television Microwave Equipment
- Communications Microwave Equipment

PHILCO
Famous for
QUALITY
the World Over

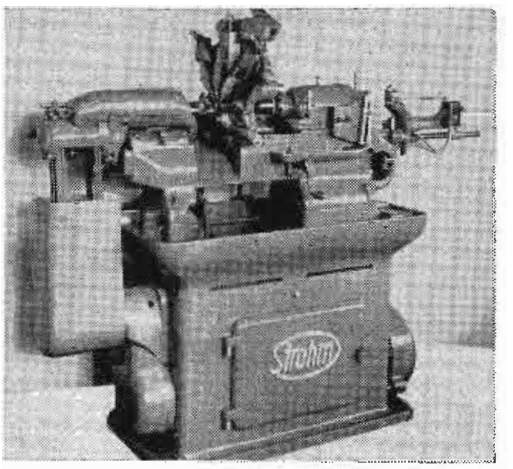
Write Department T for full details—Today!

PHILCO CORPORATION

GOVERNMENT & INDUSTRIAL DIVISION, PHILADELPHIA 44, PA.

SCREW MACHINE

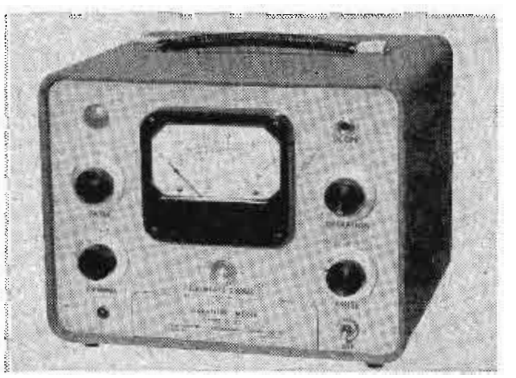
A Strohm Swiss type automat screw machine with a stock capacity of 20 mm has been added to the 7 and 10 mm



machines previously introduced by the Alfred Hoffman Needle Works, Inc. The company has also extended its activities to include a line of standard, high-precision, bench-type milling, drilling, and grinding machines. This development includes an expert tooling service which enables machines with requirements for secondary operations to be delivered ready-to-produce. Invitation is made for the submission of drawings and specifications of parts that can be suitably produced on Swiss automats for the purpose of estimating equipment costs, tooling and time cycles. **Hudson Automatic Machine & Tool Co., Div. Alfred Hoffman Needle Works, Inc., 3710 Hudson Ave., Union City, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

VIBRATION METER

Type 1-117 vibration meter weighs only 25 lbs. with three accessory filters installed and can be used wherever



standard 115 v., 50, 60, or 400 cps power is available. Where unwanted i-f frequency signals interfere with one desired, three accessory high-pass filters can cut-off sharply at 30, 70, or 110 cps. These filters plug into the case, but add nothing to its external dimensions. Both linear and torsional velocity of motion and peak-to-peak displacement are indicated on a direct-reading scale. Full-scale peak-to-peak displacement measurement from 0.0005 in. to 1.5 in. and linear velocity measurements from 0.5 in. to 1,500 in./sec. average are possible through various combinations of settings. **Consolidated Engineering Corp., N. Sierra Madre Villa, Pasadena 8, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

We shot for the moon ...on a clear night

We set our sights on developing a new electron gun . . . one whose finer beam would establish an all-time high in resolution for electrostatic-focus picture tubes.

We shot for a gun that would produce a smaller, sharper spot . . . a spot free from the effects of excessive "starring" which causes an outline blur similar to the haze around the moon on a cloudy night.

Smaller spot size, and cleaner, more uniform spot shape are the secrets of the Du Mont Hi-R Teletron. These are the features which have made possible a more vivid presentation of the television picture.

They are the reasons why, in just a few months, the Hi-R Teletron has become the performance standard of the television industry.

DU MONT®

*Teletrons**

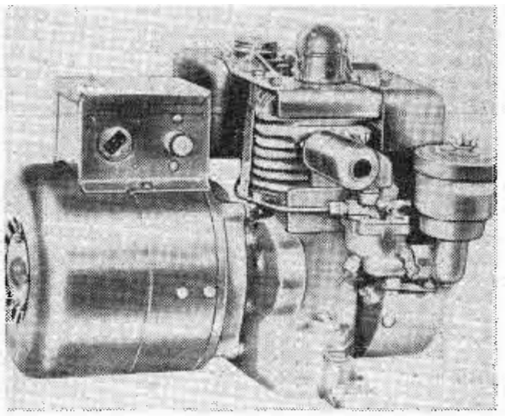
Hi-R— A new high in resolution — now being incorporated in all DuMont Electrostatic Focus Teletrons

*TRADE MARK

CATHODE-RAY TUBE DIVISION • ALLEN B. DU MONT LABORATORIES INC., CLIFTON, N. J.

ELECTRIC PLANT

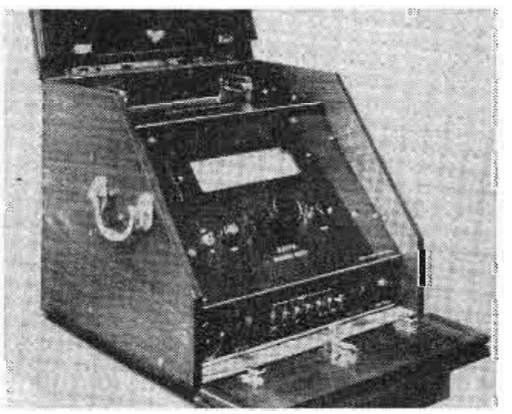
Model 550 electric plant has been re-engineered. The unit is now 5 lbs. lighter, 2½ in. shorter, and 6 in.



lower, yet it develops 500-550 watts ac, 110-220 v., as before. The engine is a one cylinder, four cycle type. The generator is oversized, self-excited, and self-regulated. Total weight is 73 lbs. The equipment is available with either electrical or manual starting. **Universal Motor Co., 498 Universal Dr., Oshkosh, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MOISTURE METER

The Kappa electronic moisture meter (U.S. Patent No. 2613249) operates at radio frequency on the capacity change



principle. It is capable of measuring the moisture content of a substance with a water content as low as 0.5% and as high as 70%, at the other end of the scale. The instrument is manufactured in two degrees of sensitivity —the "All-Purpose" and the "S" types. The former enables discrimination of better than 0.07%, the latter has an expanded scale between 0 and 15% moisture. **Marconi Instruments Ltd., Dept. TT, 23 Beaver St., New York 4, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

ALLIGATOR CLIP

Nos. 524B and 524R distinguish the black and red bodies of a new fully-insulated alligator clip that facilitates testing live circuits. Spring-loaded jaws, actuated by a thumb button in the clip body, hold firmly on conductors up to ¼ in. in diam. Connection to the clip is made with standard banana plugs. **Insuline Corp. of America, 3602 35th Ave., Long Island City 1, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

QUALITY IN MINIATURE!

Langevin PLUG-IN

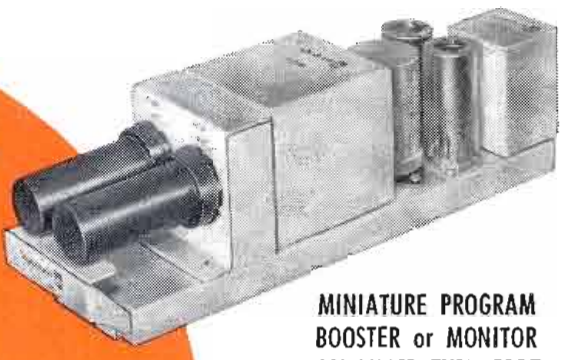
AMPLIFIERS and POWER SUPPLIES

. . Langevin-engineered to IMPROVE PERFORMANCE!

Miniature-designed to SAVE PANEL SPACE!

—for Radio and Television Broadcast, Recording Studios and Sound Systems

AVAILABLE IMMEDIATELY FROM STOCK

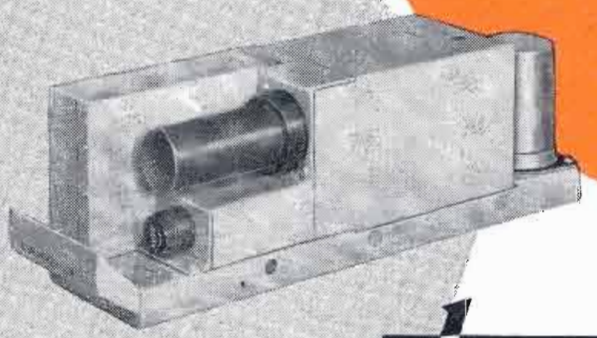


MINIATURE PLUG-IN PRE-AMPLIFIER OR BOOSTER AMPLIFIER TYPE 5116

Miniature plug-in two stage, low noise pre-amplifier or booster amplifier. The smallest high performance amplifier of its type that exceeds FCC requirements. Small size, excellent design and plug-in features make type 5116 ideal for installation in consoles and equipment racks. Push button metering facilities and gold plated plugs are standard at no extra cost.

MINIATURE PROGRAM BOOSTER or MONITOR AMPLIFIER TYPE 5117

A plug-in two stage, push-pull, fixed gain audio amplifier. The most compact amplifier available for this service. Outstanding quality recommends type 5117 for applications requiring outstanding performance and maximum availability. Push button metering facilities and gold plated plugs are standard at no extra cost.



PLUG-IN POWER SUPPLY TYPE 5208

A miniaturized power supply of extremely compact design. Built of highest quality component parts throughout, type 5208 is designed for continuous service. Capable of supplying power for 10 Type 5116 pre-amplifiers or lesser combinations of types 5116 and 5117. Overall length 10¼"; width 2⅝"; height 3".

Langevin

—the name synonymous with quality in audio equipment and components since 1923

NEW! File Catalog for broadcast engineers and sound technicians available without obligation. Request your copy today—just call or write, on company letterhead, to:

LANGEVIN MANUFACTURING CORPORATION
37 WEST 65th STREET, NEW YORK 23, N. Y.

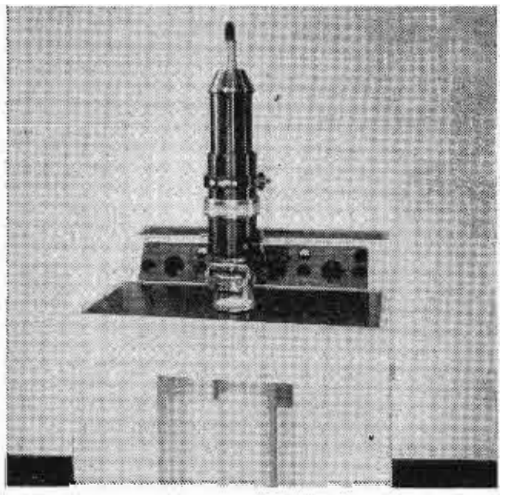
PLUG-IN POWER SUPPLY TYPE 5206

Designed for use with Langevin Miniature Amplifiers. Provides AC for amplifier filaments and well filtered DC for amplifier plate. One unit provides adequate power to operate up to 22 Type 5116 Amplifiers or lesser combinations of Types 5116 and 5117 with separately fused filament and plate supplies.

EXPORT DISTRIBUTORS: INTERNATIONAL STANDARD ELECTRIC CORPORATION, 50 CHURCH ST., NEW YORK CITY

ELECTRON MICROSCOPE

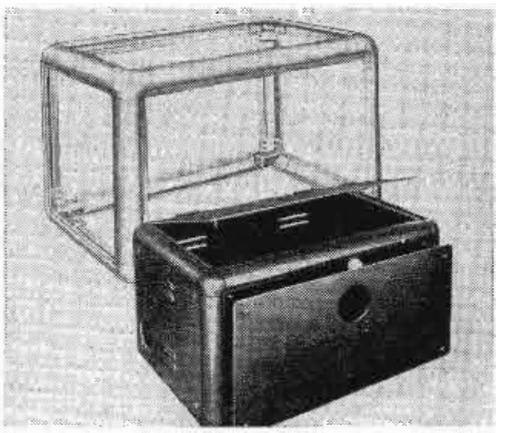
Suitable for analytical work in industrial processing, research, medicine, pathology, and biology, the EM-75 elec-



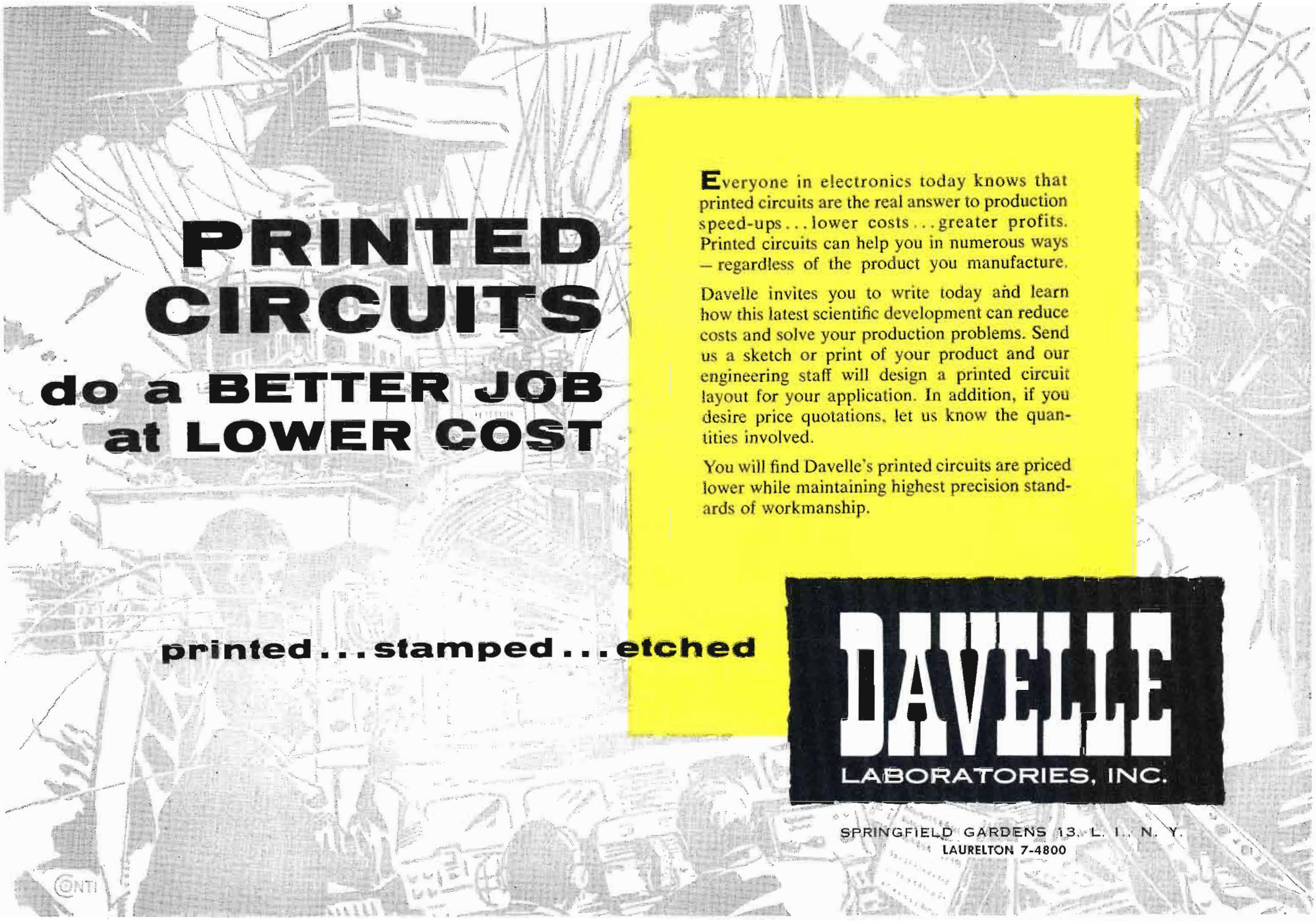
tron microscope utilizes an electron-optical system that includes condenser, objective, and projector lenses. Magnification is continuously adjustable between 1,500 and 15,000 diameters and variable between 10 and 75 kv. Resolving power is better than 100 Angstroms under average operating conditions. The new instrument is approximately 74 in. high, 37 in. wide, and 25 in. deep. Power supply is 220 v., 50-60 cps. Power consumption is about 1 kw. **North American Philips Co., Research & Control Div., 750 South Fulton Ave., Mount Vernon, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CABINET COMPONENTS

The Widney-Dorlec cabinet system consists of prefabricated die-cast corners, extruded sections, and other spe-



cial parts which fit together to form fully-radiused cabinets. Integrated into the system are a group of telescopic mountings and hardware which enable the production of finished cabinets without use of special tools. Main sections and corners bolt together to form a framework in which metal or plastic panels can be inserted. Framework components are in three radii: $1\frac{3}{16}$ in., $1\frac{3}{16}$ in., and $\frac{7}{16}$ in. Special corners enable fronts with 45° slopes. Variation of the corners with crossbar and main frame sections facilitates the assembly of any desired shape or size of cabinet. Sole U.S. agents for Widney-Dorlec equipment are: **British Industries Corp., 164 Duane St., New York 13, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

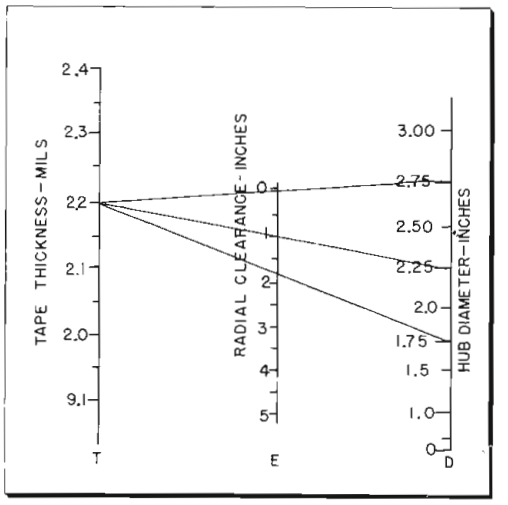


CUES for BROADCASTERS

(*Continued from page 83*)

high tension on the supply reel. Larger hub diameters are definitely indicated as the solution to this problem.

However, increasing the hub diameter leads to still another serious



Nomograph shows clearance between outside of reel flange and outside turn of tape

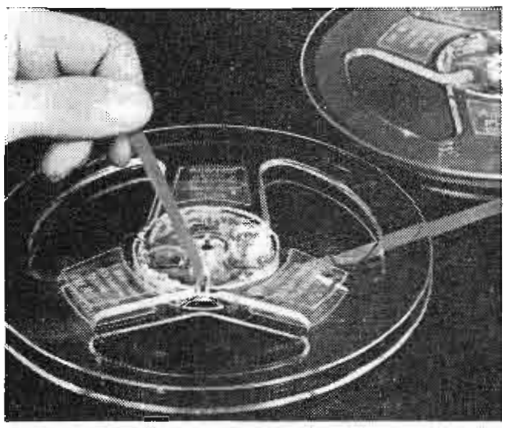
consideration. Since the outside flange diameter is fixed at 7 in. by the design features of many commercial machines, the larger hub can be attained only at the expense of winding space. This problem is illustrated by the accompanying nomograph showing the effect of hub diameter and tape thickness on the radial clearance between the outside turns and the reel flange ("E" value). The length in all cases is assumed to be 1220 feet, the usual commercial practice for a 1200-foot minimum length. Since the maximum tape thickness has been standardized at 2.2 mils, this must be considered as the most difficult condition under which to view the reel space problem.

It is apparent that, under these conditions, the relatively new 2.75-in. hub leaves only a dangerous 0.020-in. clearance, the 2.25-in. hub, a comfortable 0.10 in. and the old 1.75-in. hub a full 0.18 in. The problem then resolves itself to the question of a safe minimum "E" value, and it would appear that the 0.020 in. afforded by the 2.75-in. hub must be ruled out on this count.

Indeed, the 0.10-in. clearance for a 2.25-in. hub may be considered somewhat close, but in view of the attendant advantage in timing, this figure offers a very satisfactory compromise. Therefore, a 2.25-in. hub diameter has been adopted for the new 3M reel, while the 2.75-in. hub has been maintained for use with special "Scotch" No. 111 AP magnetic tape.

The problem of warping again brings up consideration of metal reels. While metal is more heat stable than plastic, experience has shown that permanent deformation through bending is much more serious in metal reels. Metal reels also tend to be heavier and have greater inertia, thereby creating additional hazards in starting, stopping and rewinding. In addition, the fabrication of metal reels is somewhat more complicated than that of plastic molded reels, putting economic factors also on the side of plastic. All points considered, the best approach to the problem seems to be the redesigning of the existing plastic reel with heavier cross-sections. Widening the spokes simultaneously strengthens the reel and provides more labeling space.

However, overall thickness must be maintained if the reel is to operate properly on existing machines, so any increase in spoke thickness must diminish the space between flanges. The spokes in the new reel have been thickened and tapered so that the space between flanges is only 0.306 in. at the hub and 0.336 in. at the outer edge. This accom-



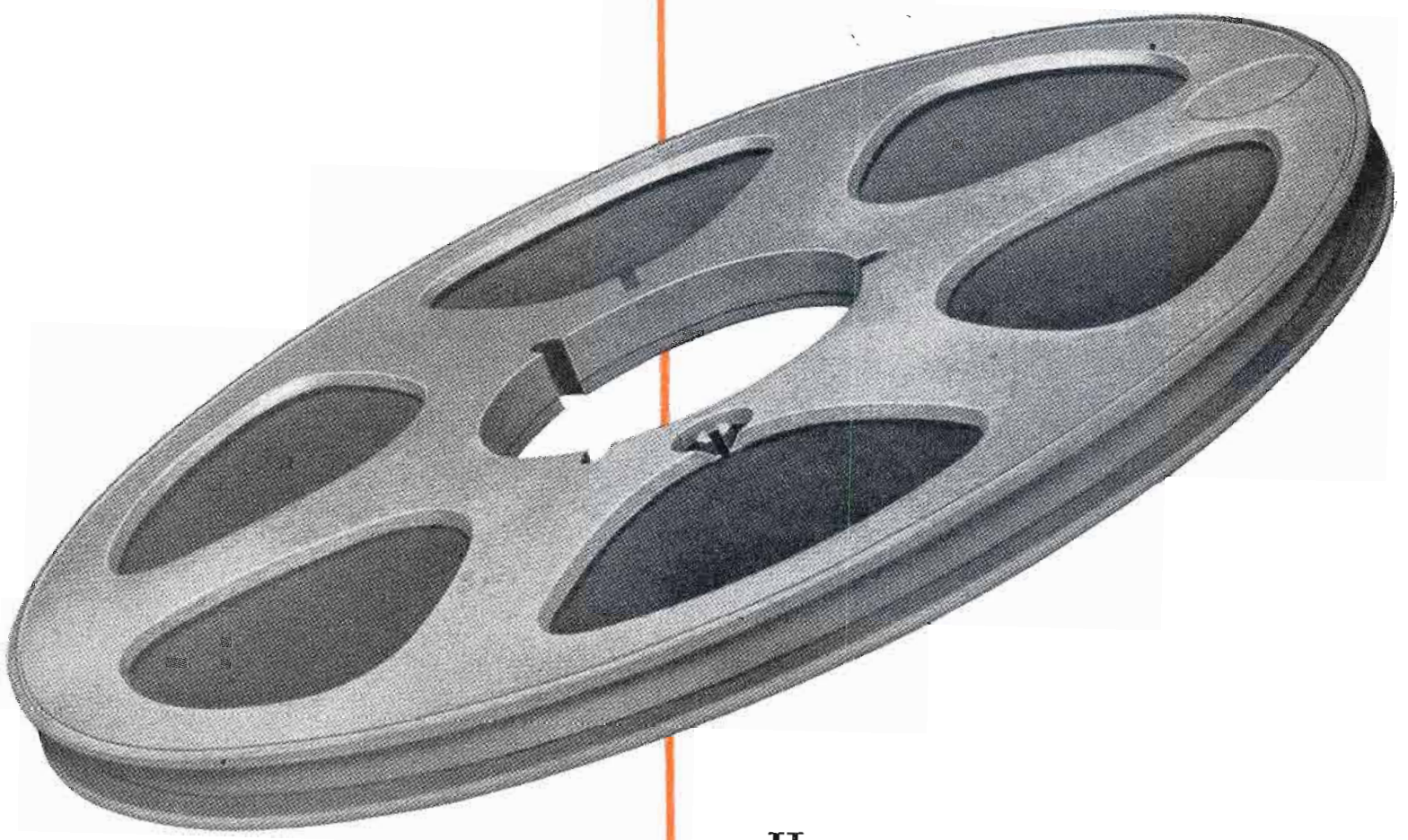
Easy threading of tape reels by pulling tape up through "V" slot in hub saves wear

plishes both a stiffening effect, and a smaller clearance to reduce uneven winding.

In considering the final problem of threading, it was found that a great many users of 7-in. reels do not thread the tape into the existing slots at all, but merely draw the tape up between two spokes and rotate the reel a few turns to cinch the tape on the hub. This is a very fast method of threading, but often leads to a bulky fold and eccentric winding. Recognizing the simplicity of this method, "V" diagonal slots have been provided in the hub of the new reel to accommodate the turned up end of the tape without bulging. Threading is easily accomplished as shown in the photo.

audiotape TRADE MARK now available

on new Fiberglas 10½" reel



SOLID, ONE-PIECE CONSTRUCTION

STANDARD N.A.B. HUB DIAMETER

25% LIGHTER THAN ALUMINUM REEL

HAS SMOOTHER FLANGE EDGES

WILL NOT BEND

RESISTS WARPING AND DISTORTION

PRACTICALLY INDESTRUCTIBLE

HERE'S A NEW 2500-foot reel with a number of improved design features that will appeal to many tape recordists.

Audiotape can now be supplied on this light-weight Fiberglas reel at *no increase in price*. For a trial order, get in touch with your nearest Audio distributor. If he doesn't have the new reels in stock, have him contact our New York, Chicago or Hollywood office and we'll see that your requirements are promptly filled.

This is another example of how Audiotape gives you *extra value* at no extra cost. Its performance speaks for itself. Output, frequency response, noise level and distortion are correctly proportioned for the most satisfactory end result—with no compromise on quality anywhere along the line.

AUDIO DEVICES, Inc.

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

Offices in Hollywood — Chicago

Export Dept., 13 East 40th St., New York 16, N.Y., Cables "ARLAB"

THEY SPEAK FOR THEMSELVES

audiodiscs
audiotape
audiofilm
audiopoints

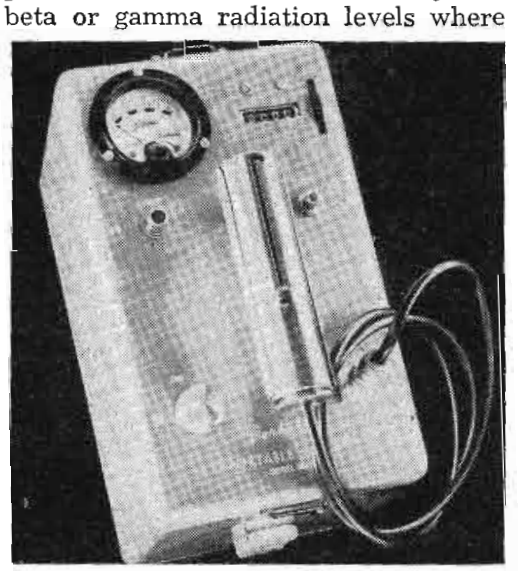
CURVE FOLLOWER

The "Autograf," a general purpose portable 2-axis graphic recording instrument, is now available as an auto-

matic curve follower which generates, as a potentiometer setting, the function Y from a graph of the relationship Y=f(X). When used as a recorder, the instrument plots instantly Y=f(X) through two independent rebalancing servo-actuated recording axes from data reduced to electrical form. The resulting Cartesian coordinate graph is drawn with pen and ink on standard 8½ x 11 in. graph paper. When used as a curve follower, the pen is replaced with a pickup stylus. The curve to be reproduced is drawn with conducting ink on a sheet of standard graph paper. **F. L. Moseley Co., 409 N. Fair Oaks Ave., Pasadena 3, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

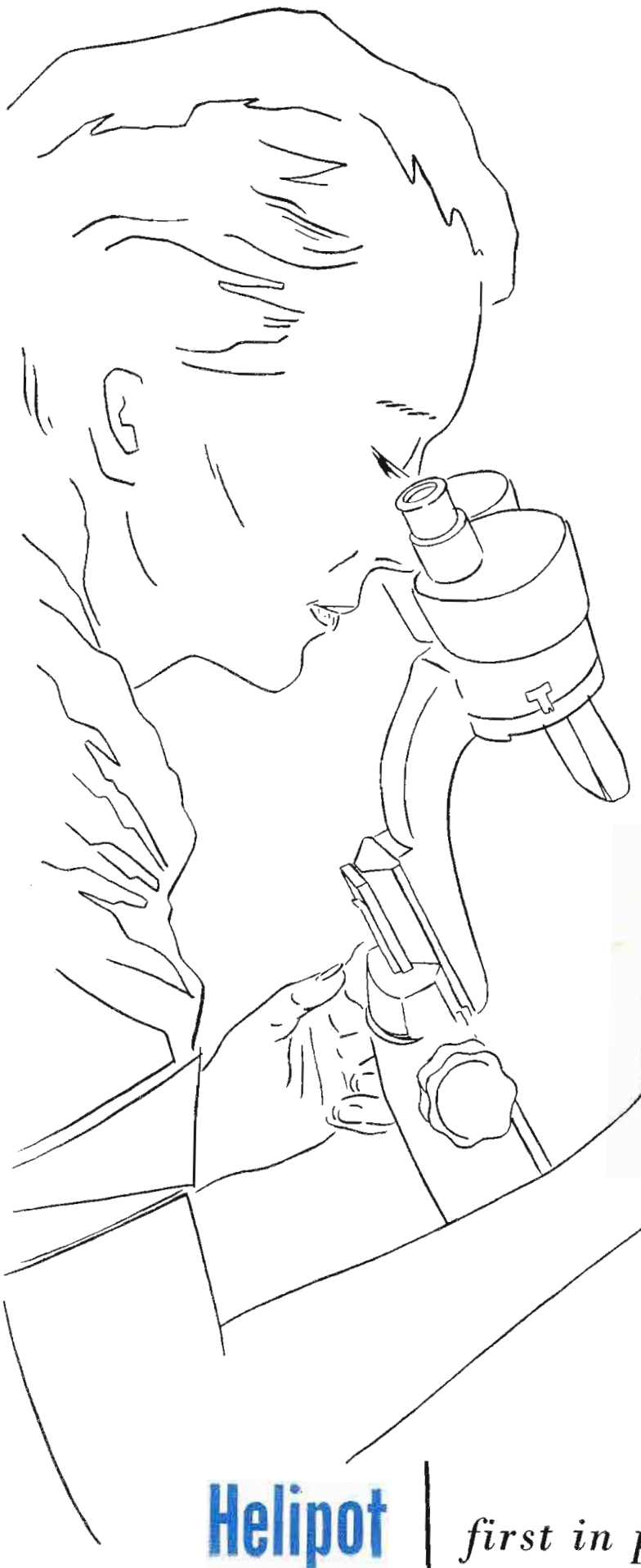
PORTABLE SCALER

Model 2080 is a battery-operated portable scaler that measures very low beta or gamma radiation levels where



the source-to-background ratio is small. It has an electronic scale-of-eight and a four digit resettable register. The electronic scaling binaries use sub-miniature tubes designed for low battery drain and maximum reliability. The vibrator type high-voltage supply is regulated at 900 v. by a corona discharge tube. Maximum counting rate is 100 counts per sec. In intermittent use, the battery life is 60 hrs. **Berkeley Div., Beckman Instruments Inc., 2200 Wright Ave., Richmond, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

Having the RIGHT CONNECTIONS *is a big help!*



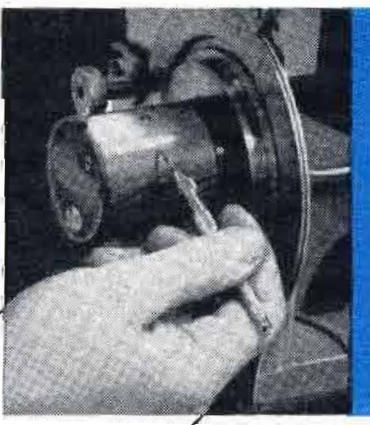
Helipot* . . . first in precision potentiometers . . . makes sure that, in *every* Helipot, you do have the right connections. No pressure-type connections are used in *any* Helipot. Tap connections are spot-welded by a Helipot-developed process, and other electrical connections are soldered . . . they all *stay put!*

The spot welding process is a particularly interesting one . . . and more important, it offers a very real advantage to users of Helipot precision potentiometers. Skilled workers, using binocular microscopes, employ a new technique in spot welding the very fine electrical connections. This technique assures that tap connections are attached to a single turn *only* of the resistance wire, rather than to several adjacent turns as is usually the case with the conventional method. Thus the high resolution, so important to the proper functioning of a precision potentiometer, is not reduced, and none of the wire turns adjacent to the one tapped are shorted out.

