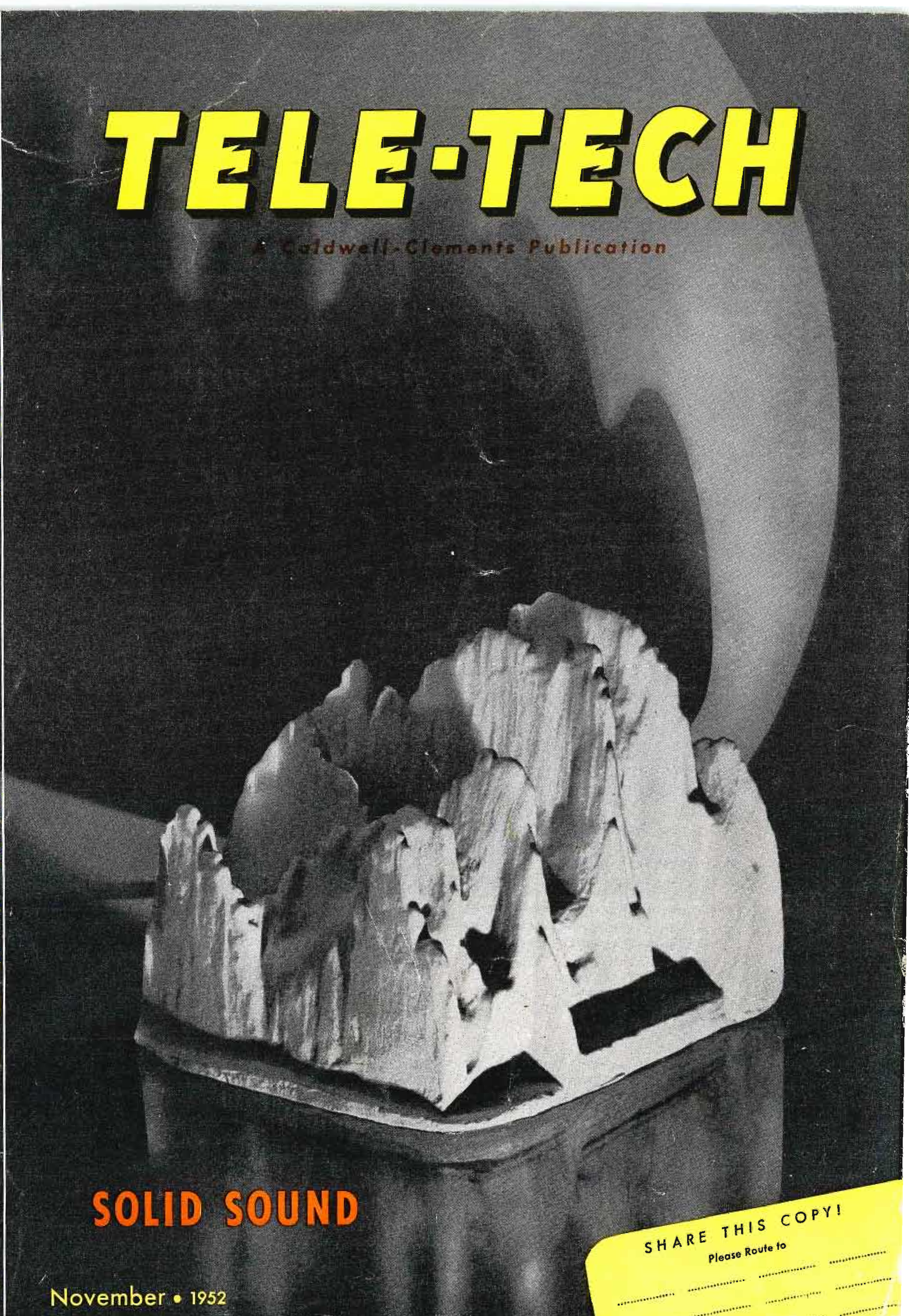
for the ELECTRONIC INDUSTRIES

TELE-TECH

A Caldwell-Clements Publication



SOLID SOUND

November • 1952

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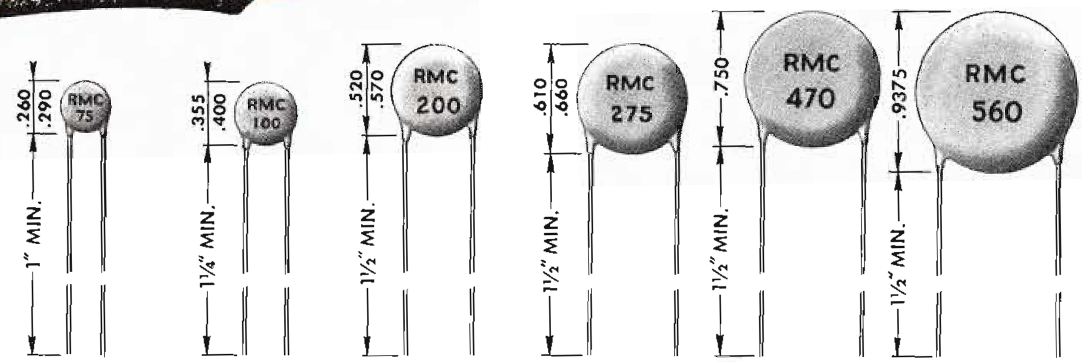

TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	—	2- 9 MMF	10- 30 MMF	—	—	—
NPO	2- 12 MMF	13- 27	28- 60	61- 75 MMF	76-110 MMF	111-150 MMF
N- 33	2- 15	16- 27	28- 60	61- 75	76-110	111-150
N- 80	2- 15	16- 27	28- 60	61- 75	76-110	111-150
N- 150	2- 15	16- 30	31- 60	61- 75	76-110	111-150
N- 220	2- 15	16- 30	31- 75	76-100	101-140	141-190
N- 330	2- 15	16- 30	31- 75	76-100	101-140	141-190
N- 470	2- 20	21- 40	41- 80	80-120	121-170	171-240
N- 750	5- 25	26- 50	51-150	151-200	201-290	291-350
N-1400	15- 50	51-100	101-200	200-250	251-470	480-560
N-2200	47- 75	76-100	101-200	201-275	276-470	471-560

If the samples you need are not here — send for them.

SPECIFICATIONS

POWER FACTOR: LESS THAN .1% AT 1 MEGACYCLE

WORKING VOLTAGE: 1000 VDC TEST VOLTAGE: 2000 VDC

DIELECTRIC CONSTANT: P-100 14K N-750 88K N-2200 265K NPO 35K N1400 165K

CODING: CAPACITY, TOLERANCE AND TC STAMPED ON DISC

INSULATION: DUREZ PHENOLIC—VACUUM WAXED

LEAKAGE RESISTANCE: INITIAL 7500 MEG OHMS AFTER HUMIDITY 1000 MEG OHMS

LEADS: #22 TINNED COPPER (.026 DIA.)

LEAD LENGTH: ¼" BODY 1", 5/16" BODY 1¼", ½" AND LARGER BODY 1½"

TOLERANCES: ±5%, ±10%, ±20%

RMC DISCAPS are Designed to Replace Tubular Ceramic and Mica Condensers at LOWER COST

SEND FOR SAMPLES AND TECHNICAL DATA

DISCAP CERAMIC CONDENSERS

RMC

RADIO MATERIALS CORPORATION

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

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Condensers

TELE-TECH

& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

Edited for the 19,000 top influential engineers in the Tele-communications and Electronic Industries, TELE-TECH each month brings clearly written, compact, and authoritative articles and summaries of the latest technological developments to the busy executive. Aside from its engineering articles dealing with manufacture and operation of new communications equipment, TELE-TECH is widely recognized for comprehensive analyses and statistical surveys of trends in the industry. Its timely reports and interpretations of governmental activity with regard to regulation, purchasing, research, and developments are sought by the leaders in the many engineering fields listed below.

•

Manufacturing

TELEVISION • FM • ELECTRONIC
LONG & SHORT WAVE RADIO
AUDIO AMPLIFYING EQUIPMENT
SOUND RECORDERS & REPRODUCERS
AUDIO ACCESSORIES
MOBILE • MARINE • COMMERCIAL
GOVERNMENT
AMATEUR COMMUNICATION
CARRIER • RADAR • PULSE
MICROWAVE • CONTROL SYSTEMS

Research, design and production of special types

TUBES, AMPLIFIERS, OSCILLATORS, RECTIFIERS, TIMERS, COUNTERS ETC. FOR LABORATORY • INDUSTRIAL USE
ATOMIC CONTROL

Operation

Installation, operation and maintenance of telecommunications equipment in the fields of

BROADCASTING • RECORDING
AUDIO & SOUND • MUNICIPAL
MOBILE • AVIATION
COMMERCIAL • GOVERNMENT

NOVEMBER, 1952

FRONT COVER: "SOLID SOUND"—Model of the word "nine" is outgrowth of sound studies being carried on by Bell Telephone Labs. Initial step in the construction process is the spectrographic recording of the frequency-intensity response of a spoken word for a continuous series of time "slices." The slice patterns are inscribed on plastic sheets and stacked to form a "loaf" of the entire word. A mold is then made and the plaster model cast. The resulting three-dimensional piece presents a full visual picture of the word, showing characteristics not readily evident in ordinary spectrograms. In the model, frequency is plotted along the horizontal, oblique right axis; time along the horizontal, oblique left axis; and intensity vertically. Studies indicate that the major ranges for any one particular word are distinctive and similar for a variety of speakers, but vary in the smaller ridges or foothills depending on the speaker's emphasis and inflection. Present object of the research is the solution of existing speech transmission problems. Long range aim is the development of voice-operated telephone dialing and teletype systems.

DEPARTMENTS:

TELE-TECH, Vol. 11, No. 11, November, 1952. 75 cents a copy. Acceptance under Section 34. 64 Postal Laws and Regulations authorized at Bristol, Conn., February 8, 1952 with additional entry at New York, N. Y. 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. Copyright by Caldwell-Clements, Inc., 1952. Printed in U. S. A. Published monthly by

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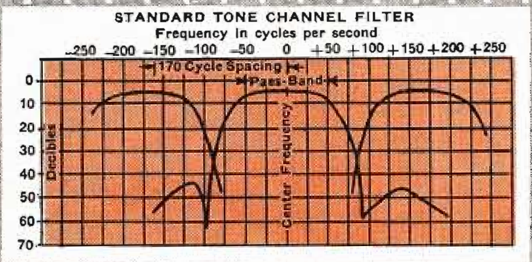
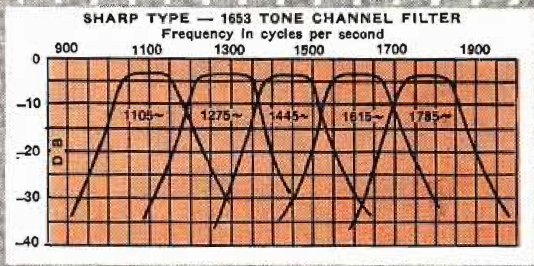
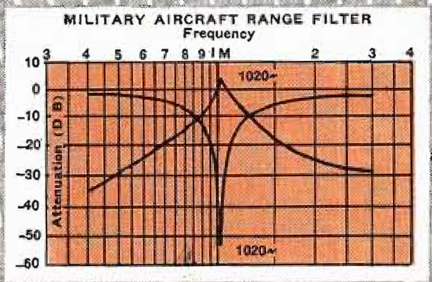
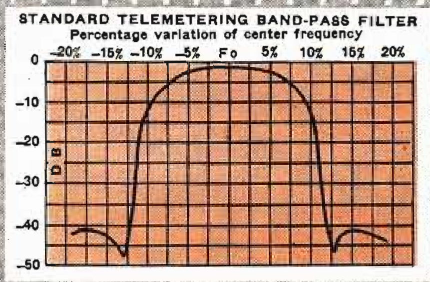
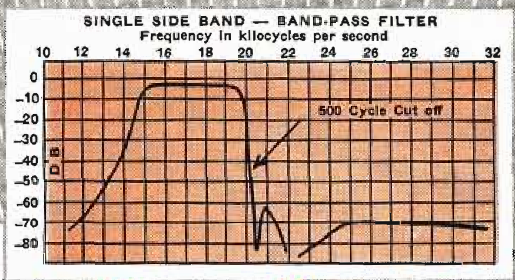
EXPERTS *in Filters for the Military*

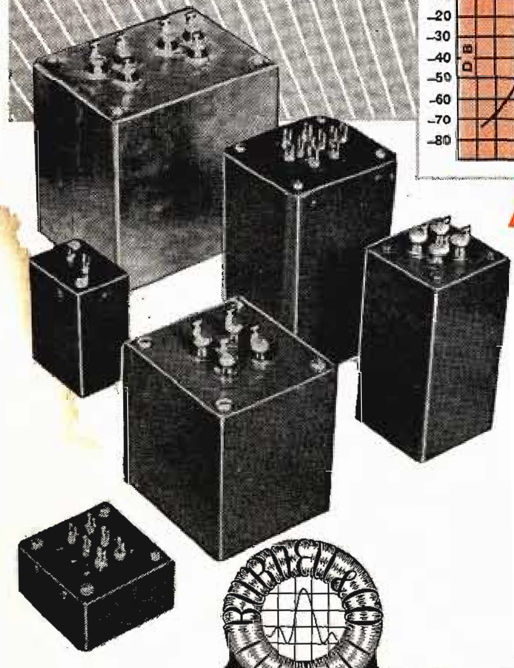












Burnell High Quality Toroids and Audio Filters

With each new technological advancement in military electronics the design engineer has had to cope with more difficult network problems.

Today it is not sufficient for the engineer just to know what signal to clean up or which to reject or separate.

His filter requirements have become increasingly complicated by other critical factors such as phase shift, linearity, transient response, extreme accuracy through wide temperature ranges etc.

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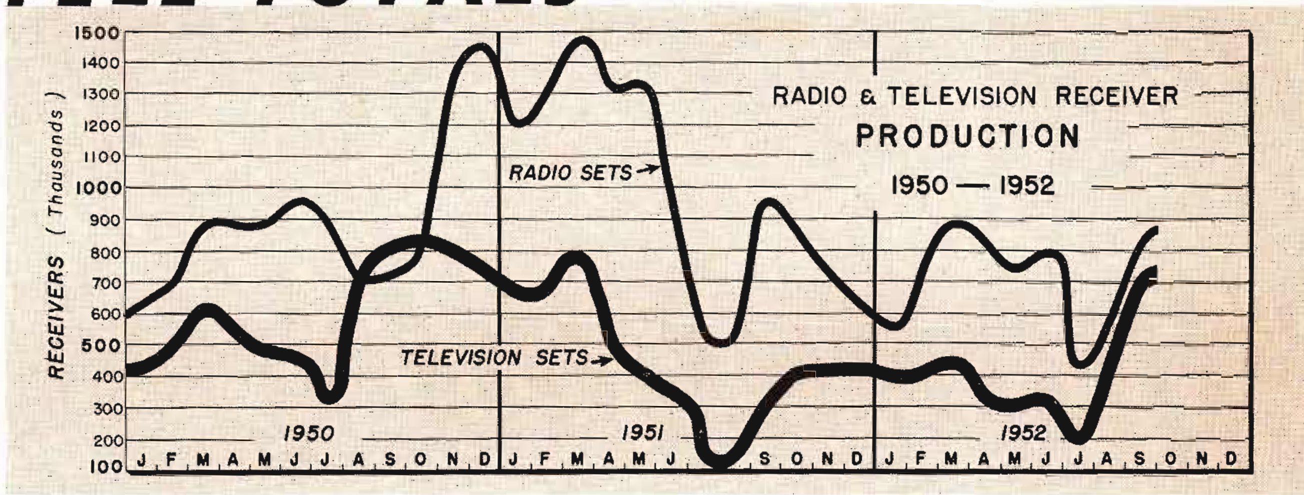
EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS

TELE-TOTALS

Facts & Figures Round-up of the Electronic Industries, November, 1952



Radio and TV Receiver Production

	TV		Radio
Sept. 1952		Home	309,459
		Battery	138,622
		Auto	228,290
		Clock	178,456
Total	719,310		854,827
First nine months through Sept. 1952		Home	2,561,018
		Battery	1,005,668
		Auto	2,020,350
		Clock	1,128,817
Total	3,666,407		6,715,853
Year 1951	5,562,000		12,895,000
Year 1950	7,520,000		14,630,000

Broadcast Stations in U.S.

	AM	FM	TV
Stations on Air	2360	628	110 VHF & 1 UHF
Under Construction (CPs)	132	68	38 UHF & 11 VHF
Applications Pending	265	11	296 UHF & 445 VHF

TELEVISION-SET OWNERS, NOV. 1, 1952

Market Area	No. TV Stations	TV Sets in Use	Market Area	No. TV Stations	TV Sets in Use
Atlanta	3	210,000	Minneapolis-St. Paul	2	340,000
Baltimore	3	430,000	Nashville	1	82,000
Binghamton	1	93,500	New Haven	1	338,000
Birmingham	2	128,000	New Orleans	1	120,000
Boston	2	980,000	New York	7	3,260,000
Buffalo	1	298,000	Norfolk	1	129,000
Charlotte	1	167,000	Oklahoma City	1	97,600
Chicago	4	1,300,000	Omaha	2	146,000
Cincinnati	3	354,000	Philadelphia	3	1,180,000
Cleveland	3	680,000	Phoenix	1	42,000
Columbus	3	235,000	Pittsburgh	1	515,000
Dallas-Fort Worth	1	195,000	Portland Ore.	1	15,000
Davenport-Rock Island	2	146,000	Providence	1	238,000
Dayton	2	209,000	Richmond	1	147,000
Denver	1	45,000	Rochester	1	166,000
Des Moines (Ames)	1	95,500	Salt Lake City	2	81,000
Detroit	3	785,000	San Antonio	2	96,000
Erie	1	94,500	San Diego	1	127,000
Grand Rapids-Kalamazoo	1	186,000	San Francisco	3	470,000
Greensboro	1	101,000	Schenectady	1	234,000
Houston	1	186,000	Seattle	1	180,000
Huntington	1	96,000	St. Louis	1	442,000
Indianapolis-Bloomington	1	312,000	Syracuse	2	180,000
Jacksonville	1	71,500	Toledo	1	213,000
Johnstown	1	178,000	Tulsa	1	81,000
Kansas City	1	234,000	Utica	1	78,000
Lancaster	1	172,000	Washington	4	410,000
Lansing	1	106,500	Wilmington	1	124,000
Los Angeles	7	1,300,000	*Not Interconnected*		
Louisville	2	156,000	Albuquerque	1	19,000
Memphis	1	152,000	Brownsville	1	11,600
Miami	1	111,000			
Milwaukee	1	370,000	Total for All Stations		19,739,700

TIMETABLE of NEW TV STATIONS COMING on the AIR

A geographical listing of the 59 new commercial TV stations and 9 noncommercial educational outlets for which post-freeze FCC grants and construction permits had been issued through October 4, 1952. Information on expected start of telecasting is from station operator's estimate, as furnished TELE-TECH.

STATE AND CITY	CALL LETTERS	CHANNEL	DATE ON AIR
ALA.: Mobile	WKAB-TV	48	December, '52
Montgomery	WCOV-TV	20	March '53
ARK.: Little Rock	KWFT	17	*
CALIF.: Fresno	KMJ	24	*
Los Angeles (NCE)	*	28	*
COL.: Denver	*	20	*
Denver	KBTV	9	October 12, '52
Denver	KFEL-TV	2	July 21, '52
Denver	*	26	*
CONN.: Bridgeport	WICC-TV	43	January, '53
Bridgeport	*	49	*
New Britain	WKNB-TV	30	January, '53
FLA.: Ft. Lauderdale	WITV	17	*
Ft. Lauderdale	WFTL-TV	23	March, '53
ILL.: Peoria	WEEK-TV	43	March, '53
Rockford	*	39	Feb. or Mar., '53
IND.: South Bend	*	34	*
KANS.: Manhattan (NCE)	*	8	*
KY.: Ashland	*	59	*
LA.: Baton Rouge	WAFB-TV	28	Feb., '53
MASS.: Fall River	*	46	May, '53
New Bedford	*	28	*
Springfield-Holyoke	WWLP	61	January, '53
Springfield-Holyoke	WHYN-TV	55	March, '53
MICH.: Ann Arbor	WPAG	20	*
Flint	WCTV	28	January, '53
Saginaw	*	12	*
MISS.: Jackson	*	25	*
NEB.: Lincoln	*	57	*
N. J.: Asbury Park	*	58	*
N. Y.: Albany (NCE)	*	17	*
Binghamton (NCE)	*	46	*
Buffalo (NCE)	*	23	*
New York City (NCE)	*	25	*
Rochester (NCE)	*	21	*
Syracuse (NCE)	*	43	*
OHIO: Akron	WAKR-TV	49	Winter, '53
Massilon	WMAC	23	March, '53
Youngstown	*	21	*
Youngstown	WFMJ-TV	73	*
Youngstown	WKBN-TV	27	*
ORE.: Portland	KPTV	27	Sept. 18, '52
PA.: Harrisburg	WHP-TV	33	*
New Castle	WKST-TV	45	January, '53
Reading	WEEU-TV	33	July 1, '53
Reading	WHUM-TV	61	December, '52
Scranton	*	73	*
Scranton	WGBI	22	April 1, '53
York	WNOW-TV	49	Feb. or Mar., '53
York	WSBA-TV	43	Nov., '52
Wilkes-Barre	*	28	*
Wilkes-Barre	*	34	*
S. C.: Columbia	WNOK-TV	67	Jan., '53
Columbia	WCOS-TV	25	Spring, '53
TENN.: Chattanooga	*	43	*
Chattanooga	*	49	*
TEX.: Austin	*	18	*
Austin	KTBC-TV	7	December 1, '52
Austin	*	24	*
El Paso	KROD-TV	4	December, '52
El Paso	KTSM-TV	9	January, '53
Houston (NCE)	*	8	*
VA.: Roanoke	WROV-TV	27	December, '52
Roanoke	WSLS-TV	10	January 1, '53
WASH.: Spokane	KHQ-TV	6	Spring, '53
Spokane	KXLY-TV	4	December, '52
HAWAII: Honolulu	KGMB-TV	9	April-June, '53
PUERTO RICO: San Juan	WKAQ-TV	2	April, '54

* Information not available at press time.
(NCE) Noncommercial educational.