The spot welding process offers the further advantage of providing the strongest possible type of connections . . . vibration proof, shock proof, corrosion proof, unaffected by temperature and humidity changes. And to cap the climax, the new process is efficient and economical . . . another example of the Helipot policy offering the lowest price consistent with the high quality you expect in Helipot products.

For information about Helipot's complete line of precision potentiometers, call your nearest Helipot representative or write direct!

*T.M. Reg. U.S. Pat. Off.



WRITE FOR YOUR COPY!

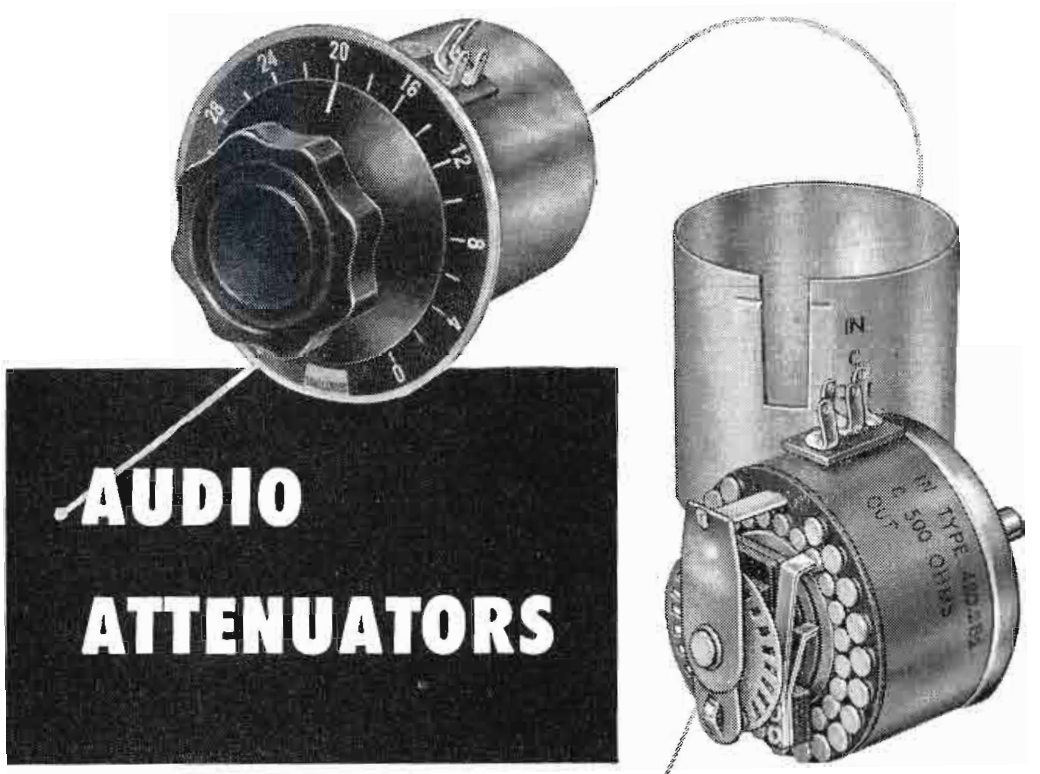
Your copy of the HELIPOT Model Selector describing every model of HELIPOT Precision Potentiometers and Duodials is now ready. Please write for it on your company letterhead. Ask for M.S. # 1203

Helipot *corporation*

a division of **BECKMAN INSTRUMENTS, INC.**
SOUTH PASADENA, CALIFORNIA

PLANTS AT SOUTH PASADENA, CALIFORNIA & MOUNTAINSIDE, NEW JERSEY
ENGINEERING REPRESENTATIVES IN PRINCIPAL CITIES

Helipot | *first in precision potentiometers*



OVER 200 BASIC TYPES TO CHOOSE FROM

Do audio attenuator problems cost you money? Chances are Shallcross has a model to match your specifications exactly—and at moderate cost.

Shallcross attenuators are made in over 200 basic types. Each type can be supplied with a choice of attenuation characteristics . . . with a positive detent mechanism . . . and in numerous input and output impedances. Where calibration must be extremely accurate, Shallcross precision wire-wound resistors are used. For less critical applications, models with high grade composition resistors can be supplied—often at lower cost.

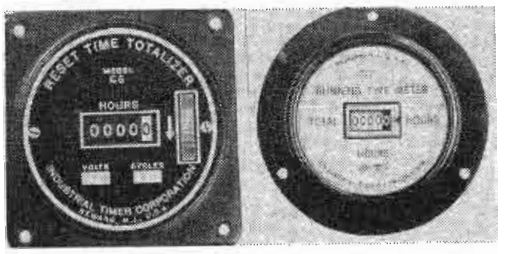
A complete description of all Shallcross attenuators — mountings, characteristics, and circuits is yours for the asking in Bulletin L-4A. SHALLCROSS MFG. CO., 518 Pusey Avenue, Collingdale, Penna.

QUICK DELIVERIES! Small quantities of popular 20 step Shallcross composition resistor potentiometers and wire-wound ladders without detents are immediately available.

Shallcross

TIME METER

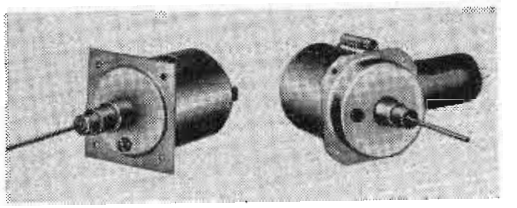
Model C5 reset time totalizer incorporates a counter that resets to zero at any time, counts in 1/10 hrs.,



and has a range of 10,000 hrs. Model C5A, for the same voltage ratings, counts in hour units, and has a range of 100,000 hrs. Self-lubricated, long-life, heavy-duty, synchronous motors are connected through gears to 5-digit counters that record in numbers of hours or minutes, depending on the model. The meter can be supplied for 115 or 220 v. operation at 60, 50, or 25 cps. Baked black-finished steel housing has a 2⅞ in. diam. and is 3¼ in. long. **Industrial Timer, 115 Edison, Newark 5, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES.

COAXIAL ELEMENTS

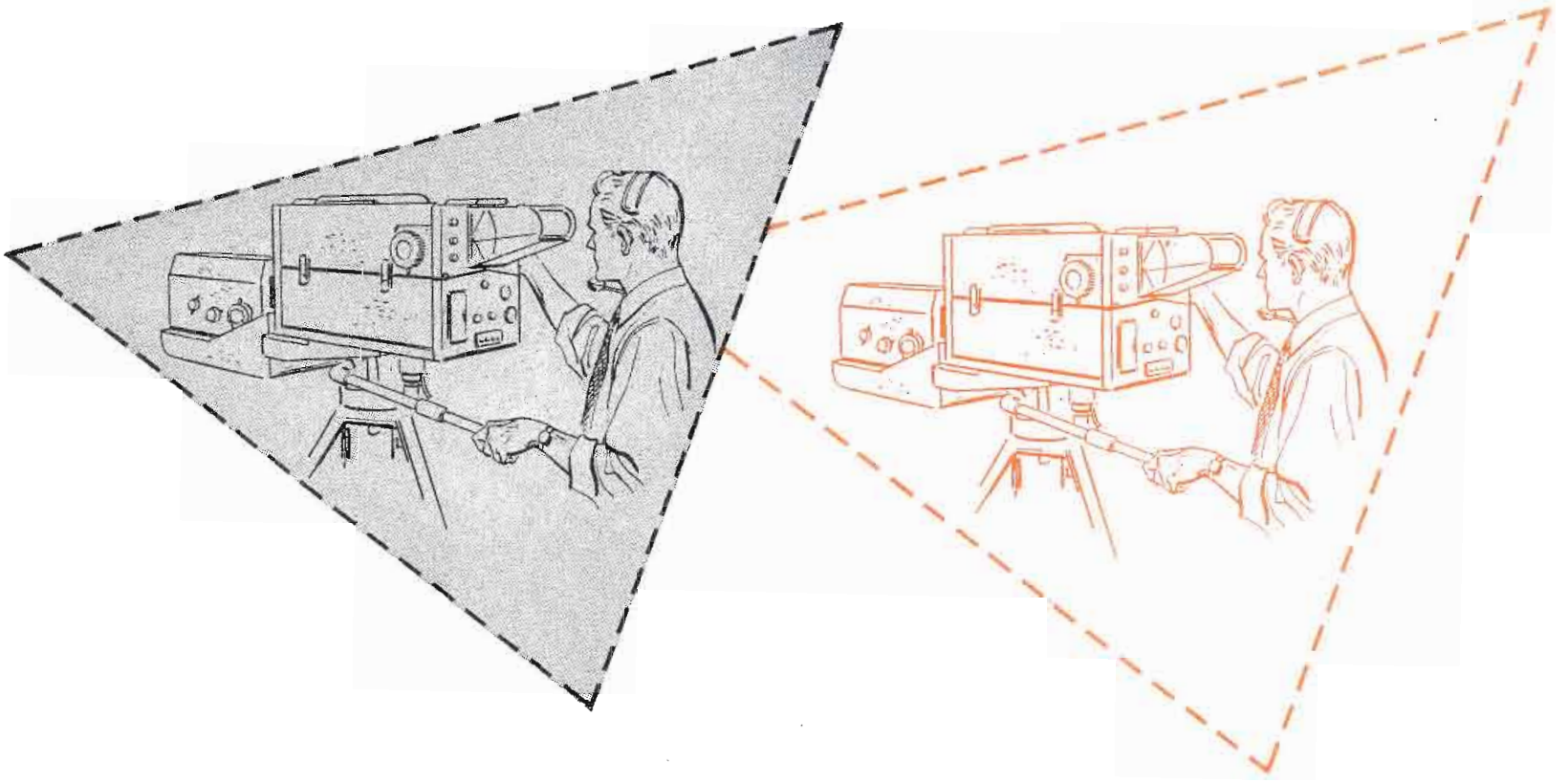
Two types of UHF coaxial tuned elements incorporate resonant cavity tuning which features a moving



plunger, enabling coverage of the entire UHF-TV band. Model UHO (right) is an oscillator element with a built-in 6AF4 tube. Model UHR is a preselector element. Both units are completely wired and tested. **Granco Products, Inc., 36-17 20th Ave., Long Island City 5, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MILLING MACHINE

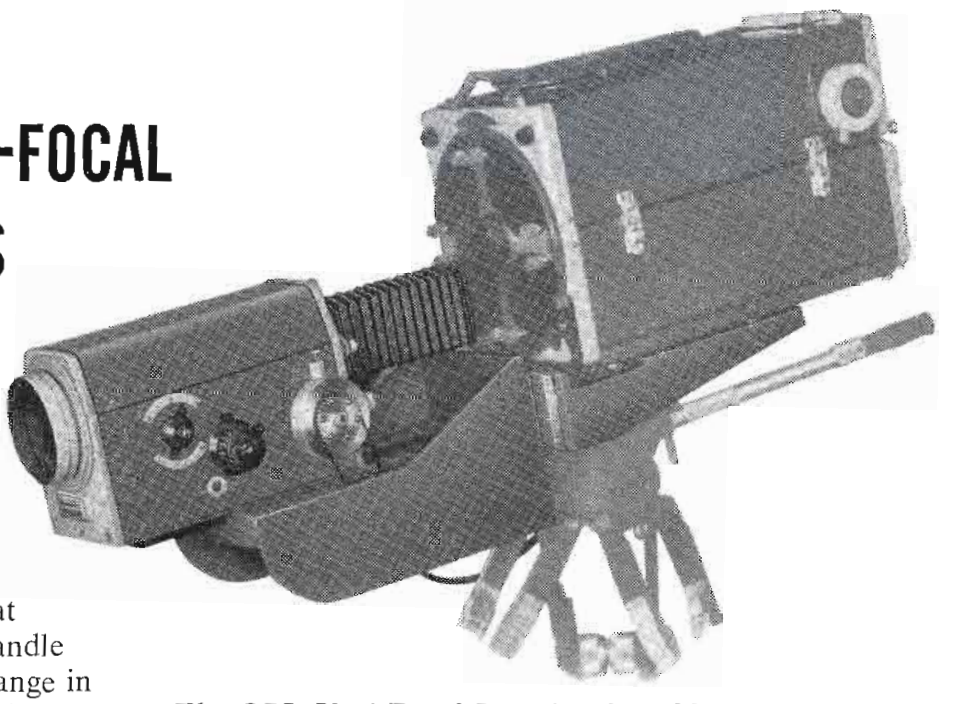
Model 3-DS three-dimensional pantograph milling and die-sinking machine comprises a high-speed vertical-milling spindle coupled to a tracer by a patented pantograph arrangement. The cutter follows the tracer both horizontally and vertically. When a master or guide for the tracer is provided, any form or impression can be cut. Drive is by round endless belts. The push-botton controlled motor is mounted on the machine head. Pantograph reduction is variable from 1½ to 1 down to 7 to 1. The spindle taper takes a series of three collets for holding parallel shank cutters. A graduated micrometer dial controls the depth of cut. Size of work table and copy table, 15 x 8 in. Vertical and horizontal motions of copy table, 6 in. Motor, ½ hp. Spindle speeds (7), rpm, 800-8,000. **British Industries Corp., 164 Duane St., New York 13, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.



TURN YOUR CAMERA into TWINS . . .

with the GPL VARI-FOCAL LENS

(3″ to 15″ or 6″ to 30″ range)



One camera and a GPL vari-focal lens equals the work of two or more chains . . . at only the cost of a lens. One camera can handle an entire show, for the lens has a 10:1 change in focal length in two 5:1 steps—from 3 to 15 inches and 6 to 30. One camera can be used in studio or field with either range. Interchangeable back elements provide quick shift of two ranges.

Fully color-corrected, this lens has perfect overall focus at f/5.6 or higher numbers, in 3-15 range. Flat field over entire range. Motor driven lens is operated from camera or control room.

The GPL Vari-Focal Lens is adaptable to image orthicon cameras of all types.

Now in network use, this lens offers station operators new scope in camera work—new economy in making twins of any camera.

Write, wire or phone for full optical and mechanical specifications.

General Precision Laboratory
INCORPORATED
PLEASANTVILLE NEW YORK

GPL

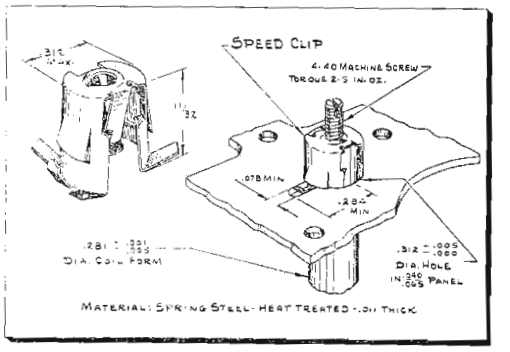
Export Department:
13 East 40th St., New York City
Cable address: Arlab

Cable address: Prelab

Camera Chains • Film Chains • Field and Studio Equipment • Theatre TV Equipment • GPL-Continental Transmitters

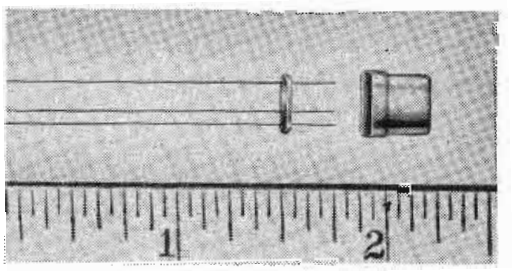
COIL FASTENER

The new spring steel coil form fastener shown is said to provide points of design that result in better maintenance of fine tuning adjustment, more uniform torque, greater shock cushioning, and wider contact area. **Tinnerman Products, Inc., P.O. Box 6688, Cleveland 1, Ohio.**—TELE-TECH & ELECTRONIC INDUSTRIES.



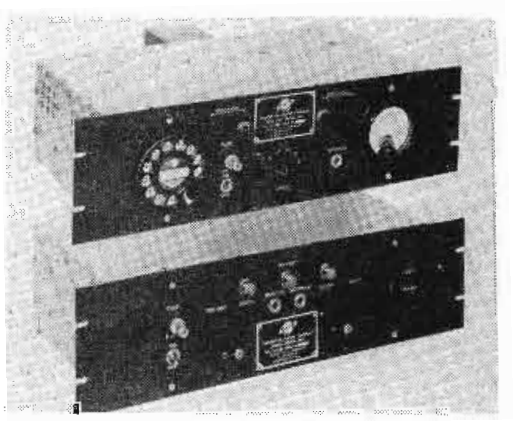
TRANSISTOR CLOSURES

The following E-I standard transistor closures are available from stock: TC-1C, can with soldering dimple and hole; TB-1A, base with plug-in lead; TB-1B base with long leads. **Electrical Industries, Inc., 44 Summer St., Newark 4, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

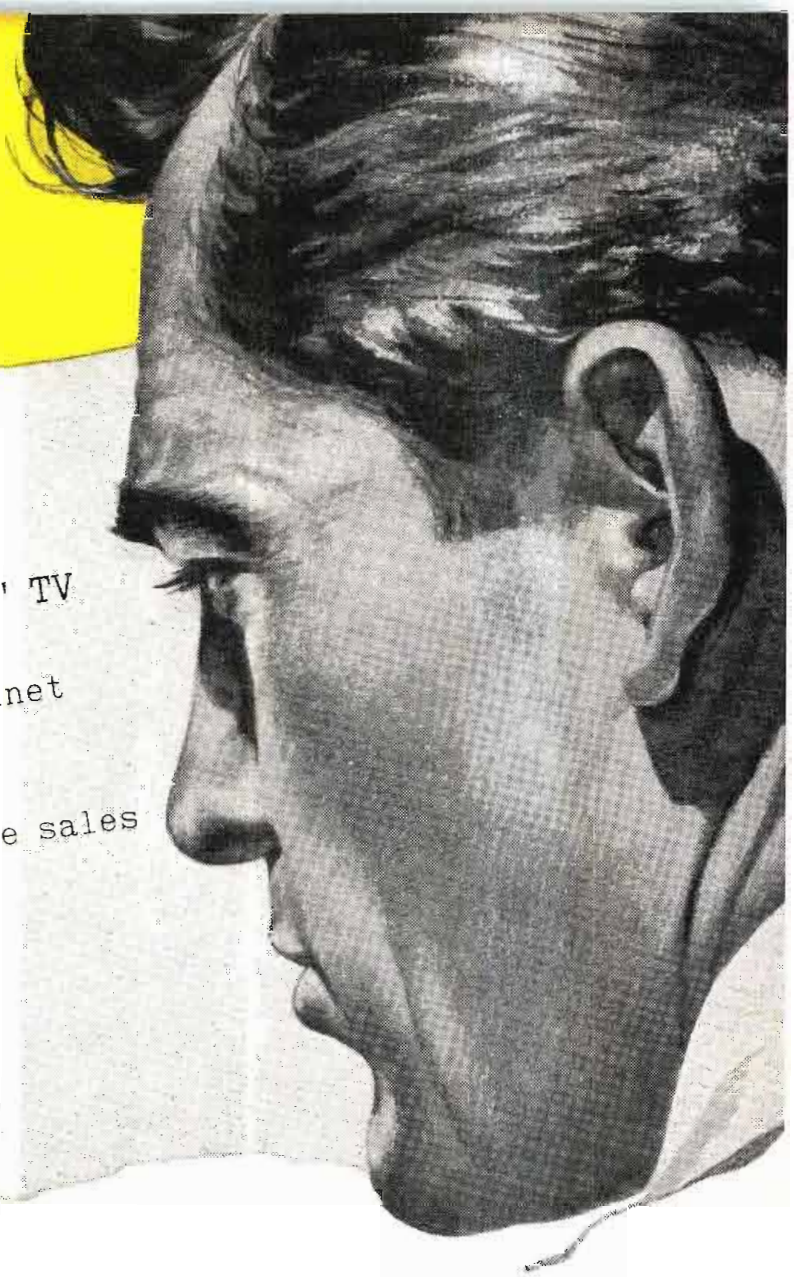


REMOTE SYSTEM

A new remote control system for unattended communications stations uses no dc on the line which permits use of any speech telephone line or radio link regardless of the number of repeaters used. The system includes provisions for operating six separate circuits with a single operator's control unit. Plug-in subassemblies provide flexibility and easy maintenance. Though designed for airways radio communications control, the equipment can be used with any other equipment that uses on-off switching and dial selection for control. **Schuttig and Co., 9th and Kearney Streets, N. E., Washington 17, D. C.**—TELE-TECH & ELECTRONIC INDUSTRIES.



"What picture tube can I use, and is it in production?"



DESIGN "MUSTS", OUR NEW 21" TV

--smaller, more compact cabinet

--more picture area

--same low price, for volume sales

New

90° G-E 21ACP4 CUTS CABINET DEPTH 3", GIVES 7% BIGGER PICTURE!

READY and available now to TV manufacturers! And price is right in line with other 21" picture tubes. It takes not a single penny more of tube cost, for you to have the compact TV cabinet, the oversize picture, which will put your big-volume receivers 'way out front . . . features that *only* the 21ACP4 will give you. Get all the facts from *Tube Department, General Electric Company, Schenectady 5, N. Y.*

* * *

NEW G-E 21ACP4 is a full 3 inches shorter than 70° tubes of similar screen size. Means you can slice that much off cabinet depth . . . Has 262 square inches of screen area, against 245 for the popular 21EP4-A . . . or 7% more picture.

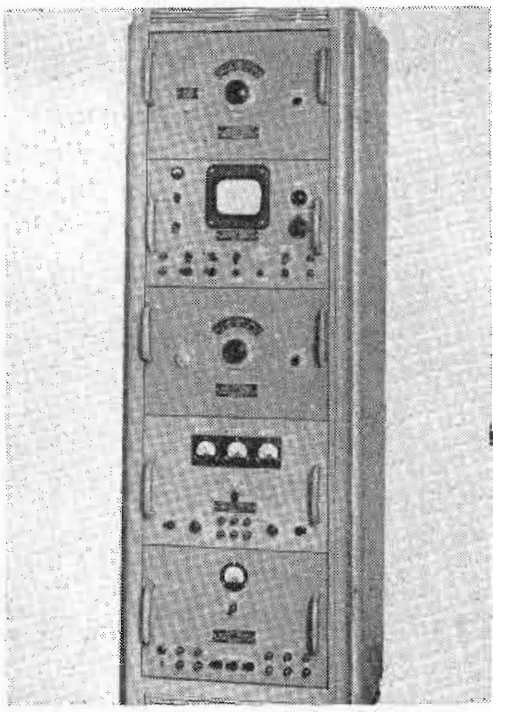
STILL OTHER 90° G-E TYPES—aluminized and non-aluminized—are ready, or on their way. Always keep in touch with General Electric for what's new and better in picture tubes!

GENERAL ELECTRIC

162-1A4

SPECTRUM ANALYZER

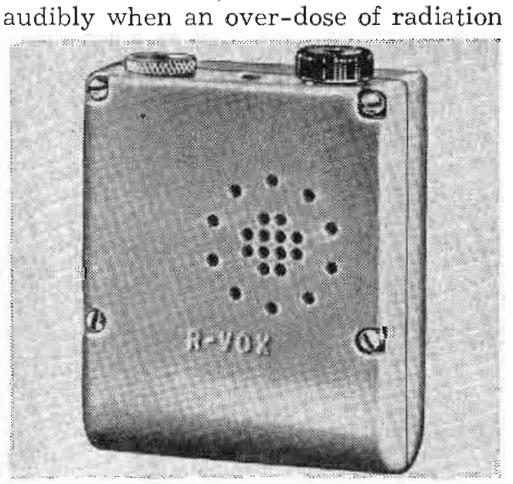
Providing direct means for the measurement and spectral display of an r-f signal, model LSA all-band spectrum



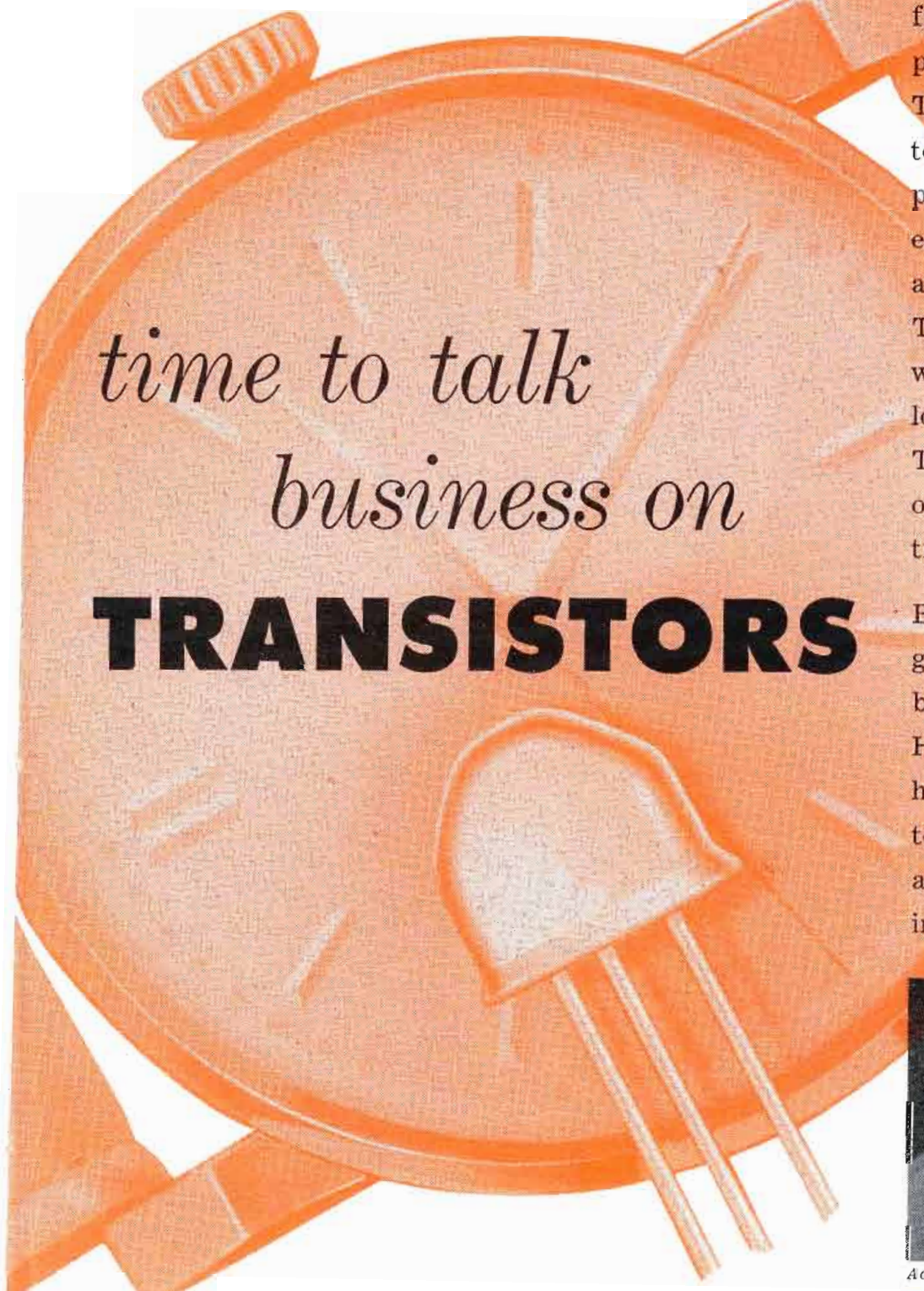
analyzer has a range extended to 21,000 MC. It is used to examine the pulse spectrum of magnetrons and klystrons and to measure noise and interference spectrum, harmonic frequency differences, bandwidth of microwave cavities; and calibrating microwave oscillators and preselectors. The tuning unit is set to the desired frequency to obtain the spectrum, and analysis is obtained by modulating the second local oscillator. **Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RADIATION ALARM

The R-VOX, a new personnel safety radiation alarm, informs the user audibly when an over-dose of radiation



has been received. It was designed for use in all laboratories in which gamma radiation exists. Weighing only 9 oz. the unit can be carried by a belt loop; or it can be used as an area monitor. Further, it operates automatically when face up, or in the vertical position. A penlight cell, used for filament current, can be replaced by removing a bayonet plug. Chambers up to 25 roentgens are available. Standard range is 100 milliroentgens. **Radiation Counter Laboratories, Inc., Nucleonic Park, Skokie, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

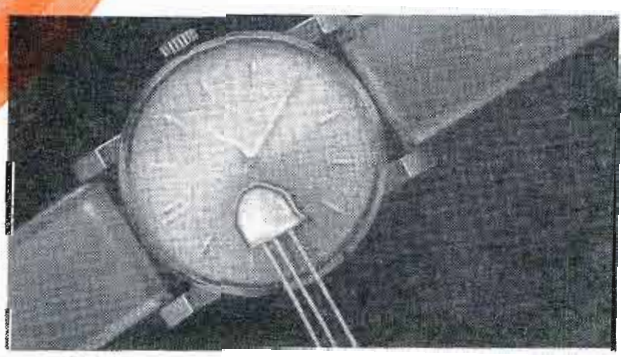


If you are in Electronics you are going to need Transistors. The time to investigate is NOW!

From now on the use of Transistors is going to spread rapidly. Their advantages in simplifying design are unique. Their potential applications are endless.

Whenever you think of vacuum tubes, from now on you should consider the possibility of substituting Transistors. True, the characteristics of the Transistor do not lend themselves to direct replacement of tubes in existing circuitry; each new application must be designed around the Transistor. What makes the Transistor so overwhelmingly worth while is its small size and light weight, long life and low cost. In addition, the Transistor's versatility of function opens up a broad new field of applications never before possible.

By consulting with Hydro-Aire now you get a head start in exploring the possibilities that Transistors hold for you. Hydro-Aire's specialized research know-how and experience in such important techniques as true hermetic sealing are at your disposal. Our engineers are waiting to consult with you—now.*



Actual size

Please address your inquiries: CHIEF CONSULTING ENGINEER,
Transistor Development and Application Division,
Hydro-Aire, Inc.,
3000 Winona Avenue, Burbank, Calif.

HYDRO-AIRE *Inc.*

BURBANK, CALIF.

Subsidiary of Crane Co.

CONSULTANTS ON TRANSISTOR APPLICATIONS

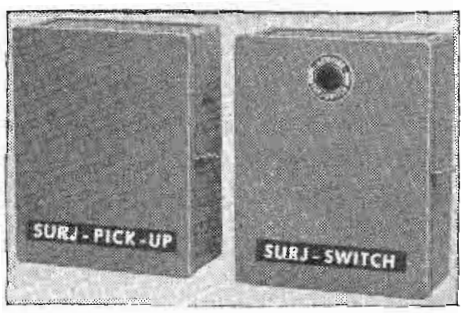
SWR AMPLIFIER

Model TAA-16B for determining standing wave ratios or comparing any two demodulated signals, incorporates

all the features of former models. It also features dual input channels with gain sufficient for full scale meter deflection with less than 2 μv input. The amplifier may be used broadband from 500 to 5,000 cps, or may be sharply tuned over the range by panel controls. For use with bolometers, an internal voltage source is supplied, and bolometer current for either input is metered and adjustable from the front panel. The meter scale is calibrated in SWR and db of SWR with a precision attenuator permitting db of SWR readings up to 50 db. Jacks provide for remote metering and for a dc recorder when a permanent record is desired. The unit is fully shielded and furnished with a cabinet and standard 8¾ in. rack panel. Weight, approx. 45 lbs. **Browning Laboratories, Inc., 750 Main St., Winchester, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

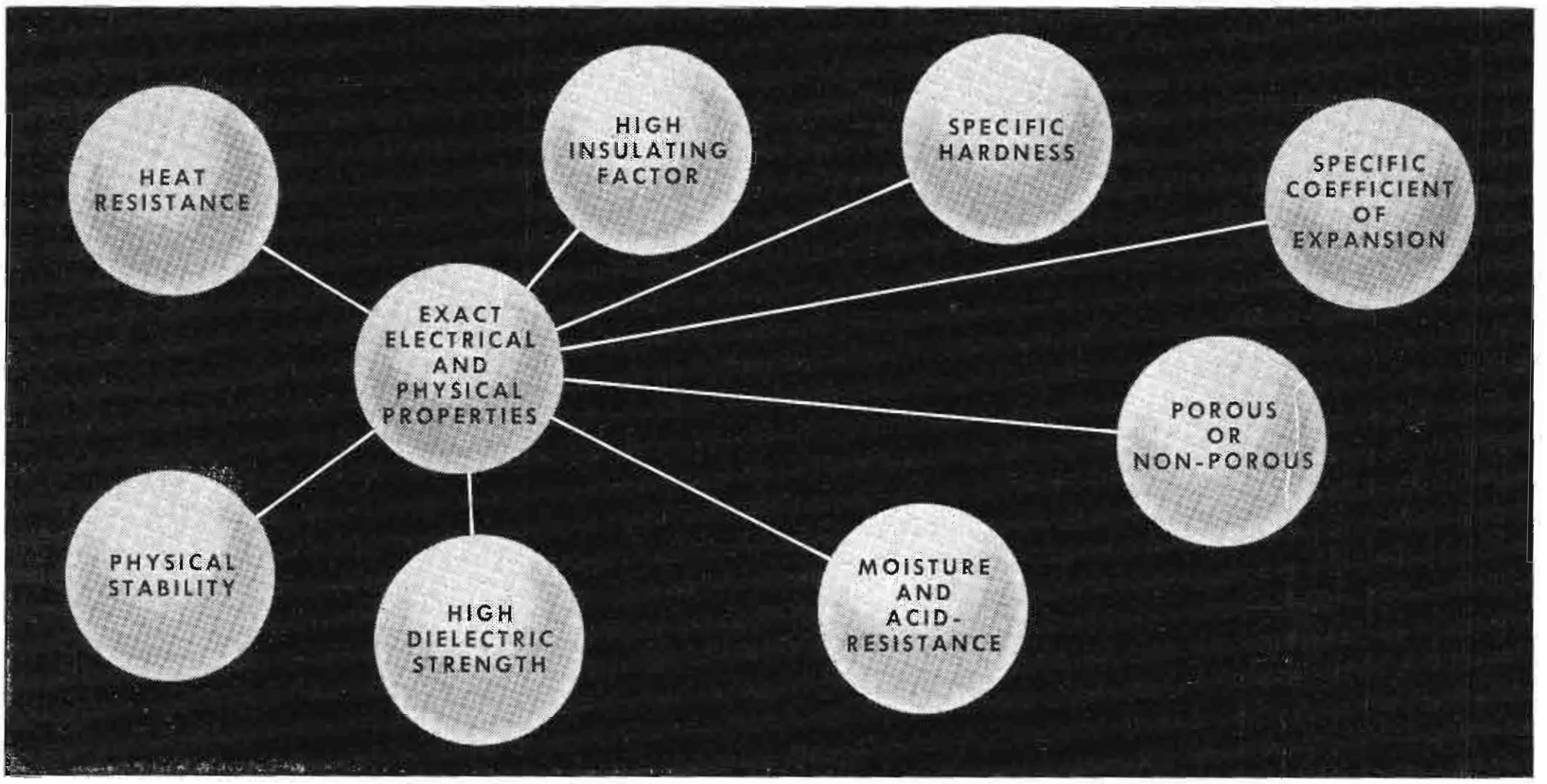
SWITCH

A new electronic control, the "Surj-Switch," is operated by increased amplitude or surge of electric current



when work is being done. The control is connected into one side or phase of the power circuit. Current surges produced by the work operate a relay. When there is no surge, the relay does not operate. Built in timers and/or auxiliary switches can weed out interfering surges. The work produced surge, therefore, need not be the greatest in the work cycle. In timer equipped models, both "Surj-Switch" and timer have relays. A complete unit includes a "Surj-Pickup" and a "Surj-Switch" housed in identical 10⅜ x 8⅜ x 4¼ in. cabinets. The pick-up can be used with a power circuit ranging from 0 to 80 amps, any voltage, 50-60 cps. ac. The switch can be furnished for either 115 or 230 v., 50-60 cps, ac. Switch and timer relay contacts are rated 5 amps, 115 v., ac, non-inductive load. **Autotron Co. 128 West Main St., Danville, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES.

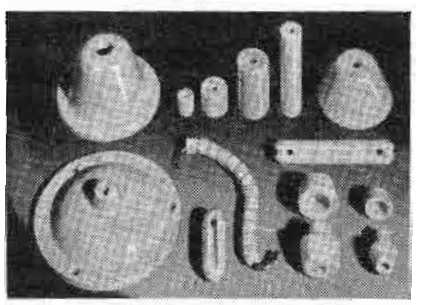
If your product requires any of these properties, you can make it better with CRL Engineered Ceramics!



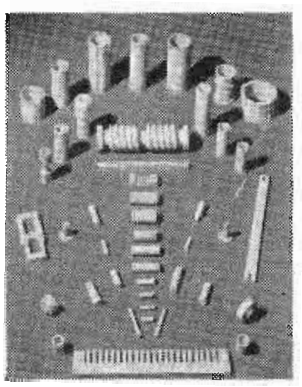
THERE'S a Centralab Ceramic material to match your individual requirements — electrically . . . physically . . . structurally. These materials are unique. We can extrude, mold or press them. What's more, Centralab Ceramics can be worked the same as metal — drilled, turned, ground or tapped. In addition, they can be metalized. Every Centralab Ceramic has some of the properties shown above, and they meet all JAN-I-8 and JAN-I-10 specifications, without exception.

Centralab is the leader in Ceramic development — making fine ceramics since 1928. We have a complete staff of engineers, physicists and chemists ready to help you develop better product design through the use of Engineered Ceramics. Write for full technical details.

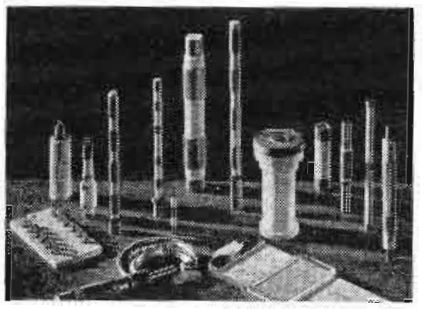
Here are examples of special Centralab Ceramics produced for structural, electrical and electronic use.



Note the Standoffs illustrated, upper center. Made to government specifications, they are also available commercially at a price lower than most standard units.



Many different ferrous and non-ferrous metals can be applied to ceramic bodies, combining the desirable properties of the metal plus the dielectric strength and other unique properties of ceramics.



Specialty items include forms for coils and various electronic components, such as variometer rotor and stator bars, heater coils, etc. Commercial units are available in Grade L-5 and L-6 Steatite if required.

Centralab
CRL ®

A Division of Globe-Union Inc., Milwaukee 1, Wis.
In Canada, 804 Mt. Pleasant Road, Toronto 8, Ont.

CENTRALAB, A Division of Globe-Union Inc.
938-L East Keefe Avenue, Milwaukee 1, Wisconsin

Please send me full technical information on Centralab Engineered Ceramics.

Name.....

Address.....

Company..... Title.....

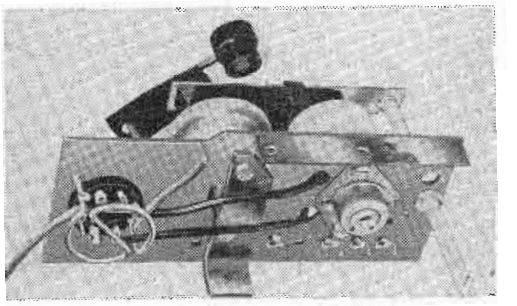
TAPE LABELS

"Scotch" write-on tape No. 48 is a new pressure-sensitive labeling tape that provides a continuous roll of 40

labels with "Reel No.—Date—Subject" printed on them. A special matte finish assures that they can be written on with pen, pencil, or typewriter. Rolled on a convenient metal dispenser, although it can be used on any magnetic recording reel, the new tape is especially convenient for use with the 3M "V" slot reel because of its smooth surface and large labeling areas. The ¾ in. tape retails for 25¢ in 100 in. lengths and $1.25 in 66 ft. lengths. **Minnesota Mining and Manufacturing Co., 900 Fauquier St., St. Paul 6, Minn.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FLYBACK TRANSFORMERS

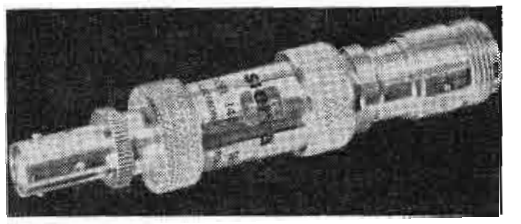
Three new flyback transformers, A-8224, A-8225, and A-8226, replace Motorola flybacks in Motorola models



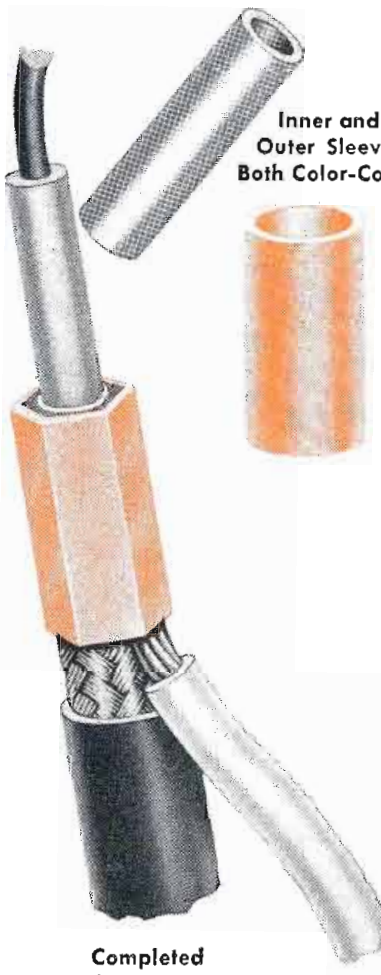
of 52 chassis. A complete list of all TV models and chassis using these transformers is given in Stancor Bulletin 476. **Chicago Standard Transformer Corp., Standard Div., Addison and Elston, Chicago 18, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CRYSTAL DETECTOR

A new crystal detector that makes sensitive readout available from VHF-UHF directional couplers is offered.



Typical sensitivity realizable with the instrument when used with a 50 μa, 1140 ohm meter is at least 30 μa of rectified dc output for an r-f input of 140 mv. rms. Model 148 is designed for use with 50 ohm transmission lines operating at frequencies from 30 to 1,500 mc. The instrument includes a IN21B crystal and a built-in low pass output filter. **Sierra Electronic Corp., 1050 Brittan Ave., San Carlos 2, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.



T&B ENGINEERED

GROUNDING SHEATH CONNECTORS

for shielded or coaxial conductors

NOW...

COLOR-CODED

Color-coding adds another "plus" for users of T & B compression-type Grounding Sheath Connectors. In 7 bright, permanent colors according to size, they eliminate production line confusion — provide at-a-glance size identification . . . easy selection from bulk bins . . . and an immediate visual check on whether the right fitting size was used. Coding also helps make sure fittings are properly compressed — various sized nests in installing tool are color-coded to match.

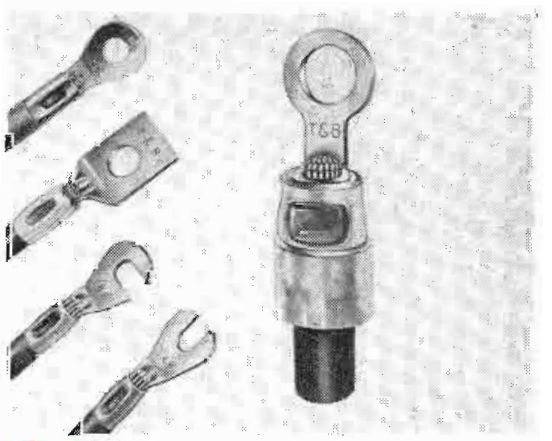
Investigate these new color-coded T & B Grounding Sheath Connectors for production line termination of all types of shielded or coaxial conductors used in AF, RF or UHF applications — they'll solve grounding problems neatly and uniformly . . . in less time.

Simply slip inner sleeve under conductor braid — ends are already chamfered to prevent possible abrasion. Add ground lead and slip on outer sleeve. Compress with T & B installing tool and the job is done.

T & B Grounding Sheath connectors can be supplied for conductors .058" to .297" in diameter . . . are also available with integral terminal tongues.

. . . and don't forget — T & B Sta-kon® terminals for mechanically-strong, electrically-sound power circuit connections.

Just slide over conductor and compress with T & B staking tool for a permanent, low resistance joint. Available in a wide variety of tongue styles for conductors #22 to 250 MCM. Self-insulated Sta-kons can be supplied for use where leads are crowded or overlapped.



Send for free sample and technical data

they're yours for the asking . . . we're sure they'll convince you of T & B's engineering leadership.

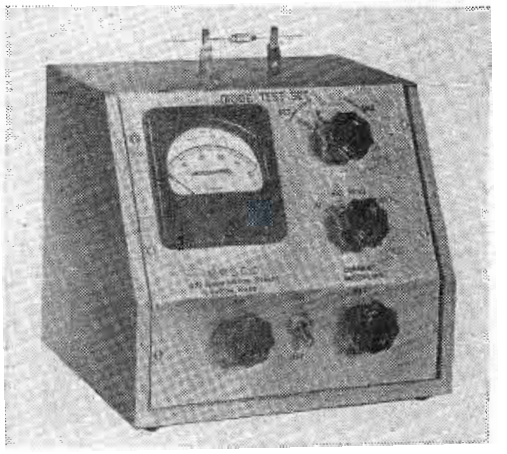
THE THOMAS & BETTS CO.
INCORPORATED

82 Butler Street, Elizabeth 1, New Jersey
Thomas & Betts Ltd., Montreal, P. Q., Canada

MANUFACTURERS OF FINE ELECTRICAL FITTINGS SINCE 1898

DIODE TEST SET

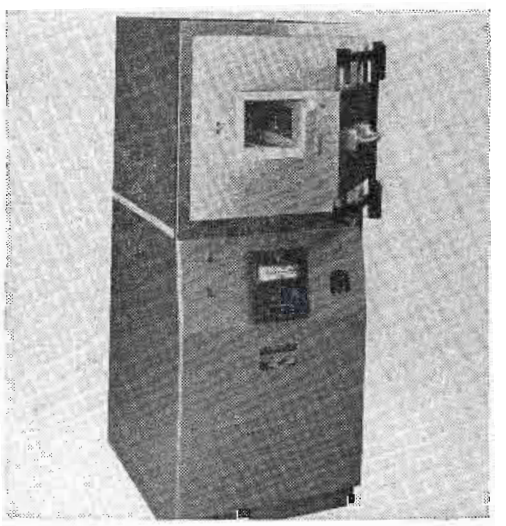
Model D102 is a flexible semi-conductor test unit capable of testing miniature or power, germanium or



selenium rectifiers, and determining transistor parameters. The unit consists of variable voltage and current sources, a precision metering device and a switching arrangement which enables rapid selection of any operating condition, and then, high-speed determination of diode forward-backward characteristics. Operating conditions (set), back-voltage 0-50 v., forward current 0.5-50 ma. Diode characteristics (test), back leakage current 0-50 ma. Forward voltage drop, 0-5 v. **Electronics Production Service Co., 871 Washington St., Canton, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

FURNACE

The series KR high-temperature, box-type, heat treating furnace is built in five sizes ranging from 6 x 6 x 9 in.



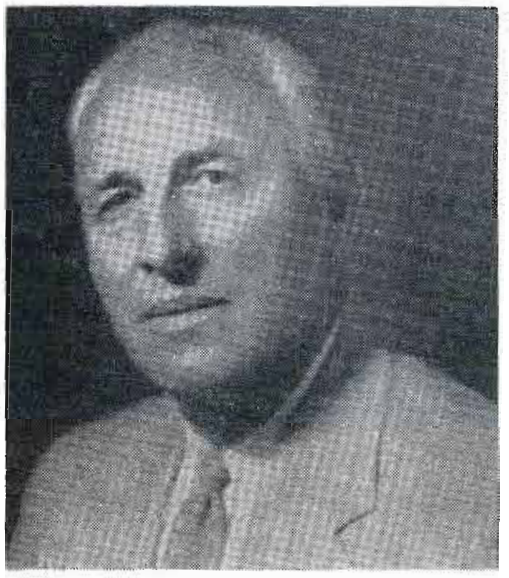
to 10 x 8 x 18 in. Contained in a skirt type cabinet, the furnace is furnished with a transformer, contactors, switch box, and an electric indicating temperature controller. The heating elements are made of high-temperature, non-scaling, non-flaking alloy wire and are practically impervious to sulphur and its compounds. Temperature range is from 300° F. to 2,000° F. Units can be either 220 v. or 440 v. single phase. Current consumption of the series ranges from 2 to 12 kw. **K. H. Huppert Co., 6830-32 Cottage Grove Ave., Chicago 37, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES.

News of MANUFACTURERS' REPS

Engineered Sales Co., 3592 N. Milwaukee Ave., Chicago 41, Ill., has been organized to serve industrial clients as manufacturers' representatives in Illinois, Iowa, Indiana, and Wisconsin.

Harry L. Lewis has been appointed field engineer by Simberkoff Sales Co., 68 Hudson St., Hoboken, N.J. where he will provide engineering liaison between customers and manufacturers served by this organization.

W. C. ("Bill") King, for eight years with Hammarlund Manufacturing Co., and former eastern sales manager, has opened his own business as a sales-engineering representative for electronic manufacturers at 1355 Westwood Boulevard, Los Angeles, Calif. Some of the lines he will handle are Hammarlund, Langevin, Condenser Products, and All-Channel Antennas.



W. C. King

The following manufacturers' representatives were recently announced by Brook Electronics Inc., 34 DeHart Place, Elizabeth, N. J.: **Terwilliger Sales Co.**, 9304 High Drive, Kansas City, Mo. will cover Missouri, Kansas, Nebraska, and Iowa. **Edwin F. Liddle**, 18925 Grand River Ave., Kansas City, Mo. will cover Michigan; and **Hoeming Sales Co.**, 1730 Clover Lane, Fort Wayne 7, Ind., will cover Indiana and Kentucky.

Robert E. Steinwedel has been appointed to the Baltimore office of Ken Randall Co., 121 North Broad St., Philadelphia 7, Pa.

Harold A. Chamberlin, 31 Milk St., Boston, Mass., **Cunningham & Mitchell**, 6101 College Building, Indianapolis, Inc., **Harry Estersohn**, 7135 Germantown Ave., Philadelphia, Pa., **Felleisen & Assoc.**, 612 N. Michigan Ave., Chicago 11, Ill., and **ABM Co.**, 15850 Third St., Highland Park, Mich. have been appointed representatives for the printed

News of MANUFACTURERS' REPS

(*Continued from page* 125)

circuits of Circuitron, Inc., subsidiary of LaPointe Electronics, Inc., Rockville, Conn.

Standard Electric Sales, 414 Times Square, Seattle, Wash., has been appointed to handle the entire Tobe Deutschmann Corp. (Norwood, Mass.), line of electronic components and parts in Idaho, Montana, Oregon, Washington, Alaska, and British Columbia. **Kemp Electric Sales Agency,** 6218 Sunshine Drive, St. Louis, Mo., will represent the company in Missouri, Kansas, and Southern Illinois.

I. A. Aaron & Assoc., 11-829 N. Marshall St., Milwaukee, Wis., have been selected by Clary Multiplier Corp., to serve as regional representatives in Wisconsin, Minnesota, and North and South Dakota. **W. A. Brown Assoc.** in Washington, D.C. will cover Maryland, Delaware, Virginia, West Virginia, the District of Columbia, North and South Carolina, Tennessee, Georgia, Alabama, and Mississippi. California, Arizona, and New Mexico were recently assigned to the **Kittleson Co.** 7614 Melrose Ave., Los Angeles, Calif. **Computing Devices,** Ottawa, Canada, is the Dominion representative.

Rockbar Corp., 211 East 37th St., New York, N.Y., has been appointed sales representative for General Hermetic Sealing Corp., Valley Stream, L. I., New York, to cover the Metropolitan, Long Island, and northern New Jersey areas.

Ernie Kohler has been appointed sales representative for Raypar, Inc., 7800 West Addison, Chicago 34, Ill. in Indiana and Ohio. His headquarters will be in Cleveland.

J. J. Powers Co., recently organized by J. J. Powers to represent electronic components manufacturers in a sales and engineering capacity in Illinois, Indiana, and Wisconsin among jobbers and industrials, has opened offices at 4938 Irving Park Road, Chicago 41, Ill.

Jack Geartner, 7711 Hawthorne Ave., Miami Beach, Fla., has been named Florida wholesaler and distributor representative for the "Silver-Line" TV set converters made by General Instrument and Appliance Corp.. Elizabeth, N. J. subsidiary of General Instruments Corp.

Southeastern Sales Co., East Point Ga. electronic manufacturers' sales representative covering Virginia, North Carolina, South Carolina, Georgia, Alabama, Florida, and Mississippi, has changed the firm name to **Paul Hayden Assoc.** to avoid confusion caused by a similarity in trade names.

D. B. Buchanan, 5130 Powers Ferry, N.W. Atlanta, Ga., has been appointed representative to cover Alabama, Flor-

An Invitation

TO AGENTS *able to provide adequate distribution and after sales service for Internal Telephone Equipment manufactured by :*

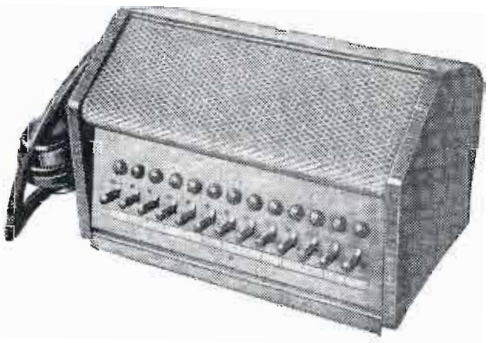
AUTOPHONE Ltd

Push-Button Intercommunicating Telephones. The fastest known method - direct communication, independent of an operator, for six, twelve or twenty lines. Desk or wall pattern.

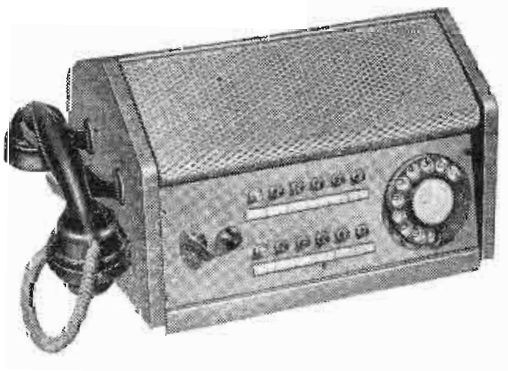
Autophone Telephone Systems comprise :

Push-Button Intercommunicating Telephones.
Loudspeaking Master Stations and Staff Stations.
Private Automatic Telephone Exchange Equipment.

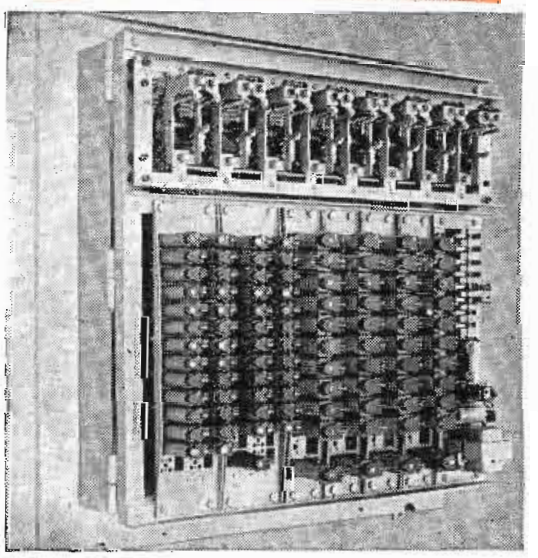
Modernistically designed and soundly constructed in the best British Tradition, these internal Telephone Systems offer speedy direct contact with all departments of any size organization.



Loudspeaking Master Systems working in conjunction with Staff Stations. No Speak-Listen Key to operate. Natural speech leaving both hands free. Handset provided for private conversations. Instantaneous time-saving contact. Priority Conference and Roundcall Facilities available.



Amplified Loudspeaking Master Station specifically designed for the executive. Used in conjunction with an Automatic Exchange.



Automatic Desk Type Dial Telephone for use with Automatic Exchange.

Private Automatic Telephone Exchanges (P.A.X.) from 10 to 200 lines or more. In addition to providing Automatic Intercommunication this system also offers such facilities as : Automatic Staff Location, Preselector Service, Conference, Priority and Secretarial features.

To suitable persons or firms with the necessary experience and organization we can offer most attractive terms. Please write for full particulars stating territories at present covered or available.

AUTOPHONE LTD
REGISTERED TRADE MARK

AUTOPHONE LIMITED

73 GREAT PETER STREET, LONDON S.W.I. ENGLAND

Cables: AUTOFON, LONDON

SPO'C. 21336

News of MANUFACTURERS' REPS

(*Continued from page* 126)

ida, Georgia, Mississippi, North Carolina, South Carolina, and Tennessee jobbers and industrials for the Tru-Ohm Div., of Model Engineering & Mfg. Co. **A. L. Perkins,** P. O. Box 488, Mt. Kisco, N.Y. will serve the jobbers and industrials in upper New York State; and **Kaelber & Mack**, 1270 Broadway, New York, N.Y., will serve industrials in metropolitan New York.

Henry ("Hank") J. Behrends will cover southwestern Ohio, Kentucky, and West Virginia for **George L. Herrick Co.**, Cleveland, Ohio, representing Phalo Plastics Corp., Worcester, Mass. Mr. Behrends was recently made manager of the George L. Herrick Co. Cincinnati office.