See also Caldwell-Clements Statistics in World Almanac, Encyclopaedia Britannica, National Industrial Conference Board Fact Book, and "Information Please" Almanac

TELE-TECH

& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

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Publishing services to the 5-billion dollar TV-Electronic-Radio industries by Caldwell-Clements, Inc., consist mainly of engineering and distribution magazines and coordinated services, as follows:

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TELEVISION RETAILING—Monthly magazine of sales and service, devoted to TV, radio, records and appliances. Includes TV-Electronic Technician, monthly supplement for service technicians.

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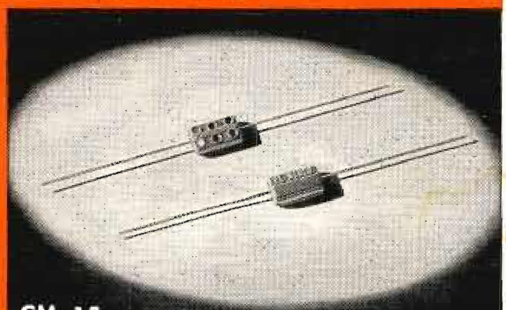
DOESN'T COUNT

A tired bull fighter that almost dodged in time . . . a defective capacitor that almost gave good service . . . have much in common.

In bull fighting as in building high quality capacitors, being close to proper performance . . . close to dependability . . . isn't good enough.

To make sure that El-Menco Silvered-Mica Capacitors maintain higher standards in every electronic application, they are built with precision by expert craftsmen using the finest materials . . . and each unit is factory-tested at more than **double** its working voltage.

Sizes for every specified military capacity and voltage.



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For larger capacity values, which require extreme temperature and time stabilization, there are no substitutes for El-Menco Capacitors.

Write on business letterhead for catalog and samples.

JOBBERS AND DISTRIBUTORS: For information write to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.—Sole Agent for Jobbers and Distributors in U. S. and Canada.

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Radio and Television Manufacturers, Domestic and Foreign, Communicate Direct With Factory—

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

NEW IMPROVED G-E GERMANIUM

1. HERMETIC SEAL **2. MINIATURE SIZE**

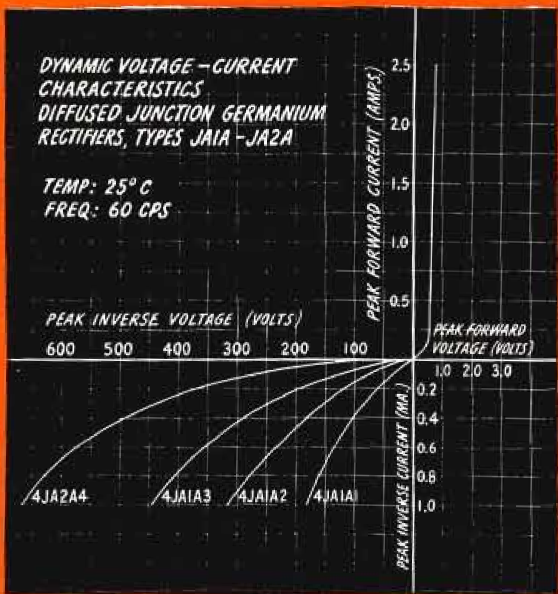
- **Hermetically Sealed** against deteriorating elements. Glass-to-metal seals throughout.
- **Miniature Size** to facilitate use in all electronic equipments, yet heat losses are dissipated efficiently.
- **Re-designed** to meet all military humidity tests and shock and vibration requirements.
- **High Output Voltage** and improved back current characteristics.

Model 4JA2A4 desgned for use in TV power supplies. DC output voltage 10 to 15 volts higher than with comparable selenium rectifiers in a typical voltage doubler circuit.

ABSOLUTE MAXIMUM RATINGS • T=25° C • RESISTIVE LOAD	4JA1A1	4JA1A2	4JA1A3	4JA2A4
PEAK INVERSE VOLTAGE (volts)*	100	200	300	400
PEAK FORWARD CURRENT (amps)*	0.5	0.5	0.5	1.3
D.C. OUTPUT CURRENT (Ma)*	150	150	150	400
D.C. SURGE CURRENT (amps)	25	25	25	25
FULL LOAD VOLTAGE DROP (volts)	0.6	0.6	0.6	0.7
OPERATING FREQ. (kc)	50	50	50	50

*Typical absolute maximum ratings. For other combinations refer to Fig. 1.

DIFFUSED JUNCTION RECTIFIER



Suggested Application Fields

Originally developed for military use, the new JA1A and JA2A Rectifiers may be adaptable to fields other than radar and military communications. Among them: Computers, magnetic amplifiers, TV receiver power supplies, telephone switchboards. Application information on other uses can be supplied. Write or wire us!

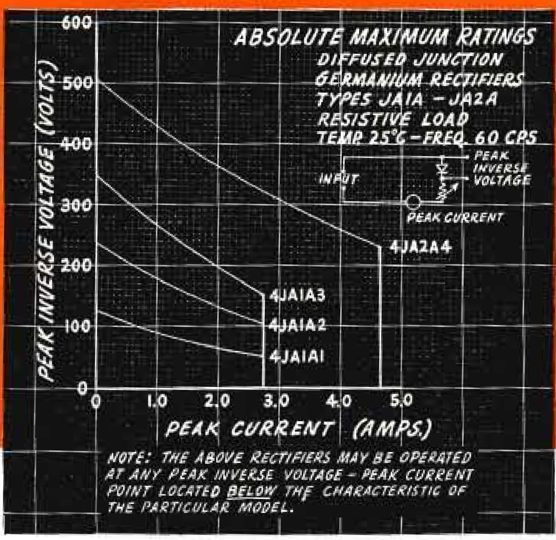
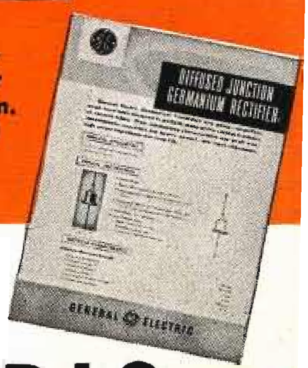


FIG. 1

NEW BULLETIN—Complete specifications on the diffused junction rectifier are contained in this illustrated bulletin. It's yours on request. Write: General Electric Company, Section 48112, Electronics Park, Syracuse, N. Y.



GENERAL ELECTRIC

Westinghouse

announces a great new division to manufacture a full line of

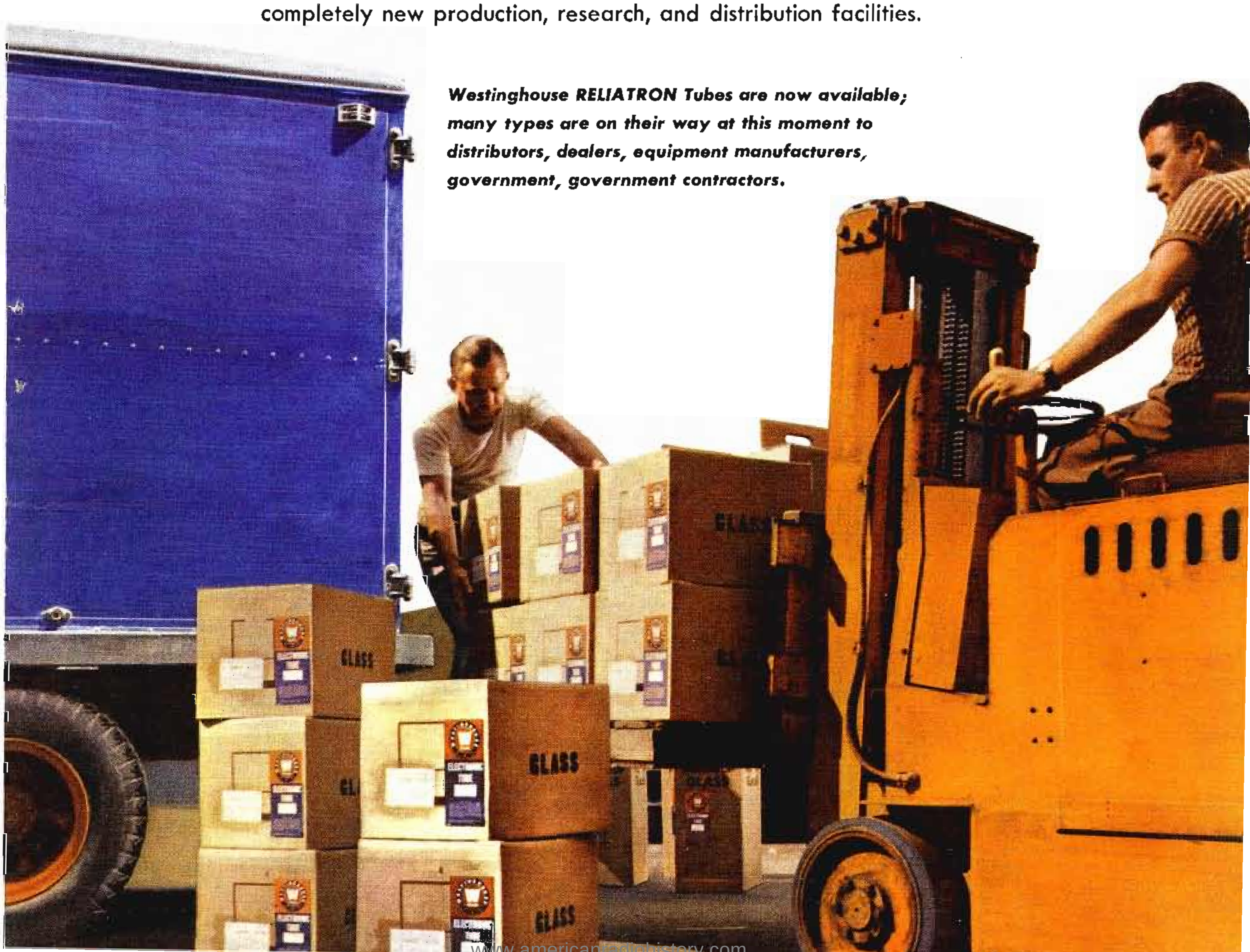
RELIATRON™ TUBES

Receiving Tubes—
Television Picture Tubes—
Power Tubes

Westinghouse proudly announces a completely new division—*THE ELECTRONIC TUBE DIVISION*. Its aim is this: To become the leader of the industry in providing better electronic tubes and better service to all tube users.

To provide this new standard of service to all branches of the electronic tube industry, Westinghouse has equipped its new tube division with completely new production, research, and distribution facilities.

Westinghouse RELIATRON Tubes are now available; many types are on their way at this moment to distributors, dealers, equipment manufacturers, government, government contractors.



THE

Westinghouse

ELECTRONIC TUBE DIVISION

- **Experienced Personnel**
- **Modern Facilities**
- **Rigid Standards**

Westinghouse offers the electronics industry thirty years of experience in tube development, application, and manufacture. From this experience have come many of the tube innovations that today are the basis for the electronics industry. In all cases, Westinghouse customers benefited by being first with new types. The list at the right indicates a few Westinghouse contributions.

The personnel of the new Westinghouse Electronic Tube Division comprise a brilliant engineering, production and sales team—recruited from Westinghouse's 46 manufacturing divisions and key experts from throughout the industry.

Tubes produced by Westinghouse will bear the name . . .

RELIATRON

. . . an unbreakable bond of reliability and electronics. It indicates performance and dependability on a new scale for the electronic tube industry.

Look at This Brilliant History of Westinghouse Electronic Tube Achievements:

★ The Westinghouse-designed WD-11 tube was the first dry battery type and was part of the first commercial radio receiver ever produced in America.

★ Westinghouse was the first manufacturer to develop and mass-produce tubes utilizing an indirectly heated cathode.

★ Westinghouse designed and produced the first ac-operated detector tube, the Type 27.

★ Westinghouse established the first commercial radio broadcast station, KDKA, in 1920 and thus opened the mass market for home radios.

★ Basic development and demonstration of the cathode ray television system was performed in Westinghouse laboratories and patented in 1929.

★ Westinghouse developed and introduced both electromagnetic and electrostatic types of cathode ray tubes in 1930.

★ Westinghouse design engineers invented the Ignitron, which solved long-standing problems of precise, high-speed switching of heavy electric currents.

★ Westinghouse pioneered in high-powered transmitting tubes for use in both pulsed and CW radar applications. The famous Westinghouse Type WL-530 was in the Pearl Harbor radar set which gave the warning of the approach of Japanese planes in 1941. This tube led the way to all subsequent radars.

THESE MEN LEAD THE WESTINGHOUSE ELECTRONIC TUBE DIVISION TEAM

HAROLD G. CHENEY,
General Sales Manager:
A Westinghouse tube and lamp sales executive for 31 years, Mr. Cheney was appointed General Sales Manager of the Electronic Tube Division in August, 1951. Prior to his appointment he was assistant to the general lamp sales manager and supervisor of lamp sales contracts. He was a key factor in giving to the lamp industry the stabilizing influence of Westinghouse's fair, sound business and sales policies.

EUGENE W. RITTER,
Vice-President and Manager:
For eight years he was with the Corning Glass Works as vice-president and director, later president of the Corning Glass Works of South America. Previously he had been employed by the Radio Corporation of America for 12 years as a member of the Radio Tube Design and Development Division, manager of the Radiotron Company, later vice-president of the RCA Manufacturing Company.

JAMES L. BROWN,
Manager, Receiving and Cathode Ray Tube Sales:
For 14 years Mr. Brown was an electronic tube and apparatus sales executive and engineer for the General Electric Company—on the West Coast for 7 years and later as central regional sales manager for receiving and television picture tubes. He is a former purchasing agent of Hoffman Radio Company.

DR. E. A. LEDERER,
Manager of Engineering:
He was formerly chief engineer for National Union Radio Corporation and for 17 years was a member of the tube development staff of Radio Corporation of America. He participated in early vacuum tube development work with the Westinghouse research and engineering staffs from 1923 to 1930.

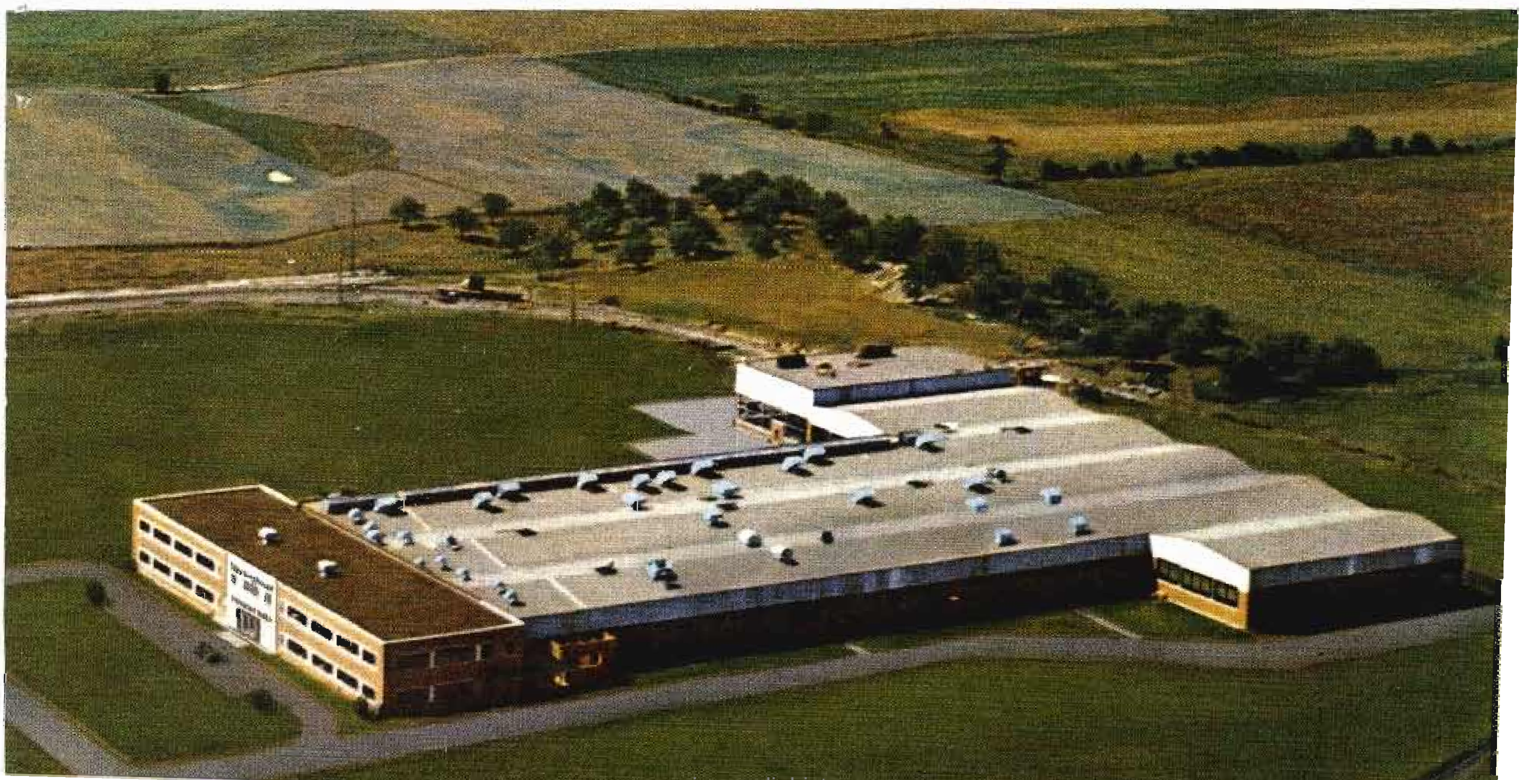
JOHN J. DOYLE,
Manager, Power Tube Sales:
A veteran of 25 years' Westinghouse service, Mr. Doyle was manager of electronic tube sales to distributors prior to his present appointment. Previously he was manager of electronic tube parts sales and has held various sales executive positions in the Lamp Division.

WESTINGHOUSE IN ELMIRA, NEW YORK

360,000 square feet of steel, glass and brick designed for one thing—to house the most efficient electronic tube production in the world. Here, completely modern straight-line exhaust, Lehr, and screen settling equipment produce Westinghouse RELIATRON Television Picture Tubes of unsurpassed quality. Here also are produced the famous Westinghouse line of power, transmitting, industrial and special purpose tubes. Plant layout is designed around efficient, straight production lines. Into them feed raw materials and sub-assemblies. From them, tubes enter an exacting testing cycle. To assure prompt delivery, tubes are loaded directly into trucks or railroad cars waiting on Westinghouse's own spacious rail siding. Here at Elmira, too, is located the headquarters of the Westinghouse Electronic Tube Division with sales, engineering and production management ready to extend a warm welcome to you.

WESTINGHOUSE IN BATH, NEW YORK

Located at Bath in the scenic Finger Lakes region of upstate New York, this Westinghouse Receiving Tube Plant is another 220,000 square feet of modern production efficiency. It lies only a few miles from a major source of glass tube envelopes. It is served by sidings of one of the nation's leading railroads—only hours away from all principle markets. It is less than one hour from the Elmira factory and the advice and supervision of the Division's headquarters staff. Here at Bath, the most modern cathode-coating, grid-winding, spot welding and sealex equipment is operated by the industry's leading craftsmen. Famous Westinghouse quality control standards rule from raw material to testing of finished tubes. From this plant are shipped the finest receiving tubes in the industry—Westinghouse RELIATRON Tubes.



RELIATRON TUBES are backed by Westinghouse reliability

TUBE RESEARCH AND DEVELOPMENT

The Westinghouse position of leadership in electrical and electronic manufacturing is founded on the untiring efforts of its research staff. The Electronic Tube Division is already at work improving present tube types and developing new types for superior service and new applications, including UHF.

QUALITY CONTROL

RELIATRON tube performance is assured by an exacting program of quality control. Every step in the manufacture of RELIATRON Tubes—from raw materials to finished product—must meet standards which are the toughest in the industry.

ENGINEERING AND SALES SERVICES

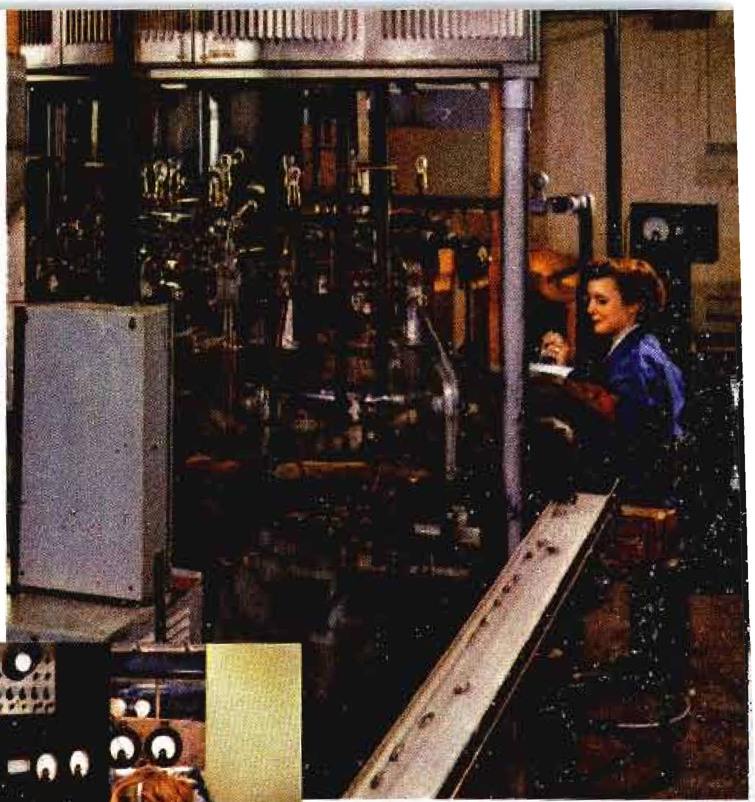
Whatever your problem, whether you are an equipment manufacturer, government laboratory, or parts distributor, you will find Westinghouse sales representatives and application engineers in your area at your service. Sales and engineering offices are located strategically throughout the country to serve you.

ADVERTISING

Trade acceptance of Westinghouse RELIATRON Tubes will be supported by a nationwide advertising campaign second to none. Technical data, pricing service and application information are available to all tube users. Sales promotion programs for distributors and service dealers will be hard-hitting, sure sales builders. Your product or service will profit from consumer acceptance built by the tremendous national advertising of the name "Westinghouse."

DISTRIBUTORS, EQUIPMENT MANUFACTURERS, WRITE NOW

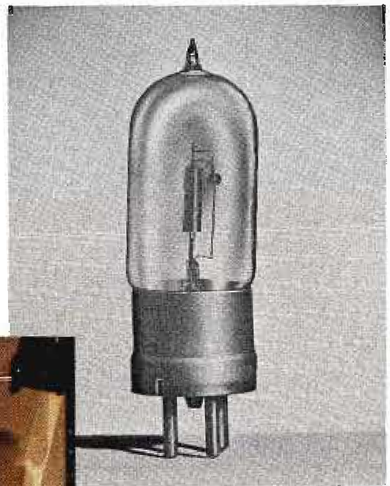
For complete information on the Westinghouse line of RELIATRON Receiving Tubes, Television Picture Tubes, and Power Tubes, write or wire Westinghouse Electric Corporation, Dept. 101, Elmira, New York. Or call your nearest Westinghouse Electronic Tube Division Sales Office.



Sealex units at Bath, New York, turn out miniature tubes for government and commercial use. From here, tubes enter a rigorous program of checks and testing.

This exclusively-Westinghouse quality control test set is one of a large battery of equipments which provide you with tubes of the highest quality and reliability.

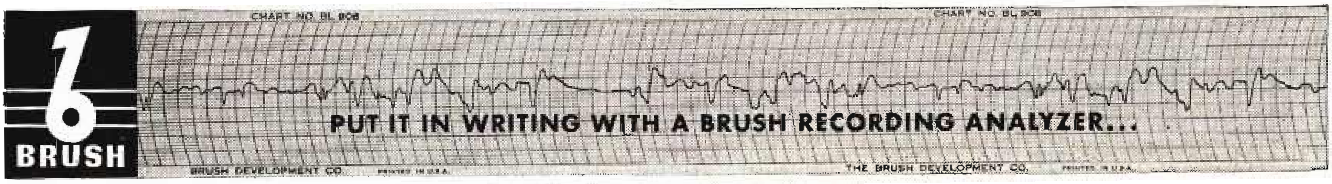
Here, an early Westinghouse WD-11 tube, one of the earliest types ever made, is shown just as it was used in the first commercial radio receivers.



Basic and application research are of prime importance in the Westinghouse Electronic Tube Division's plans. Such research has helped build the tube industry, and has made Westinghouse dominant in development.

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

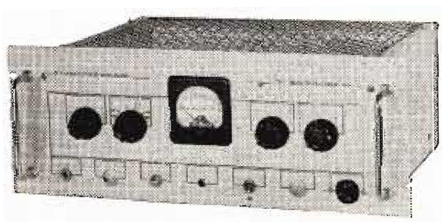
WESTINGHOUSE ELECTRIC CORPORATION, ELECTRONIC TUBE DIVISION, ELMIRA, N. Y



Checks dialing on Micro-wave and Carrier Current Equipment

● Brush Recording Analyzers save plotting and testing time in applications everywhere. Here, at a substation of the Bonneville Power Administration, a Brush direct-coupled dual channel amplifier and dual-channel oscillograph record dialing pulses for a maintenance check. The test immediately indicates any dialing troubles in the system, and their nature. The Brush equipment is also used to check relay operation, and has been found essential to keeping the micro-wave system "on the air". Duplicate Brush equipment is used to service communication facilities in each Bonneville maintenance area.

MEASURES ELECTRICAL VARIABLES . . . CHART AVAILABLE INSTANTANEOUSLY



Brush Direct-Coupled Amplifier for Rack Mounting, Model BL-962.

This high gain, low-drift D-C amplifier is designed for mounting in a standard 19-inch rack. Other Brush amplifiers and oscillographs are being designed for rack mounting. When used in conjunction with Brush direct-writing oscillographs, amplifier can be used to make recordings of many types of phenomena which previously required complicated intermediate equipment. Voltage gain gives one chart millimeter deflection per millivolt input. Frequency response is essentially linear from D-C to 100 cycles per second. (Bulletin F-698)

Direct-writing Two-Channel Magnetic Oscillograph Model BL-202

The Brush Magnetic Oscillograph, used with the proper Brush Amplifier, makes a direct chart recording of voltage or current, or of physical phenomena such as strain, pressure, acceleration, torque, force, temperature, displacement and vibration. Either direct inking or electric stylus models available. Gearshift provides chart speeds of 5, 25, and 125 mm per second. An auxiliary chart drive is available for speeds of 50, 250, and 1250 mm per hour. Accessory equipment provides event markers where an accurate time base is required, or where it is desirable to correlate events. Photo shows two-channel model for recording of two phenomena simultaneously.

For Bulletin 618 describing these instruments write The Brush Development Co., Dept. FF-33, 3405 Perkins Avenue, Cleveland 14, Ohio. Representatives located throughout the U. S. In Canada: A. C. Wickman Limited, Toronto.

THE Brush DEVELOPMENT COMPANY

BRUSH

Piezoelectric Crystals and Ceramics
Magnetic Recording
Acoustic Devices
Ultrasonics
Industrial & Research Instruments

Here's what makes RAYTHEON

RELIABLE SUBMINIATURE TUBES

RAYTHEON RELIABLE SUBMINIATURE TUBES

CK5702WA
RF Amplifier Pentode

CK5703WA
High Frequency Triode

CK5744WA
High Mu Triode

CK5783WA
Voltage Reference

CK5784WA
RF Mixer Pentode

CK5787WA
Voltage Regulator

CK5829WA
Dual Diode

CK6021
Medium Mu Dual Triode

CK6111
Low Mu Dual Triode

CK6112
High Mu Dual Triode

CK6152
Low Mu Triode

✓ **EXPERIENCE** Raytheon has been in constant, large scale production of subminiatures for fourteen years — has made millions of them.

✓ **ENGINEERING** Many Raytheon engineers have worked exclusively on the development and improvement of Subminiature tubes. Raytheon designs have proved themselves in the field.

✓ **EQUIPMENT** Raytheon's production, testing and inspection facilities are custom built. Improved welding, sealing and exhaust procedures are among the many exclusive Raytheon advances.

✓ **EXCLUSIVE SUBMINIATURE TECHNIQUES** Include closer production tolerances for all parts; separate production and inspection personnel free of production-incentive pressure; grid inspection with high optical magnification; microscopic inspection of each assembly; longer, more complete electrical aging; rigid tests for shock, vibration, acceleration and all other factors affecting performance and life.

RAYTHEON®
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

Newton, Mass. Bigelow 4-7500 • Chicago, Ill. NAtional 2-2770 • New York, N. Y. WHitehall 3-4980 • Los Angeles, Calif. Richmond 7-5524

RAYTHEON MAKES ALL THESE:

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

INSTALLED IN 1941 AND STILL GOING STRONG...

DELTA AIR LINES
INCORPORATED

General Offices: Municipal Airport – Atlanta, Georgia

June 16, 1952

Eitel-McCullough, Inc.
San Bruno, California

Gentlemen:

From time to time in your advertisements, I have noticed reports of Eimac tubes that have served an exceptionally long life. You may be interested in the 450TL statistics at our Atlanta, Georgia, station.

The transmitter in this station uses eight 450TL's in RF service. Of the eight, seven have been in operation since the transmitter was installed in October, 1941. Our Dallas, Texas, transmitter installed about the same time still has five of its original 450TL tubes.

The most important factor in the operation of an airline is safety. This is determined largely by the dependability of the equipment it uses. Delta Air Lines, like any business operating on a sound financial basis, must obtain the most value for every dollar spent. It would appear, in the case of our radio tubes as well as many other products, that the two factors, safety and economy, go hand in hand.

Very truly yours,

DELTA AIR LINES, INC.

J. B. Kramer
J. B. Kramer
Supervisor of Ground Radio

JBK:dg

. . . reports

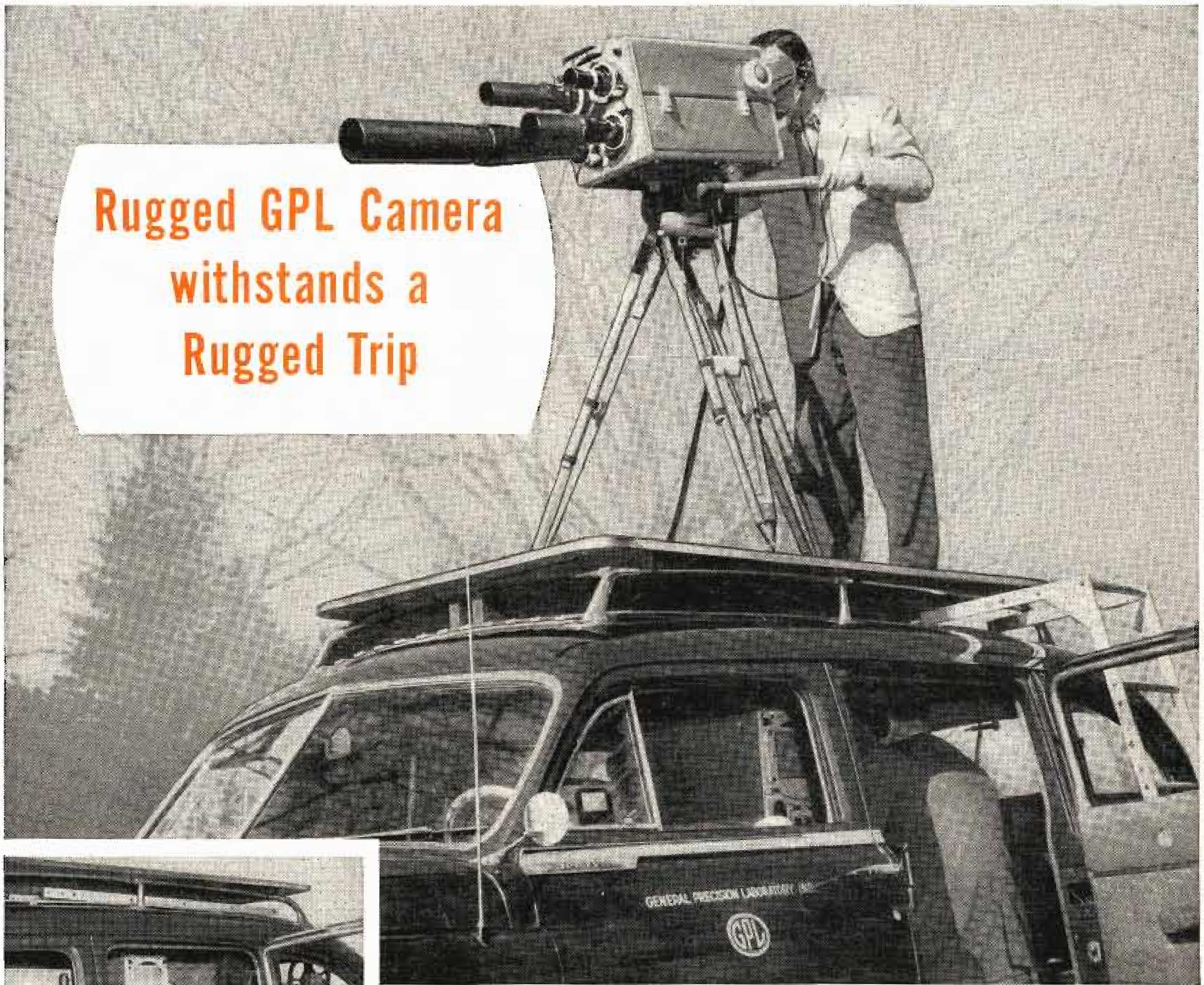
DELTA AIR LINES of EIMAC Tubes

This story of dependability through more than a decade of day in, day out operation is typical of what leading users of electronic equipment are finding whenever Eimac tubes are employed. Write our application engineering department for information about the complete line of Eimac transmitting power tubes.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Eimac REG. U.S. PAT. OFF. TUBES

Rugged GPL Camera withstands a Rugged Trip



EQUALLY RUGGED and service-free on trip was GPL Utility Projector with "3-2" intermittent which permits use with I. O. camera for film telecasting from remotes.

GPL STUDIO CAMERA CHAIN was packed in station wagon . . . demonstrating mobility of entire chain for fast coverage of news events, sports, other programs in the field.

20,000 Miles Cross-Country Without Camera Service

This GPL image orthicon camera has just completed a demonstration tour to studios in 67 cities from Maine to Mexico . . . Michigan to Miami.

Without a single service operation, it took the bumps of 20,000 miles of hard driving. It was loaded and unloaded more than 150 times. Every working element received far more than normal wear and tear, as usual on demonstrations. Yet nothing failed, nothing needed replacing.

This is the kind of ruggedness you may have for both studio and field operations, PLUS all the precision of GPL camera design. This unit is engineered for smooth, fast control, from pushbutton turret change to remote adjustment or iris and focus.

For the stations just starting, it has many special advantages: in compactness of chains, ease of operations.

Write, wire or phone, for full details of the camera equipment that is the "industry's leading line—in quality, in design."

General Precision Laboratory **GPL**

INCORPORATED

PLEASANTVILLE NEW YORK

Export Department: 13 E. 40th St., New York, N. Y. Cable address: Arlab

TV Camera Chains • TV Film Chains • TV Field and Studio Equipment • Theatre TV Equipment

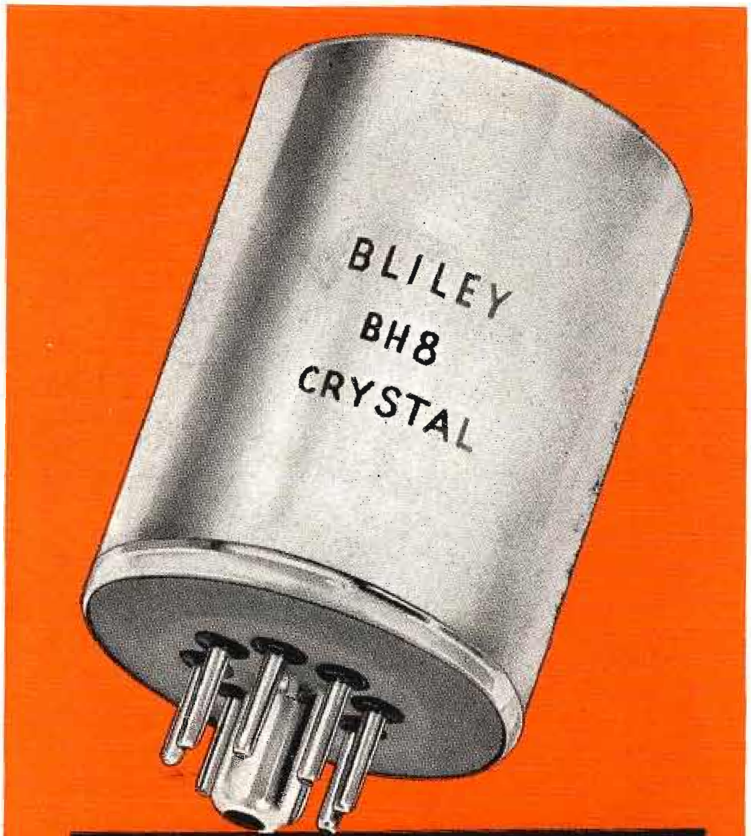

PHILCO
Advanced Design MICROWAVE
COMMUNICATIONS SYSTEMS
ENGINEERED FOR GREATEST ECONOMY!
Philco Advanced Design Microwave Systems are unsurpassed in reliability, performance and economy. They are designed to give you the greatest value for your communications dollar!
Finest quality components, conservatively rated, insure long life and economy of operation and maintenance. Years of production experience enable Philco to produce microwave systems for the lowest possible cost consistent with highest quality.
Philco Advanced Design Microwave is flexible. The broadband microwave channel may be divided to carry up to 24 simultaneous 2-way telephone conversations . . . or be further divided for telegraph, teletype, telemetering, signaling or supervisory circuits. Future expansion can be easily accomplished with no loss of original investment.
Philco Advanced Design Microwave Systems give you maximum reliability . . . plus low cost installation, operation and maintenance. Don't settle for Less!
PHILCO CORPORATION
INDUSTRIAL DIVISION
PHILADELPHIA 34, PENNSYLVANIA

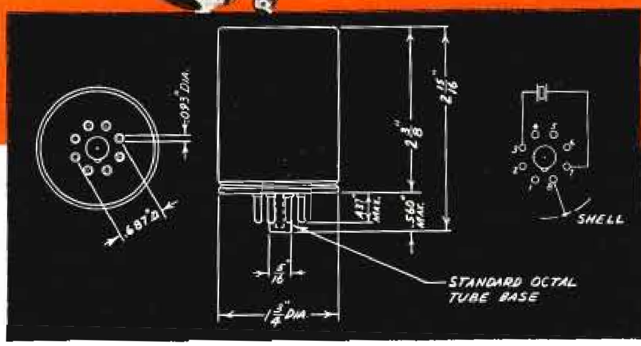
ENGINEERING

PLUS

CRAFTSMANSHIP

SOLVED THIS UNUSUAL REQUIREMENT





THE PROBLEM:

The problem was to develop a crystal unit for AM broadcast (550-1600 kc) which would maintain frequency tolerance per FCC requirement (±20 cycles) *without temperature control.*

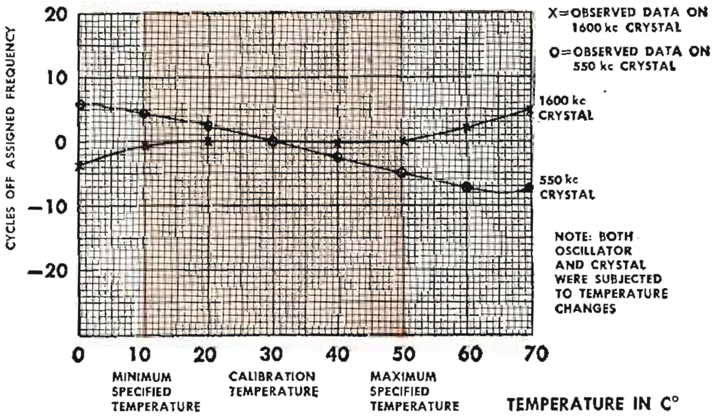
THE SOLUTION:

When designing the crystal oscillator, the transmitter manufacturer gave primary consideration to voltage stability and low r.f. current. The resultant design provided an ideal environment for realization of the inherent stability of the crystal unit employed.

Bliley designed a plated crystal utilizing precision orientation to achieve the low drift characteristic needed. Contrary to ordinary practice in this frequency range, the crystal was soldered between rigid supports to prevent frequency deviation due to physical displacement. The assembly was then hermetically sealed in a dry nitrogen atmosphere to prevent contamination and minimize aging.

The resultant production units,type BH8, are calibrated at 30°C with maximum deviation not exceeding ±10 cycles thru the temperature range from +10°C to + 50°C.

TYPICAL STABILITY DATA



Bliley CRYSTALS

BLILEY ELECTRIC COMPANY • UNION STATION BUILDING • ERIE, PA.

TELE-TIPS

LOOK FOR a new style in horizontal output transformers for television receivers. Latest word from designers is that adjustable cores will be used to provide width control in lieu of the old width coil, or potentiometer width control which recently came in favor. Shades of the good old days of radio when we had adjustable transformer cores! Once again the radio cycle repeats!