John F. Bivins, David J. Caldwell, and **C. M. Smith, Jr.** of Bivins & Caldwell, Security Bank Building, High Point, N.C., now represent Shallcross Manufacturing Co., Collingdale, Pa., in North and South Carolina, Georgia, Tennesee, Alabama—north of U.S. Highway 80, and Virginia, excepting Fairfax and Arlington counties. **R. B. Sivernell** of Industrial Associated Electronics, 1900 Queen St., Fort Worth, Texas, will represent Shallcross in Texas, Louisiana, and Arkansas **John Herring & Co., Ltd.,** 3565 Dundas St., Toronto, Can., and **Instrument Service Labs., Ltd.,** 21 West Broadway, Vancouver, B.C. represent Shallcross in Canada, and **Rocke International Corp.,** Export Department, 13 East 40th St., New York 16, N.Y. handles the company's export business.

New Magnet Material Developed

A completely new type of magnet, composed of ceramic material which is lighter in weight than metal and requires no critical ingredients, was announced recently by The Indiana Steel Products Company of Valparaiso, Ind.

Although the new permanent magnet, called Indox, is composed of materials which are "earthy" in nature and are non-organic and non-metallic, it is magnetized in the same manner as metals. The magnitude of the magnetizing force required, however, is more than three times that necessary for Alnico, the metallic permanent magnet in common use today.

In addition to being lighter than Alnico, and requiring no critical materials, Indox has twice as much coercive force as Alnico and is a non-conductor.

Test Prods

(*Continued from page 85*)

uniform operation of embedded vacuum tubes. They also serve to lower the generated exothermic heat during curing.

The epoxy resins, in general, are simpler to apply. Exothermic heat is low, curing temperatures are ambient or very low, the resins adhere well to inserts and do not tend to crack away from lead-in wires, dielectric constants are relatively low and mixing ratios are not unduly critical. Again, in all these characteristics Scotchcast seemed superior. The silica filler provides sufficient body to the resin that flash is virtually eliminated, the dielectric constant is not materially affected providing an excessive amount of filler is not used, and the heat from the 5718 triode in the cathode follower is adequately dissipated. As an added safeguard, the triode is covered by a close-fitting sleeve of vinyl tubing which serves as a cushion against curing shrinkage and the stresses of thermal shock.

It is desirable that assemblies be dried at an elevated temperature before the potting operation. All of the test prods are baked at 150° F. for one-half hour immediately prior to addition of the resin. All joints and points of contact are coated with the DC-7 mold release to reduce flashing. The DC-7 handles more easily when warmed above room temperature. The Scotchcast No. 2 resin is heated to 150° F. until its viscosity is nearly that of water. At room temperature the pourability is considerably less and complete penetration of the test prods may not take place. Equal volumes of Hardener "B" and silica filler are agitated into the heated resin upon which the mixture is immediately poured into the heated assemblies. After two hours at room temperature a final cure of two hours is made at 150° F. In some applications, such as transformer windings or coils a vacuum cycle is advised to insure impregnation.

Cleaning with MEK

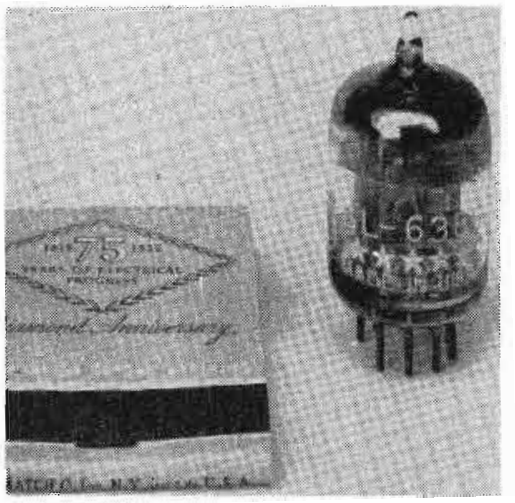
Any flash that may occur is cleaned just after gelling with MEK (methyl ethyl ketone) which serves also to remove the excess DC-7. If this is not done before complete hardening it becomes impossible to adequately remove the undesired resin. The usable pot life of the resin as prepared above is about one half hour after which time the viscosity increases rapidly and gelation takes place followed by com-

(*Continued on page 134*)

New Technical Products for the Electronic

RECEIVING TUBE

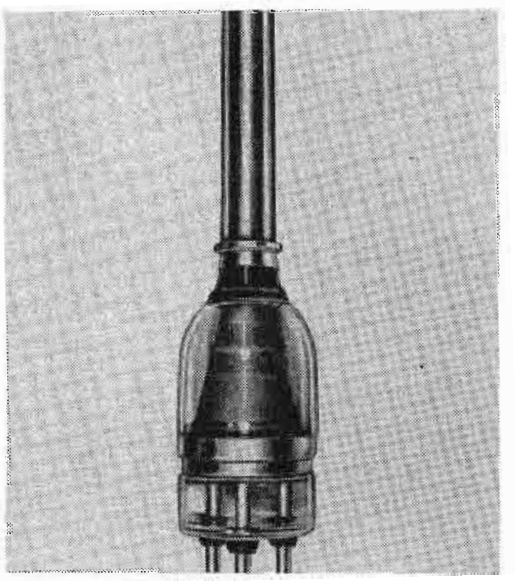
Type G1-6386, a new "Five Star" miniature receiving tube, is designed primarily for remote-cutoff cascode ap-



plications. A medium-mu twin triode, in which each section exhibits a remote-cutoff characteristic, the tube can minimize cross-modulation which can occur in the first stage of a receiver when a strong signal is close to the frequency of the desired signal. It is designed for application as a cascode r-f amplifier, i-f amplifier, or a mixer in circuits in which auto-gain-control is desired. **General Electric Co., Tube Department, Electronics Park, Syracuse, N.Y.**—TELE-TECH & ELECTRONICS INDUSTRIES.

TRIODE

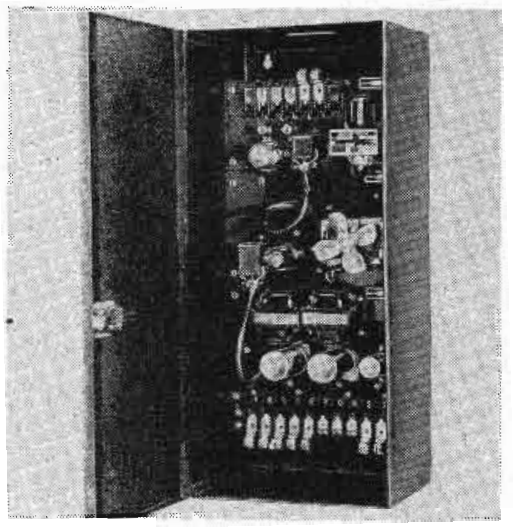
Type 6333 triode is an improved, ruggedized version of the standard type 892. The new tube is completely inter-



changeable with its prototype, and is said to be superior in construction, performance, and shock resistance qualities. Improvements are a powdered glass stem, kovar grid ring, shorter overall length, internal conical grid support, kovar anode seal, spiral filament, and lower inductance. **Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L.I., N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

LIGHTING CONTROLS

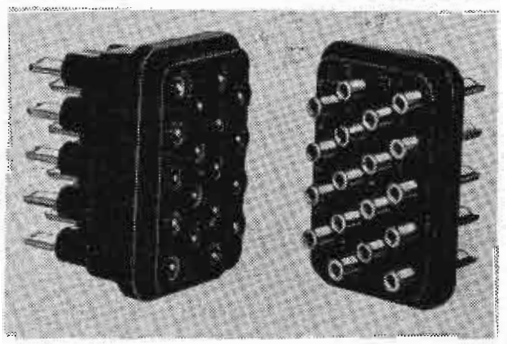
Three new microwave antenna tower lighting control units are designed to meet FCC requirement. They are designated: models LC-100, towers to 150 ft., LC-200, towers 150 to 300 ft., LC-300, towers 300 to 350 ft. Model LC-100, a low cost model, contains a photo-electric unit to turn tower lights on and off, and an alarm panel to warn of obstruction light lamp or power supply failure. Models LC-200 (shown) and LC-300 have, additionally, a beacon lamp flasher panel, and a beacon lamp or



obstruction light lamp alarm panel which warns of lamp failure and also power supply failure. **Hughey & Phillips, Inc., 3300 N. San Fernando Blvd., Burbank, Calif.** — TELE-TECH & ELECTRONIC INDUSTRIES.

CONNECTOR

Miniaturized MAQRE 18 quick-disconnecting electrical connector has a re-arrangement of contacts and omits guides which, it is said, results in a 35% saving over comparable connectors. Floating contacts have 0.073 in. diameter solder cups for No. 16 A.W.G. and their arrangement allows engagement only in a position that makes polarization positive. Patented spring-loaded contacts are precision machined and gold plated over silver. The molded melamine body assures high dielectric, arc resistance, and mechanical strength, and one piece construction eliminates

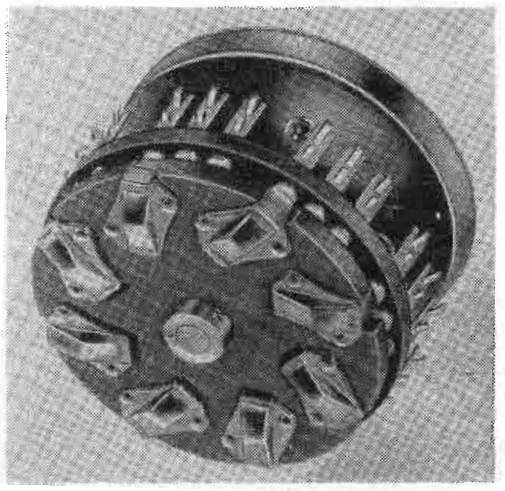


unnecessary creepage paths and dust pockets. **Winchester Electronics, Inc., Dept. M, 15 Crescent, Glenbrook, Conn.** —TELE-TECH & ELECTRONIC INDUSTRIES.

Industries

ROTARY SWITCH

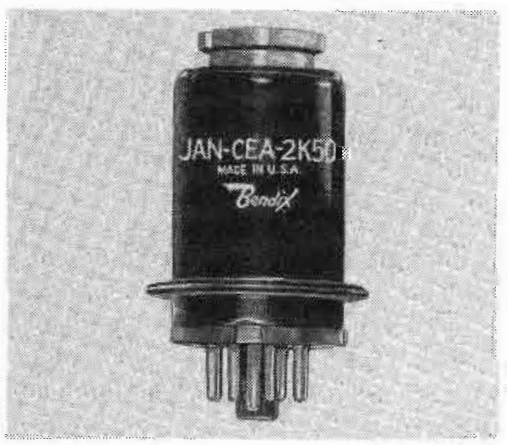
Type 87-EM rotary switch has 8 poles on one deck, a feature made possible by a patented "knee-action" rotor. From 1



to 5 positions per pole are available with shorting-type action; up to 3 positions with non-shorting action. Spacing between live positions with shorting-type action is 15°. Spacing with non-shorting action is 30°. Silver alloy rotors, slip rings, and contacts are used exclusively. A roller dentent is used that does not add to the overall depth of the switch. Contact panels and rotors are fabricated from XXXP phenolic in accordance with MIL-3115B. Current capacity is 15 amps. **The Daven Co., 191 Central Ave., Newark, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

KLYSTRON

A thermally tuned reflex klystron tube (JAN 2K50) designed for K-band operation, has a frequency range of 23,504 MC to 24,464 MC with a minimum



power output of 8.5 mw. and will tune this frequency range in 1.2 to 2.6 secs. It is tuned by varying the grid bias voltage of a triode section incorporated in a metal envelope. The plate of the section is attached to the klystron structure. Thermal expansion of the plate, caused by current variations, is transmitted to the klystron cavity. This changes the gap spacing and, consequently, the frequency. **Bendix Aviation Corp., Red Bank Div., Eatontown, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

IRE Elects Officers for 1954

William R. Hewlett, vice president of Hewlett-Packard Co., Palo Alto, Calif., has been elected president of the Institute of Radio Engineers for 1954. He succeeds Dr. James W. McRae, president of the Sandia Corp. and vice president of the Western Electric Co., as head of the international society of over 35,000 radio engineers and scientists.

Maurice J. H. Ponte, director of Compagnie Generale de Telegraphie Sans Fil, Paris, France, will succeed S. R. Kantebet, general manager of the Government of India Overseas Communications, as TRE vice president in recognition of the international character of the Institute's membership and activities.

Elected as directors for the 1954-1956 term are Axel G. Jensen, director of television research, Bell Telephone Laboratories, Inc., Murray Hill, N. J., and George Rappaport, chief engineer Countermeasures Branch, Aircraft Radiation Lab., Dayton, Ohio.

Regional Directors elected for 1954-1955 are as follows: Region 1 (North Atlantic), Lucius E. Packard, president of Technical Instrument Corp., Acton, Mass.; Region 3 (Central Atlantic), Harry W. Wells, chairman of Upper Atmosphere Section, Carnegie Institution of Washington, D. C.; Region 5 (Central), Charles J. Marshall, chief scientist, Search Radar Branch, Wright-Patterson Air Force Base, Dayton, Ohio; Region 7 (Pacific), Joseph M. Pettit, associate professor of electrical engineering, Stanford University.

William R. Hewlett was born in 1913 at Ann Arbor, Mich. He received the A.B. degree from Stanford University in 1934. After a year of graduate work at Stanford, he enrolled at the Massachusetts Institute of Technology where he received the degree of Master of Science in 1936. In 1939 he received the E.E. degree from Stanford University, after spending the period from 1936 to 1938 engaged in electro-medical research in Palo Alto, Calif. In 1939, Mr. Hewlett joined David Packard in organizing the Hewlett-Packard Company in Palo Alto.

In 1942 he was called to active duty in the Army and was assigned to the Technical Division of the Office of the Chief Signal Officer in Washington, D. C., for the next three years. He was then transferred to the New Development Division of the War Department's Special Staff where he served as the head of the Electronics Section. In 1945 he was a member of the Compton Mission,

which was sent to Japan immediately after surrender to form a quick appraisal of the Japanese scientific war effort. In December of that year he returned to the Hewlett-Packard Company and has since then continued his activities there.

Mr. Hewlett is a member of Sigma Xi and the American Institute of Electrical Engineers. In 1948 he received the IRE Fellow award "for his initiative in the development of special radio measuring techniques."

New Radiation Detection System

A new radiation detection system consisting of a radiation-sensitive phosphate glass detector, which can be worn around the neck or in the garment lapel, and a photosensitive tube which becomes luminescent proportionally to the time and intensity of radiation exposure is being made under government contract under U. S. Navy specs by Admiral Corp., Corning Glass Co. and Poloroid Corp. The advantages of the system, according to Ray DeCola, Admiral's director of engineering, are that the system is more economical, simpler, and faster, and its production involves no critical materials.

Acoustic Feedback

(*Continued from page 77*)

$$G = \frac{\mu R_L}{R_p + R_L}$$

$$G' = \frac{\mu R_L}{R_c(\mu + 1) + R_L + R_p}$$

$G = 13.3$

$G' = 9.91$

Voltage ratio = 13.3/9.91 = 1.34 = 2.97 db loss.

The inserted network does not alter the frequency response of the console. A frequency run made with cathode transformer installed and properly terminated by a ladder type attenuator indicates that the frequency characteristics of preamplifier V2 are substantially flat within 1 db from 40 to 17,000 cycles.

If the turntable is wired through conventional broadcast normalling jacks, a remote program may be "patched" into the turntable position. Then by use of cathode transformer T3 in V2 it may be transmitted into the local studio while the microphone is open to permit local participation in the remote program. It is of course necessary to place variable attenuator R2 in the "off" position. Application of the remote signal to the local transmitter may be accomplished by a bridging amplifier located across the output of attenuator R3.

TEST PRODS (Cont.)

(*Continued from page* 129)

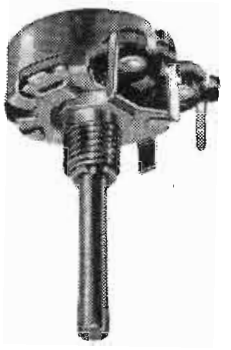
plete hardening. No toxic vapors are present in the particular resin employed although adequate ventilation should be provided when activating any large quantities. This precaution is especially applicable to the use of MEK.

The use and reliability of the encapsulated test prods is excellent over the typical military environmental conditions. Moisture, temperature extremes, corrosive atmosphere, or high altitude have no appreciable effect where conventional packaging would have presented insuperable problems in meeting the limits of, for example, MIL-T-945A on test equipment. The detector test prod can be used with any oscilloscope by selecting a proper cable to match the input connector of the scope. The attenuator prod being frequency compensated can be used with a scope having an input resistance of one megohm shunted by 26 μμf. The length of the cable and the input impedance of the oscilloscope may vary within the limits of the prod trimmer capacitor to compensate for the loading conditions. The highly useful low capacity or cathode follower prod may be used with any oscilloscope providing the mating connector (Cannon type SK-C4-15) is mounted to provide 6.3 volts ac and approximately 100 v. dc. The coaxial contact may be paralleled with the regular Y-axis input and for this reason the lead length should be held as short as possible.

UHF TOWER for WBES

Buffalo's TV outlet (WBES) recently installed an ultra high frequency tower on top of the Lafayette Hotel with the help of this 30-ton Lorain Moto-Crane, model MC-524. Owned by the Siegfried Construction Co. of Buffalo, the Lorain was equipped with 110 feet of boom plus a 25 ft. tip extension to handle loads up to 5900 lbs.

Type U70, 3/4″ diameter *miniaturized* variable composition resistor with special printed circuit terminals. Wattage rating: .3 watt for resistances through 10,000 ohms, .2 watt with 350 volts maximum across end terminals for resistances over 10,000 ohms.



Type U45, 15/16″ diameter, variable composition resistor with blade-type printed circuit terminals. Wattage rating: 1/2 watt for resistances through 10,000 ohms, 1/3 watt for resistances over 10,000 ohms through 100,000 ohms and 1/4 watt with 500 volts maximum across end terminals for resistances over 100,000 ohms.

Type GC-U45, 15/16″ diameter, variable composition resistor with blade-type printed circuit terminals same as U45 except with attached SPST, 3 ampere, 125 volt "GC" type switch. Also available with type "WF", DPST, 3 ampere, 125 volt switch. (Variable resistor type WF-U45.)

CHICAGO TELEPHONE SUPPLY
Corporation

ELKHART • INDIANA

REPRESENTATIVES

Henry E. Sanders, McClatchy Bldg.
69th & Market St., Upper Darby, Penna.
Phone: Flanders 2-4420

W. S. Harmon Company, 1638 So. La Cienega Blvd.
Los Angeles 35, California • Phone: Bradshaw 2-3321

John A. Green Company, 6815 Oriole Drive
Dallas 9, Texas

IN CANADA

C. C. Meredith & Co., Ltd., Streetsville, Ontario

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, N. Y.

Specialists in Precision Mass Production of Variable Resistors

Alloy Shields

(*Continued from page 76*)

the other for transverse fields. The current through the coils was held constant. Readings were taken along the axis with no shield present and with the shield in place. The difference of these two values was taken at each point along the axis, and this difference was plotted as the shielding effectiveness.

Fig. 3 shows a comparison of the uniformity of magnetic field along the axis with no shield present for both the large coils and the small coils. It is evident that the field of the smaller coils approximates a uniform field only for smaller shields. Consequently, for shields longer than about 9-in. the larger coils were used.

Variation of Shielding

Fig. 4 shows the variation of shielding along the axis of thin cylindrical shields for a transverse field of 0.5 gauss. Fig. 5 shows the same type curves for an axial field of 0.5 gauss. Curves are shown for shields of the same size of low nickel alloy and of high nickel alloy. The slight departure from symmetry is felt to be due to the presence of small mounting tabs on one end of the shields.

Several facts are evident:

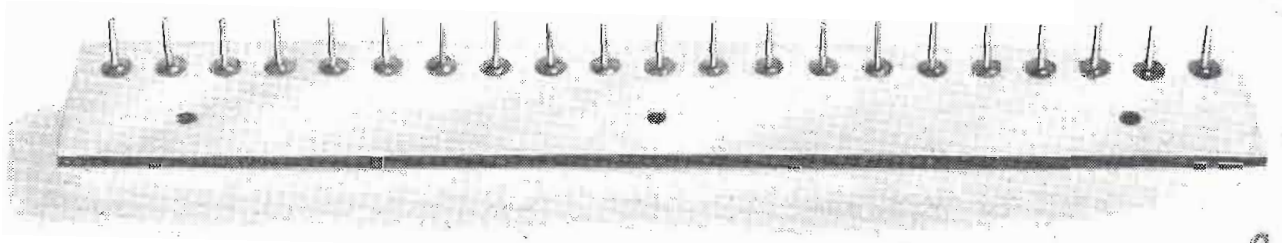
2. The shielding of the transverse center of the shield, as should be expected.
2. The shielding of the transverse field is about 10% better than that of the axial field (26 db vs. 17 db).
3. The cylinder shields a transverse field from the interior by proximity for a few inches from the edge of the shield. There is no appreciable shielding of an axial field by proximity. For an axial field, a cylindrical shield "casts no shadow."
4. There is an overshoot effect when shielding the axial field, i.e., the field outside the ends of the shield is actually stronger than the original uniform field which was to be shielded. There is no overshoot effect when shielding the transverse field.

Shielding Efficiency

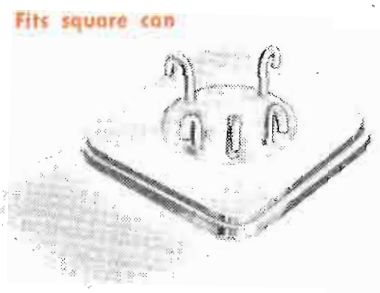
The curves of Fig. 2 indicate that the shielding efficiency of thin shields should increase markedly with thickness. Data were taken to verify this expected variation. Table II gives values of shielding efficiency at 60 cycles measured at the center of cylindrical shields of different materials and of different dimen-

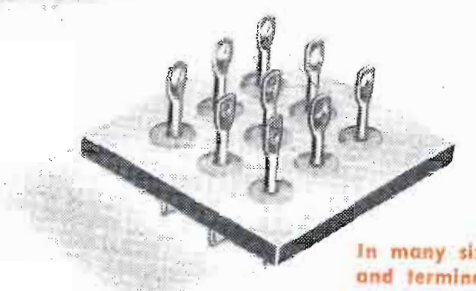
the shapes of things to come...


Fits rectangular can

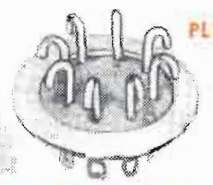

Terminal strip

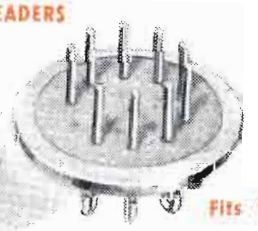
are here


Fits square can


In many sizes and terminations

PLUGS AND HEADERS


Fits ¾" round can


Fits ⅞" round can

with Hermetic's new Vac-tite* Compression Seals

Shapes and sizes in hermetic seals that are now available in **VAC-TITE** Heavy Duty Compression Seals were formerly impractical due to the inability of conventional designs to withstand mechanical abuses and deflection during installation and in use. It is now practical to produce small runs with little or no tooling at reasonable prices. Vacuum tightness is guaranteed, proven by mass spectrometer tests. Applications include use as an integrally fused cover-header combination, making it no longer necessary to solder headers and terminals into the cover . . . and as terminal strips assembled as one piece instead of many individual terminals.

Let our design engineers provide you with the most economical, rigid, fused, multi-terminal assembly for your requirements. Just tell us how many terminals you need and types of terminations (such as tubular, hooked, flattened and pierced, lug or turret) . . . the electrical characteristics such as current capacity and voltage breakdown . . . maximum size (rectangular coordinates or diameter) . . . and the type of enclosure or mounting.

***VAC-TITE is HERMETIC's new vacuum proof compression-construction glass to metal seal. In addition to special shapes, many standard sizes such as .800 O.D. and .900 O.D. multi-terminal headers and a large variety of individual terminals are available in VAC-TITE Compression Seals.**

SEALED IN by HERMETIC HEADERS

Hermetic Seal Products Co.

33 South Sixth Street, Newark 7, New Jersey

FIRST AND FOREMOST IN MINIATURIZATION

sions. These measured values are compared with values read from Fig. 2 for long cylinders.

It is evident that the figures in the last two columns agree rather well, with the exception of low measured values for the third and fourth entries, for which the length-to-radius ratio is so small (about 2.4) that the end effects are quite significant. One rule of thumb mentioned in the literature[5] states, in effect, that the shielding efficiency at the center of a cylinder approximates that of an infinite cylinder for a length-to-radius ratio of 4 or larger.

Thus, the shielding efficiency does increase markedly as the shield thickness increases, and the silicon-iron alloy is much less effective than the nickel alloys. Some slight variations between the theoretical values and the measured values are to be expected due to the eddy currents at 60 cycles.

Conical Shields

Many measurements were made on truncated cones of circular cross section made as shields for color TV tubes. These cones were made of a wrap-around construction and were welded at the overlap. Most readings were made on shields of the size shown in Fig. 6 with a half angle of cone of 25°. In particular, curves were prepared showing the effectiveness of shielding for five different shielding structures:

A Single silicon-iron alloy cone, 25 mils thick
B Single silicon-iron alloy cone with one insert of high-nickel alloy at the small end
C Double silicon-iron alloy cones, spaced 0.25 inches
D Single silicon-iron alloy cone with inserts of high nickel alloy at both ends
E Single low-nickel alloy core 92 mils thick

These shielding curves are shown as Figs. 6 and 7 for an applied field of 0.5 gauss and as Figs. 8 and 9 for an applied field of 11.5 gauss. Just as for cylinders, these curves for conical shields indicate several basic differences between the shielding of a transverse field and the shielding of an axial field of the same magnitude and frequency.

1. For axial fields the maximum amount of shielding is about 9 db, and off the ends of the conical shield (particularly at the smaller end), the field is actually stronger than the original field by as much as 2 to 3 db, an overshoot effect.
2. For transverse fields the maxi-

mum amount of shielding is much higher (about 25 db), and there is no overshoot at the ends of the conical shield. Recall that the measurements on cylinders also indicated overshoot for axial fields and no overshoot for transverse fields, as is shown, for example, in Figs. 4 and 5.

3. For transverse fields there is shielding by proximity on both ends of the shield. There is no appreciable shielding by proximity for axial fields.

The curves of Fig. 2 can be used to predict the maximum value of shielding which can be obtained from a conical shield. Consider, for example, a conical shield of low

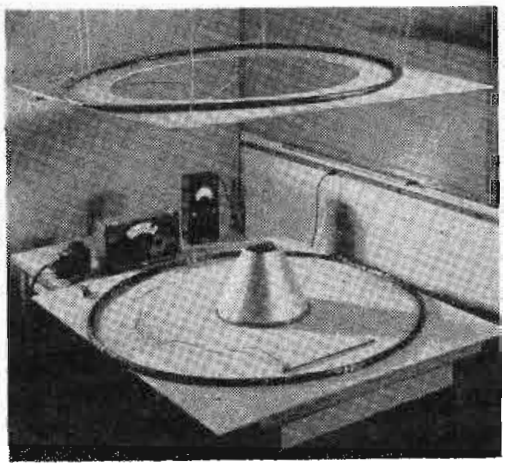


Fig. 10: Truncated conical shield for color TV tube is inserted in uniform magnetic field produced by the two parallel Helmholtz coils

nickel alloy 92 mils thick, with dimensions as shown in Fig. 6: for the large end t/b = 0.0136, which corresponds to a shielding efficiency against transverse fields of 31.2 db; for the small end t/b = 0.033, which corresponds to a shielding efficiency of 38.5 db. The average of these two values is 34.8 db, (98.2%) which compares with the measured values of 23.5 db (93%) given in Fig. 6 for an applied field of 0.5 gauss, and 27 2 db (96%) given in Fig. 8 for an applied field of 11.5 gauss. Here again the average length-to-radius ratio is so low (only 1.8) that the actual measured values should be expected to be much lower than the values read from Fig. 2, which are based upon a cylinder of great length.

Conical Insert

Dr. A. W. Friend suggested that the addition of a small conical insert of high nickel alloy inside the small end of an inexpensive silicon-iron shield could greatly improve the shielding efficiency at a total cost much below that of a complete shield of high nickel alloy. Curves A

ALLOY SHIELDS (Cont.)

and B show that, for transverse fields, the single high-nickel insert does increase the shielding effectiveness considerably, but for axial fields the insert has little effect. The improvement occurs mostly near the small end, as should be expected. When a second insert of high-nickel alloy is added at the large end, curve D shows that the shielding efficiency is increased over the length of the shield for transverse fields, but again no decided improvement results for axial fields. It is thus possible, for transverse fields, to employ strategically-located linings or inserts of high permeability to improve the shielding efficiency of less expensive shields of lower permeability. For axial fields, however, such inserts increase the shielding efficiency only slightly.

In addition to investigating single conical shields, measurements were also made on the effectiveness of a double conical shield of silicon-iron alloy. The readings showed that a spacing of ¼-in. between the two shields was about optimum, and the results obtained with this double shield are shown as curve C in Figs. 6 through 9.

The double-silicon shield is at all points better than the single silicon; however, the improvement is better for axial fields than for transverse fields. This result should be contrasted with the effect of inserts which gave the greatest improvement for transverse fields.

Effect of Applied Field Strength

For low field strength, the efficiency of shielding should be independent of the applied field strength. However, as the applied field becomes stronger, the permeability changes, and some variation is to be expected.

The curves of Figs. 6 through 9 show the shielding efficiency of five conical structures for applied magnetic fields of 0.5 gauss and 11.5 gauss. For transverse fields, the effectiveness of shielding increased by 3 to 10 db for all structures at higher fields. For axial fields, the increase in applied field caused only small improvements in the shielding efficiency. The improvement was much larger for the low permeability silicon-iron shields than for high permeability nickel shields.

Any comparison of shielding costs should consider the wide range of cost of the various magnetic alloys. The initial cost for low nickel (50%) alloys is about six times that of silicon-iron. For high nickel (80%) al-

loys, the cost is about twelve times that of silicon-iron. Further, the cost of annealing nickel shields can be about 10 times that of annealing silicon shields, so the relative cost of shields of equal size for high nickel, low nickel, and silicon should be in the range of ratios of 120 to 60 to 1.