SUPERCONDUCTIVITY of metals and crystals is proving itself a promising field of application for scientists engaged in extremely low temperature research. Some 50 laboratories are presently involved in ultra-cold investigations. Also, an exceptionally hard stainless steel was the outgrowth of one experimental study which immersed the metal in liquid nitrogen at -320° F.

NOISE RECORDING of power transformers operating in the field is another application of the versatile magnetic tape recorder. GE engineers, using a Magnecord tape recorder, have found that by recording transformer hum and analyzing the data in the laboratory, they obtain better results than by transporting the lab equipment to the operating site. The new method makes two-minute recordings of sound level meter output for various microphone locations. Every 15 minutes a standard sound is recorded for calibration purposes. An additional advantage is that playback in a known amount of laboratory ambient noise permits subjective judgment of less tangible aspects of apparatus noise.

AIR-TECH INTELLIGENCE—A little known department—and naturally so, of the Air Force, is Air Technical Intelligence at Wright Field. Here the secrets of enemy electronic equipment are extracted from piles of seeming junk which have been brought back from Korea and other areas. A development of military intelligence of World War II, this division has fingers in literally all corners of the earth, and generally speaking, it is not long before the boys at Wright Field learn what makes the latest enemy radio equipment operate.

Built for the toughest service....

Mallory Q Series Wire Wound Controls

If you need a wire wound control that will stand up under the most severe conditions, here's the answer to your problem—Mallory Series Q controls. These new features make the Q series your best choice for military and other exacting applications:

IMPERVIOUS TO MOISTURE AND FUNGUS: all insulation used in this control is made of high resistance material which has exceptionally low moisture absorption . . . treated to prevent fungus growth.

WEATHERPROOF FINISH: nickel plated case, stainless steel shaft, and all other metal parts will pass a 100-hour salt spray test.

LONGER LIFE: hard nickel-silver contacts withstand the wear of thousands of rotations.

SELECTION OF TAPERS: all standard JAN tapers are available.

In addition to these standard features, Q series controls can be supplied in a number of special variations invaluable in applications requiring complete waterproofing or extreme resistance to vibration:

WATERPROOF SHAFT BUSHING: a waterproof gasket between shaft and bushing, sealed with silicone grease, prevents leakage along the shaft.

WATERPROOF PANEL SEAL: gasketed seal prevents leaks at the point of panel mounting.

BUSHING LOCK: a split bushing, when tightened, prevents shaft rotation even under severe shock and vibration.

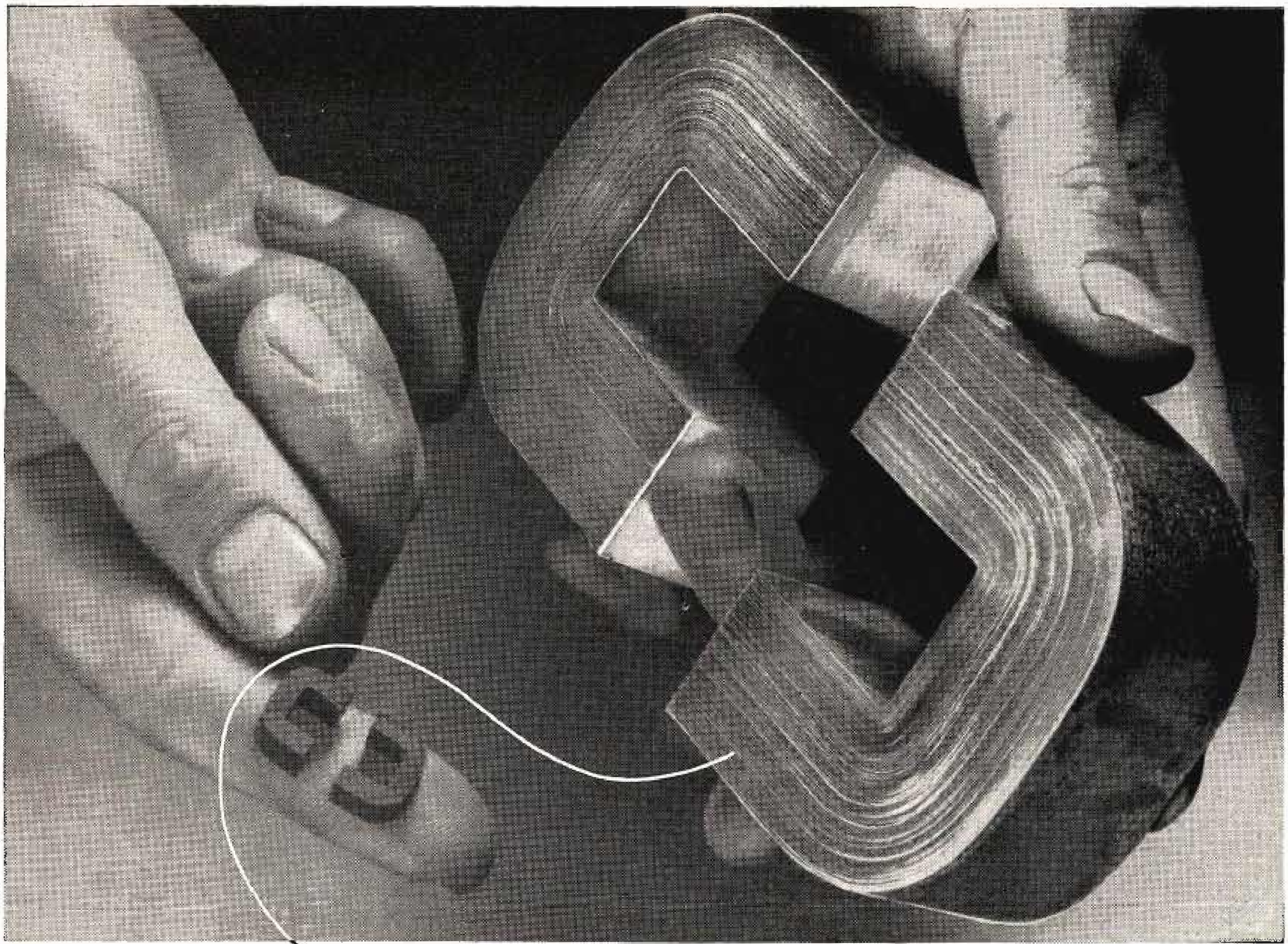
New Technical Bulletin Number 76-3 includes complete details on Mallory wire wound controls. Write for your copy.

Series	Watts	Diameter	Similar JAN Type
QC	2	1 1/16"	RA15
QR	2	1 1/4"	RA20
QM	4	1 5/8"	RA25 & RA30

P. R. MALLORY & CO. Inc.
MALLORY

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

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



SILECTRON C-CORES... BIG or LITTLE

...*any quantity and any size*

Wound from precision rolled oriented silicon steel strip as thin as .00025"

For users operating on government schedules, Arnold is now producing C-Cores wound from ¼, ½, 1, 2, 4 and 12-mil Silectron strip. The ultra-thin oriented silicon steel strip is rolled to exacting tolerances in our own plant on precision cold-reducing equipment of the most modern type. Winding of cores, processing of butt joints, etc. are carefully controlled, assuring the lowest possible core losses, and freedom from short-circuiting of the laminations.

We can offer prompt delivery in production quantities—*and size is no object, from a fraction of an ounce to C-Cores of 200 pounds or more.* Rigid standard tests—and special electrical tests where required—give you assurance of the highest quality in all gauges. ● *Your inquiries are invited.*

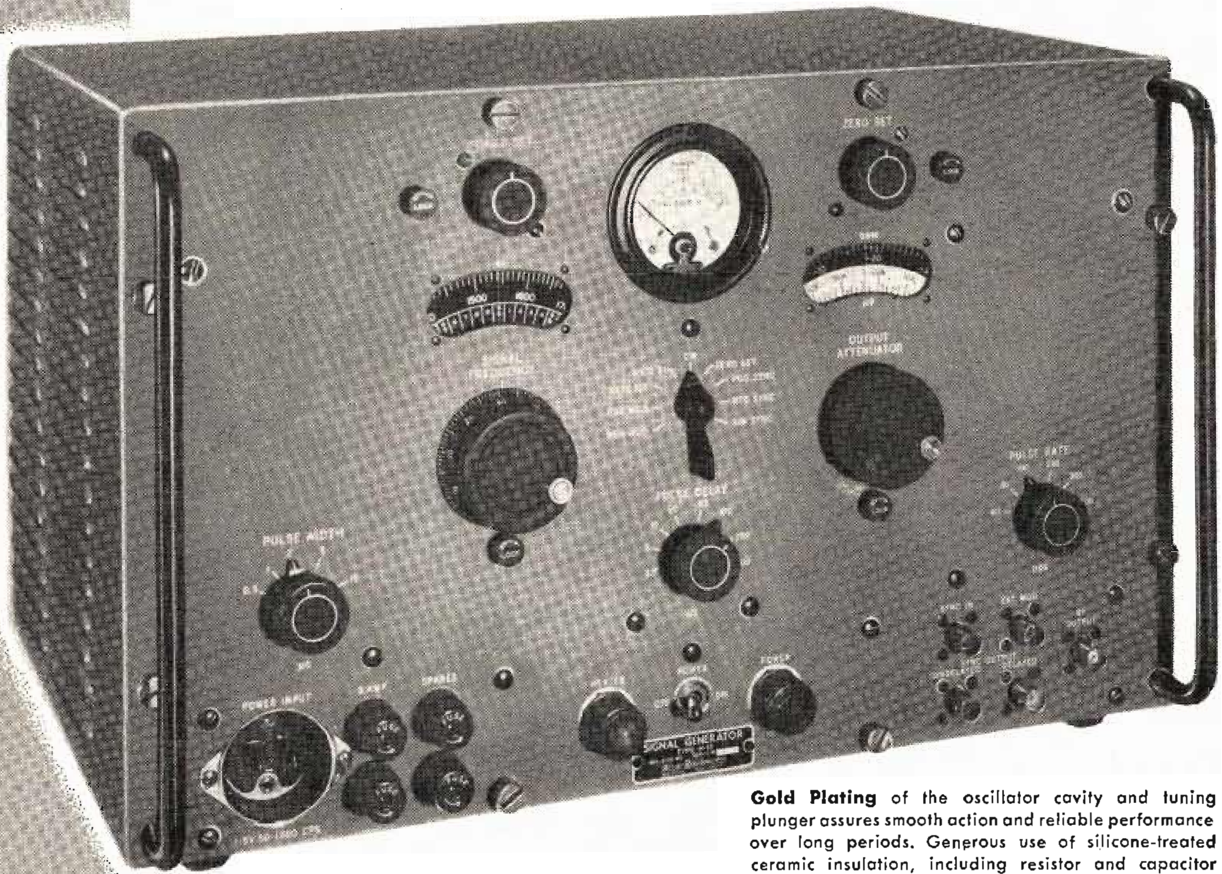
THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

General Office & Plant: Marengo, Illinois

W&D 4363

Accurate — Portable — **AVAILABLE**



Gold Plating of the oscillator cavity and tuning plunger assures smooth action and reliable performance over long periods. Generous use of silicone-treated ceramic insulation, including resistor and capacitor terminal boards, and the use of sealed capacitors, transformers, and chokes, insures operation under conditions of high humidity for long periods.

The Type H-12

UHF SIGNAL GENERATOR

900-2100 Megacycles

This compact, self-contained unit, weighing only 43 lbs., provides an accurate source of CW or pulse amplitude-modulated RF. A well-established design, the Type 12 has been in production since 1948. The power level is 0 to −120 dbm, continuously adjustable by a directly calibrated control accurate to ±2 dbm. The frequency range is controlled by a single dial directly calibrated to ±1%. Pulse modulation is provided by a self-contained pulse generator with controls for width, delay, and rate; or by synchronization with an external sine wave or pulse generator; or by direct amplification of externally supplied pulses.

Built to Navy specifications for research and production testing, the Type H-12 Signal Generator is equal to military TS-419/U. It is in production and available for delivery.

Price: $1,950 net, f.o.b. Boonton, N. J.

Type H-14 Signal Generator

(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/150 cps localizer, left-center-right on phase localizer, Omni course sensitivity, operation of TO-FROM meter, operation of flag alarms.

Price: $942.00 net, f.o.b. Boonton, N. J.

ARC

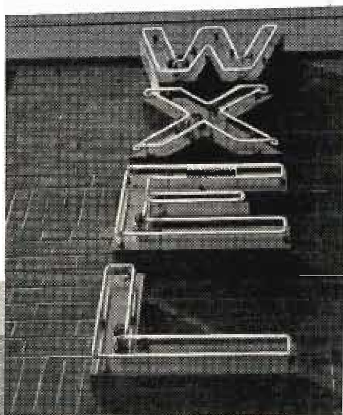
Aircraft Radio
CORPORATION — BOONTON, N. J.

WRITE TODAY for descriptive literature on A.R.C. Signal Generators or airborne LF and VHF communication and navigation equipments, CAA Type Certificated for transport or private use.

Dependable Electronic Equipment Since 1928

"G-E TUBES HELP US GIVE CLEVELAND DEPENDABLE TV!"

Says **THOMAS B. FRIEDMAN**
Chief Engineer, WXEL—Cleveland



"OUR AUDIENCE is loyal, because—for one thing—WXEL programs rarely are interrupted by transmission failures. Part of the reason is G-E tube dependability. Rectifiers, power tubes, receiving types: all these G-E tubes keep doing their rated job once we install them—don't fail unexpectedly, 'blacking out' our signal without warning.

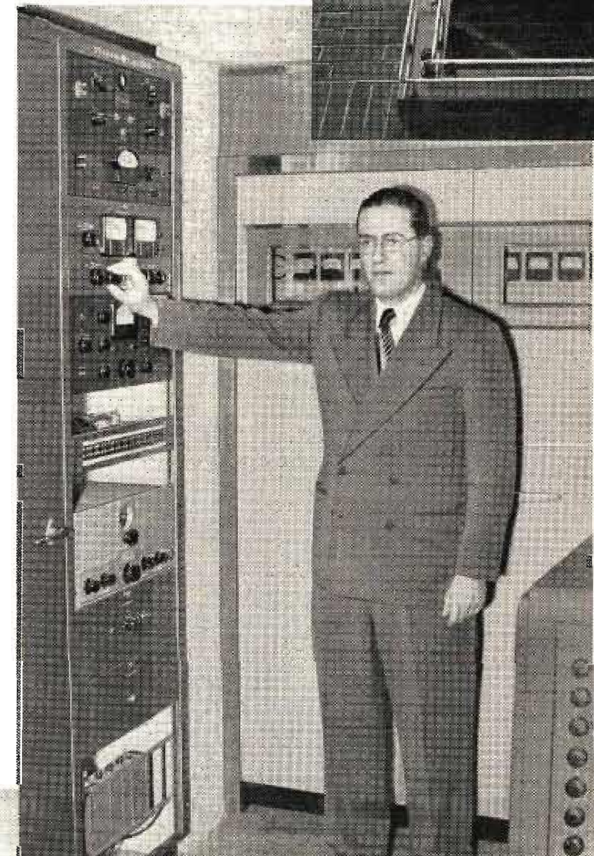
"I'd like to say something about service, too. When we need a tube, G-E distribution goes all-out to get it to us fast. Their service day is 24 hours long. If a critical power tube arrives in the city by plane at 11 P.M., G.E. gets it to us from the airport before midnight!"

★ ★ ★

Thanks for your praise of G-E tube dependability and service, Mr. Friedman. General Electric is glad to have contributed to WXEL's success.

Station engineers everywhere can rely on (1) reliable G-E tube performance, (2) fast deliveries, (3) help from local G-E distribution in obtaining—by sound conservation measures—long life and high value from tubes in service. Benefit from these plusses. Get in touch with *your* nearby G-E tube distributor today.

AVAILABLE TO STATION ENGINEERS—"Essential Characteristics," a pocket guide to all receiving tubes in common use. Ask your G-E tube distributor for this convenient, useful reference book! Or write to *Section B, Tube Dept., General Electric Company, Schenectady 5, N. Y.*



TELECASTS ALL INDIAN HOME GAMES

● To thousands of Cleveland baseball fans, WXEL takes first place in video as a result of putting Indian home games on the air. Good mobile facilities also enable the station to cover all other local events of importance. Cleveland viewers have come to rely on WXEL for their spot pictorial news, and high-quality unbroken transmission—to which G-E tubes contribute—plays a key part in maintaining station popularity.

You can put your confidence in—

GENERAL ELECTRIC

161-1C2

LETTERS . . .

BBC for TransAtlantic TV

Editors TELE-TECH:

I have read with interest your proposal that the possibilities of trans-Atlantic television should be further considered.

The BBC looks forward to the day when a television link across the Atlantic will be a reality because this will make possible an interchange of programmes between the BBC on the one hand and the American networks and Canada on the other. The technical difficulties are very great, and the cost of an acceptable scheme is bound to be high. Nevertheless these problems are certain to be solved.

H. BISHOP
Director of Techical Services, BBC.
Broadcasting House,
London W1.

TV Audience Limitation on VHF and UHF

Editors TELE-TECH:

I have read with much interest your editorial "Let's Take a Careful Look at Subscription-TV." Assuming for the moment that a subscription-TV service would be successful from an economic standpoint, the question is whether or not as a matter of public policy the Federal Communications Commission can be prevailed upon to provide for this type of service in its Rules and Regulations. While this is a policy question, nevertheless important factors affecting the answer are very likely to be those based upon engineering and allocation considerations. Therefore, the comments of an engineer may have some value.

There are only 12 VHF television channels. The Commission's Rules and Standards with respect to station separations applicable to these 12 channels are such that the number of available services in most areas is severely limited. Forty-one large cities and adjacent areas have only one VHF television assignment; 8 cities have only two, and 9 cities have only three. There are quite a few cities of substantial size which have no VHF television assignments.

The policy with respect to sound broadcasting has always been that broadcast programs must be available to any listener at no cost except that involved in the purchase of a radio receiving set. The same policy exists with respect to television broadcasting. The inauguration of a subscription television service on any one of the VHF channels would limit the availability of programs to those willing to pay a subscription charge. In vew of the inherent severe limitation with respect to the availability of television service which already exists, it is difficult to see how the agency charged with regulation of broadcasting in the public interest could be prevailed upon to permit a type of

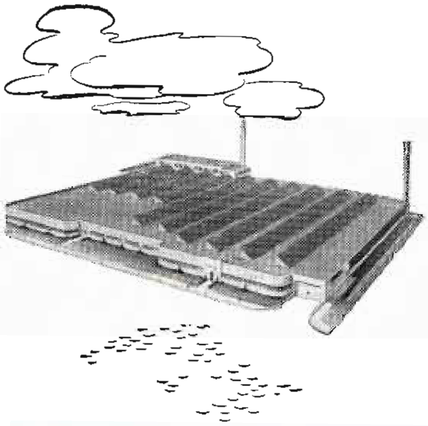
(*Continued on page* 30)

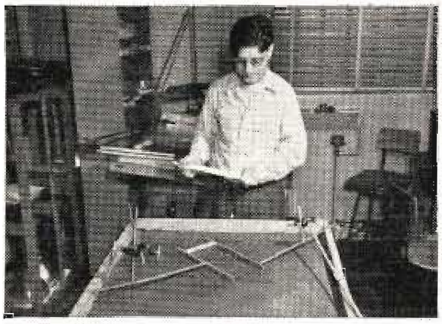
What Rauland means by "Perfection Through Research"

Rauland is one of the few companies devoting so much top engineering talent full time to picture tube improvement and perfection.

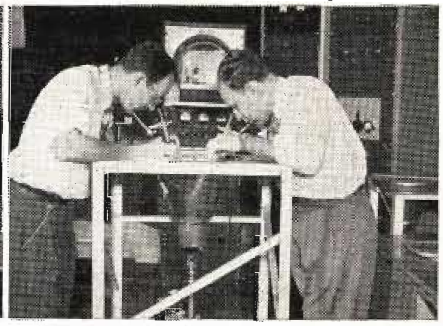
The result has been to give you more picture tube advancements since the war than any other manufacturer . . . first chance at the latest developments for companies using Rauland tubes as original equipment . . . and a real selling edge at the retail level because of the extra satisfaction which Rauland advantages offer.

That's why so many alert manufacturers look to Rauland for the best in picture tubes.

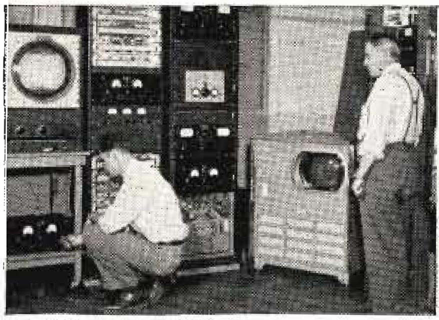




Rubber model for studying electron optical designing—basis for Rauland's exclusive Indicator Ion Trap.

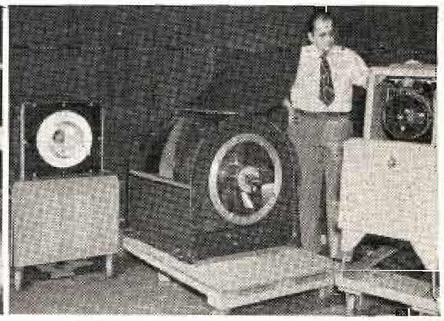


Alignment of the screen and parallax mask of tri-color tube containing approximately a million fluorescent dots.

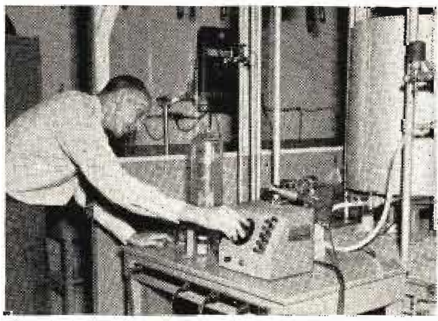


All-electronic tri-color tube in electronic receiver system (left) in comparison with mechanical system (right).

Inspection and checking of perforations .0075" in diameter in masks of tri-color picture tubes.



Rauland large-screen projectors using three different optical systems, all of which give theater-size pictures.



Careful study of the formation of thin metallic films in a vacuum . . . basis for the aluminizing of tubes.

Examination with polarimeter permits careful control of strains for superior glass-to-metal sealing.

A physicist using a Rauland-developed radiation meter in checking X-ray radiations from cathode ray apparatus.

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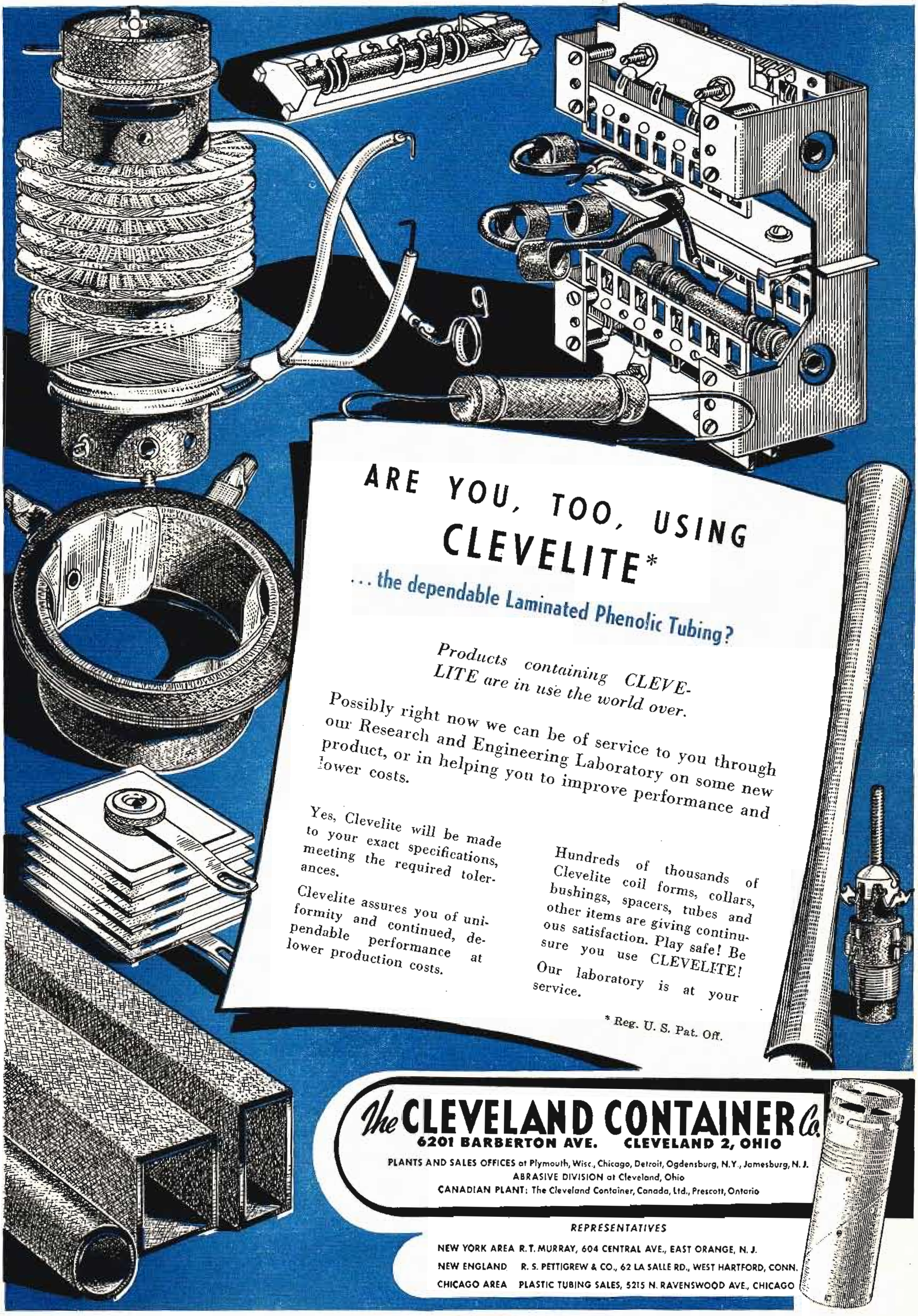
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LETTERS

(*Continued from page* 26)
operation which would still further restrict the availability of service by requiring the listener to pay for it.

The above comments with respect to the future of subscription TV appear logical to me as an engineer insofar as VHF channels are concerned. Just what future subscription TV might have on the UHF channels is something else again. There are more UHF television channels than VHF channels. Because of economic and other considerations, demand for UHF channels for general television broadcasting is not as yet nearly so great as for the VHF channels. Therefore, it might be that the same reasons for prohibiting subscription television on VHF channels would not apply to UHF channels.

C. M. JANSKY, JR. ..
Jansky & Bailey, Consulting Engineers
National Press Bldg., Washington, D.C.

Development of 450-470 MC Mobile Band

Editor, TELE-TECH:

Your article by Robert E. Tall in the August issue, page 47, on the subject "Mobile Radio Looks to UHF" fails to give any credit to the writer who has pioneered this 450-470 MC frequency spectrum for the past three years.

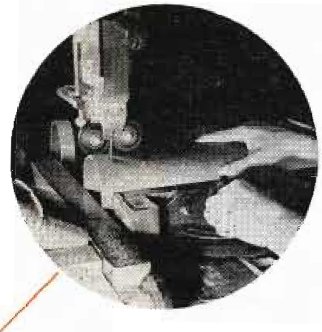
Every 2-way radiotelephone system in operation today was surveyed, sold and installed under my direction and the installations in New York, Newark, Chicago, Detroit, Baltimore and San Francisco which formed the basis for the National Utilities Radio Committee report were made by me using Link 450-470 mc equipment developed under my direction. We have over 600 mobile units in regular service for Checker Cab, Detroit—Yellow and Checker Cab, Chicago—20th Century Cab, Newark—Broadway Maintenance Corp., Long Island City, New York and Pittsburgh, Pa.—New York Daily Newspaper, New York City—Consolidated Gas & Electric Co., Baltimore, Pennsylvania Bell Telephone Co., Philadelphia, Pa.—Canadian Marconi Co.—Montreal, Canada—Paris, France Police Department—Palo Alto California Police Dept.—Welsbach Company, New York City—U.S. Signal Corps., Fort Monmouth, New Jersey—U. S. Air Force.

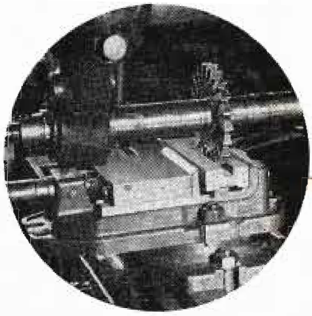
Pioneers seem to get little credit for their efforts but at least we can keep the records straight.

One Fifth Ave.
New York 3, N. Y.

NORMAN E. WUNDERLICH
Consulting Engineer

TRANS-ATLANTIC TV is predicted within a decade by Dr. W. B. Engstrom, director of RCA's Princeton laboratories. Speaking before the Centennial of Engineering at Chicago, he said that to string repeater stations across the ocean would be too expensive, but a fleet of fast cargo planes, running on close schedule, might well carry the relay transmission equipment.





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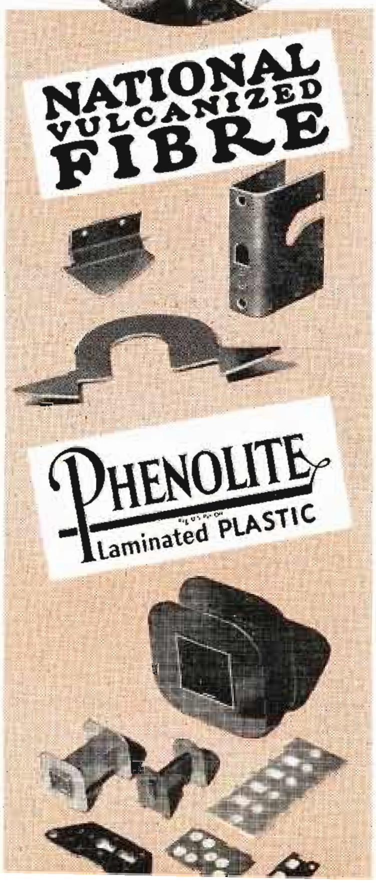

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TELE-TECH
& ELECTRONIC INDUSTRIES—RADIO-TELEVISION

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

A 19-Step Outline to Aid

Military Deferment for Key Engineers

Although more than a million men have been drafted since the outbreak of the Korean War, this is still not enough and a heavy call on Selective Service by the Pentagon will continue. Pentagon officials have disclosed that inductions must continue indefinitely at the rate of about 600,000 men per year for our "peace-time" armed forces.

Congress has extended the authority to draft men between the ages of 18½ and 26 for 2 years' active military service. Military men say that even after 1955 there is little chance that the military can cut back its demands on the American manpower pool.

This can only mean a tightening up with respect to deferments. It becomes even more important for employers requesting occupational deferments for their personnel to present the facts fully.

Engineering Manpower Commission's Recommendations

With this in mind the Engineering Manpower Commission of Engineers Joint Council, Engineering Societies Bldg., New York 18, New York, points to a 19-step outline to aid employers in preparing requests for deferments for their key engineers and scientists. This outline was prepared by the Scientific Advisory Committee of the Selective Service System, and has been circulated to local boards through Volume II, Number 7 of the bulletin of the Selective Service System. The "Outline for an Occupational Investigation," as it is called, follows:

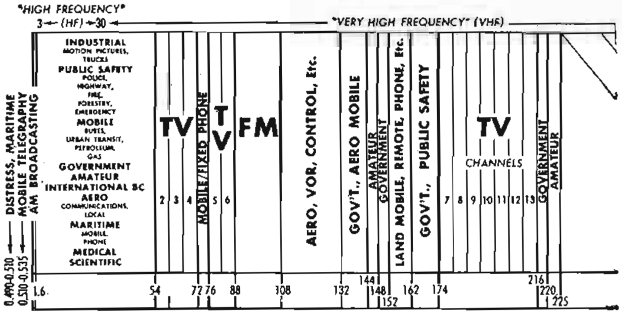
(1) What is the training and educational history of the registrant? Where did he stand in his class (if information is available?)
(2) What was his employment experience prior to job with present employer?
(3) What was the nature of his previous job assignments with present employer?
(4) What are his employment assignments on present job?
(5) What is the size, nature, and function of the group registrant is assigned to as a worker?
(6) What is the registrant's function in the group?
(7) What are the products on which the registrant is working and what is their end use? If he is not working on a product, what are the services in which he is engaged?
(8) What is the relation of these products or services to national health, safety, and interest?
(9) What is the relation of these products or services to defense or mobilization?
(10) What is the range of salaries on this job and what is the average salary of comparable employees? What is the salary of the registrant?
(11) What is the frequency with which nonprofessional personnel are hired in a similar category?
(12) Is a formal period of training customary for the job? What is its scope?
(13) How long does the training program last?
(14) If the registrant is on a training program, how long has he been on it?
(15) What is the registrant's effcetiveness in relation to his fellows?
(16) What success and/or difficulties has the employer encountered in recruiting for the registrant's type of job?
(17) What are the shortages or overages in this category of employment in the registrant's plant? Nationally?
(18) If classified previonsly in II-A, how long has he been so classified?
(19) To what extent has the employer already lost employees to the Armed Services in the category of the registrant?

Were such information supplied originally to the local board, it would enormously simplify the process of classification, particularly with reference to II-A. In a difficult case probably nothing can take the place of the expert knowledge of a specialist as to the skill of the registrant and the importance of his functions. But there are few such cases compared with the number which would be readily decided on the basis of adequate information available to the local board.

EMC also reminds employers of the necessity for appealing adverse decisions received with respect to occupation deferments. For unless the employee is valuable enough for an appeal to be made, then it is most probable that no deferment should have been requested in the first place.

RADARSCOPE

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



REARMAMENT

NAVY COMPONENTS DEVELOPMENT—The most important current problem of the Navy Bureau of Aeronautics in its meeting of the electronics-radio requirements for naval aviation, it was authoritatively reported to TELE-TECH, is that the application of electronics has proceeded at a far greater pace than component development, to maintain some degree of overall reliability. During the current fiscal year (running from July 1, 1952 to June 30, 1953) naval aeronautics procured approximately 90 complete major items of radio and radar equipment from 75 different manufacturers by prime contract. For airborne equipment the Navy Bureau of Aeronautics is procuring during the current fiscal year $255 million of radar apparatus and $98 million of radio equipment. Major effort by the Navy, as well as the other armed services, is being made to reduce the lead time in the production and delivery of electronic-radar-radio equipment.

UHF-TV

PORTLAND, ORE., ON AIR WITH UHF-TV—Here's the transmitter of NBC's famous old Bridgeport, Conn., UHF experimental station which, in a whirlwind deal, Herbert Mayer, president of Empire Coil Co., purchased, along with its tower, and rushed to Portland, Ore., where it was quickly installed and went on the air as KPTV, first UHF station to begin regular broadcasting. Russ Olsen, KPTV's chief engineer, is at control desk; NBC engineers Bill McAllister and Vic Bary, stand by.

MILITARY AVIATION

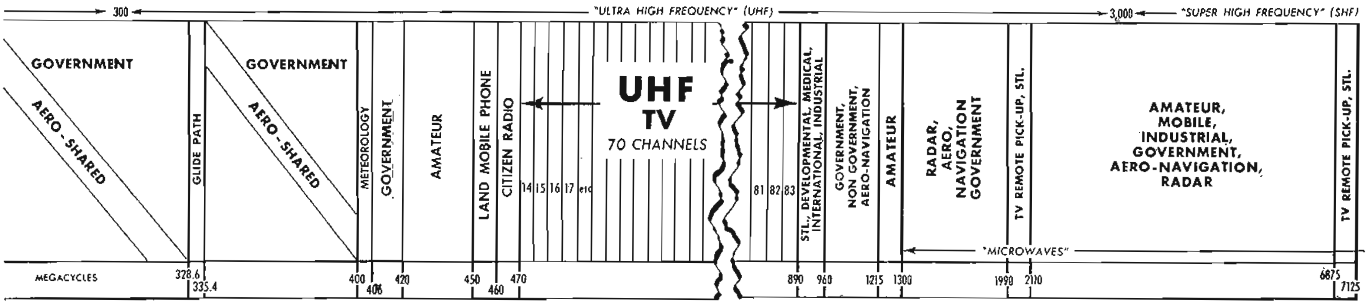
AUTOMATIC FIGHTERS. The vital role that electronic control plays in today's air operations is exemplified by the Lockheed F94 *Starfire*. It carries 1200 pounds of electronic equipment compared to the 168 pounds of radio equipment in the Lockheed P-38 which was in service only ten years ago. Night fighters of World War II had automatic fire control equipment which was designed to fire their guns when the enemy aircraft was in range, but today's *Starfire* fighter carries as much navigational equipment as a modern air liner. The radar equipment in the aircraft will locate the enemy bomber, guide the aircraft to within opening range, and discharge deadly rockets when in proper firing position—all without the pilots ever seeing their target.

AUDIO

"ROUND SOUND"—British radio listeners may soon be talking of "three-dimensional," "stereophonic," or "round" sound. "Through it, instead of getting your radio program from a hole-in-the-wall, you will have the impression that one end of the room where you listen is a concert platform where the artists are performing. If a piper is walking up and down, as he plays before the microphone, he will seem to be walking up and down in your home." The foregoing is the excited report of a British journalist after visiting the London Radio Show. Continuing he says: "The demonstration was so startlingly real that a woman in the audience publicly declared her belief that the music she had heard came from a piano hidden behind a drape. To satisfy her, the drape was lifted and she saw a tape-recording machine playing back the music through two 30-watt British-made amplifiers. In the United States, similar two-channel AM/FM demonstrations were made recently in the Middle West. And a similar stereophonic test is planned in New York by WQXR-AM-FM during the Audio Fair of '52.

MOTION PICTURES

FILMS FOR TV—The advent of magnetic striping on 16mm film opens the way to many dual-purpose uses for this motion-picture stock. Apart from its obvious use in turning old silent prints into sound prints by the simple addition of a magnetic stripe along the film, it has also doubled the usefulness of sound films which are used in bilingual markets. Prior to the introduction of magnetic striping it was necessary to make two different sets of film prints, one for English and one for the foreign language. With the advent of sound striping and half-width optical tracks it now becomes possible to have two different sound tracks on one film! In practice, the



standard optical sound track is reduced one-half, and a magnetic stripe laid over the blanked half of the optical track. The original sound track is still available for reproduction by normal photo-electric means, and the second language can be recorded on the magnetic stripe and reproduced by magnetic methods in the motion picture projector. An even more attractive use of magnetic striping and half-width optical tracks is in the preparation of prints for use in motion-picture theatres and over television. Due to the control which the musicians' union has over music for motion pictures it is, in most cases, economically unfeasible to use music in motion pictures and for television use. By use of this split track it is possible to record all dialogue on one track with musical effects on the other. When the film is used in the theatre both tracks are reproduced, and when used over television only the dialogue track need be reproduced, thus union restrictions are not violated. It is predicted that magnetic striping will widen tremendously the usage obtainable from single motion-picture prints.

TV RECEIVERS

PHONO JACKS FOR ALL SETS! A combined industry effort having the dual purpose of promoting music in the American home and increasing sales of all types of recorded music and recording and playback equipment was launched at New York in late September. During the meeting a combined industry committee under J. A. Berman, Shure Brothers Inc., who respresented RTMA, was established to carry out the promotion campaign. One phase of the program is aimed at promoting increased production and sales of combination receivers and phonographs and the inclusion of phono jacks in all television and radio sets.

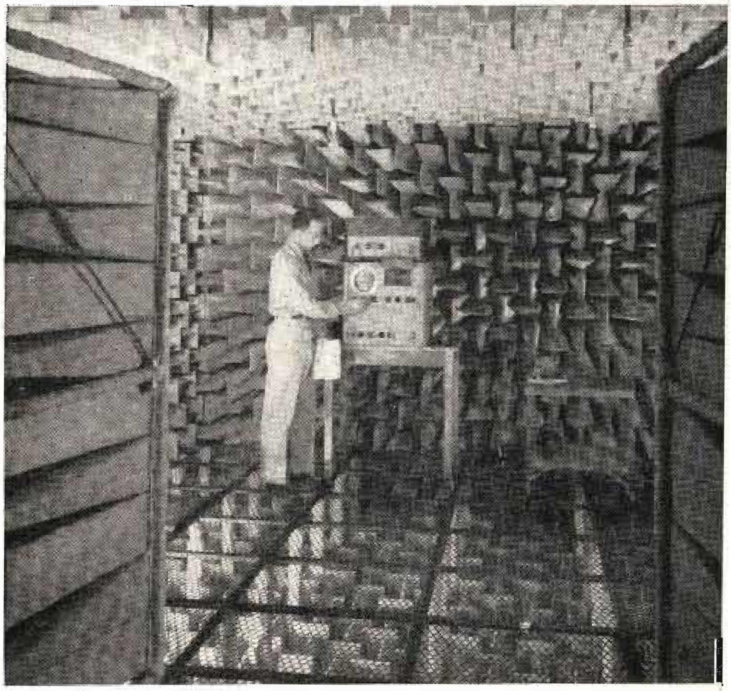
AUDIO

MAGNETIC SOUND—The tremendous upsurge in the popularity of magnetic sound on tape for the movie industry—spurred of course, by the need for low-cost television films—has created a demand for a quick method for transferring and monitoring magnetic and photo electric tracks. Col. Richard Ranger, of Rangertone, has introduced the "Ranjola" to assist the tape-to-film editor. By use of two speakers, one on each side of the editor's head, one connected to the tape pickup and the other to the film pickup, it is possible to synchronize the tape and film within 1/200th of a second. When the two sound sources are accurately synchronized, the sound appears to come from straight ahead. If one source is heard before the other it indicates a loss of synchronization between the tape and the film.

MANUFACTURING

SMALL-ORDER EVIL is one of the troubles which continue to bedevil parts manufacturers—even more exasperatingly now than in more settled and conservative times. These limited and experimental orders come from both military and domestic-receiver sources, and many run from 10 to 50 units, presenting a production nuisance to a company accustomed to tool up for runs of 100,000 or more. But with the patriotic obligation involved for military experimentation, or the need to help out a big customer, the factory staff have to accept such tiny orders along with more reasonable runs—although the costs in time and factory-upset make such small orders expensive and loss-productive. And though such small orders are usually accepted without protest, this does not mean that there is not inside growling and grousing all along the line.