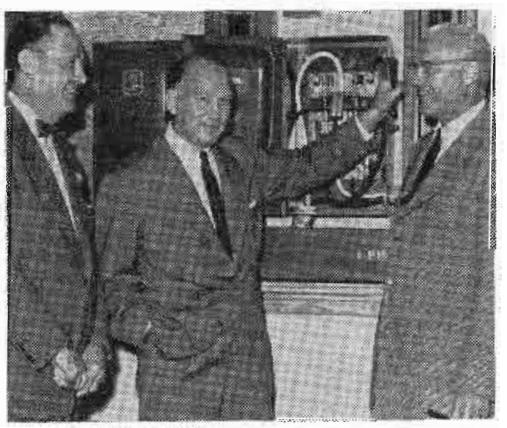
Conclusions

1. Curves and equations are given which show how the low-frequency shielding effectiveness of cylindrical and spherical shields depends upon the dimensions and the permeability of the shield. Experimental results confirm these curves and show that they give reliable figures for cylinders if the length to radius ratio exceeds 4 to 1.
2. For several magnetic alloys, such as silicon-iron, low nickel, and high nickel, Figs. 1 and 2 show the effect of shield dimensions upon the low-frequency shielding efficiency for cylindrical shells and spherical shells. For thin shields of practical importance, these curves show that the effectiveness of shielding is greatly improved by slight increases in the shield thickness and/or slight de-

Kaiser and Willys Divisions Merge

Edgar F. Kaiser, president of Kaiser Motors Corp. and Willys Motors, Inc., has announced the consolidation of the electronics research and production facilities formerly operated as separate Kaiser and Willys divisions. He also announced the appointment of Clay P. Bedford as vice president in charge of the new division, which includes Willys electronics plants at Toledo and Anderson, Indiana, and Kaiser facilities at Nashua, New Hampshire, and Arlington, Virginia.

WEST COAST PLANT

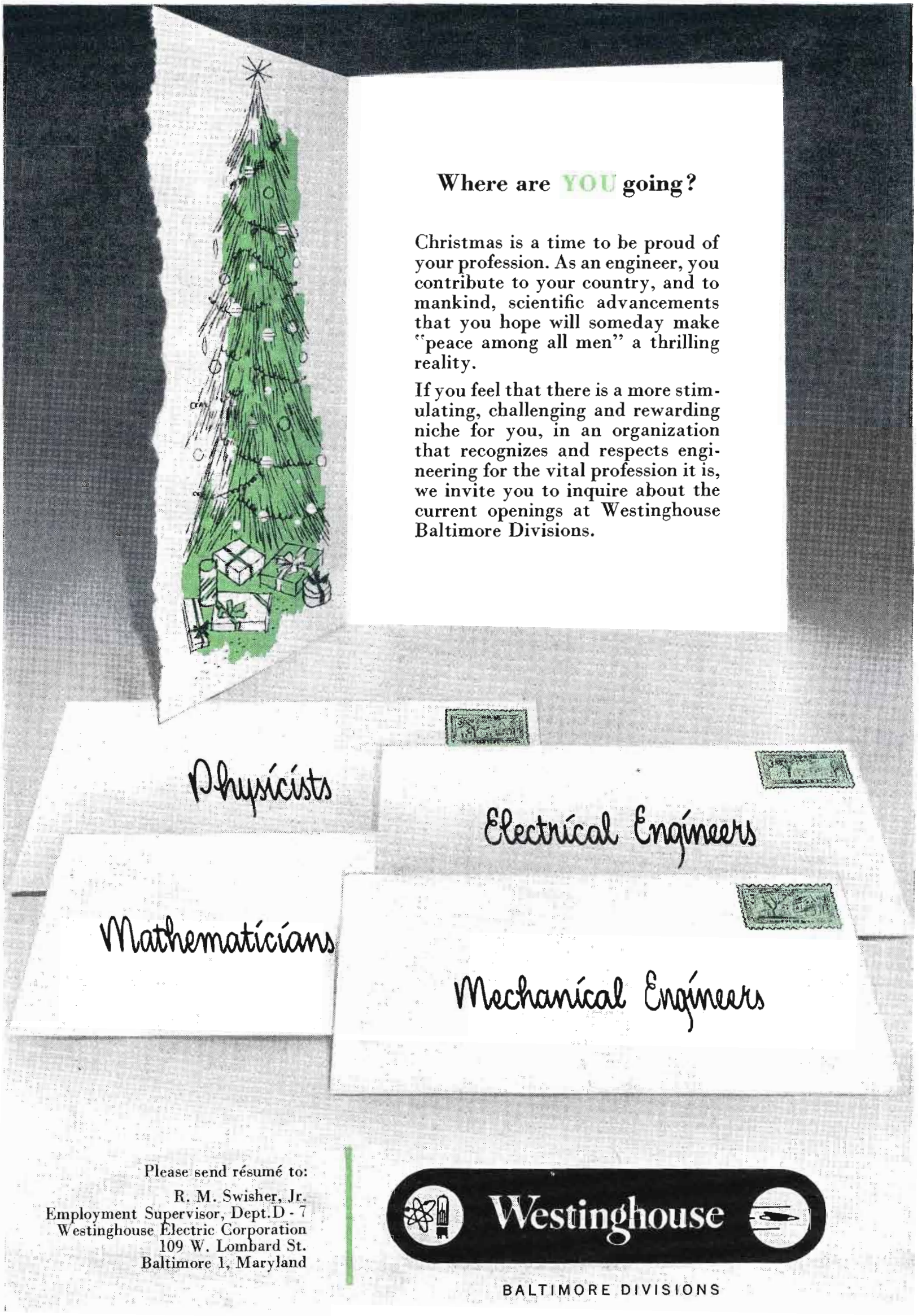


Laurence M. Perrish, president Pioneer Electronics Corp. starts new 1000-per-day black and white and color tube plant at West Los Angeles. Left to right: Ed Grigsby, sales manager Altec Lansing and, vice-president WCEMA, Laurence Perrish, and H. L. Hoffman, president Hoffman Radio Corp.

ALLOY SHIELDS (Cont.)

creases in the outer diameter of the shield. This conclusion is true for all values of permeability.

3. The curves for spherical shields give a good estimate for the amount of shielding possible in a completely enclosed shield.
4. For a given material, the shielding efficiency depends only upon the *ratio* of t/b and not upon t or b alone. Thus, if the shield diameter is doubled, the shield thickness must be doubled also to keep the same degree of shielding.
5. The ultimate shielding ratio of single shields (aside from eddy current effects at higher frequencies) cannot exceed 0.25 μ for long cylinders and 0.222 μ for spheres. Table I lists ultimate values of shielding for several magnetic alloys. The shielding efficiency is close to these ultimate values for thicknesses beyond 40% of the outer radius of the shield.
6. For thin cylindrical and spherical shells, the shielding efficiency increases rapidly with even slight increases in the thickness or slight decreases in the shield radius. Table II compares theoretical and measured values for cylinders of various thicknesses and various lengths.
7. The shielding efficiency of spheres and long cylinders of the same radius, thickness and permeability is about the same.
8. The same shield behaves so differently for axial and transverse applied fields that, whenever possible, on should determine which direction of field is most important before he designs or selects a shield for it.
9. A cylindrical or conical structure shields transverse fields much better than axial fields, e. g., 23 db (93%) vs. 8 db (60%) for a field of 0.5 gauss.
10. A silicon-iron alloy conical structure shields an axial field almost as well as a nickel alloy one. For transverse fields, however, the nickel alloys are greatly superior.
11. For axial fields in particular, one should physically shield all regions of importance. Nearby shields cannot be counted upon to shield by proximity. Indeed the axial field is often stronger off the edge of a shield than the original axial field which is to be shielded.
12. Partial inserts of high permeability alloy in a shielding



structure of lower permeability material cause significant increases in shielding efficiency for transverse fields but not for axial fields.

13. A double shield of silicon-iron alloy is at all points better than a single shield, but the improvement in shielding efficiency is better for axial fields than for transverse fields.
14. Experimental results are given for conical shields for cathode-ray tubes for both axial and transverse fields of 0.5 gauss and 11.5 gauss.
15. Aproximate relative cost figures are given for shields made of various magnetic alloys.

This paper has benefited greatly from the helpful suggestions and constructive criticisms of H. F. Porter and H. R. Brownell, and from the careful measurements made by D. W. Stanton and B. R. Huddell. Dr. A. W. Friend suggested the use of an insert of high-nickel material in a single shield made of silicon-iron alloy.

REFERENCES

1. J. A. Stratton, *Electromagnetic Theory*, McGraw-Hill Book Co., Inc., New York, N.Y., p. 265, 1941.

2. W. R. Smythe, *Static and Dynamic Electricity*, McGraw-Hill Book Co., Inc., New York, N.Y., 1950.

3. E. Weber, *Electromagnetic Fields*, John Wiley & Sons, Inc., New York, New York, 1950.

4. H. Kaden, "Die elektromagnetische Schirmung in der Fernmelde- und Hochfrequenz technik," Springer, Berlin, Germany, 1950.

5. W. G. Gustafson, "Magnetic Shielding of Transformers at Audio Frequencies," *Bell System Technical Journal*, p. 416, July, 1938.

This paper was presented at the National Electronics Conference held in Chicago, Sept. 28-30, 1953.

Federal Problems

(*Continued from page* 59)

ernment systems at the expense of the health of private systems, promote efficiency, eliminate duplication, and provide long-range technical planning. It would help to achieve policy on a national scale. It would decide whether all government communication systems should make and collect charges for the services they render to their own as well as to other agencies.

Advantage should be taken of the recently established Hoover Commission charged by Congress to make recommendations to it for legislative action. That Commission would be well advised to establish a special task group to look into this important subject which cuts across so many governmental activities.

Until Congress enacts suitable statutes, national telecommunication administration is apt to continue to be secondary to the individual interests of the using government agencies. And the objectives sought to be attained by the President's Communications Policy Board of 1950 will not be realized.

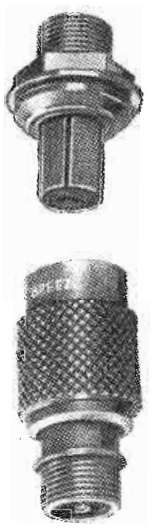
When Standard Connectors won't do . . .

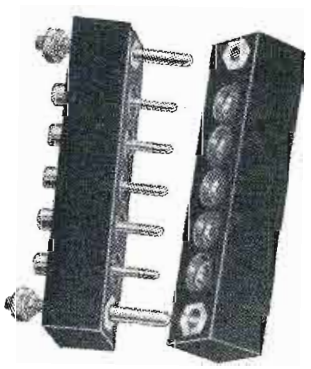
HIGH TEMPERATURE

Permits continuous operation at 800° F. or over. Plug and receptacle keyed for positive polarization. Lava inserts.

QUICK DISCONNECT

Simply push plug and receptacle together to engage. Pull sleeve on plug shell for instant disconnect. No unscrewing or twisting. Self-polarizing.





PANEL MOUNTING

Monobloc, for small space. Correct alignment of mating pins assured. Easily removable contacts save time and money.

Get BREEZE MARK

Custom Made

ELECTRICAL CONNECTORS

We design and manufacture connectors for special applications where stock parts would not meet requirements.

If high temperature is your problem, our engineers can design a connector with lava inserts to meet your conditions. Perhaps it is unusual structure, dimensions or installation. Call on Breeze!

Where there is no time for awkward unscrewing or twisting, quick disconnects are indicated. We can provide drawer and panel mounting connectors incorporating removable contacts. These will enable you to repair or service one circuit without disturbing others.

We have the specialized experience and the facilities. Tell us your problem in connectors. Our engineering staff is at your service.

BREEZE CORPORATIONS, INC.

41 South 6th Street, Newark 7, New Jersey

OTHER BREEZE PRECISION PRODUCTS

Ignition Shielding

Flexible Metal Tubing

Aeroseal Hose Clamps

Actuators

Guided Missile

(*Continued from page 57*)

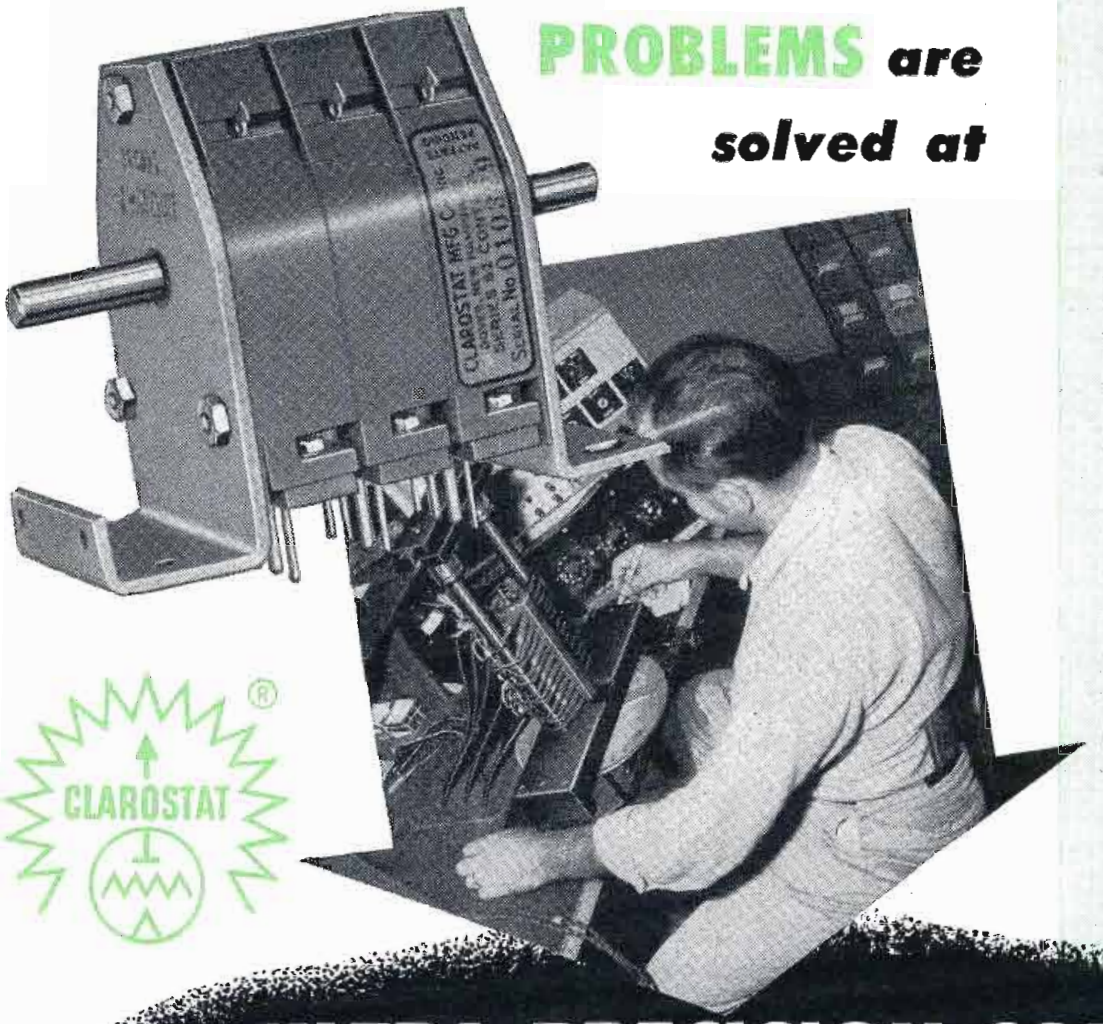
of this equipment to be used throughout the Florida Missile Test Range. It is somewhat easy to understand that as requirements and workloads increase more equipment is necessary at the many telemetry sites and additional panels will be required in the "Lines Distribution Racks." Sometimes new techniques coupled with varying missile programs results in a reduced workload and some sites require fewer facilities. The rack and components shown in the photographs are located at the main site where maximum facilities are now required. Thus, the rack is nearly filled with panels. However, at sites where less equipment is installed, fewer quantities of information or data is available and thus less patching is required.

Panel Location

Wherever multiple stations are installed at one site a "Lines Distribution Rack" is provided as a part of the installation but the quantity of patch panels available is proportional to the quantity of telemetry equipment at the site and requirements. Panels are always located in their same respective location and in the event a panel is to be omitted a blank panel is inserted in its respective location and all other panels are unchanged in position. This permits the operating personnel to become familiar with procedures without the peculiarities of different locations creating various patterns of operational techniques. Any improvement in operational procedure standardization is very beneficial since it reduces the possibility of patching errors and personnel training.

The illustrations show all the rack wiring terminating at the base of the rack on terminal strips. This permits very neat factory wiring of the entire rack. After the rack is located at a site, it is then only necessary for a field installation crew to tie it into all the equipment and remote line distribution boards at the site. For some installations it has been to better advantage to omit all the factory rack wiring and cable termination in the base of rack. The installation group then run all wiring directly to the respective panels instead of to the base terminations. This installation procedure has proven beneficial because it is easier for the men to wire and harness the cabling from this way since they are associating the cable directly

THE MOST CRITICAL CONTROL PROBLEMS *are solved at*



CLAROSTAT ®

FEATURES...

individual sections or tandem assemblies up to 18 sections.

Resistance tolerance: Standard overall, plus/minus 5%. Plus/minus 0.5% available where resolution permits.

Linear and non-linear within plus/minus 0.5%, or a voltage ratio accuracy of 0.005 where resolution permits.

Resistance range of 10 to 100,000 ohms. Non-linear, maximum of 350 ohms per degree of rotation.

One or more taps available. Taps can be located to within one winding convolution.

Power rating: 3 watts at 40° C. Non-linear, approximately 0.01 watt per degree of rotation.

Rotation: Effective up to maximum of 358°. Mechanical, any value up to 360°.

ULTRA-PRECISION CONTROLS HEADQUARTERS

For applications requiring *ultra-precision* controls, again you can "stand pat with Clarostat."

Originated by Clarostat, such ultra-precision potentiometers are now used in intricate and critical assemblies such as servo-mechanisms, range finders, fire-control systems, computing devices, and so on.

And now the latest, further-refined, plug-in version, Series 52, is available. Arch-shaped low-loss phenolic casing. Prong terminals engaging with corresponding sockets for plug-in circuitry. Side terminal lugs on each unit facilitate checking section voltages. Heavy metal end brackets insure rigid mounting.

Built by craftsmen working under instrument-shop conditions, these Clarostat Series 52 units are *the finest controls ever offered.*

Torque: 1 oz.-in. maximum per section.

Insulation: 1000 V.A.C. at atmospheric pressure.

End brackets and other types of mountings meet any mechanical considerations.

These units exceed applicable JAN-R-19 specifications.

Section-by-section assembly of tandem controls, with critical checkups of mechanical and electrical factors at each step insure *ultra precision.*

STAND PAT WITH CLAROSTAT

Data on request. Let us collaborate on your ultra-precision control requirements.

CLAROSTAT Controls & Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE

In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

with the panel and equipment of the same nature instead of numerous rows of coded terminals in the base of the rack. In addition, the cost of each "Lines Distribution Rack" is then reduced considerably.

It is felt that this equipment satisfies an instrumentation need that has existed for a long period of time. A quantity of FM or PWM telemetry stations are integrated into a complete telemetry site and in turn the site becomes part of an instrumentation network. Equipment which is duplicated at the various stations is made readily available for use in any of the other stations at the site by ordinary patching techniques. By the selection of equipment patching greater flexibility has resulted while at the same time adoption of layout and procedures has resulted in standardization.

Pictures used with this article are U. S. Air Force photographs.

Paste Solder

(*Continued from page 71*)

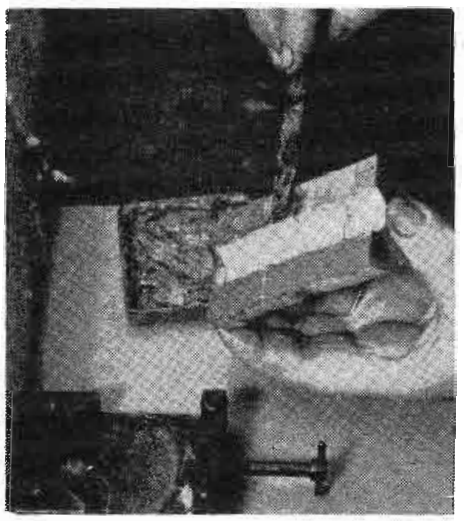
bly. This operation is done with a wooden spatula. The operator holds four or five magnets in one hand, spreads the paste alloy evenly across the exposed magnet ends. Upwards of 10 to 15 magnets at one time will be prepared in this fashion.

When the operator starts assembly, the three parts are placed in the jig assembly and the set screw is drawn up lightly to "snug" the separate parts, affording a good solder joint. As the Fusion alloy contains the required fluxing and tinning agents in the paste, the separate fluxing operation is eliminated.

As fast as the jigs are assembled, the units are placed by the operator in the cold end of a small induction-heating track-type furnace which is located on her bench within easy reach. The jigs are moved through the 40-in. long track as new assemblies are inserted at the cold end. Temperature is maintained at 550° F. When the operator removes the jig from the furnace, the solder, located evenly throughout the joints is in a molten condition. A paste solder with a 400° F melting temperature is used so that the operator has time to tighten the hot jig with pliers before the solder can set. After the jig is drawn up tight, the assembly is water quenched to set the solder and to reduce the temperature for re-loading.

Use of the pre-application of paste solder with a separate heat

cycle permits the operator to devote almost full time to assembly. Savings of time over the former method now enables the same operator to produce 300 pole pieces in eight hours, 120 additional pieces per shift over the former method. As these units are valued at 54¢ each, the increased production amounts to approximately $324 per week. Due to the wide range of variables with separate fluxing, soldering assembly



Paste solder is applied to the ends of eight Alnico magnets with spatula in one operation

and heating, the company was originally faced with breakage amounting to four to five out of 180 pieces. This has been reduced to not more than one out of 300 pieces with the present paste soldering method.

WPTZ Originates Color Telecast

Several Philadelphia, Pa., advertisers were able to see their own products on color television recently when WPTZ, NBC TV affiliate, held a special demonstration in its downtown studios. The video originated from the Philco Corp. Research Laboratory at C and Tioga Streets, Philadelphia. The four-mile distance between the laboratory and WPTZ studios was spanned by microwave relay.

Engineering Dept. of RETMA Moves

The Engineering Department of the Radio - Electronics - Television Manufacturers Association has moved its New York office to larger quarters. The department now is located at 500 Fifth Ave., New York City, and the new telephone number is Longacre 5-3450.

The move was necessitated by the growing scope of the department's activities and its recently enlarged staff under the supervision of RETMA Chief Engineer Ralph R. Batcher.

Protective Coatings

(*Continued from page 89*)

were found to be the same as those taken at 22 volts. After 17 days in the humidity cycle the boards were removed from the test chamber, and the resistance readings for recovery were taken at room temperature and 50% relative humidity.

Table I is a summary of the results obtained from forty-four test boards coated with the materials shown. Boards were removed for resistance readings from the test chamber during the room temperature portion of the humidity cycle. The unmodified epoxy resin maintained the highest resistance readings, but had relatively slow recovery; whereas, a polystyrene coating showed very rapid drop in resistance to a low value and a very fast recovery. The phenolic coating containing a solvent showed relatively good results, but would be difficult to apply without "solvent traps." Fig. 3 shows the resistance readings for various thicknesses of epoxy

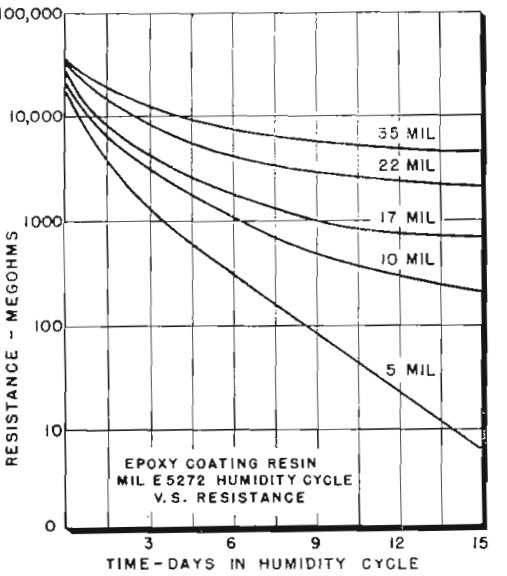
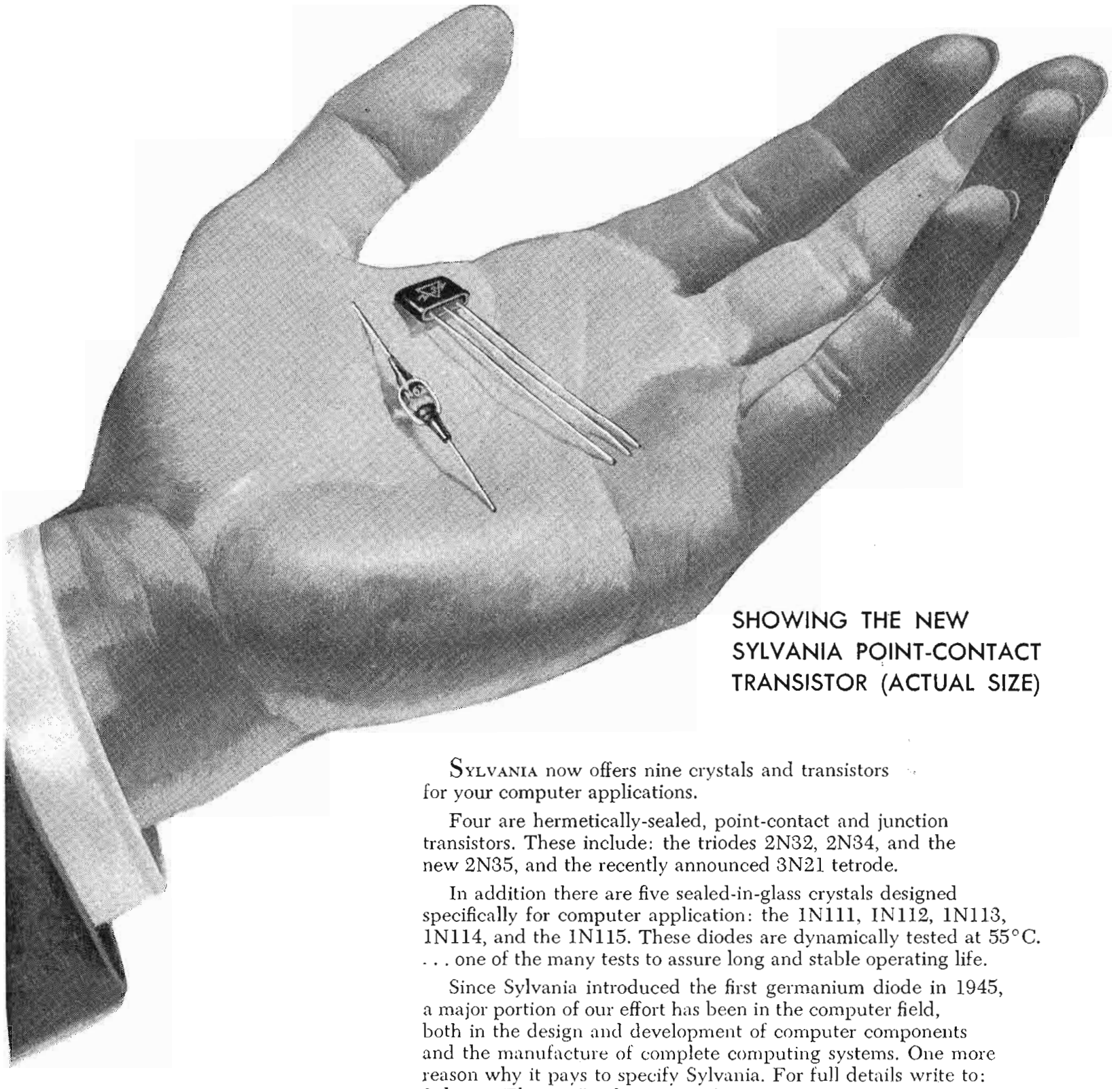


Fig. 3: Resistance of epoxy coating resin for different thicknesses under humidity cycle

resins, showing that the thicker coatings gave higher resistance to moisture penetration than the thinner coatings. These non-solvent epoxys could easily be applied in coatings as thick as desired. Recovery is not shown for coatings thicker than 10 mils as there was no change in resistance readings over a twenty-four hour period. These curves represent the average values for 22 test boards. Twelve uncoated boards also were humidity cycled and gave an average reading of 2 megohms for one day exposure and 10,000 megohms for four days exposure. After four days exposure these boards showed severe corrosion and very little recovery. All the modified epoxy resin boards

(*Continued on page 165*)

Specify Quality-tested SYLVANIA COMPUTER CRYSTALS and TRANSISTORS



SHOWING THE NEW SYLVANIA POINT-CONTACT TRANSISTOR (ACTUAL SIZE)

SYLVANIA now offers nine crystals and transistors for your computer applications.

Four are hermetically-sealed, point-contact and junction transistors. These include: the triodes 2N32, 2N34, and the new 2N35, and the recently announced 3N21 tetrode.

In addition there are five sealed-in-glass crystals designed specifically for computer application: the 1N111, 1N112, 1N113, 1N114, and the 1N115. These diodes are dynamically tested at 55°C. . . . one of the many tests to assure long and stable operating life.

Since Sylvania introduced the first germanium diode in 1945, a major portion of our effort has been in the computer field, both in the design and development of computer components and the manufacture of complete computing systems. One more reason why it pays to specify Sylvania. For full details write to: Sylvania Electric Products Inc., Dept. 3E-3012, 1740 Broadway, New York 19, N. Y.

LIGHTING • RADIO
ELECTRONICS • TELEVISION

In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., St. Catherine Street
Montreal, P. Q.

SYLVANIA

Air-Cooled Tetrode

(*Continued from page* 90)

sertion and removal of the tube in coaxial-type circuits. The glass seal between screen and plate is adequately cooled by the cooling air directed through the radiator from the plate seal end to the handle end.

Radiator Design: The 10-kw. plate-dissipation rating of the 6166 presented a problem in radiator design. If the conventional fin construction used in many previous power-tube designs were utilized,

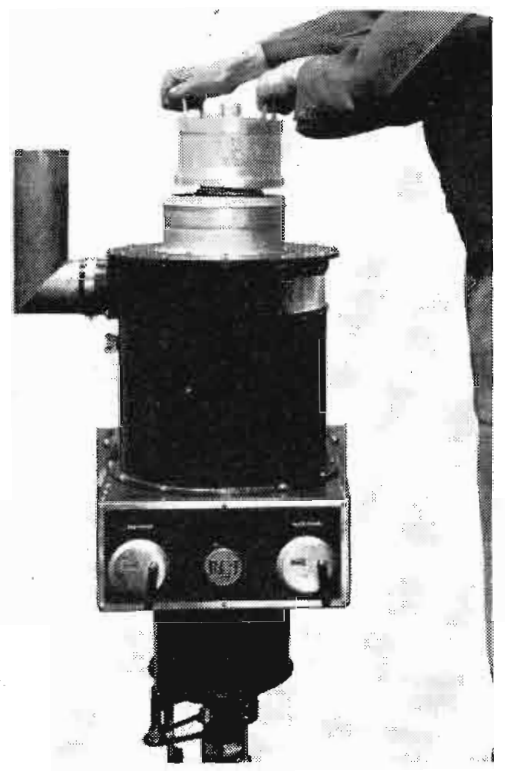
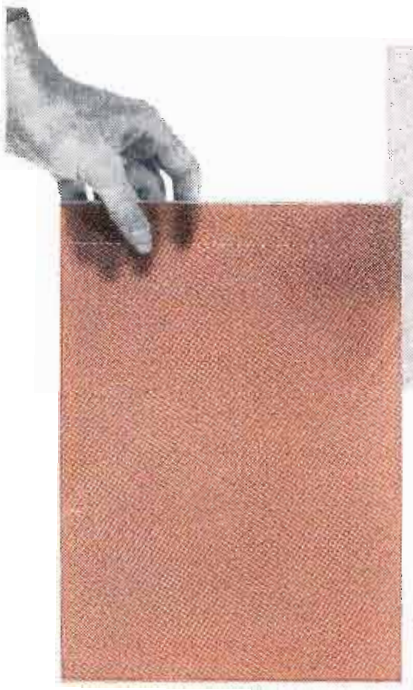


Fig. 3: RCA-6166 air-cooled power tetrode is inserted into TT-10AL 10-kw TV transmitter

the size of the radiator and the airflow and pressure requirements would be excessive. The individual fins of the 6166 radiator have many punched-out louvers which cause air turbulence as the air passes over the fin. As a result, the heat-transfer coefficient between fin and air can be more than doubled. When this fin structure is used, a radiator 6 in. in diameter and 4 in. long can dissipate 10 kw with moderate airflow requirements. A comparison of watts dissipated per sq. in. of plate surface shows that the 6166 operates with a power density twice that encountered in several of the standard water-cooled power tubes currently in use.

Operation

Early in the development of the 6166, complete crystal-controlled 216-MC 500-watt driver chain, a power supply, and a coaxial cavity-type circuit were constructed so that performance data at full power input at the maximum rated frequency



Formica

announces another new

ENGINEERED GRADE

FF33

No other single grade of laminated plastics has ever offered a more useful combination of properties:

- Lowest moisture absorption
- Great arc resistance
- Excellent dimensional stability
- High dielectric strength
- Low loss electrical properties
- Dependable continuous service at temperatures as high as 350°F
- Good chemical resisting properties

How can you use it? Send for your sample today!

The new Formica FF-33 has more useful electrical and mechanical properties than have ever before been combined in a single grade. Made of a fine weave fibreglass cloth and impregnated with a special new resin, FF-33 promises to be one of the most useful and popular grades ever developed by Formica. It has already been tested and approved by several leading U.S. manufacturers.

FF-33 may be the perfect solution to one of your problems. You can see and test it without obligation. Why not send for your sample today? Use convenient coupon below.

THE FORMICA CO.
4644 Spring Grove Avenue
Cincinnati 32, Ohio

Gentlemen: Send me promptly and without obligation 6" x 6" x 1/16" sample of the new Formica FF-33.

NAME_____

COMPANY_____

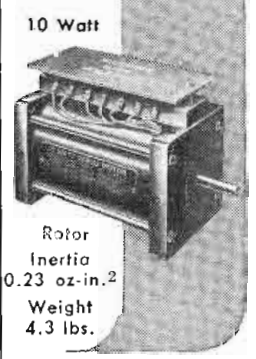
ADDRESS_____

CITY_____ ZONE___ STATE_____

FORD

control motors...

for extremely low inertia and high frequency response



HIGH VOLTAGE MOTORS

60 Cycle, 1½ - 5 - 10 watt models

Designed specifically for electronic systems—operate directly in the plate circuit of a vacuum tube amplifier.

LOW VOLTAGE MOTORS

60 and 400 Cycle, 2½ - 5-10 watt models

Recommended for normal two-phase applications.

advantages

- Linear torque—voltage characteristics
- Linear torque—speed characteristics
- Withstand continuous stalling
- High torque efficiency
- Flexibility of mounting

Write for Descriptive Brochure about all Ford Control Motors.

FORD INSTRUMENT COMPANY
Division of The Sperry Corporation
31-10 Thomson Avenue, Long Island City 1, N.Y.

PRECISION paper tubes

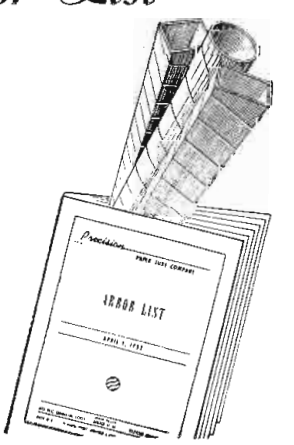
ANY SHAPE . . . LENGTH . . . ID OR OD . . . TO MEET YOUR SPECIFIC REQUIREMENTS

• *Send for Arbor List* •

Free to you upon request . . . lists over 2000 sizes . . . all promptly available. Ask for free sample—send in your specifications.

Precision Paper Tubes are spirally wound from the finest dielectric kraft, fish paper, cellulose acetate, phenol impregnated materials or combinations.

WRITE US TODAY!



PRECISION PAPER TUBE CO.
2057 W. Charleston St., Chicago 47, Ill.
Plant No. 2: 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Coil Bobbins

could be obtained as developmental tubes became available. In this circuit the 6166 was driven by a 4X500A operating as an amplifier at 216 MC, which was driven in turn by a 4X150A operating as a doubler. Additional low-power multiplier stages were included so that the driver could be controlled with a 6-MC crystal. With the drive power available, overall power gains of 20 to 1 from driver stage to output-stage water load have been obtained. Under broadband TV conditions, power gains of 10 to 1 are easily obtained.

Life Tests

Extensive life tests were conducted in this equipment under both dynamic and static operating conditions. Filament stability tests, in which the filament was switched off and on several thousand times, produced no signs of failure. This filament cycling corresponds to several years' use in a transmitter. Two developmental tubes were given dynamic life tests on channel 13 under broadband conditions with a CW power output of 7 kw measured in the water load. The first developmental tube tested completed 1000 hours without any noticeable deterioration. A second tube, which is still in operation, has completed 3000 hours with no change in tube operation or characteristics. All life tests made have indicated long life and reliable operation. No high-voltage "aging in" is required in the transmitter, and no tripouts due to tube flashing have been experienced. Fig. 3 shows the tube in place in the TT-10AL 10 kw TV transmitter.

Although the 6166 will probably be required to operate in CW service at little more than 5800 watts, one tube was operated on life test at 220 MC with 10 kw of continuous output and 18 kw input. No signs of grid or screen emission were encountered. The test results indicate that even higher output powers may be possible, but the capacity of the power supply prevented further increases in power input. Overall efficiencies of 5% including circuit losses, have been easily obtained. Efficiencies as high as 62% have been obtained at somewhat lower power levels and under optimum loading conditions. The close agreement of operating conditions with those calculated from the characteristic curves indicates that no serious transit-time effects occur up to the maximum rated frequency.

Transmitter-Receiver

(*Continued from page 73*)

triode half of the 3A5 tube is used as a self-quenching superregenerative detector.

A peculiar problem arose as a result of the combination of the transmitter output stage and receiver detector in the one envelope. The capacitance between the two plates of the triodes coupled the tank circuits of these two stages. Since they are normally operating on the same, or nearly the same frequency, the "resting" tank absorbs power from the operating circuit. This reduces the transmitter power output, and in "receive" can lower the receiver tuned circuit impedance sufficiently so that the detector tube will not superregenerate. This problem was solved by resonating the capacitance between plates with a small iron-cored inductor. This increased the impedance of the coupling path, and

Fig. 4: Arrangement of "A" and "B" batteries

provided the isolation necessary to eliminate the "suck-outs". The solution to the problem was further aided by the fact that both tank circuits are tuned with the antenna connected. Therefore, when switching from "transmit" to "receive" the "resting" tank is detuned far enough off resonance so that "suck-out" does not occur.

Power Conservation

A second 3A4 is used as an audio power amplifier for both modulation and receiver output. Conservation of "A" battery power is effected by using only one-half the filament of the 3A4. Adequate output is available under these conditions for modulation and receiver output. Sufficient gain to operate the 3A4 output modulator tube is realized from a 1U5 diode-pentode. When transmitting, a magnetic speaker/microphone unit is connected to the 1U5 input grid through a microphone transformer, while at the same time the output of the 3A4 modulator is connected through a modulation transformer to the 3A5 R.F. final tube. On "receive" the magnetic unit is connected as a loud speaker to the voice coil winding on the same trans-

former; while the input grid of the audio amplifier is connected through an R.F. filter to the output of the superregenerative detector.

A novel circuit has been provided to supply bias for the audio output amplifier eliminating the need to "steal" this voltage in the negative return of the "B" battery supply. The diode in the 1U5 is connected to the plate of the audio output tube so as to take a small portion of the audio output voltage both on "transmit" and "receive" and after rectifying approximately 8 volts to the grid of the output tube as bias. This bias is held constant by means of a long time constant RC combination which is common to the low voltage end of the diode and the control grid return of the 3A4 modulator tube. When using this unit in the "receive" position, bias is derived from the superregenerative noise in the absence of a modulated signal. With weak signals the balance between falling audio output and increasing superregenerative noise keeps the bias surprisingly constant.

Antenna System

The antenna system is the result of evolution from previous experience on a unit of this type designed for the Army Air Force. A quarter-wave antenna operating against a quarter wave grounded counterpoise was originally used in this unit. In physical form it looks like a horizontal dipole and creates many problems relative to the storage of the antenna elements, and further is very difficult to maneuver through

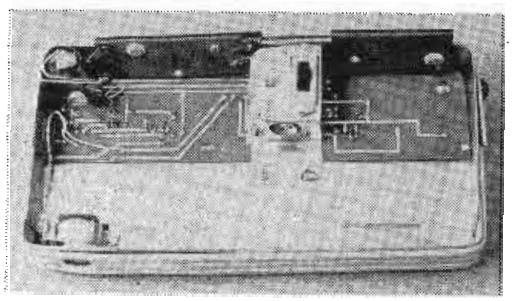


Fig. 5: Printed wiring contributed greatly to 20 cu. in. volume reduction in the final model

doorways and other restricted areas such as might be found in the debris of a bombing or other emergency. A simple quarter-wave whip is not as effective a radiator as the horizontal antenna because it does not have a suitable ground system to work against. Results with half wavelength vertical voltage fed antennas indicate that these are ideal radiators for hand carried equipment of this type. The antenna used on the PM-1 is a vertical whip approximately 3/8

(*Continued on page* 164)

Soldering Methods

(*Continued from page 64*)

resin filled laminates commercially available.

Multiple Selective Soldering

It is sometimes desirable not to have solder adhere to certain locations where mounting of components may be interfered with due to a build up of solder. This single selection of points to be soldered is called multiple selective soldering and may be accomplished by several means, one of the simplest of which is to merely apply masking tape to the areas not to be soldered prior to fluxing of the board. The tapes are subsequently removed after the dipping operation, and as the heat of the solder bath melts the tape adhesive it becomes necessary to wash the board thoroughly to remove any trace of tape adhesive. Usually the flux remover will have the solvency to accomplish this. Mechanical selectivity can be provided by use of drilled jig plates made from such heat and solder resistant materials as aluminum, asbestos sheet, or other insulators. The jig plate is either floated or suspended on the solder surface or attached to the circuit panel proper prior to dipping.

Heat Resistant Coating

Another means of selectivity is through the utilization of a solder and heat resistant coating which is applied to all areas except where solder connections are to be made. See Fig. 6. Such a coating may be applied by either brush or silk screen and generally requires a slight baking cycle to set it.

This coating will remain with the board during and after the solder dipping operation to provide, as an additional feature, good moisture and fungus resistance characteristics.

Multiple Jig Soldering

Where volume is very large and complete automatization is contemplated, multiple jig soldering can be used to great advantage. Multiple jig soldering is a soldering process realized by the application of multiple of self feeding hot soldering tips which will heat the spots to be soldered and simultaneously flow controlled amounts of solder alloy to complete the soldering function. This system has been generally used where eyelets have been inserted at all points where a solder connection is planned, the eyelets forming solder wells and reinforcing the attachment

of the circuit to the board at the points where there is a possibility of damage due to too great a heat transfer. This system has seen its greatest application to panels where there is concern as to the heat resistant properties of the bonding agent between the circuit and the board.

Another method of multiple selective soldering quite foreign to the dip soldering process is the selective multiple spot soldering method. This process requires a circuit board which has been prepared with the "hot solder" soldering aid mentioned earlier. A board so prepared usually has anywhere between 0.003 in. and 0.015 in. thickness of solder evenly distributed over the entire circuit pattern. When the board is fully assembled and ready for soldering, a hot iron or a fixture holding a number of irons is then brought to bear on the coated surfaces at the points where a solder joint is desired, and retained in position only long enough to flow the solder and fuse the connection. This process particularly lends itself to splicing the conductors of mortised board multiples which are to be solder joined, after a satisfactory mechanical attachment has been made. Resistance or induction heating could also be employed to flow the solder instead of hot irons in variations of this process.

Complete Automatization

While all these methods have been tried and proven, it seems in most cases that the lean is toward the one pot method using a board prepared with a soldering aid finish and cleaning off all flux residue after soldering. Considerable activity is developing toward complete automatization with conveyorized two pot dip soldering.

These multiple soldering processes outlined here are all particularly applicable to printed wiring requirements but each method has been utilized successfully in other applications.

WESCON to be Held Aug. 25-27

The 1954 Western Electronic Show and Convention is scheduled for Aug. 25-27, 1954 in the Pan Pacific Auditorium, Los Angeles, Calif. It will feature 450 standard 10' by 10' booths located on one floor. Mal Mobley, Jr., WESCON business manager for 1954, announced that floor plans and contracts will be available by Dec. 15, 1953.

Transmitter-Receiver

(*Continued from page* 159)

wavelength long and represents a compromise between optimum radiator efficiency and practical length of antenna. The base impedance is inductively reactive and is tuned out by a small capacitor in series with the antenna and the coupling loop. The "transmit-receive" switch transfers the antenna from the transmitter to the receiver.

A service range of approximately 1 mile between two PM-1 units can be realized consistently over level ground and moderately open terrain. By taking advantage of high points this range can be extended many miles.

The transmitter carrier power output is approximately 250 mw at rated battery voltages. The madulation capabilities are 100%.

Receiver Sensitivity

The receiver sensitivity is approximately 15 μv for a signal-to-noise ratio of 6 db with a modulation of 30%. Audio power output under these conditions is 80 milliwatts, and increases with strong signals. Sufficient acoustic output is provided to allow satisfactory hearing on all useable signals with the microphone/speaker unit held close to the mouth so that it is unnecessary to continually move the unit between mouth and ear when switching between "transmit" and "receive."

The PM-1 uses two 1.5 volt size "D" flashlight cells. The Eveready D99 is preferred, but any cell of the same physical size may be used. The "B" batteries used are two 67.5 portable "B" batteries RCA #VSO16 or equivalent. For an average daily operation of two hours the filament battery life will be approximately 18 hours. Approximately three times this life will be obtained from the "B" batteries.

Layer Construction

Crowded space conditions made the early development models of this unit difficult to work on and maintain because of the necessity for "layer-built" construction. To improve this condition and the reliability, the final design makes full use of the advantages of printed wiring (Fig. 5), and has ample accessibility for all components even though the telescoping antenna was also moved inside the case for storage. The use of this technique resulted in considerable increase in efficiency of space utilization such that the volume of the final unit was reduced by 20 cu. in., and approximately ¾ lbs. in weight.

Protective Coatings

(*Continued from page* 152)

showed no corrosion of the copper pattern after 17 day humidity exposure. Polyester resins showed a tendency to crack and peal off the board leading to corrosion of the copper. Other materials showed varying degrees of copper corrosion and whitening of the coating, but no cracking or pealing of the coating.

The coating showing the highest humidity resistance, at the present time, would be a thick (20 to 35 mil) coating of an undiluted or unmodified epoxy resin. However, this thickness of coating would make component replacement almost impossible. Also, this degree of protection may not be required by the circuit in question. Another important factor established in these tests was that all commercial epoxy resins do not show equally high resistance to moisture. Apparently the modification of epoxy resins with reactive diluents, fillers, and solvents reduces moisture resistance.

There have been no plastics found which, when applied under the conditions as described in this report, are completely impervious to water vapor penetration. Recognizing this fact, the penetration of water vapor into electrical equipment is best impeded by a thick epoxy resin coating, which, however, shows very slow recovery after long exposure to high humidity conditions. Conversely, coatings which show very poor moisture protection, polystyrene for example, may have very rapid recovery. Another factor to be recognized in the application of protective materials to etched circuits is that a non-solvent coating material is desirable when a low temperature curing procedure is to be used. This will eliminate the problem of uncured areas of coating material which occur underneath components and various unexposed areas.

Polarad Equipment for Color Television

Polarad Electronics Corp., 100 Metropolitan Avenue, Brooklyn 11, N. Y., has announced the release for production of a complete line of NTSC color TV picture generating and monitoring equipment. Orders for this equipment are being accepted at the present time. Among the units being produced are Color Monitors, Color Slide Picture Signal Generators, Color Synchronization Generators and Color Bar Generators.

Transistor I-F

(*Continued from page* 69)

$$R_{in} = \frac{r_e + r_b(1-\alpha)}{1-\alpha} = \frac{r_e + r_b + \frac{r_e \alpha}{1-\alpha}}{} \quad (12)$$

The g_m value is the same for either connection. The input resistance of the grounded emitter however, is $1/(1-\alpha)$ times as high as that of the grounded base.

The output resistance Ro can be found by feeding a generator into the collector. Doing this we find

$$R_{out} = r_c\left[1 - \frac{\alpha r_b}{r_e + r_b + R_g}\right] \quad (13)$$

for the grounded base

$$R_{out} = r_c\left[1 - \alpha + \frac{r_e \alpha}{r_e + r_b + R_g}\right] \quad (14)$$

for the grounded emitter.

If R_g is very small and r_b large compared with r_e the two values approach each other. On the other hand if R_g is large, Eq. (13) approaches r_c and Eq. (14) approaches $r_c(1-\alpha)$. Thus under certain conditions the grounded base output resistance will be $1/(1-\alpha)$ times that of the grounded emitter. Under practical conditions the grounded base has some advantage in output resistance over the grounded emitter.

Experimental Work

Early experimental work indicated that the values of input impedance for the grounded base and grounded emitter circuits approached each other in value as the frequency was raised. This has not been indicated in the theory given above.

It is well known that α is a function of frequency. One of the standard tests made on transistors is the α cutoff test which determines the frequency at which α has dropped 3 db from its low frequency value. The cutoff frequency will be designated f_{co}. The effect of α cutoff has been considered by Pritchard[1] and Thomas.[2] Pritchard considered grounded emitter connection while Thomas considered both the grounded emitter and grounded base connections. Following the method of Thomas we can express the g_m for either connection, Eq. 9 taking α cutoff into consideration as

$$g_m = \frac{\alpha_o}{R_{11}\left[1 - \frac{\alpha_o r_b}{R_{11}}\right]\left[1 + j\frac{f}{f_{co}\left[1 - \frac{\alpha_o r_b}{R_{11}}\right]}\right]} \quad (15)$$

Where:

α_o = Low Frequency α

$$\alpha = \frac{\alpha_o}{1 + j\frac{f}{f_{co}}}$$

f_{co} = α cutoff frequency
f = test frequency
$R_{11} = r_b + r_e$

Thus we see that feedback has reduced f_{co} the same amount that it increased g_m. Without feedback the low frequency g_m would be $\alpha_o/(r_e + r_b)$ but feedback has increased this to $\alpha_o/(r_e + r_b\ 1-\alpha)$.

We can see what happens to circuit g_m for the grounded base connection by substituting $R_e = R_g + r_e + r_b$ for R_{11} in the above formula.

(16)

$$g_m = \frac{\alpha_o}{R_e\left[1 - \frac{\alpha_o r_b}{R_e}\right]\left[1 + j\frac{f}{f_{co}\left[1 - \frac{\alpha_o r_b}{R_e}\right]}\right]}$$

The generator resistance R_g thus tends to decrease the value of g_m but makes it more constant with frequency.

In the case of the grounded emitter the circuit, g_m is almost as high as the true g_m and has about the same frequency characteristics.

(17)

$$g_{mc} = \frac{\alpha_o}{R_e\left[1 - \frac{\alpha_o (r_b + R_g)}{R_e}\right]} \times \frac{1}{\left[1 + j\frac{f}{f_{co}\left[1 - \frac{\alpha_o (r_b + R_g)}{R_e}\right]}\right]}$$

The generator resistance, being in the base, is degenerated to the same extent that r_b is degenerated in the equation. If we wish to stabilize the grounded emitter connection we can add resistance in the emitter.

The input impedance will also be a function of α. If we substitute for α the value $\alpha_o/(1+jf/f_{co})$ Eq. 11 becomes for the grounded base.

(18)

$$Z_{input} = r_e + r_b\left[\left[1 - \frac{\alpha_o}{1 + \left[\frac{f}{f_{co}}\right]^2}\right] + j\frac{\alpha_o\frac{f}{f_{co}}}{1 + \left[\frac{f}{f_{co}}\right]^2}\right]$$

In the case of the grounded emitter we substitute for α the value $\alpha_o/(1+jf/f_{co})$ in Eq. 12. We have

$$Z_{input} = r_e + r_b + \frac{r_e + \alpha_o(1-\alpha)}{(1-\alpha_o)^2 + \left[\frac{f}{f_{co}}\right]^2} - j\frac{\alpha_o r_e \frac{f}{f_{co}}}{(1-\alpha_o)^2 + \left[\frac{f}{f_{co}}\right]^2} \quad (19)$$

It is seen that the resistive component of the input impedance for either connection approaches r_e+r_b as the frequency increases. The values of input impedance computed from these equations were close to the values realized at r-f when the correct value of r_b was used.

The upper set of curves of Fig. 1 shows the variation of mutual conductance vs. frequency for seven transistors. The theoretical value is about 76,000 μmhos for 2 ma and 42,000 to 76,000 μmhos are realized at low frequencies. The circuit g_m for the grounded base connection is shown by the lower set of curves. These curves are considerably lower than the upper group due to the insertion of 50 ohms in the emitter input lead. The curves in the lower group are in general flatter than the upper set of curves due to the degeneration caused by the insertion of the 50 ohm resistor.

The lower set of curves of Fig. 2 shows the variation of α with frequency. Due to reasons which will appear later the α curves are flatter with frequency than the g_m curves. The variation of $\alpha/(1-\alpha)$ is shown by the upper set of curves in Fig. 2. These vary rapidly with frequency above 10 kc so the g_m curves are flatter than the $\alpha/(1-\alpha)$ curves which factor will be explained below.

Fig. 3 shows the variation of base impedance with frequency. With the exception of 210 the lower the base impedance the better the high frequency performance.

Early[3] showed that base resistance is composed of two parts, one frequency sensitive and one frequency insensitive. This effect is due to the effective return of the collector capacity being to some point in the base resistance instead of to the junction of the base, collector and emitter. This connection is shown by Fig. 5. This effect was found experimentally in the alloy junction transistor tested.

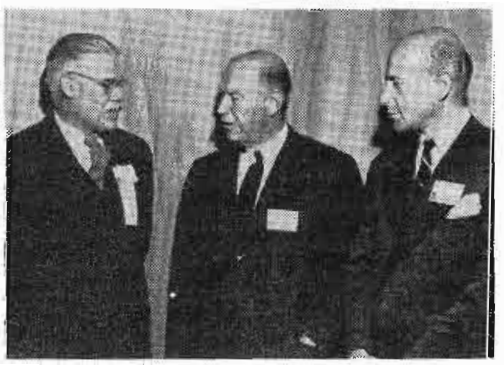
Fig. 4 shows the variation of input impedance with frequency for the grounded emitter and grounded base connections. The grounded emitter impedance decreases with frequency due to base resistance decreasing and the effective series capacity reactance decreasing above some frequency. This explains why the constant voltage g_m curve, decreases slower than the $\alpha/(1-\alpha)$ curves. With constant voltage the current would increase as the impedance decreased thus tending to hold constant collector current.

The grounded base impedances tend to hold about constant until inductive term becomes appreciable. This is shown by Fig. 5. The inductive term increases faster than the frequency due to resonating with the input capacity. The curves, if carried further, would reach a peak and then decrease rapidly. The α curve will thus be more constant with frequency than the gm curve in this case because the input current in the g_m curve will decrease with frequency as the impedance curve increases.

The amplifier chosen for this study was considered to be part of a multistage amplifier. This imposed the requirement that each stage of the amplifier would have to feed into the low impedance of the next stage. The problem would have been simpler if the stage could have worked into a high impedance circuit. The impedances as measured were low enough to consider placing the input of either connection in series with the tuned circuit.

Fig. 6 shows the grounded base circuit used. The coil was tapped about one-third for the collector. The tuning condenser was connected to the input of the next transistor. Reaction in tuning was minimized

THE "TELETRONIC AGE"



Dr. Allen B. DuMont (center), president of Allen B. DuMont Laboratories, Inc., forecast the future of the "Teletronic Age" and TV for 750 teachers, social science leaders, and writers at the recent Industrial Conference at Rensselaer Polytechnic Institute. At the left is Robert Paxton, exec. vice-president General Electric Co. Charles F. Adams, Jr., president of Raytheon Mfg. Co., is at the right.

TRANSISTOR I-F (Cont.)

by tuning the collector stage of the second transistor to the same frequency as that of the first Transistor. The Q of the second stage was adjusted to be about the same as that of the first stage. The gain may be calculated by making a few measurements. The value of α will be about 0.9 at this frequency; 450 KC. The impedance of the coil with the collector connected is about 20 ohms. The resistance due to the emitter was about 19 ohms determined by measuring the Q of the coil. The Q as seen at the emitter input is 43.8. The collector voltage was 36 percent of the total coil voltage. The collector output resistance was determined as 12,800 ohms. The impedance of the coil was 52,500 ohms and as this was tapped at 6600 ohms this value is in series with the collector. Gain = $0.9 \times 0.36 \times 43.8 \times 12800/19400 = 10.5$ times. The measured value was 10.9 times.

The circuit used for the grounded emitter is shown in Fig. 7. It is essentially the same as that for the grounded base except that only 0.6 of the tuning condenser is placed in series with the next base input. The emitter input resistance is higher than for the grounded base. The reactance of the tuned circuit has been reduced to about 700 ohms. The Q as seen at the second base input is 24.6 or about one-half that of the grounded base. The transistor output impedance here is only about 6300 ohms. The impedance of the tuned circuit is about 17,200 ohms and the collector was tapped at 2100 ohms. The $\alpha/(1-\alpha)$ for the transistor used was 4.6 times. The collector was tapped at one-third the coil.

The gain is $4.6 \times 1/3 \times 24.6 \times 3/5 \times 6300/8400 = 16.95$ times.

The measured gain was 16.1 times.

The data on the transistors used is given in Table 1. The results could be varied considerably by the choice of the second transistor. Care must be taken in the grounded emitter so as not to overload the transistor. The base current is the differential current and if the ac current gets too high the input impedance of the transistor starts to change rapidly thus causing bad distortion. We have found that about 25 mv is all that should be used on the input with 2 ma emitter current. If a larger input is necessary use the grounded base connection or increase the emitter current.

1. R. L. Pritchard, "Frequency Variations of Current-Amplification Factor for Junction Transistors," *Proc. IRE*, Nov. 1952, p. 1476.
2. D. E. Thomas, "Transistor Amplifier—Cutoff Frequency," *Proc. IRE*, Nov. 1952, p. 1481.
3. J. M. Early, "Effects of Space-Charge Layer Widening in Junction Transistors," *Proc. IRE*, Nov. 1952, p. 1401.

"Fluxcote" Solves PC Problems

Baked and stand-to-dry phenolic base boards presented a handicap to the printed circuit industry because of ineradicable electrical leakage that produced "hum" in finished receivers. Some blamed it on acid penetration caused by etching and plating processes, others on "activated" fluxes used for dip tinning, etc. Rapid oxide formation during the storage of copper circuits was another problem. Leo Mead, research director of Hallicrafters Co., Chicago, Ill., suggested seven improvements on a rosin flux developed by London Chemical Co., Chicago, that would produce a flux coat that could be applied centrifugally, dipped or sprayed after the etching process, that would dry rapidly to a non-tacky film, insulate the board, protect the copper or silver circuit from oxidation, enable smooth even tinning, and leave an insulating residue that need not be removed. The result was "Lonco Fluxcote 21XR. Boards coated with the material after dip tinning showed readings of 50,000 megohms, across the board, at 350 F.

Leo Mead, research director of Hallicrafters Co., testing the new Lonco "Fluxcote"

More Space for Tel Instrument

Tel Intrument Co., manufacturers of electronic and color TV test equipment, formerly located in East Rutherford, has moved to larger quarters at 728 Garden St., Carlstadt, N. J. The new plant provides double the amount of space formerly occupied.

Kudos for Kinzie

Mrs. Martha Kinzie, tireless secretary of the NTSC, was awarded a plaque (complete with primary colors red, green and blue) during the annual Radio Fall Meeting in recognition of her efforts on behalf of the NTSC in its work of formulation of a successful compatible standard for color TV.