ACOUSTICS



AIR FORCE'S NEW TEST CHAMBER AT DAYTON—The anechoic chamber (Greek, "without echo"), new $35,000 facility of Wright Air Development Center, Dayton, Ohio. Physically-handicapped persons made the 4280 43-inch sound-absorbing wedges (composed of formaldehyde-treated fiber-glass) which line ceiling, floor and walls. The chamber's walls, 5¼ ft. thick, contain cork, acoustic tile, dead air space, glass wool blanket and fiber-glass, and have cement exteriors. Dimensions of chamber 26 by 27 ft. Height 18 ft. A removable grid serves as flooring. During tests, all personnel, flooring and equipment, except equipment being tested, are removed from the chamber.

UHF & VHF RECEIVERS (Continued)

less VHF channels by the same selector switching as we have on the majority of VHF receivers.

Continuous tuning has many advocates since it is possible to choose any of the 70 possible channels between 470 and 890 MC, despite the fact that there are no locations planned where even 50% of these channels will be within a useful radius. (Example: the whole state of Pennsylvania with only 48 UHF proposed station allocations, whereas there are 70 channels to be tuned.) Continuous tuning from 470 to 890 MC requires a precision mechanism and dial to enable sufficiently accurate tuning for best picture and sound. It appears to me, that the most desirable would be selection by pre-set channel positions similar to the majority of present day VHF receivers. However, when the number of channels reaches 70, it is impractical to have this many fixed positions on one switch.

It is possible to construct a tuner so that some twelve (12) positions throughout the UHF band are

Global Microwave System for

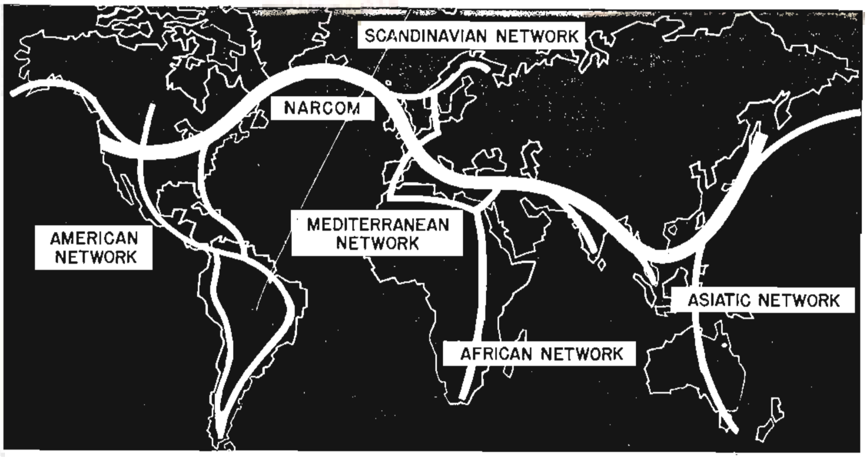
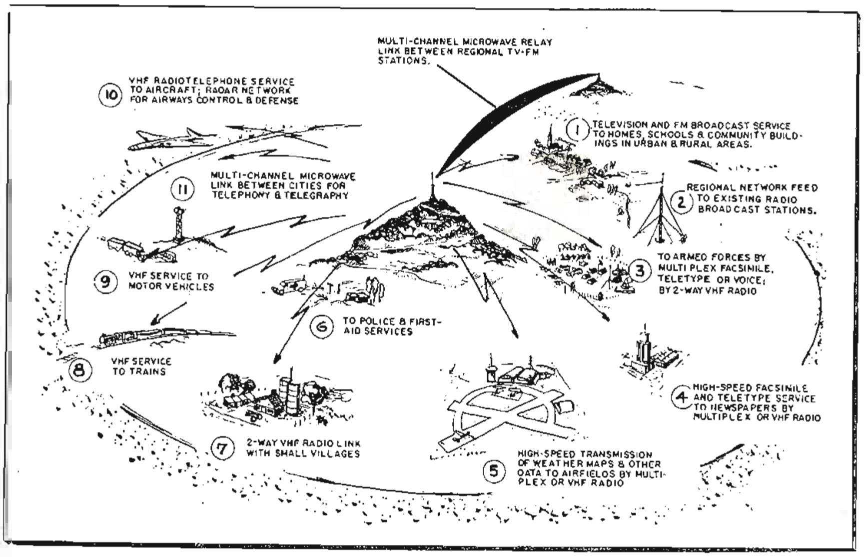
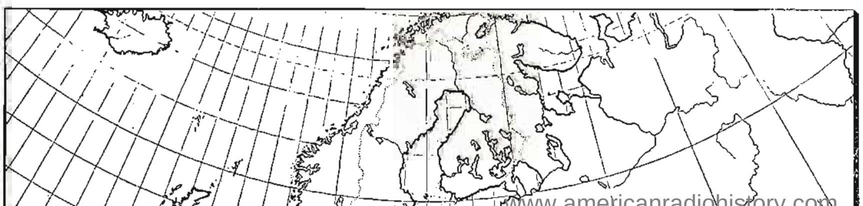


Fig. 1: Main route of UNITEL's communications system is U.S.-Greenland-Europe-Southern Asia-Japan

Fig. 2: Regional mountain-top station provides broadcast, communications, and relay services for area





Series of mountain-top stations uses latest existing techniques to circle globe. Plan favorably received by industry and government leaders here and abroad

By ALBERT J. FORMAN
Assistant Editor, TELE-TECH

A NEW and boldly imaginative system of integrated global communications is stirring the interest of engineers, educators and government leaders throughout the world. The name of the proposed system is UNITEL—Unified Telecommunications—and constitutes a novel and feasible approach to the problem of linking the peoples of the world together.

Fundamentally, UNITEL comprises a series of mountain-top multi-channel microwave and FM-type VHF radio relays linking regional broadcast and communications stations. Fig. 1 shows how the main network path will go from the U. S. to Europe via Greenland and Iceland, then through the Near East, across southern Asia, and up to Japan. The relay system is based on the little realized fact that all large land masses are linked by island chains. Exhaustive studies of maps have pointed out that the greatest single jump in this globe-girdling path, the span between Iceland and Faeroe Islands, is only 290 miles! The only uncovered distance in this plan is the string of Soviet-controlled islands north of Japan.

From the outset, it should be noted

Phase Shift Measurement System

Simple test arrangement for laboratory and production use provides accuracy within 0.5° on conventional oscilloscope

By *EUGENE S. KATZ*
Research Div., Philco Corp.
Tioga & C Streets
Philadelphia 34, Pa.

It is difficult in the course of ordinary phase shift measurements to get a high degree of accuracy when measuring small phase shift angles. Presented here is a simple system which provides accuracy within 0 5°, when made on a conventional 5-in. oscilloscope.

Reference to Fig. 1 shows that the phase angle, θ, is equal to arc sin B/A. For very small angles, B may be only a few times the thickness of the trace. We can "buy" an n increase in sensitivity of measurement at the expense of an n increase in ambiguity. As will be shown, the ambiguity may be quickly resolved.

Instead of applying equal frequency sine waves as in Fig. 1, we place on one set of deflection plates a frequency n times that applied on the other to obtain patterns similar to those of Fig. 2. In Fig. 2, for example, $n = 4$. The distance between adjacent crossover points is equal to 360/2n degrees. So for $n = 4$, AB is 45°

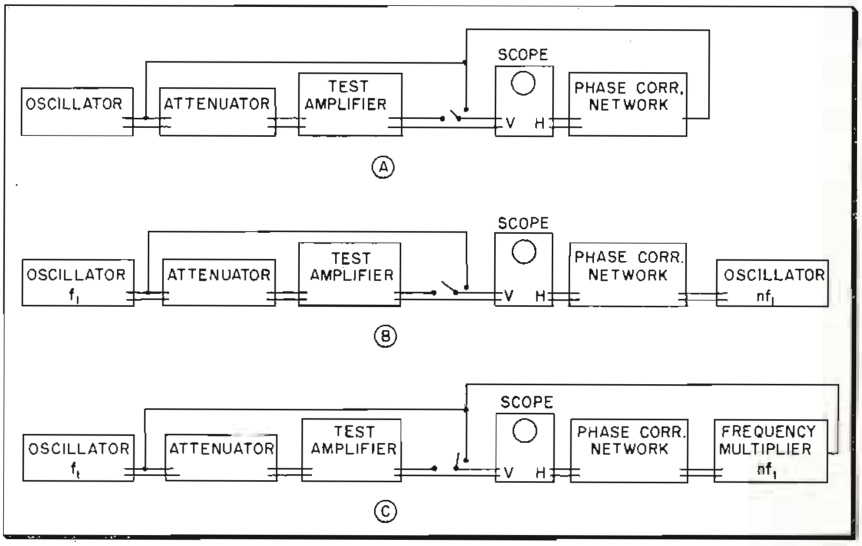


Fig. 3: Test set-ups for phase shift measurements: (A) Basic system using same frequency on vertical and horizontal plates; (B) For small angles, separate laboratory oscillator applies higher frequency to horizontal; (C) Frequency multiplier is useful for amplifier production testing

The test set-ups are shown in Fig. 3. It is convenient to use a phase correction network in the horizontal circuit. This compensates for the difference in phase shifts through the horizontal and vertical oscilloscope amplifiers. After adjusting for zero phase shift, the trace may be expanded to a size such that the adjacent crossover points, a and b, are near the opposite edges of the

(Continued on page 124)

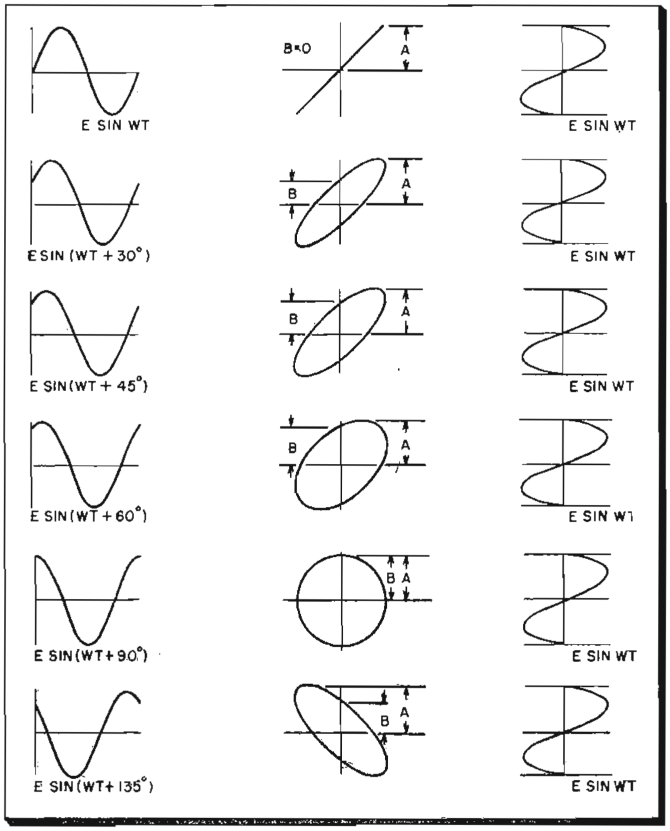
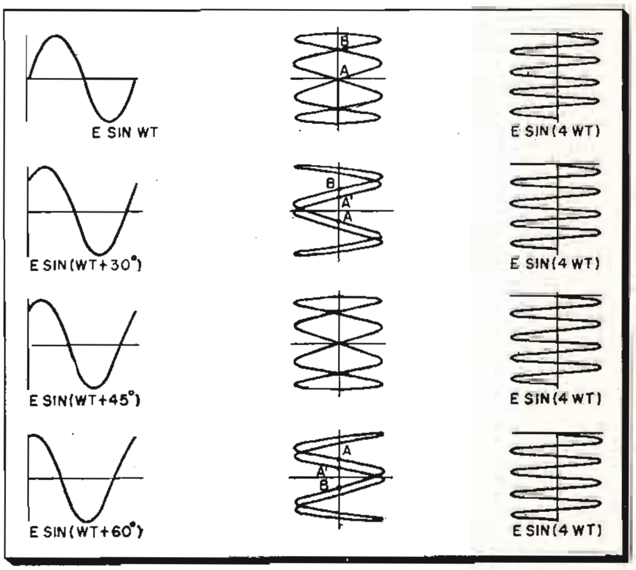
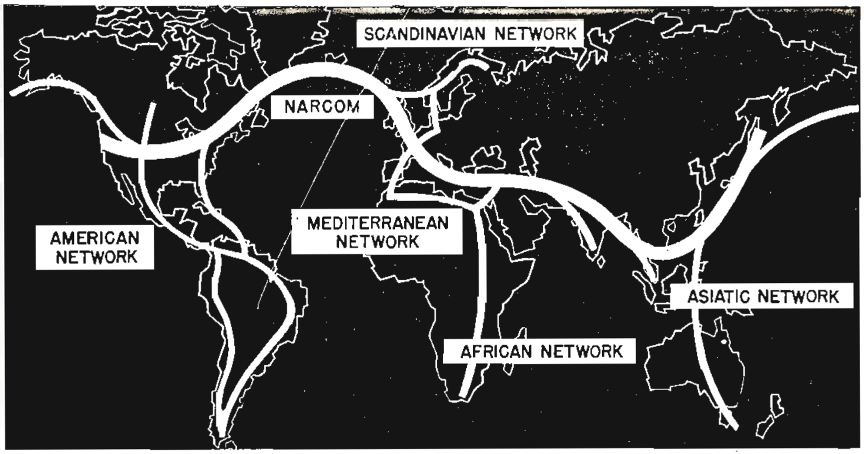


Fig. 1: (left) Phase relations of horizontal and vertical inputs produce scope patterns shown in center column. (W shown is Greek ω)

Fig. 2: With frequency applied to one set of deflection plates n times that on other set, an n increase in phase shift readability results



Global Microwave System for



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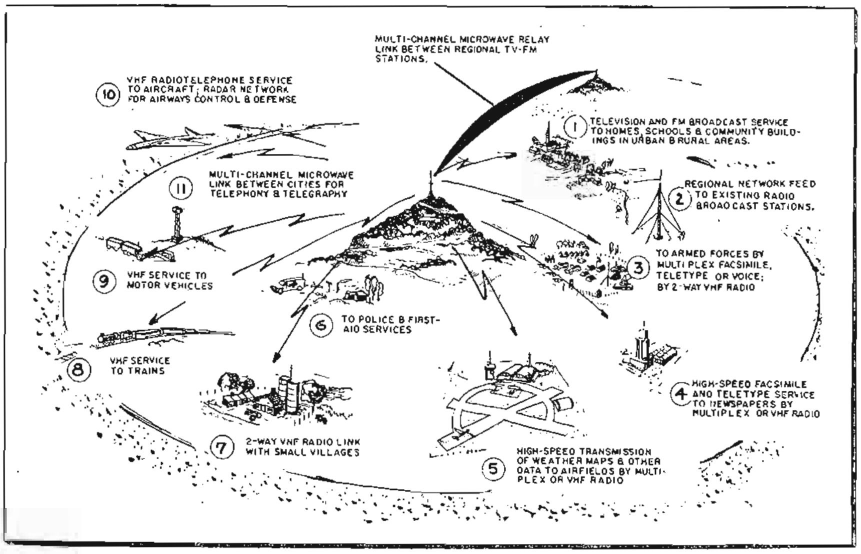

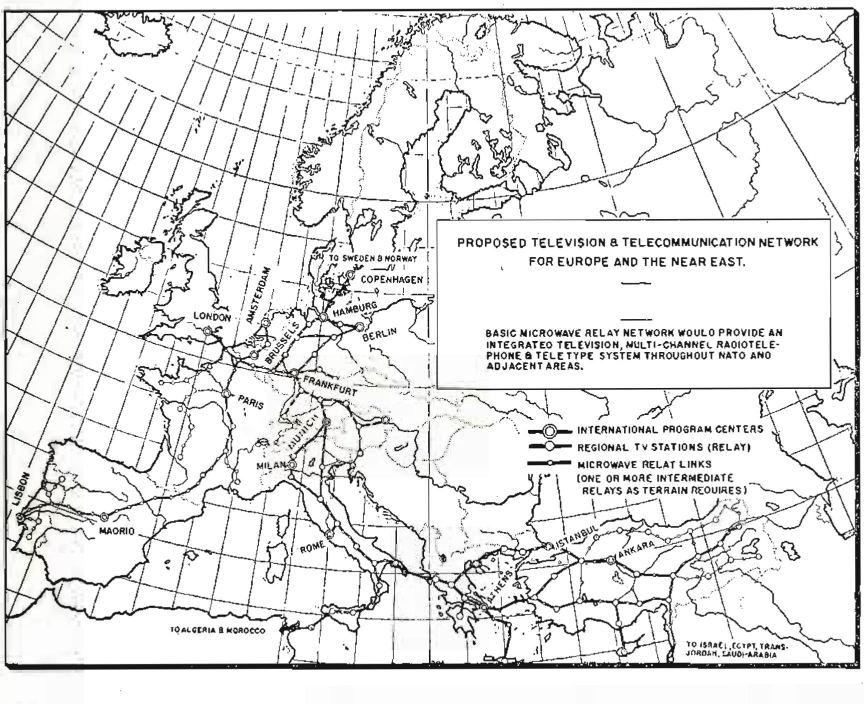

Series of mountain-top stations uses latest existing techniques to circle globe. Plan favorably received by industry and government leaders here and abroad

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From the outset, it should be noted that the detailed engineering design incorporates the latest *existing* techniques, makes use of installations already constructed wherever possible, and recognizes the extreme need for maximum utilization of the frequency spectrum. Also, while the TV channel in this network has entertainment value, its primary object is informing, unifying and educating people internationally using community receivers if necessary.

Credit for the conception and for-

Fig. 3: Map shows how principal European cities would be linked by mountain-top microwave relay stations, then integrated with global net

TV and Communications

mulation of UNITEL belongs to four men: William S. Halstead and Murray G. Crosby, system planners; Dr. Walter Duschinsky, station designer; and Henry F. Holthusen, attorney and diplomat.

Basic building block of the projected plan is the regional mountain-top station shown in Fig. 2. Its functions include TV, AM network feed FM broadcasting, radar, communications and air navigation. Of notable interest is the inclusion of a new method of low level frequency division multiplex which gives standard FM transmitters two additional program channels for one facsimile or 15 teletype units, without interfering with the regular broadcast.

The regional station will be linked with similar installations either directly or by relay stations. High altitude and air turbulence increase propagation distance, allowing microwave relay separations of over 50 miles. For longer jumps, say 125 to 150 miles, high power VHF can be the connecting medium. For 200-mile spans over water, coaxial cable, super-power VHF or intermediate weather-ship relay can do the job.

Construction and servicing may be accomplished by helicopter techniques presently being used in Korea. A station can be set up in this way in about 60 days. Besides saving the time and money that would be required for road construction if airlift were not used, a central engineering maintenance crew could be flown to trouble spots, thereby minimizing the number of technicians needed. Most of the relay stations would be unattended and all would have duplicate equipment in case of failure.

Progress to Date

Over a period of three years, an intensive examination of geographical problems throughout the world was made, followed by survey trips. The Japanese Network was designed with the idea of connecting with a world-wide system. Using the mountain top and relay system approach, construction has started on the Tokyo station (see Feb. 1952 TELE-TECH, p. 57) and in five years, 22 stations will entirely cover Japan's islands.

Fig. 3 illustrates a telecommunications network for Europe and Near East. In some cases, existing broadcast installations are utilized, being tied together to permit unified network operation which is so badly lacking. Inadequate communications systems are the reason UNITEL planners have been invited to Turkey, Japan, Egypt and Pan-American nations. Overcoming these limitations on a national basis is the immediate application of the plan. Ultimately, interconnection of these national systems will provide the global coverage.