New Acoustical System Developed by Reynolds

The Reynolds Metal Company's new acoustical system is now being distributed nationally through Elof Hansson Inc., 220 East 42nd St., New York City. Perforated corrugated aluminum panels are suspended on aluminum angles to aluminum angles to form a ceiling. Then, glass fiber insulation is placed either on top of the panels or attached to the existing ceiling. Or, the panels can be suspended from the roof, framing, or truss work by wires or metal straps, or by direct attachment to the existing ceiling.

In addition to providing a noise-reduction coefficient up to 0.90, the blanket is non-combustible, moisture-repellent, and provides efficient thermal insulation. When the blanket is separated from the panel, the ceiling is adaptable to any air conditioning system. The panels are 0.024 in. thick and 33¾ in. wide and give 32 in. net coverage. They come in 6 and 8 ft. lengths and weigh 0.364 lbs. sq. ft. Extruded aluminum tee-runner supports are 2x2x$\frac{3}{16}$x12 in., the extruded aluminum angles are 2x2x$\frac{1}{8}$x12 in. The glass fiber blankets vary from ½ to 2 in. in thickness and are mounted with various backings to meet specific needs. Installations are made by a national chain of acoustical contractors.

Plans Filed for Radio-Relay Link

Plans filed with the FCC, for the construction of a radio relay system by Southern Bell Telephone and Telegraph Co. and the Long lines Department of American Telephone and Telegraph Co. would provide a second link in a proposed route ultimately to extend from Atlanta, Ga., to West Palm Beach, Fla.

Broadband facilities on the existing routes between Jacksonville and Orlando have reached their practical capacity. The proposed new microwave route would augment the cable and open wire lines of the area.

Initially, four channels are planned for the route. One in each direction for conventional and private line services, and one in each direction for protection and maintenance. These additions would release two channels on the coaxial cable for TV service.

Long Lines plans to construct five intermediate stations along the 134-mile skyway equipped with tapered steel antenna-towers ranging in from 200 to 237 ft. in height.

BOOKS

Practical Television Engineering

By Scott Helt. 2nd Ed. Published 1953 by Rinehart & Co., Inc., 232 Madison Ave., New York 16, N.Y. 744 pages. Price $7.50.

The growing complexity of the TV art has fostered the need for a comprehensive reference work which will enable the practicing engineer to find what he wants quickly and easily. It must be accurate, clearly written, and above all, practical. In all these respects, this text is highly satisfactory, and a tribute to the author's ability to select that information which is essential and useful from the vast disorganized fund of knowledge currently available.

The dominant emphasis of this book, now revised and brought up to date, is on TV broadcast and associated equipment. Mr. Helt, now with Allen B. DuMont Labs, makes good use of his extensive experience in this field. The first four chapters cover picture fundamentals, the CRT, CRO and TV pick-up tubes. The next three are on generator, amplifier and power supply circuitry. Chapter 8 explains the receiver, Chapter 9 analyzes the camera chain, and Chapter 10 the transmitter. The next chapter discusses TV broadcasting techniques. The 12th and final chapter on UHF and color TV is adequate, but not nearly so thorough as those preceding. The book is liberally illustrated and will lend itself well to textbook use.

This book merits favorable recommendations. Without doubt it should receive the same hearty reception accorded the first edition. AJF

Wheeler Monographs, Vol. I

By Harold A. Wheeler. Published 1953 by Wheeler Labs., Great Neck, N.Y. 500 pages. Price $5.00.

The conceptual aspect of electronic engineering relies heavily on the symbolic representation of ideas and equipment. These symbols are actually shortcut tools ranging from the symbol R for resistance to intricate geometric structures for complex impedances. In this book a collection of what may be called "little treatises" is presented. First the basic concepts are covered: transmission lines, slide rule for radio problems, superregenerative receivers, and circle diagram geometry. Then follow feedback amplifiers, powdered iron, superselectivity, piston attenuator, converter efficiency, and speed of amplification. There is a wealth of analytical information in this book, and it should be a notable help to engineers involved in circuit development. AJF

Principles of Transistor Circuits

Edited by Richard F. Shea. Published 1953 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16, N.Y. 535 pages. Price $11.00.

Practicing engineers and graduate students will find a wealth of highly

(*Continued on page* 184)

FM/FM Telemetering

(*Continued from page 93*)

cuit and may require an additional amplifier.

The variable inductance pickup is used in conjunction with a Hartley oscillator, whose tank circuit inductance forms an integral part of the pickup. A mu-metal pad is attached to one side of a beryllium copper diaphragm, and the assembly mounted in a housing carrying the tank inductance in the form of an E coil at one end. The diaphragm divides the housing into two compartments, and in one of these the pad and coil face one another across a narrow air gap. Pressure tubing connects either one or both chambers to the pressure source or sources to measure respectively referenced gauge or differential pressure.

Pressure Differential

Changes in the pressure differential across the diaphragm cause it to be distorted and so to increase or reduce the air gap, thus altering the effective inductance and the frequency of oscillation of the subcarrier oscillator.

Several pressure pickups are shown at positions (F), (I), (K), and (L) on Fig. 3, while the E coil may be seen separately at position (G). The compact inductance oscillator is shown in one view at (M) on Fig. 1 and in the reverse view at (H) on Fig. 4. The circuit diagram of the oscillator is given on Fig. 10. It should be noted that commutation of inductance pickups to a single oscillator presents certain problems related to transient effects, especially when one of the switched wires carries B+ as is the case with the present Hartley oscillator inductance. This problem is one of the arguments in favour of the dc type of pickup.

Measurement of Linear Acceleration: The pickup used for measuring linear acceleration is similar to the pressure gauge of the variable inductance type. An exploded view is shown in Fig. 11. The diaphragm is weighted with a balanced mass at its center which reacts to the acceleration in a given plane. This plane is at right angles to the plane of the diaphragm and to its circular surface. Damping is achieved by filling the whole unit with oil and perforating the diaphragm with a few holes to allow oil flow. A second diaphragm allows for expansion of the oil when the temperature is raised. This pickup operates in conjunction with the same Hartley in-

ductance modulated oscillator as is used with the pressure gauge. A view of the pickup is at position (G) on Fig. 4. As in the case of the pressure pickup dc potentiometer and strain gage types are also available.

Measurement of Motion: Using the same principle as the inductance pressure gauge and accelerometer is the mechanical angle pickup seen at positions (A) and (B), on Fig. 3, the latter a cutaway view of the nonlinear type. In this latter design the angular motion of the shaft operates a cam which causes

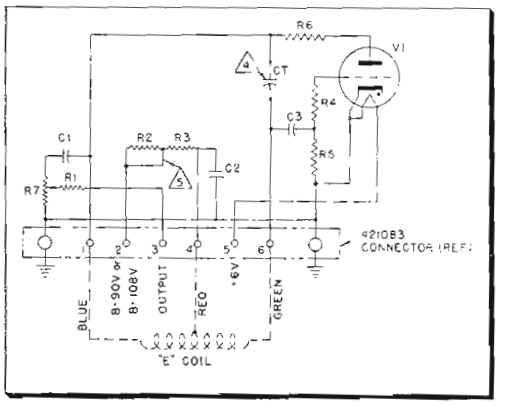


Fig. 10: Inductance controlled oscillator

the air gap to be varied nonlinearly for certain rotations, in degrees, of the shaft. The more commonly used linear type has an anti-backlash spring built into it to eliminate backlash in the gearing, which would affect the accuracy. The same Hartley oscillator is used with this pickup as is employed with all inductance type pickups. The dc potentiometer type is also in use and has proved satisfactory in certain applications.

Measurement of Vibration: Types of vibration pickups all employing barium titanate crystals are shown at Positions (R) and (H) on Fig. 3, and at (P) on Fig. 4; others are under development to extend the frequency range. The one in common use shown at (H) delivers 15 mv rms per peak g vibration at 100 CPS, and this output is maintained from 40 to 200 CPS, falling off to 13.5 mv rms at 20 CPS and to 12 mv rms at 1000 CPS. The impedance is about 1 megohm. To obtain still higher frequency response, a second unit has been developed with an even higher impedance of 5 megohms. This makes it very susceptible to lead capacity and the model shown at (R) incorporates a double shielded cable with the inner conductor connected to the cathode of a very high impedance cathode follower stage.

The pickup shown at (H) has a

FM/FM TELEMETERING (Cont.)

peak resonance at 200 cps and so it is always used in conjunction with the filter unit shown at (O) on Fig. 4. This parallel T band rejection filter has a sharp attenuation characteristic between 2000-2100 cps. The combined pickup-filter frequency characteristic is thus relatively flat

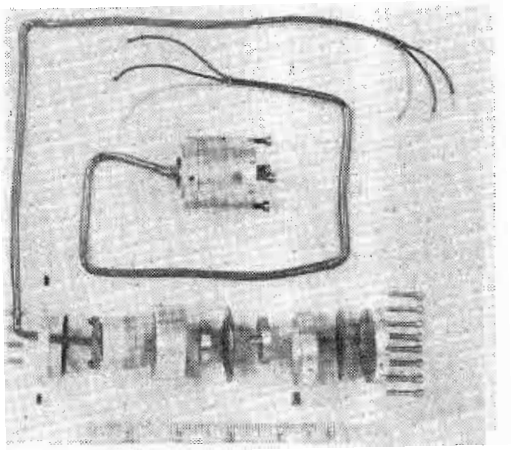


Fig. 11: Exploded view of the accelerometer

over the operating range of the pickup.

The output of the pickup-filter combination must be amplified to provide a sufficient signal to modulate the subcarrier oscillator. This special amplifier coupled to the filter may be seen by inspection of the photograph at position (N) on Fig. 4. The circuit diagram is given on Fig. 7.

The multivibrator type of voltage oscillator is used for most vibration measurements since the frequency response required necessitates the use of a super-audio subcarrier band.

An important factor in the value of telemetered vibration data is accurate calibration of the overall channel. To accomplish this it is necessary to inject a set of known frequencies of given amplitudes, in place of the output from the pickup, at the input to the filter. This is done with a commutator switch through which is supplied a signal burst of known voltage and frequency from a specially designed calibration oscillator. In addition, the same switch may be utilized to commutate the outputs of several pickups to the same filter-amplifier-oscillator channel

Part Two will appear in the January issue.

Doubles Plant Area

Geo. Stevens Manufacturing Co., Chicago, Ill. has completed an addition which doubles the area of their modern plant. The additional space will be used for the manufacture of high speed coil winders and for an enlarged engineering and design department.

Economics

(*Continued from page* 81)

their costs significantly over the usual printed wiring board. For a life expectancy of several million operations and up, the copper contacts should be plated with nickel and rhodium. Extremely long wearing contacts can be made with rhodium plating 0.000020 in. to 0.00010 in. thick. The rhodium itself, exclusive of plating labor, costs about $.015 sq. inch. 0.00001 in. plated; hence it can be a significant cost factor. Another feature required especially in high speed rotary discs is that the switch contacts be flush with the surface of the insulator for no bounce contact operation. Often the surface of the insulator must be a melamine resin for hardness and arc resistance. These special requirements may more than double the cost of the unit; however, the final cost is usually less than half the cost of doing the job by some other means.

Printed components (see Fig. 2) are inductances, capacitors and resistors made by printed circuit methods. The most striking examples of cost savings are shown in this field. Naturally, it is possible with the etched or plated circuit methods to print only low values of inductance and capacitance. For instance, a spiral coil 1 in. in diameter with 0.020 in. wide lines made 0.020 in. apart has an inductance of about 1.4 μh. Since the dielectric constant of the plastics range from about 2 to 7, it is possible by printing capacitor plates on opposite sides of thin materials such as 0.006 in. thick glass cloth to obtain capacitances near 200 μμf/sq. in.

These low values of inductance and capacitance are useful in filter circuits, transformers, traps, tuners and other inductance capacitance networks operating in the frequency range of 20 MC and up. They have received large-volume commercial acceptance as high-pass filters, band-pass filters, TV antenna crossover networks, TV i-f transformers, TV tuner inductances, etc. The advantage other than cose is that they are reproducible. It is often possible to eliminate tuning systems or alignment procedures since the coils or filter networks can be printed with tolerances which are sufficiently close to eliminate a final tuning operation. In terms of actual volume, more printed filters have been made than any other type of printed wiring part.

Printed resistors in connection with etched or plated circuits are of vital importance. A two year research program carried out by Photocircuits Corp. has produced good

quality resistor materials capable of being printed on etched circuits. The printing system devised is reliable and efficient, allowing a projected selling price in the neighborhood of $.01 per resistor in place on the circuit. This is in high production quantities where there are a number of resistors on a board. The market aimed at is the home radio and TV field where a saving of $.015 or more per resistor would be very attractive to the manufacturers. This resistor printing program is now in the pilot production stage.

Waveguide elements can be made by printed wiring methods. The savings are out of all proportion. A $50.00 part may be replaced by a $.40 part. Considerable research is being carried out along these lines by many companies.

Certain types of heater elements ranging in size from small bimetal element heaters to radiant heat panels for home heating can be made on a competitive basis using printed conductor elements.

Sample costs are very important since arriving at a finished production design invariably calls for prototypes, changes, more prototypes for final approval, etc. Time is always of the essence. Fortunately the etched circuit technique is adaptable to low cost, rapid sample work. For a small number of photo-etched samples, the procedure is simply to photograph the master drawing and use the negatives obtained to apply a resist photographically to the copper clad plastic sheet which is then etched.

As an example, six unfabricated boards with pattern on one side of 1/16-in. phenolic would cost around $30.00 or less.

The trend in electronic assembly is toward the automatic factory. A necessary part of the automatic assembly system is some sort of prefabricated conductor pattern that can be fed into the machine to receive and connect the circuit components. Viewed from this angle printed wiring has an assured future.

The cost of printed wiring boards themselves will inevitably decrease as further technical advances are made in materials and methods and their manufacture is more completely mechanized. Steps in that direction are proceeding at a rapid pace. If, as has been shown, printed wiring justifies itself economically at this time when the art is still new and in a relatively crude state, there can be no doubt as to what will happen in the next few years.

Sprague to Head Bomb Defense Study

Robert C. Sprague has been named by the Senate Armed Forces Sub-Committee on Preparedness to direct a full-scale study of hydrogen and atomic bomb defense. Mr. Sprague is chairman of the board of the Sprague Electric Co., North Adams, Mass. He is a former president and is now chairman of the board of the RETMA.

Fellowship Awarded to NYU Graduate

The Westinghouse fellowship at the New York University College of Engineering for 1953-54 has been awarded to Albert W. Charmatz. The fellowship, sponsored by the Westinghouse Educational Foundation, provides an annual grant of $2,000 for graduate study. Mr. Charmatz, who lives at 935 Ogden Avenue, the Bronx, received the degree of bachelor of electrical engineering from NYU in 1953 and is now working toward a master's degree in the same field. He is a member of Eta Kappa Nu and Tau Beta Pi, honorary engineering societies, and the student branches of the Institute of Radio Engineers and the American Institute of Electrical Engineers.

Bendix Pacific Division Expands

Bendix Aviation Corp., has begun construction of a new engineering building in North Hollywood, Calif. to accommodate expansion of its Pacific Division's airborne and hydraulic engineering departments. R. C. Fuller, general manager of the division, Navy Captain J. S. Laidlow, and Col. Daniel A. Cooper of the Air Force participated in recent ground-breaking ceremonies.

TI PLANT EXPANSION

J. E. Jonsson and Eugene McDermott, president and board chairman of Texas Instruments Inc. congratulate each other on the completion of the TI plant expansion program at 6000 Lemmon Avenue in Dallas.

PERSONAL

Carl F. Schunemann has been appointed chief engineer of the electronics division of Thompson Products, Inc., Cleveland, Ohio, where he will be in charge of research and development of microwave components, accessories, and specialized test equipment. **Jerome L. White** has been made senior project engineer of the company's Columbus, Ohio, antenna research laboratory.

Jack Colvin was recently made director of engineering of the Gates Radio Co., Quincy, Ill. Prior to joining Gates, Mr. Colvin was chief engineer and plant manager of Commercial Radio Co., chief audio engineer for American Broad-

Jack Colvin

casting Co., and systems engineer for Radio Corp. of America. The position of director of engineering has been open since the death of Mr. Fred O. Grimwood in April, 1952. **Francis W. Wentura**, Gates chief engineer, until Mr. Colvin's appointment, had been handling both positions.

John E. Martin, former senior engineer for the British Broadcasting Co., specializing in antenna design, is now director of research for The Gabriel Co. laboratories at Needham Heights, Mass. Mr. Martin, who came to the United States in 1952, joined Gabriel Laboratories as a senior staff member, a position he held at the time of his recent appointment.

Dr. Adair Morrison has been named head of the research section of Sprague Electric Company's research and engineering department. He will be in charge of investigations of the fundamental sciences related to electrical component technology. Dr. Morrison went to Sprague from Arthur D. Little, Inc. Priorily, he was associated with the National Research Council of Canada, and represented the physics section at the Sixth International Congress of Radiology in London in 1950.

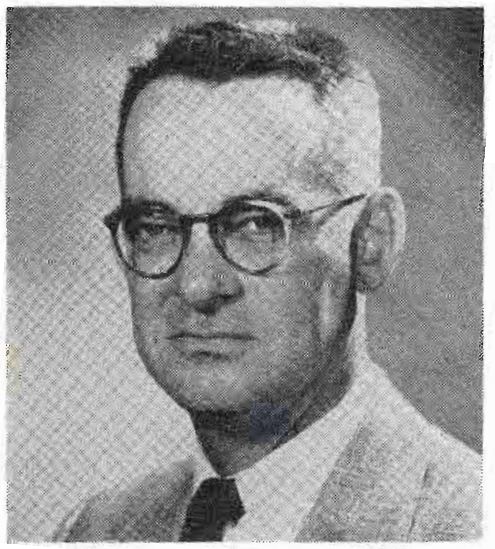
Jack G. Smith recently assumed the duties of chief engineer and **Walter J.**

;eneral counsel, took over Mr. duties as plant manager of Varo o., Inc., Garland, Texas. Mr. oegan with Varo as project engi- 1 the electrical design section in agmin joined the company in 1949. . Mr. Jagmin joined the company 1949.

William D. Fuller, for five years chief engineer of Engineering Labs., and **Bruce M. Williams,** former John A. Green Co. manufacturers' representative have become project engineers for the company. **Charles E. Campbell,** former U.S. Patent Office examiner, has been named company patent agent.

William C. Brown, manager of Raytheon Manufacturing Company's magnetron research and development laboratories, Waltham, Mass., has been appointed assistant vice-president of the company. Mr. Brown, one of the outstanding authorities on magnetrons, joined Raytheon in 1940. **Stanley D. Crane** was recently made director of engineering and research for the special products division of the company's TV and radio division, Chicago, Ill. Mr. Crane has been with Raytheon since 1944 and was previously chief engineer of the special products radar division.

Dr. O. G. Haywood, Jr., has been made manager of engineering planning of Sylvania Electric Products Inc. In cooperation with operating division and laboratory executives, Dr. Haywood will coordinate engineering planning in lighting, radio, electronics, and TV. He was formerly a colonel in the Air Force,



Dr. O. G. Haywood, Jr.

and two years ago organized the Office of Scientific Research of the Air Research and Development Command, Baltimore, and headed it until his recent resignation.

James R. Bradburn, who joined the company in 1945 as treasurer and assistant to the president, has become vice-president of the computer division of Consolidated Engineering Corp., Pasadena, Calif. Since 1948, he has served as vice-president in charge of engineering. **Joseph H. Lancor, Jr.,** will succeed Mr. Bradburn in that position, and **Walter B. Claus** will move into the

PERSONNEL

(*Continued from preceding pa*

post vacated by Mr. Lancor as direc. of the company's transducer divisio Mr. Lancor joined Consolidated in 1951 to head the transducer group and was named director in October this year.

Neal T. Williams has been assigned to the physics research group of Thomas A. Edison, Inc., West Orange, N. J. Immediately before his assignment to the Edison Laboratory staff, he was chief engineer of L. L. Constantin and Co. Priorily, he was supervisor of engineering in the Westinghouse magnetron division, associate research physicist in the Columbia University Radiation Laboratory, and a member of the electrodynamics group in Bell Telephone Laboratories.

Vincent S. Kraeger has been appointed chief engineer of Sterling Engineering Co., Inc., 54 Mill, Laconia, N. H., subsidiary of American Machine

Vincent S. Kraeger

& Foundry Co. Before joining Sterling, Mr. Kraeger was project engineer at Fenwal, Inc.

William B. Allen, Robert A. Brennan, Harvey G. Cragon, Sidney Grossfield, Sidney L. Hasin, John D. Holmgren, Robert J. Pedersen, George Schuettinger, Edward R. Adelson, Cecil A. Deutschle, Carl L. Jackson, Sheldon C. Shallon, and **Robert G. Williams** have become members of the technical staff of the Hughes Research and Development Laboratories, Culver City, Calif.

Ralph H. Anderson, formerly associated with Crystal Research, Inc. and Cambridge Thermionic Corporation of Cambridge, Mass., has been appointed staff engineer for the company.

Martial A. Honnell, former professor of electrical engineering in charge of communications and electronics at

Jagmin, g
Smith's d stitute, and radar and UHF Mfg. C g engineer, was recently Smith vice-president and chief engineer in Measurements Corp., Boonton, Mr. J. subsidiary of Thomas A. Edison, 1947

in **Donald F. Volkman** was recently appointed chief engineer of Station WRTV, Channel 58. Former assistant chief of field operations for Radio Free Europe, Mr. Volkman will maintain WRTV's signal on the air under the supervision of Harold C. Burke, station managing director.

Dr. Thomas G. Wilson, until recently with the United States Naval Research Laboratory, Washington, D.C., has joined the engineering development staff of Magnetics, Inc., Butler, Pa. Priorily, he worked on equipment design for supersonic wind tunnel measurements in the Naval Ordnance Laboratory.

Stephen B. Metcalfe has been appointed assistant district manager of operation for the Worcester District, American Steel & Wire Div. of the United States Steel Corp. He was promoted from the position of general superintendent of the wire division's plants in New Haven, Conn., and Trenton, N.J., a post he has held since 1942.

Samuel Dente was recently appointed plant superintendent of the electronic equipment division of Air Associates, Inc., Orange, N.J., where he will coordinate and supervise the assembly, production engineering, fabrication, and general service departments.

Joseph S. Robb has been made director of engineering in charge of all engineering functions at Radio Condenser Co., Camden, N. J. **Melvin V. Weiss** has become chief engineer of special apparatus and TV; and **Jack Teaf** has been made chief engineer of the auto tuner division.

C. H. Achenbach, who was with the Bell system for 38 years engaged in power and development work, has been made consulting engineer on telephone power equipment development, by Holtzer-Cabot Telephone Equipment Div. of National Pneumatic Co., and Holtzer-Cabot Divisions, Boston, Mass.

Largest Microphone Repair Center

The world's largest microphone repair center is located in the plant of the American Microphone Co., Pasadena, Calif. Damaged microphones of every type are received at the center from far away spots on the globe—from the U. S. Fleet, the Air Corps, and foreign and domestic industrial and broadcasting companies. At the center a full-time, experienced, all-woman crew discover instrument flaws and faults by microscopic test and repair the delicate mechanisms. According to G. N. Christensen, plant general manager, the common troubles are diaphragms, voice coils, and ribbons.

BOOKS

(*Continued from page* 173)

useful information in this volume which reportedly is the first integrated treatment of transistor characteristics and transistor circuits. Coauthored by Messrs W. F. Chow, S. K. Ghandi, E. Keonjian, V. P. Mathis, C. A. Rosen, J. S. Schaffner, R. F. Shea and J. J. Suran at General Electric in Syracuse, N.Y., the book presents the basic theory plus an elaboration of techniques applicable in the field. After a brief introduction, the book is divided into three parts covering low frequency, high frequency, and large-signal nonlinear applications. Special chapters on duality, matrix methods and on the application of feedback are included. The section at the beginning of the book listing all of the symbols used throughout the volume is especially valuable as is Appendix II on "Definitions of Terms." The resemblances of transistor and vacuum tube circuits are pointed out and current network theory modified to fit transistor circuits is employed in the discussions. In all the book is a valuable addition to any electronic engineering library. BFO

Television Broadcasting

By Howard A. Chinn. Published 1953 by McGraw-Hill Book Co., 330 W. 42 St., New York 36, N.Y. 700 pages. Price $10.00.

The engineer engaged in TV broadcasting work is faced with the necessity of remembering (or having at his fingertips) an imposing amount of information, not only the theory of how something works, but also what type of equipment is available and how it is used. This book is exceptionally complete and up-to-date in this respect. The author, Chief Engineer of CBS' Audio-Video Div., has produced a technical reference without resort to involved mathematical analysis. From TV fundamentals he takes the reader through camera, sync and studio equipment. The chapter on studio lighting and camera techniques, and the one on installation practices, contain much down-to-earth data. Other valuable chapters in this outstanding book cover film, video recording, building planning, measurements and color TV. AJF

BOOKS RECEIVED

Higher Transcendental Functions, vol. II

Edited by Arthur Erdelyi. Published 1953 by McGraw-Hill Book Co., 330 W. 42 St., New York 36, N. Y. 396 pages. Price $7.50. Compendium of highly advanced mathematical functions. Results of work started by Prof. H. Bateman of Cal Tech.

Dielectric Aerials

By D. G. Kiely. Published 1953 by John Wiley & Sons, 440 Fourth Ave., New York 16, N.Y. 132 pages. Price $2.00. Monograph of microwave dielectric antennas.

BULLETINS

Slides & Opaques

Eastman Kodak Co., Rochester 4, N. Y., have released a new booklet that outlines practical production techniques for slides and opaques for television. It includes a number of diagrams and sketches which provide templates for use on the ground glass of cameras, finished slides, and photographing on high contrast film and enlarging to size to check art work.

Deflection Yokes & Focus Coils

Syntronic Instruments Inc., 100 Industrial Road, Addison, Ill. have released two two-page loose-leaf inserts which provide technical data covering the company's magnetic deflection yokes and electromagnetic focus coils.

Gamma-Ray Detector

Western Radiation Laboratory, 1107 West 24th St., Los Angeles 7, Calif. have released literature that describes a new pocket-size gamma-ray detector using three 10w-voltage counter tubes, transistor amplification, and headphone indication.

Antenna System

Sound Products Dept., RCA Victor Div., Engineering Products Dept., Camden, N. J. has released an attractive four-page folder (2R8612). It presents the new RCA "Community Antenaplex System" which picks up TV signals on a near-by hilltop and feeds them directly into sets in homes and institutions.

Permanent Magnets

Latest information on the properties, design, manufacture, and uses of Alnico permanent magnets, sintered grade 5, has been released by Carboloy Department of General Electric Co., 11177 E. 8 Mile Rd., Detroit 32, Mich.

AF Amplifier

Bulletin DB 89-950 discusses the new type FG 5, or 10 kw, variable frequency audio amplifier capable of amplifying 30 to 10,000 cps signals as much as a million times. The booklet describes the design, construction, and operation of the equipment and includes complete electrical characteristics. Write Westinghouse Electric Corp., Box 2099, 401 Liberty Ave., Pittsburgh 30, Pa.

Transistors

Texas Instruments Inc., 6000 Lemmon Ave., Dallas 9, Texas, has released a new 4-page bulletin covering two types of hermetically sealed point-contact transistors. The theory and application of transistors—with formulae, equivalent circuits, and characteristics curves—is contained in a two-page section.

Glass-Bonded Mica

A 24-page booklet, "From One Designer to Another," containing tables, specifications, charts, and workbench sketches on designing Mycalex glass-bonded machine parts has been issued by Mycalex Corp. of America, 125 Clifton, Clifton, N. J.

Transistor Bulletin

A new bulletin on available types of transistors, manufacturers, and supplementary data; and bulletins covering the model TT-11 transistor tester, model CC-60 constant current converter, and the model 110 transistor power supply can be obtained from Electronic Research Associates, Inc., Box 29, 715 Main St., North Caldwell, N. J.

Electronic Instruments

Brochure, Part No. 01-156-5040, illustrates and describes the complete electronic test equipment line of the Philco Corp., Accessory Div., Philadelphia 34, Pa.

(Continued on page 186)

BULLETINS

(*Continued from page* 185)

Radio Communications

Ten new bulletins, ECR 80, 81, 86, 92, 93, 110, 111, 113, 114, and 115, released by General Electric Co., Commercial Equipment Department, Electronics Park, Syracuse, N.Y. describe six base radio communication station combinations and four mobile combinations which cover many of the company's latest equipments for industrial and civil defense applications, taxicabs, utilities, and police and fire departments.

Loudspeakers

A 10-page catalog, designated form 5-53-50M, released by Racon Electric Co., Inc., 52 E. 19th St., New York 3, N. Y., presents illustrations, characteristics, and performance data covering driver units, straight trumpets, re-entrant trumpets, cone projectors, marine speakers, tweeters, paging speakers, cobra-type loudspeakers, and microphone stands.

Hi-Fi Booklet

"What You Should Know About High Fidelity" can be obtained for 10 cents from Admiral Corporation, Advertising Dept., 3800 Cortlandt St., Chicago 47, Ill.

Electronic Equipment

A 16-page summary of electronic equipment gives descriptions, applications, and operations of surge comparison testers, portable balancers vibrographs, magnetic amplifiers, transistors, capacitors, relays, etc. The booklet also gives information on semi-finished materials such as cores, magnetic materials, and alloys. Write for booklet, B-6093, Westinghouse Electric Corp., Box 2099, 401 Liberty Ave. Pittsburgh 30, Pa.

Magnetic Recorder

Product Specification Sheet DS-3-1-2 released by Ampex Corp., 934 Charter St., Redwood City, Calif. illustrates, describes, and presents technical data covering the Model 306 carrier type recorder.

Electronic Enclosure

Bulletin 101-CA10M-953, published by Elgin Metalformers Corp., 903 No. Liberty St., Elgin, Ill., presents the units of a new flexible electronic enclosure system.

Keys & Switches

Section EU of Catalog E, 1953, replaces Catalog EU2 and describes technical information covering the keys and switches designed for industrial and laboratory applications made by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa.

STL & Film Scanner

A two-page announcement and two supplementary data sheets describe and present the features and applications of the model TLR-2C TV microwave relay and the models FSS-4 (35 mm) and FSS-5 (16 mm) film scanner, produced by Philco Corp., Government and Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa.