Receiving strong interest is the North Atlantic Relay Communications System (NARCOM), which employs microwave and VHF stations from New York through Canada, across Greenland and Iceland, and on to Scotland via the Faeroe and Shetland Islands. See Figs. 4 and 5. In addition to carrying a TV chan-

(*Continued on page* 118)

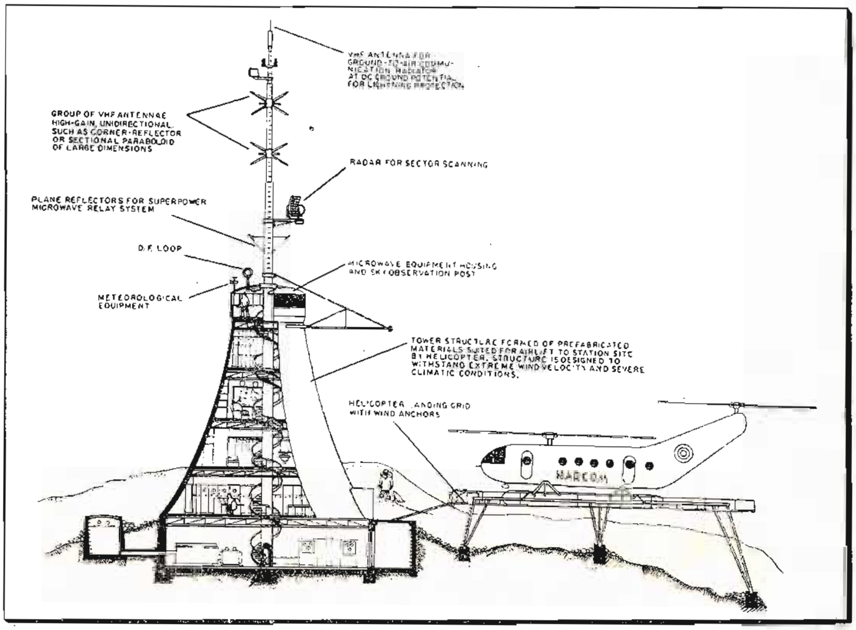
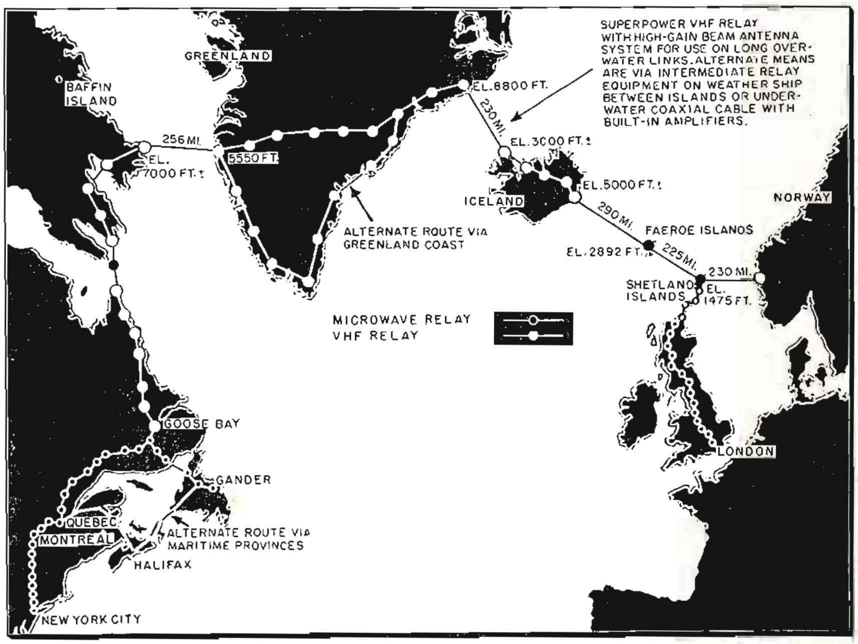


Fig. 4: Representative station in NARCOM system has equipment for microwave relay, VHF communications, weather telemetering, and radar scanning. Radar for air-warning service should prove effective since Path coincides with shortest eastern bombing route from the Soviet Union. Present helicopter techniques would be used for construction and maintenance. Other stations would remain unattended

Fig. 5: NARCOM route requires some 70 microwave and VHF relay stations to span Atlantic Ocean. Longest jump of 290 mi. from Iceland to Faeroe Isls. would be made by coax, ships, or super-power VHF



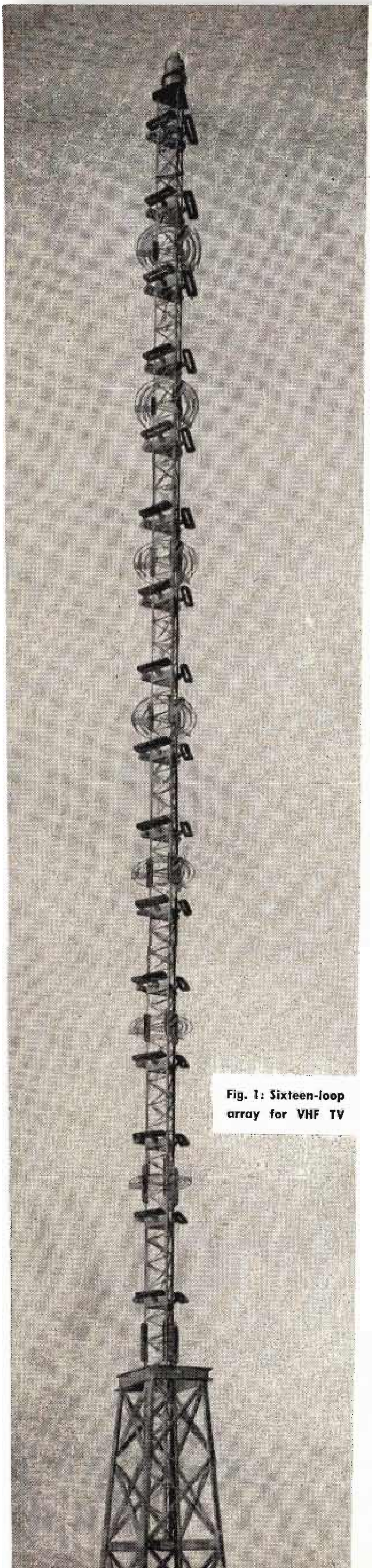


Fig. 1: Sixteen-loop array for VHF TV

High-Gain Loop

Sixteen-loop array for high-band VHF produces 316 kw ERP. Radiation pattern is omnidirectional within 0.5 db. Loop phasing improves close-in coverage

By A. G. KANDOIAN R. A. FELSENHELD W. SICHAK
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THE trend in TV broadcasting is towards higher effective radiated powers. It is generally more economical to increase the ERP by increasing the antenna gain than by increasing the transmitter power output as long as the required antenna gain is less than about 20 (for high-band TV channels 7-13). This paper discusses the extension of the previous design[1] to allow the use of as many as 16 loops. Fig. 1 shows a 16-loop array and Fig. 2 shows details of an individual loop.

The structural design of the antenna system was worked out in cooperation with the Blaw-Knox Co. The loops are mounted on a triangular steel lattice structure to whatever height necessary to achieve the desired power gain. The loop spacing is a constant 5 ft. for channels 7-13. For the eight loop array designed originally the maximum height was 40 ft. A steel lattice 14 in. on a side was sufficient for this height structure. In order to accommodate as many as 16 loops—a total height of 80 ft.—it is necessary to go to a larger lattice 17 in. on a side. Fig. 3 shows structural data for antennas with 2, 4, 8, 12 and 16 loops. It is seen that actually four sizes of tower sections are available, types D, E, F and K. Two and four loop arrays use type D sections, 8-loop array use D and E sections, 12-loop array uses D, E and F sections, while the 16-loop array uses all four type sections. The antenna meets all the RTMA specifications.

The theory and characteristics of the loop have been previously described[1] and do not require elaboration. The impedance at the center feed point is essentially 50 ohms. Since this impedance is subject to some variation because of manufacturing tolerances, slight variations in tower section etc., we introduce at this point a variable Z_0 transformer whose design is shown in Fig. 4. It is essentially a quarter-wave transformer that uses flattened elliptical center and outer conductors whose relative axes are adjustable. This enables final adjustment for a swr of less than 1.05 on each individual loop. However, this is not an adjustment that need be used in the field.

Feed System

The feed system used previously is shown in Fig. 5. The length of line to all loops is the same. Each loop is matched to a 1⅝ in., 50 ohm air line. At each junction a quarter-wave transformer is used to match to 50 ohms. Thus all interconnecting lines are matched and their lengths are determined by mechanical considerations. Electrically, this design is straightforward, and can be applied to feed a very large number of radiators. Mechanically the design becomes difficult if more than eight loops are fed because there is not enough room within the steel lattice structure for all the rigid lines and right angle bends. All the lines being rigid also represents a difficult me-

Antenna for Television Broadcasting

chanical alignment problem during the assembly of the loops on the steel structure. These difficulties may be eliminated if solid dielectric cables are used to feed the individual loops. Such a design is shown schematically in Fig. 6. From a common transformer assembly, equal lengths of RG-17/U cables go to each loop.

If all of the cables of a 16-loop array were tied in parallel at the junction point the resulting impedance would be 50⁄16 or approximately 3 ohms which is too low to transform conveniently back to 50 ohms over the complete video spectrum. The matching problem would be greatly simplified if it were possible to connect the cables in series-parrallel combinations as is often done in lumped circuit work. Fig. 7a shows one of the ways sixteen 50 ohm loads can be connected together such that the input impedance is 50 ohms. This circuit cannot be obtained in a simple system using transmission lines, but 16 transmission lines can be connected together so that the input impedance is 50⁄4 ohms instead of 50⁄16 ohms as shown schematically in Fig. 7b.

This is done by using a balun, which is normally used to connect a coaxial line to a balanced antenna. In a simple balun, Fig. 8a, the two 50 ohm output lines are in series so that the input impedance is 100 ohms. If two more lines are connected to the output, Fig. 8b, the input impedance becomes 50 ohms. If N 50 ohm lines are connected to the output, the input impedance becomes 200/N. The number of output lines must be a multiple of 2. Fig. 8c is a sketch of the balun transformer. The shield is a half wavelength long, shorted at both ends, so that it presents a high impedance at the center. The inner conductors of the output lines are connected to the two sides of the gap in the input line. The lines connected to one side of the gap are all in phase, but are 180° out of phase (at all frequencies) with the lines connected to the other side of the gap. The loops connected to one side of the balun are reversed so that all loops radiate in phase. Two quarter-wave transformers are used to match to 50 ohms. Only these transformers are changed to accommodate any even number of output lines from 4 to 16 at any channel between channels 7 and 13; all other parts of the balun remain the same.

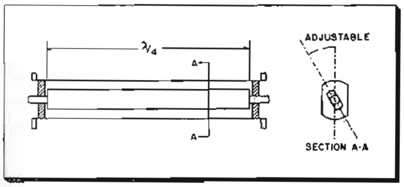


Fig. 4: Variable Z_0 quarter-wave transformer

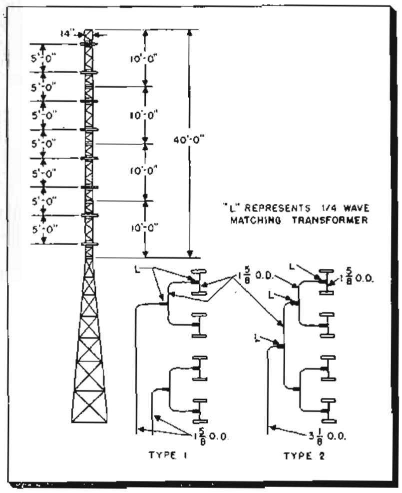


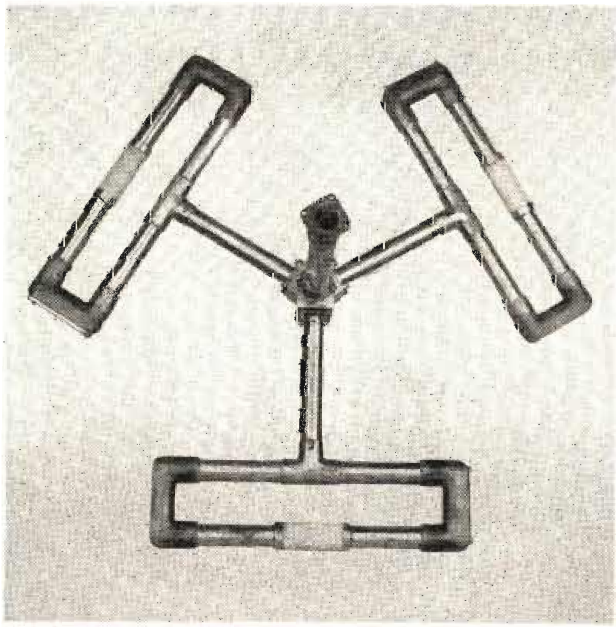
Fig. 5: Feedline arrangement used previously

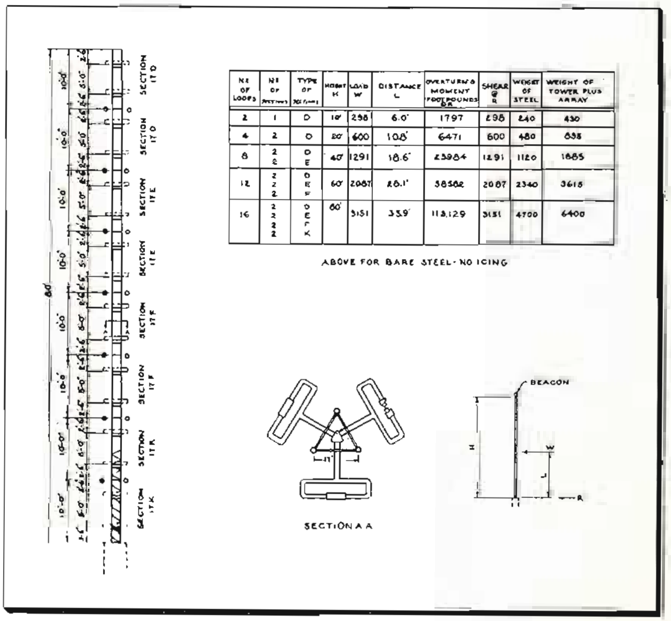
Coupling Between Loops

A problem, not fully foreseen in the original design of the stacked loop array for TV application is the effect of the very slight coupling between successive pairs of loops on the input impedance of each loop (the swr looking in each loop). Even though this coupling is low it puts a small but noticeable variation in impedance over the video bandwidth.

It turns out that it is not possible to compensate for this effect electrically in a simple manner because of the long path length between successive pairs of loops. A practical way out however is to place simple untuned isolation rings between pairs of loops. Fig. 10 shows some of the details of the isolating ring and balun located at the center of the antenna array.

Fig. 2: (l) Detail of an individual loop. Fig. 3: (r) Structural data for FTL Type 17 high-band tower shows number of sections for various arrays





No. of Loops	No. of Sections	Type of Sections	Height H	Load W	Distance L	Overturning Moment Foot-Pounds @ R	Shear @ R	Weight of Steel	Weight of Tower Plus Array
2	1	D	10'	298	6.0'	1797	298	240	430
4	2	D	20'	600	10.8'	6471	600	480	838
8	2 2	D E	40'	1291	18.6'	23984	1291	1120	1685
12	2 2 2	D E F	60'	2087	28.1'	58562	2087	2340	3618
16	2 2 2 2	D E F K	80'	3151	35.9'	113,129	3151	4700	6400

ABOVE FOR BARE STEEL - NO ICING

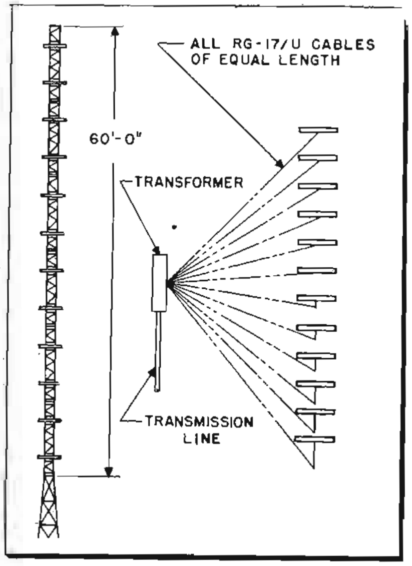


Fig. 6: Common transformer feedline system

A schematic of the diplexer is shown in Fig. 9. The two cavities are tuned to the sound carrier frequency. Cavity #1 acts as a band pass filter for the sound transmission line while cavity #2 acts as band reject filter for the sound signals in the picture line. A small amount of the sound transmitter power (less than 0.3 db) is absorbed in each cavity. Because of their high selectivity these cavities have a negligible effect on the picture transmission from the transmitter to the antenna.

An additional quarter-wave tuned circuit is coupled at the input end of the visual line in order to load it at the sound frequency. This is required to suppress possible oscillation of the output stage of the picture transmitter at that frequency due to the highly reactive load that the diplexer would otherwise present.

The cavities are formed of 6⅛ in. coaxial transmission line. Connecting sections are of 1⅝ in. coaxial line. Lengths of the line elements are cut to quarter wavelength for the aural carrier of the band for which the diplexer is to be used. Fine adjustment of the tuning of each cavity is provided by a capacitance plate and screw with locking nut on the side of the cavity. This has been found to be more satisfactory than vernier adjustment of the length of the inner conductor.

Typical performance data, measured on a diplexer tuned to channel 7, are as follows:

SWR at picture carrier less than 1.05
SWR at sound carrier less than 1.20
Insertion loss—picture
carrier to antenna line negligible
Insertion loss—sound carrier
to antenna line less than 0.5 db
Rejection of sound carrier
into picture line more than 26 db
Rejection of picture carrier
into sound line more than 23 db

The above data were taken with matched loads. A photograph of the unit is shown in Fig. 11.

A blower is used to supply cooling air to the cavities. The cavity inner conductors are made of silver plated invar to minimize the shift in resonant frequency due to heating, but a small amount of air (40 cu. ft. per minute per cavity) is used so that the cavities, tuned with a signal generator, need not be retuned when full transmitter power is applied.

The complete antenna system consists of the diplexer, transmission line, and the antenna proper. The diplexer is installed near the transmitter and connected to the antenna through 50 ohm coaxial air line. The size of the transmission line depends on the average power level and how much loss can be tolerated. Generally 3⅛ in. or 6⅛ in. diameter line is used. Only one coaxial line is required with this antenna.

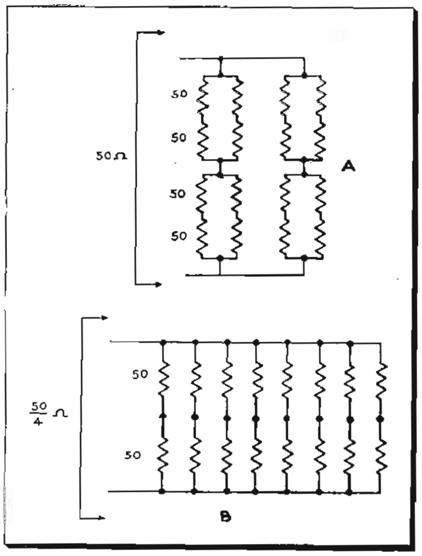


Fig. 7: Series-parallel combinations of sixteen 50-ohm loads shows (a) ideal and (b) practical

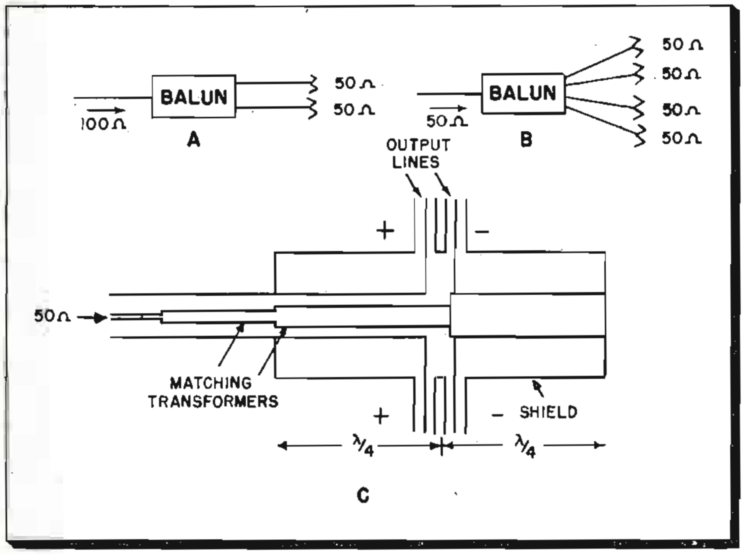
TABLE I

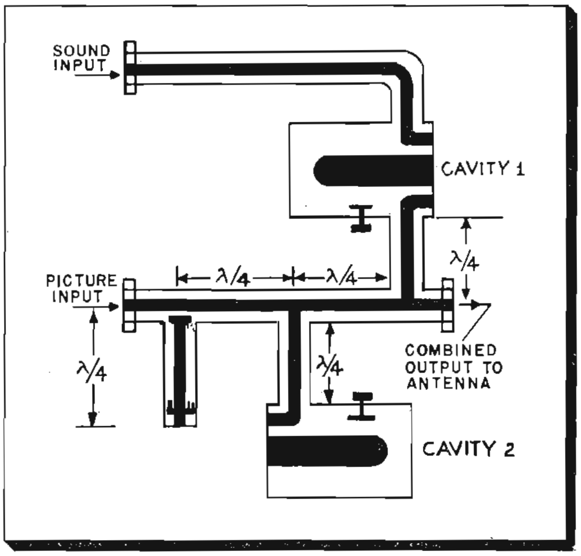
Number of Loops	Gain
2	2.0
4	4.0
8	8.4
12	13
16	17

The gain over a half-wave dipole of the FTL-23A is given in Table I for channels 7 to 13.