Sine-Cosine Mechanism

A catalog sheet, No. 304062, describes and illustrates a sine-cosine mechanism, or precision angle resolver for analog computers made by Librascope, Inc., 1607 Flower St., Glendale, Calif.

Thermal Conductivity

Bulletin GMH-853 is a four-page folder that describes and presents applications and performance data covering a thermal conductivity instrument manufactured by Gow-Mac Instrument Co., 100 Kings Road, Madison, N. J.

(*Continued on page* 188)

BULLETINS

(*Continued from page* 186)

Radiation Detector

Western Radiation Laboratory, 1107 West 24th St., Los Angeles 7, Calif., has issued a data sheet that describes a new pocket-size radiation detector, the model V Counter.

Punched Card Computer

Bulletin TM 842, a new 6-page illustrated brochure, gives full details on the Remington Rand electronic punched card computer. Copies are available at Remington Rand, Inc., 315 Fourth Ave., New York 10, N. Y.

Sound Connectors

The Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif., recently issued a revised and redesigned bulletin, No. XL 8, covering its series XL low level sound connectors.

Printed Circuits

A 4-page folder issued by Centronics Co., 21-04 122 St., College Point, New York, N. Y., discusses printed circuit applications, base materials, coatings, and other pertinent engineering data.

Metal Laminates

Bulletin No. 37, issue No. 3, superseding issue No. 2, released by Continental-Diamond Fibre Co., Newark, Del., presents eight pages of data covering metal clad laminates, metal foils, composite laminates and their property values, test methods, fabrication and ordering information.

Capacitors

Technical Bulletins 42-4R, 42-101R, 42-59R, 42-206, and 42-123R comprise new and revised catalog sheets released by Centralab, Div. of Globe-Union Inc., 900 E. Keefe Ave., Dept. K-38, Milwaukee 1, Wis., covering disc, feed-through, and high-accuracy capacitors, and ceramic and tubular trimmers. A new 12-page catalog, 42-164, recently issued by the company, covers its Models 1 and 2 variable resistors.

Production Tools

Kahle Engineering Co., 1307 Seventh St., North Bergen, N. J., have released seven new catalog pages added since Novem er 1952 covering tube, lamp, and transistor production machines. Sheet 2197 covers lead wire making; 1998, grid winding; 2178, and 2010, button stem making; 2144, indexing; 2185, neck cutting, splicing, and sealing; 2087, pillar stem heads.

Data Systems

A new six-page folder describes the electronic equipment made by Clary Multiplier Corp., Junipero, San Gabriel, Calif., used in the reduction, handling, and printing of data in electronic systems required by laboratory, industrial, and business accounting operations.

Wavemeter

Thompson Products, Inc., Electronics Div., 2196 Clarkwood Road, Cleveland 3, Ohio, has announced the availability of technical literature covering the company's 6-60 cm survey wavemeter, Model W1N6AA.

Transformers

Catalog 953, recently issued by Audio Development Co., 2833 13th Ave. South, Minneapolis, Minn., illustrates, describes and presents performance data and characteristics of the power transformers, inductors, audio transformers, filters, etc. made by the company.

INDUSTRY NEWS

Paul William Lawrason has been made sales manager of Radiation Counter Laboratories, Inc., Skokie, Ill. From 1945 to 1951, he was sales manager of Heppner Manufacturing Co. For two years prior to his new assignment, he represented several electronics manufacturers.

Paul L. Lewis has been appointed vice-president and general manager of the Motorola-New York Co. where he will supervise the distribution, sales, and servicing of Motorola radio and TV products in the Greater New York area. He succeeds **Edward L. Pincus**, presently the head of the Motorola-Philadelphia Co.

William L. Dunn, who had been associated with Raytheon Manufacturing Co., and its subsidiary, Belmont Radio Corp., for 21 years, recently became president of Magnecord, Inc., Chicago, Ill. Mr. Dunn was successively chief engineer of Colonial Radio Corp., Sprague Specialty Co., and Grigsby Grunow Co. Before joining Belmont, he was vice-president of Detrola Radio Corp.

Circuitron, Inc., pioneer in printed circuits and subsidiary of LaPointe Electronics, Inc., has moved from Hoboken, N. J., and has completely relocated its plant and general offices in Rockville, Conn. Facilities have been increased there to provide complete service from adaptation and circuit design to components assembly, solder-dipping, and unit package casting.

Edward J. Davenport has been appointed chief of the Cathode Ray Tube Commercial Engineering Division of National Union Radio Corp., Hatboro, Pa. where he will be responsible for engineering, quality, measurements, sales engineering, and liaison.

Brig. Gen. Tom C. Rives (retired), former chief of the electronics sub-division in the Air Materiel Command at Wright-Patterson Air Force Base, and special research associate professor, at the University of Illinois has been appointed manager of a new laboratories department within the General Electric Electronics Div. Electronics Park, Syracuse, N. Y. The new department comprises the Electronics Laboratory at

(*Continued on page* 191)

Annual Index

of all articles published in TELE-TECH & ELECTRONIC INDUSTRIES during 1953, classified according to subjects, may be obtained free of charge by writing to:

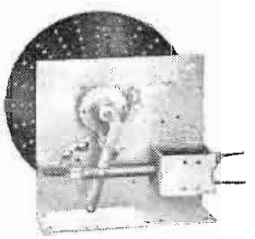
The Editors
TELE-TECH & ELECTRONIC INDUSTRIES
480 Lexington Ave., New York 17, N. Y.

Photo Courtesy
NEVCO SCOREBOARD CO.

GUARDIAN® STEPPING RELAYS

tell the score!

At the touch of a button, the special Guardian Stepper (illustrated) lites up changing scores, downs, yards to go and the quarter being played. Guardian Stepper Applications also include control of animated signs and displays—intricate timing devices—automatic elevators—automatic business machines—automatic circuit selections from a pulsing dial—automatic wave changing on short wave transmitters—plus an endless variety of "special" operations. Send b/p for cost free recommendations.



GUARDIAN SPECIAL STEPPER

GUARDIAN ELECTRIC

1607-P W. WALNUT STREET CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

A NEW FAST 10 mc SCALER

with 0.1 microsecond RESOLUTION

MODEL 410

The EPIC Model 410 Fast Scaler has been designed to allow convenient and precise high speed counting of the fast pulses encountered in nuclear work, computer and pulse control problems, high frequency measurements (to 10mc), and small time interval measurements (to 0.1 μsec. accuracy). The scale factor of 128 and the output pulse characteristics have been chosen so that almost all slow, conventional (app. 10^5 counts/sec.) commercial scalers, and frequency counting equipment can be operated from the output pulse with ease, hence the speed and range of previously purchased slower equipment can be extended at a minimum of cost. Fast binary flip-flops have been exclusively used to insure maximum reliability of performance at high speed operation.

FEATURES

1. Resolving Time: 0.1 μsec
2. Maximum Continuous Uniform Rate: 10mc or 10^7 counts/sec.
3. Interpolation: Simple neon light indicators usually available only in slower scalers.
4. Scale Factor: Binary scale of 128 for maximum reliability and usefulness.

EPIC

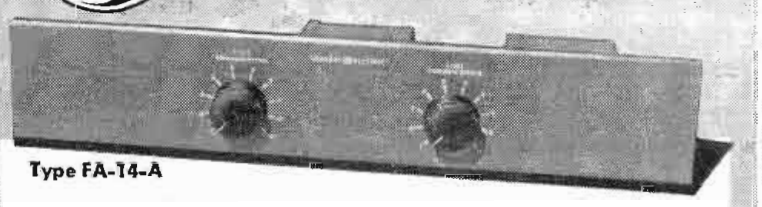
ELECTRICAL and PHYSICAL INSTRUMENT CORP.

25 WEST 43rd STREET
New York 36. N. Y.
Tel.: Longacre 4-2265

Engineering Division
42-19 27th STREET
L. I. C. 1, N. Y.

Complete literature on request to Dept. TS-12

Broadcast EQUALIZER PANEL



Type FA-14-A

FACILITIES	Provides equalization for *two* lines
OPERATION	*Front-panel adjustment* in steps of 3db
RANGE	Equalizes short lines up to 15 KC...long lines up to 10 KC
MOUNTING	Simple clamp-type mounting—fits any 19″ rack. Requires just 3½″ height clearance

For complete information write: General Electric Co., Section 48123, Electronics Park, Syracuse, New York.

Other G-E Audio Equalization & Filter Accessories Include:

FA-18-A	FA-14-B
Sound Effects Filter Panel	Equalizer Unit

GENERAL ELECTRIC

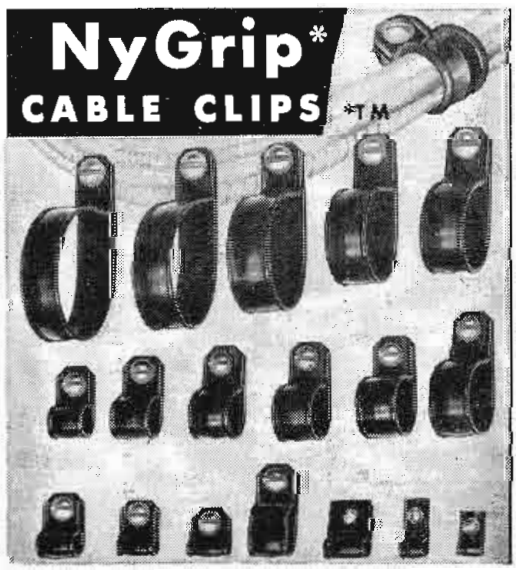
YOUR SOURCE FOR FABRICATED SPONGE RUBBER

- Adhesive Coated Specialties
- Parts made to **your specifications**
- Die cutting — slitting
- Largest assortment in the Midwest
- Fast Delivery

WRITE FOR COMPLETE INFORMATION TO

DURABLE RUBBER PRODUCTS CO.

549 West Fulton Street — Chicago 6, Illinois



They're made of Solid NYLON—light weight—strong—tough—easy to apply—no sharp edges—may be used from —60 to 250° F. —write for free samples and full information.

WECKESSER CO.
5259 N. Avondale Av.
Chicago 30, Ill.

INDUSTRY NEWS

(*Continued from page* 189)

Syracuse, and the Advanced Electronics Center at Cornell University, Ithaca, N. Y. Together they employ nearly 500 persons, including 300 engineers and scientists.

Paul W. Jansen has been promoted to the position of sales manager for sound recording tape by Minnesota Mining &

Paul W. Jansen

Manufacturing Co. Mr. Jansen joined 3M in 1947, and succeeds **Roy J. Gavin**, recently named vice-president of the Irvington Varnish & Insulator division of 3M.

Dr. Harvard L. Hull has been appointed vice-president and general manager of the research and development division of the Capehart-Farnsworth Co., division of IT&T. **Philo T. Farnsworth**, vice-president and technical director, will continue to be in charge of special research activities.

R. N. Stoddard, former midwestern regional manager of the Westinghouse Electronic Tube Div., Elmira, N. Y., has been appointed to the newly-created post of headquarters assistant to the general sales manager. Mr. Stoddard has been associated with the company for 37 years, and is credited with developing the ignitron welding system. His successor, as midwestern regional manager, is **John G. Thompson**, former product manager of the cathode ray tubes at the headquarters plant. Mr. Thompson joined Westinghouse in April, 1951.

Lawrence S. Thees, former general sales manager, has been elevated to the post of general commercial manager on the staff of Richard T. Orth, vice-president of the RCA Tube Department. Mr.

(*Continued on page* 192)

INDUSTRY NEWS

(*Continued from page* 191)

Thees will be responsible for the department's overall commercial viewpoint, policies, and long range planning. **Douglas Y. Smith** has advanced to the new post of general marketing manager, and will be directly responsible for the four marketing divisions: receiving tube and transistor; cathode ray and power tube; electronic components; and parts and equipment.

Frank L. Snyder, vice president of Westinghouse Electric Corp., has reassumed management of the company's Transformer Division and Sharon, Pa. in the capacity of general manager. Mr. Snyder served the division as manager from 1949 to 1951. He succeeds **Chris. H. Bartlett** who has been chosen by Westinghouse to attend the Harvard School of Advanced Management. Mr. Bartlett will return to Sharon to direct the division's planning and other special management programs.

William T. Welsh, sales manager of Raytheon Manufacturing Company's power tube division, has been appointed an assistant vice-president. Mr. Welsh was appointed sales manager of the division in September, 1952. He joined the sales staff of the power tube division in 1941, and, following service in the Air Force, he returned to become a junior engineer in the quality check department.

Harry R. Carradus, chief accountant, has been promoted to assistant treasurer of the Philco Corp. of Canada, Ltd., Toronto, and **Merritt L. Harding** has been transferred to the Philco Canadian subsidiary from Philco International headquarters in Philadelphia to succeed Mr. Carradus as chief accountant.

E. Arthur Hungerford Jr., returning from a leave of absence for special work with the Joint Committee on Education Television, has been named manager of the TV department of General Precision Laboratory, Pleasantville, New York. **Nathaniel M. Marshall**, a field representative for GPL since 1950 and formerly head of TV operations at the U. S. Navy Special Devices Center, will cover the northeast states from Washington, D. C. throughout New England in the capacity of eastern district manager. **Edward Manzo** has been assigned as southeastern district manager with headquarters in Atlanta, Ga. **Robert F. Johnston**, former chief engineer of radio station WILL, has been made manager of the midwest district with headquarters in Chicago, Ill.

Robert S. Windt was recently made publicity and promotion manager of CBS-Columbia Inc., TV and radio set

(*Continued on page* 194)

TELE-TECH ADVERTISERS — DECEMBER, 1953

ADAMS & WESTLAKE CO. 47
Agency—Henri, Hurst & McDonald, Inc.
AEROVOX CORP. 55
Agency—Austin C. Lescarboura & Staff
AIRCRAFT RADIO CORP. 188
Agency—Burke Dowling Adams, Inc.
ALDEN PRODUCTS CO. 174
Agency—Richard Thorndike Agency
ALLIED RADIO 104
Agency—George Brodsky
ALPHA METALS, INC. 130
Agency—Jules Wagner Advertising
ALTEC LANSING CORP. 116
Agency—Dan B. Miner Co.
AMERICAN LAVA CORP. 33
Agency—Power and Condon
AMERICAN MICROPHONE CO. 118
Agency—Clifford Woolsey
AMERICAN PHENOLIC CORP. 132, 133
Agency—Burton Browne Advertising
ANDREW CORP. 50
Agency—Burton Browne Advertising
ARNOLD ENGINEERING CO. 16
Agency—Walker & Downing, General Agency
ASTRON CORP. 30
Agency—Salow & Associates
AUDIO DEVICES, INC. 111
Agency—Rickard & Co., Inc.
AUTOPHONE LTD. 127
Agency—S. P. O'Connor & Co. Ltd.
AVERY ADHESIVE LABEL CORP. 183
Agency—Martin R. Klitten Co., Inc.

BERKELEY DIV., BECKMAN INSTRS. INC. 152
Agency—Geo. C. McNutt, Adv.
BERNDT-BACH, INC. 192
Agency—Abbott Kimball Co. of Calif., Inc.
BIRTCHER CORP. 191
Agency—Crossley & Jeffries, Inc.
BLAW-KNOX CO. 41
Agency—Al Paul Lefton Co. Inc.
BOMAC LABORATORIES, INC. ..... Cover 3
Agency—Larcom Randall Advertising
BOONTON RADIO CORP. 180
Agency—Frederick Smith Advertising
BRAND & CO., INC., WILLIAM 169
Agency—Cory Snow, Inc.
BREEZE CORP., INC. 147
Agency—Burke Dowling Adams, Inc.
BROWNING LABORATORIES, INC. 141
Agency—Engineered Advertising
BRUSH ELECTRONICS CO. 6
Agency—Griswold-Eshleman Company
BURNELL & CO. 2
Agency—Mitchell Advertising Agency
BURROUGHS CORP., ELECTRONIC INSTRS. DIV. 24
Agency—Campbell-Ewald Co.
BUSSMANN MFG. CO. 27

CALDWELL-CLEMENTS INC. 184
CAMERA EQUIPMENT CO. 173
Agency—J. M. Kesslinger & Assoc.
CARGO-PACKERS INC. 163
Agency—George Homer Martin Assoc.
CECO DISTRIBUTING CORP. 187
Agency—J. M. Kesslinger & Assoc.
CENTRALAB DIV., GLOBE-UNION INC. 121
Agency—Klau-Van Pietersom-Dunlap, Inc.
CENTRONICS CO. 42
CHICAGO TELEPHONE SUPPLY CORP. 136, 137
Agency—Burton Browne Adv.
CINCH MFG. CO. 101
Agency—D. T. Campbell Inc.
CINEMA ENGINEERING CO. 186
Agency—R. L. Power
CIRCUITRON INC. 159
Agency—F. W. Prelle Co.
CLAROSTAT MFG. CO., INC. 149
Agency—Austin C. Lescarboura & Staff
CLEVELAND CONTAINER CO. 17
Agency—Nesbitt Service Co.
COAXIAL CONNECTOR CO. 118
Agency—Picard, Marvin & Redfield
COMMUNICATIONS CO., INC. 194
Agency—W. Bentley Glass
CORNELL-DUBILIER ELECTRIC CORP. 125
Agency—Friend, Reiss, McGlone Adv.
CROSBY LABORATORIES, INC. 154
Agency—Gotham Advertising Co., Inc.
CRUCIBLE STEEL CO. OF AMERICA 37
Agency—G. M. Basford Co.
CUNNINGHAM, SON & CO., INC., JAMES .. 173

DAGE ELECTRIC CO., INC. 183
Agency—Jim Bradford, Adv.
DALE PRODUCTS, INC. 110
Agency—Ayres & Assoc., Inc.
DAVELLE LABORATORIES, INC. 109
Agency—Conti Advertising Agency, Inc.
DEJUR-AMSCO CORP. 158
Agency—Friend, Reiss, McGlone Adv.
DIALIGHT CORP. 165
Agency—H. J. Gold Co.
DUMONT LABS., INC., ALLEN B. 28, 105
Agency—Austin C. Lescarboura & Staff
DURABLE RUBBER PRODUCTS CO. 190
Agency—McGiveran-Child Co.

EBY INC., HUGH H. 171
Agency—Renner Advertisers
EITEL-McCULLOUGH, INC. 40
Agency—Conner, Jackson, Wolker, McClure Adv.

ELCO CORP. 178
Agency—Fien and Schwerin
ELECTRALAB, INC. 177
Agency—Robert Hartwell Gabine
ELECTRICAL INDUSTRIES 43
Agency—George Homer Martin Assoc.
ELECTRICAL & PHYSICAL INSTR. CORP. 190
Agency—Adrion E. Clark Jr. Adv.
ELECTRONIC ENGINEERING CO. 186

FAIRCHILD CAMERA & INSTRUMENT CORP. .. 167
Agency—G. M. Basford Co.
FAIRCHILD RECORDING EQUIPMENT CORP. . 156
Agency—Buchanan & Co., Inc.
FEDERAL TELEPHONE & RADIO CO. 26
Agency—J. M. Mathes, Inc.
FORD INSTRUMENT CO. 155
Agency—G. M. Basford Co.
FORMICA CO. 155
Agency—Perry-Brown, Inc.
FREED TRANSFORMER CO. 160
Agency—Franklin Advertising Service

GENERAL ELECTRIC CO. 23, 49, 117, 190
Agency—Maxon Inc.
GENERAL ELECTRIC CO. 178
Agency—Batten, Barton, Durstine & Osborne Inc.
GENERAL INDUSTRIES CO. 166
Agency—Meldrum & Fewsmith, Inc.
GENERAL PRECISION LAB., INC. 115
Agency—Burke Dowling Adams, Inc.
GENERAL RADIO CO. 53
Agency—K. E. Morang Co.
GRANT PULLEY & HARDWARE CO. 142
Agency—Milton Herder Adv.
GRAY RESEARCH & DEV. CO., INC. 44
Agency—Taylor & Greenough Co.
GUARDIAN ELECTRIC MFG. CO. 190
Agency—Kennedy & Co.
GUTHMAN & CO., EDWIN I. 104
Agency—Burton Browne Adv.

HAMMARLUND MFG. CO., INC. 143
Agency—Roeding & Arnold Inc.
HELIPOT CORP. 113
Agency—Darwin H. Clark Co.
HEMINWAY & BARTLETT MFG. CO. 176
Agency—R. T. O'Connell Co.
HEPPNER MFG. CO. 144
Agency—Burton Browne Adv.
HERMETIC SEAL PRODUCTS CO. 139
Agency—Art-Copy Advertising Agency
HICKOK ELECTRICAL INSTR. CO. 194
Agency—Ritchie & Sattler, Inc.
HOUSTON FEARLESS CORP. 21
Agency—Taggart & Young Adv.
HUGHES AIRCRAFT CO., SEMICONDUCTOR DIV. 57
Agency—Faote, Cone & Belding
HUGHES RESEARCH & DEV. LABS. 146
Agency—Foote, Cone & Belding
HYDRO-AIRE, INC. 119
Agency—Roy S. Durstine, Inc.

INDUSTRIAL HARDWARE MFG. CO., INC. ... 170
Agency—Walter J. Bergman Adv.
INTERNATIONAL RESISTANCE CO. 4, 5
Agency—John Falkner Arndt & Co., Inc.
I-T-E CIRCUIT BREAKER CO. 164
Agency—Richard A. Foley Adv. Agency, Inc.

JENNINGS RADIO MFG. CORP. 124
Agency—L. H. Waldron Adv. Agency
JFD MFG. CO. 181
Agency—Burton Browne Advertising
JOHNSON CO., E. F. 36
Agency—Firestone-Goodman Adv. Agency, Inc.
JONES DIV., HOWARD B., CINCH MFG. CORP. 187
Agency—Symonds, MacKenzie & Co., Inc.

KAHLE ENGINEERING CO. 35
Agency—Conti Advertising Agency
KENYON TRANSFORMER CO., INC. 128
Agency—Picard, Marvin & Redfield
KESTER SOLDER CO. 39
Agency—Paul J. Steffen Co.
KETAY MFG. CORP. 7
Agency—Hicks & Greist, Inc.
KEYSTONE ELECTRONICS CO. 170
Agency—Walter J. Bergman Adv.
KLEIN & SONS, MATHIAS 168
Agency—Erwin, Wasey & Co., Inc.
KNIGHTS CO., JAMES 122
Agency—Kenneth B. Butler & Assoc.
KOLLMORGEN OPTICAL CORP. 189
Agency—Sanger-Funnell, Inc.
KOLLSMAN INSTRUMENT CORP. 151
Agency—Erwin, Wasey & Co., Inc.

LANGEVIN MFG. CORP. 107
Agency—George Homer Martin Associates
LITTELFUSE, INC. 135
Agency—Burton Browne Adv.

MAGNECORD INC. 140
Agency—Arthur Towell, Inc.
MALLORY & CO., INC., P. R. 13, 54, 160
Agency—Aitkin-Kynett Co.
MEASUREMENTS CORP. 184
Agency—Frederick Smith Adv. Agency
MELPAR, INC. 182
Agency—Lewis Edwin Ryan Adv.
METHODE MFG. CORP. 112
Agency—Sander Rodkin Agency, Ltd.
MICROTRON CO. 184
Agency—Chambre Advertising

MIDLAND MFG. CO., INC. 12
Agency—R. J. Potts, Calkins & Holden, Inc.

NEW LONDON INSTRUMENT CO. 177
N.R.K. MFG. & ENGRG. CO. 185
Agency—Kreicker & Meloan Inc.

PAR-METAL PRODUCTS CORP. 175
Agency—H. J. Gold Co.
PEERLESS DIV., ALTEC LANSING CORP. 192
Agency—Dan B. Miner Co.
PHILCO CORP. 103
Agency—Julion G. Pollock Co.
PHOTOCIRCUITS CORP. 52
Agency—Kotulo Co.
POLARAD ELECTRONICS CORP. 179
Agency—Picard, Marvin & Redfield
POLYTECHNIC RES. & DEV. CO. 51
Agency—George Homer Martin Assoc.
PRECISION PAPER TUBE CO. 155
Agency—Symonds, MacKenzie & Co. Inc.
PRESTO RECORDING CORP. 25
Agency—Lewin, Williams & Saylor, Inc.
PROCEEDINGS OF THE I.R.E. 56

RADIO CORP. OF AMERICA 46
Agency—Al Paul Leiton Co. Inc.
RADIO CORP. OF AMERICA ..... 29, Cover 4
Agency—J. Wolter Thompson Co.
RADIO MATERIALS CORP. ..... Cover 2
Agency—Turner Advertising Agency
RADIO SHACK CORP. 181
Agency—Engineered Advertising
RAULAND CORP. 45
Agency—Burton Browne Advertising
RAYPAR INC. 120
Agency—Buti-Roberts and Assoc.
RESINITE CORP. 176
Agency—Symonds, MacKenzie & Co.
ROBINSON AVIATION, INC. 108
Agency—Platt, Zachary & Sutton, Inc.
RUST INDUSTRIAL CO., INC. 32
Agency—Meissner & Culver, Inc.

SAMPSON CHEMICAL & PIGMENT CORP. ... 191
Agency—Austin Advertising Agency
SANGAMO ELECTRIC CO. 48, 150
Agency—Arthur R. Mogge Inc.
SARATOGA INDUSTRIES 172
Agency—Sylvan A. Wolin & Assoc.
SARKES TARZIAN INC., RECTIFIER DIV. 185
Agency—Argyle Wampler Adv.
SEL-REX PRECIOUS METALS, INC. 179
Agency—Bass and Co., Inc.
SHALLCROSS MFG. CO. 114
Agency—Horry P. Bridge Co.
SICKLES, F. W. 157
Agency—Conti Advertising Agency, Inc.
SIGMA INSTRUMENTS, INC. 131
Agency—Meissner & Culver, Inc.
SPRAGUE ELECTRIC CO. 58
Agency—Stuart Sande Advertising
STACKPOLE CARBON CO. 22
Agency—Harry P. Bridge Co.
STANDARD ELECTRONICS CORP. 8, 9
Agency—Wehner Adv. Agency
STANDARD PIEZO CO. 182
Agency—The Godfrey Agency
STEWARD MFG. CO., D. M. 148
Agency—Merchandising Advertisers, Inc.
SUPERIOR TUBE CO. 34
Agency—John Falkner Arndt & Co., Inc.
SYLVANIA ELECTRIC PRODUCTS INC. 10, 153
Agency—Cecil & Presbrey Inc.
SYNTHANE CORP. 187
Agency—John Falkner Arndt & Co., Inc.

TECHNOGRAPH PRINTED ELECTRONICS, INC. 19
Agency—Gasman-Levin Co., Inc.
TELECHROME, INC. 126
Agency—Powerad Co.
TEL-INSTRUMENT CO., INC. 174
Agency—Lewis Advertising Agency
TEL-RAD MFG. CO., INC. 172
Agency—Sonder Rodkin Adv. Agency
TENSOLITE INSULATED WIRE CO., INC. 175
Agency—George Homer Martin Assoc.
THERMADOR ELECTRICAL MFG. CO. 189
Agency—West-Marquis, Inc.
THOMAS & BETTS CO. INC. 123
Agency—G. M. Basford Co.
TINNERMAN PRODUCTS, INC. 15
Agency—Meldrum & Fewsmith, Inc.
TURNER CO. 106
Agency—W. D. Lyon Co. Inc.

U. S. COMPONENTS, INC. 188
Agency—Mitchell Advertising Agency

VICTOREEN INSTRUMENT CO. 180
Agency—Carpenter Adv. Co.

WATERMAN PRODUCTS CO., INC. 134
Agency—Abner J. Gelula & Assoc., Inc.
WECKESSER CO. 190
WESTINGHOUSE ELECTRIC CORP. 20, 31, 38
Agency—Fuller & Smith & Ross Inc.
WESTINGHOUSE ELECTRIC CORP. 145
Agency—H. W. Buddemeier Co.
WHITE DENTAL MFG. CO., S. S. 129, 138
Agency—Peterson & Kempner, Inc.

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.

Annual Index

of all articles published in TELE-TECH & ELECTRONIC INDUSTRIES during 1953, classified according to subjects, may be obtained free of charge by writing to:

The Editors
TELE-TECH & ELECTRONIC INDUSTRIES
480 Lexington Ave., New York 17, N. Y.

(*Continued from page* 192)

manufacturing subsidiary of Columbia Broadcasting System. Since 1947, Mr. Windt had been vice president of the David O. Alber Associates public relations organization and account executive handling public relations for Allen B. DuMont Laboratories, Inc. His headquarters will be at CBS-Columbia Inc. offices at 3400-47th Ave., Long Island City, New York.

William J. Morlock has been appointed general manager of General Electric Company's new Commercial Equipment Department at Syracuse, N. Y.

Edward W. Stone has been appointed sales engineering district manager of Standard Electronics Corp., Newark, N. J. a subsidiary of Claude Neon, Inc. Active in the broadcasting and electronics fields since 1932, Mr. Stone went to his Newark assignment after serving as manager of electronic sales in the southern district of the Graybar Electric Co. in Atlanta, Ga.

Robert A. Elliot has become manager of the distributor sales division of Erie Resistor Corp., Erie, Pa. Prior to his association with Erie Resistor, Mr. Elliot was sales manager for Pioneer Electric and Research Corp. at Forest Park, Ill.

Henry C. Roemer, president of Federal Telephone and Radio Co. has been designated vice-president in charge of the administration of the Domestic Divisions of the International Telephone and Telegraph Corp., Clifton, N. J., comprising Federal Telecommunication Laboratories, Nutley, N. J.; Kellogg Switchboard and Supply Co., Chicago, Ill.; Coolerator Co., Duluth, Minn.; and Capehart-Farnsworth Co., Fort Wayne, Ind. Joining IT&T in 1927, Mr. Roemer became president of Federal in 1951. Mr. Roemer's successor to the presidency is **Raymond S. Perry,** former vice-president and general sales manager. He joined the company in 1949.

Harry E. Allen has been made government products manager of the Jensen Manufacturing Co., Chicago, Ill. and will be in charge of all activities that relate to such products. Mr. Allen joined the company in 1946.

Stanley Lowitt was recently made assistant sales manager of Bud Radio, Inc., 2218 East 55th St., Cleveland 3, Ohio.