(*Continued on page* 126)

Fig. 8: (l) Construction and impedances of a balun transformer for connecting the coax line to the antenna. Fig. 9: (r) Two-cavity TV diplexer





Subminiaturization of Servo Amplifiers

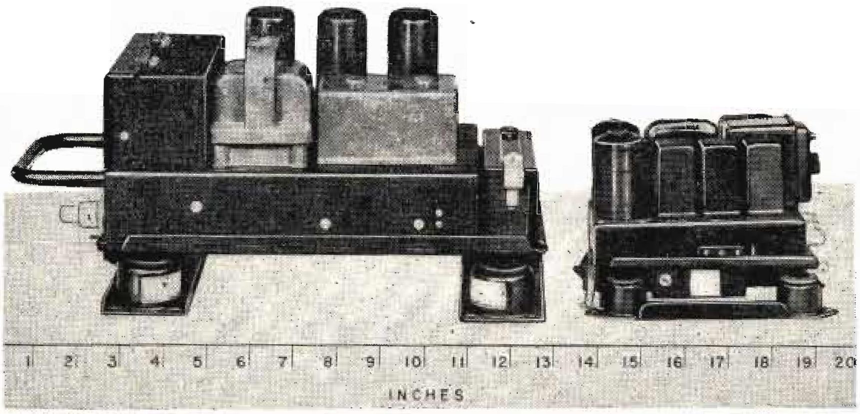


Fig. 1: Using unitized construction and resin embedment, size of power unit is reduced 70%

Unitized construction, cast resin component embedment reduce power unit volume 70%. Pressurized connectors, parts placement permit operation at high temperature and altitude

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THE approach to the design of a servo-amplifier is somewhat different from the design of a communications type amplifier. The servo-amplifier has something more to do than to amplify. It must perform physical work. Servo-amplifiers operate on comparatively low frequencies, usually 400 cycles. Depending upon whether the amplifier drives the servo motor through a relay or by impedance match between the output tube and the motor, different problems are encountered. Relay type output, required for some systems, can result in a more universal amplifier, but brings up the problem of radio noise interference and the use of usually bulky filters. Impedance matching directly between the output tube and motor largely eliminates the radio noise problem, but brings up the problem of finding a suitable miniature or subminiature tube capable of handling the power required and having an impedance that can be matched with optimum windings.

Great strides have been made in size and weight reduction of this type of equipment. These have been largely through the use of unitized construction and/or cast resin embedment. Fig. 1 shows the size reduction realized in the power unit for a capacitance type liquid measuring system. The reduction in overall volume of the unit is approximately 70%, and weight reduction is over 50%.

With the newer specifications becoming more and more challenging with regard to conditions of high altitude pressure, temperature extremes, presence of water, and vibration, hermetic sealing of certain critical parts is required.

Unitized Construction

Fig. 2 shows the unitized construction of three of the critical components of the small power unit previously mentioned. The power unit is designed to meet a specification which requires functional tests to be made over the range of temperatures from −65° F. to +160° F. For continued operational use, however, the maximum recommended ambient temperature is 125° F.

One amplifier, being designed for applications which require performance at an ambient temperature of 200° F., is a universal control amplifier. This unit is expected to pass tests combining high and low temperature with high and low altitude pressures. Because of the high ambient temperature and the desire to mount a subminiature triode, rectifier, and pentode in one envelope, the construction shown in Fig. 3 was used. This unit places the three tubes in a minimum amount of space and in metal clamps which readily conduct the heat to the case and chassis for lower bulb temperatures. The unit shown has solder type terminals; however, it may be produced with plug-in terminals for commercial use.

Hermetic Sealing

The problems of electrical spacing for high altitude conditions are presently met by both the hermetically sealed components and those which are cast in resin. The cast resin types, however, offer excellent integral support to circuit components.

Most of our control and measurement systems utilize the selfbalancing null type bridge circuit and use the ac bridge or dc bridge input. One component often used in servo-amplifiers and one which has proven difficult to miniaturize is the 400 cycle synchronous vibrator, which depends partly upon physical dimensions for resonant frequencies.

One representative circuit uses a typical dc bridge input wherein a vibrator is used to chop the output of the dc bridge to provide the proper input for an ac amplifier, in order to amplify the signal and use it on a servo motor in the output. The dc bridge circuit is used where extremely low values of input signal are encountered. Because of the extremely high responsibility placed upon the control circuits wherein the vibrators are used, the miniature synchronous vibrator is being designed for a minimum life of 1000 hours. Fig. 4 shows the internal structure of the miniature 400 cycle vibrator.

Component Locations

From the standpoint of minimizing the effect of heat-producing parts, much attention should be given to the relative placement of those parts with respect to other critical circuit components. Power transformers, tubes, and power supplies should be located as far as possible from bridge R-C networks, reference capacitors, etc. Fig. 5 shows one unit which follows this practice. Note that the tubes and transformer are on the back of the chassis, while the reference capacitors are located near the front.

Since the servo amplifier unit

SERVO AMPLIFIERS (Continued)

usually contains any necessary calibration adjustments for the servo system, potentiometers become a large influencing factor in the layout of a new unit. Current systems require, in one design, two potentiometers and, in another, 14. One design which previously required the use of two adjusting potentiometers and a range switch, has been re-designed to make use of two ten-turn helical potentiometers. In these units, the potentiometer wipers require 10 complete turns of the adjusting screw to travel from stop to stop. This increased travel range permits a higher degree of resolution for any given rotation of the adjusting screws, to facilitate easier settings. On some units, use of tandem potentiometers with concentric shafts is contemplated.

External connections to the servo amplifier unit can consist of both low and high impedance lines. For the high impedance lines a series of small pressurized connectors has been developed. These connectors are similar to, but not interchangeable with, AN type BNC r-f connectors. They feature more positive cable clamping provisions, have longer creepage distances between conductor and shell, and are liquid and pressure tight. Fig. 6 shows one application of these connectors. In this case, the mating receptacles on the amplifier have been scaled down considerably in size and weight. Compatibility with other standard size mating connectors has been retained. For some other connections to other amplifiers, standard AN type connectors are used where suitable. Special harness connectors have been used in some instances where the size and shape can become an integral part of the design.

Power Supplies

In the servo-amplifier, a certain amount of distortion and nonlinearity can usually be tolerated. This fact allows us to run the tubes at lower than normal plate voltages. As a result, we now use capacitors rated at 200 dc, where previously 450 v. and 600 v. capacitors were required. This results in appreciable size reduction in power supplies.

The use of autotransformers wherever possible results in a material saving in size and weight. Fig. 7 shows typical servo-amplifier output circuits using (a) the conventional transformer and (b) the autotransformer. In circuit (a), the servo-motor amplifier phase winding and resonating capacitor are connected in the center tap of the discriminator plate transformer winding. In circuit (b), the servo-motor amplifier phase winding and resonating capacitor are connected in the cathode circuit of the discriminator tube. This type of connection results in a gain of less than one for the discriminator stage. In order to use this type of circuit, it was necessary to design a two-stage voltage amplifier, with a gain of from 12 to 1500, and to use a coupling transformer to provide adequate grid voltages for the discriminator. With proper selection of tubes, etc., the particular system for comparable performance now requires 18 watts power as against 25 watts for the previous design and uses the smaller transformer. Careful selection of tubes as regards filament drain will, of course, also tend to reduce the size and weight of required transformers. Further reductions may be obtained by the use of higher operating temperatures.

Use of Class A insulating materials with accompanying derating of the life of the transformer would be one possible solution. Class A insulating materials consist of the currently used paper, tapes, varnish, etc. Of particular interest for larger type transformers, that is where considerable power is used, the use of Class H insulating materials is desirable. These are glass laminates, silicone tapes, Teflon, etc.

Dissipating Heat

With the allowance of higher heat dissipation, the heat must be disposed of in the best possible manner. One particularly advantageous way is the use of higher heat-conductive filling materials such as magnesium oxide, and casting resins with various fillers.

We have used selenium rectifiers primarily where current drain is low and in operating ambient tempera-

Fig. 2: Components of the miniaturized power unit of Fig. 1 shows unitized construction

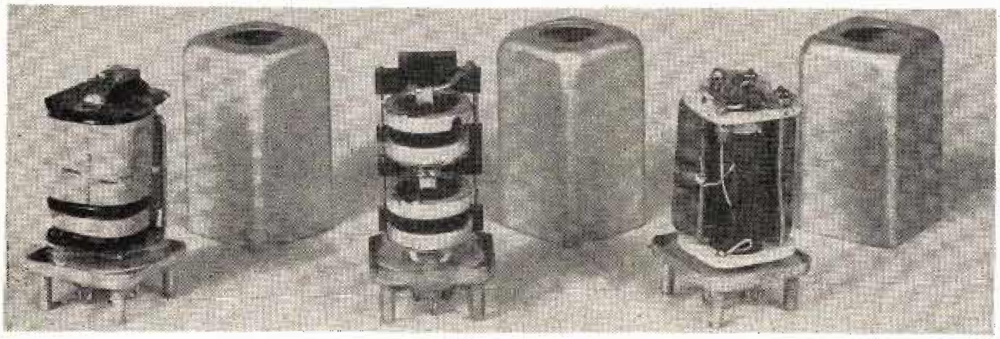


Fig. 3: Tube assembly for amplifier contains subminiature triode, rectifier and pentode

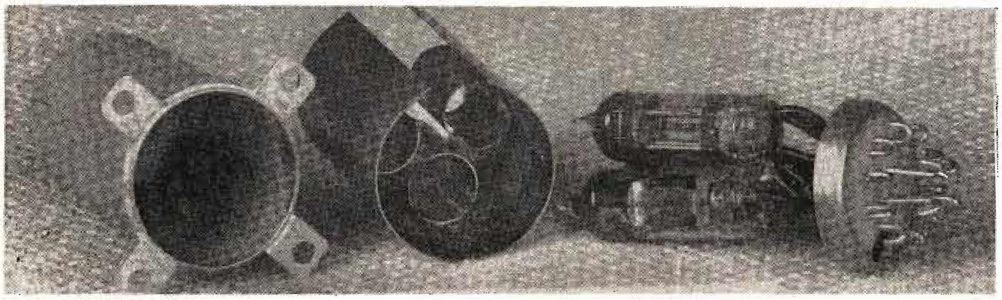
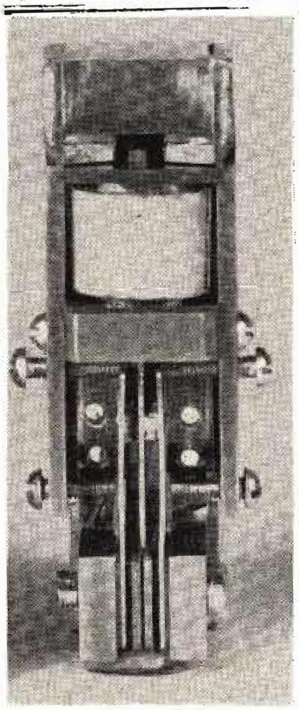


Fig. 4: Miniature 400-cycle vibrator



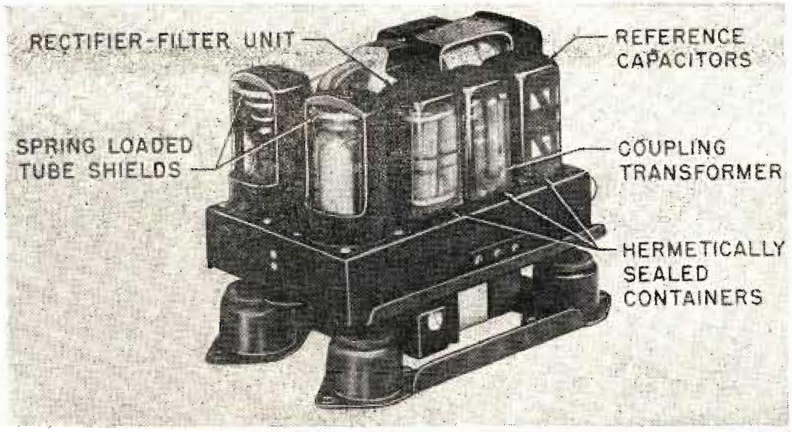


Fig. 5: Proper placement minimizes effect of heat-producing components. Note that tubes and power transformer are at left and rear, reference capacitors at right front

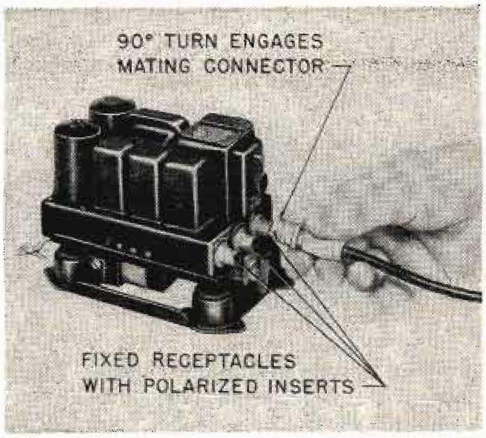


Fig. 6: External connections to servo amplifier are made with scaled-down, pressurized connectors

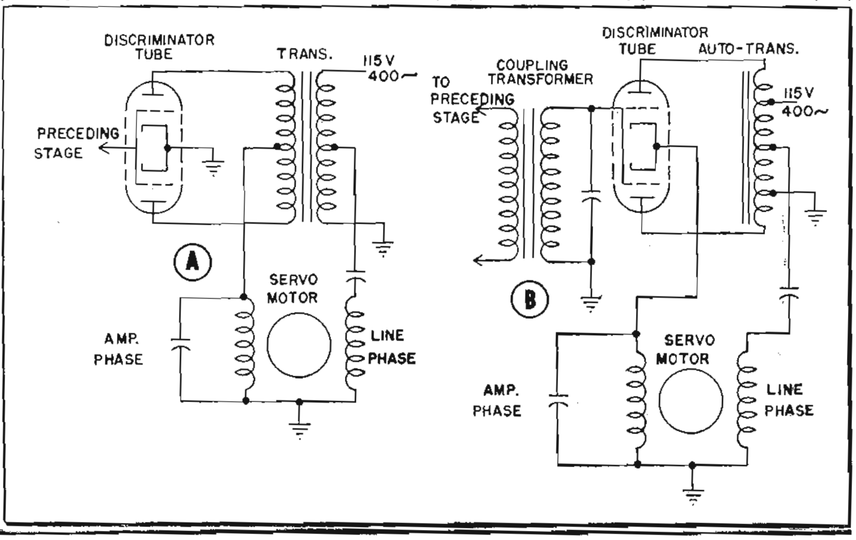
ture up to 160° F. In power supplies where heavier currents are required or higher ambient temperatures are specified, the tube type rectifiers are being used.

Vacuum Tubes

Subminiature tubes have been the major factor in providing the impetus towards miniature design and construction. We are using subminiature tubes in all new designs with the exception of output tubes, where the miniature twin triode type is still used. Recent developments have provided subminiature triodes of sufficient power output such that two subminiatures may be used to replace the miniature. With the need

(*Continued on page* 122)

Fig. 7: Typical discriminator servo output circuits using (a) conventional and (b) autotransformer coupling



An Inexpensive TV Prompter

LOW-cost spot announcements have strong appeal to small advertisers, particularly if a method can be used which is less expensive than film or slides. Since the cameras are on all day and operators are also on duty, live studio commercials appear to be the answer. Not only are they cheaper, but they have the added appeal of personal sales. The only obstacle is the announcer's difficulty in memorizing five or six different commercials in a day.

The inexpensive solution is the simple TV prompter described by Leonard W. German, engineer at WHIO-TV, Dayton, Ohio, which costs only a few dollars to build. With the aid of this prompter, shown in Fig. 1, the number of live spots in front of the WHIO-TV camera has increased tremendously in the last six to ten months, but the size of the announcing staff has not been increased.

The idea of mounting this instrument on the camera pedestal right below the lenses is to keep the announcer's eyes trained directly toward the camera. See Fig. 2. By operating the camera at the proper distance from the announcer (12 to 14 ft. for 90 and 135 mm lenses) it is difficult to detect that he is looking below the lenses rather than into it. The width was determined so his eyes would not be seen roaming back and forth.

(*Continued on page* 132)

Fig. 1: Prompter consists of base board, frame, and two rollers rotated by handles. Mounting bracket on back of center base board is box which fits into larger box fixed on pedestal

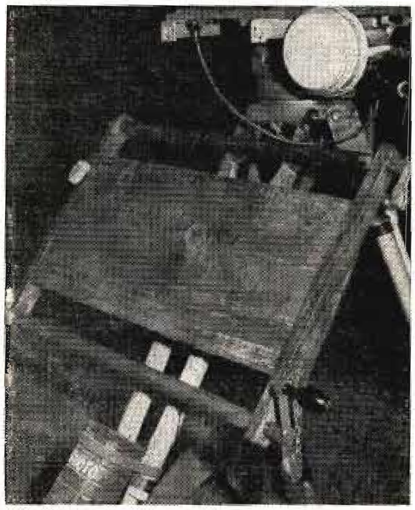
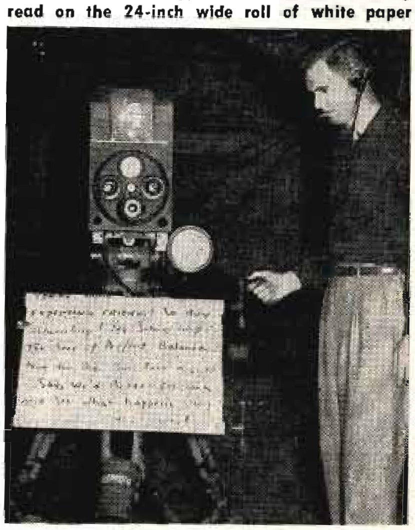


Fig. 2: In operation, prompter is mounted just below camera and moved by turning upper handle. Pointer at upper left indicates line being read on the 24-inch wide roll of white paper



Recording Binaural

Use of LP discs having two recorded bands offers a very compatible and practical binaural record system. Great new market potential indicated for record player manufacturers.

Author viewing binaural cut in process on special recording lathe

By EMORY COOK
Cook Laboratories
Stamford, Conn.

IF the advantages and potential wide sales appeal of binaural sound are to be exercised, the realm of disc-recording, where cost and compatibility factors with existing standards are favorable, offers great possibilities. Let us then review the several ways in which a synchronized double track in disc can be produced:

1. A binaural recording can be made on opposite sides of a disc, playing back both sides simultaneously. This method is not very practical however, because stampers cannot possibly be centered and aligned in the press in the necessary rotational accuracy, and a wholesale redesign of playback turntables would be necessary.

2. Interleaved grooves are another theoretically possible means of binaural disc recording. This method however is costly to record and to playback and further, a great deal of special equipment would be necessitated.

3. A single sideband carrier system has been proposed, but the limitations of this method are such that the frequency range of each "ear" is restricted to a low value that could not be considered acceptable from a fidelity standpoint.

4. To date then, it appears that by far the most compatible and practical system is that of placing two recorded bands on the same side of an LP disc as diagrammed in Fig. 5.

As with ordinary recording equipment, the cutting styli move on a radius,—from outside in. Therefore existing recording equipment is easily modified to perform the mastering function. The playback arms may be integrated into a single arm containing two cartridges side by side as shown in Fig. 1.

Compatibility

The confusion of multiple standards has already shaken up the record industry once or twice and another upheaval would probably be impossible. Therefore, both the binaural record and its playback means must be interchangeable with existing standards. Due to the halving of available elapsed time with two channels, the 12-in LP is a natural starting point. With a normal 12 minutes of binaural playing time and a possible maximum of 14-15 minutes, most musical requirements can be met. The method described here produces a record which can be played (one "ear" at a time) on existing equipment, and the binaural reproducing system will likewise play regular records by simply blocking one of the cartridges up off the record.

Accurate Radial Relation

In Fig. 5 is shown the schematic arrangement for playing back the record of Fig. 4. Within the limits of travel in arc of the arm across the narrow band of grooves a high degree of accuracy of radial relation of playback points is obtained. In the practical case the positive error is made to equal to the negative error in terms of wavelengths, —at 1000 cps for instance. The maximum error then measures to be of the order of magnitude of 0.01-in. along the groove longitudinally at the middle of the record corresponding to less than a wavelength at 1000 cps along the groove. The purist might say here that we cannot tolerate a phase error of 180° in the range of maximum directional sensitivity of the human ear, but this is not true, and it is not a matter of "toleration" anyway unless we confine our remarks to the use of earphones as a listening medium. As a matter of fact, earphones can be given no consideration at all commercially. If we think in terms of spaced loudspeakers in a room then a full wavelength error at 1000 cycles can be thought of as corresponding to a motion forward or backward of one of the loudspeakers of about one foot, or a corresponding random motion of the listener in the room (such as turning the head) while the music is playing which is easily possible, in fact probable, without getting up from the chair.

Sound on Discs

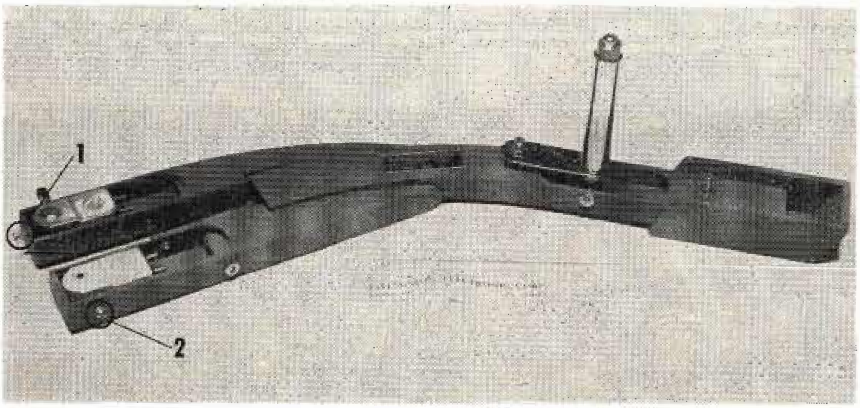


Fig. 1: Close-up of dual cartridge playback arm as manufactured by Livingston Electronic Corp., Livingston, N. Y. (1) and (2) are adjustment screws

A typical modified arm would display a dimension of 10½-in. from pivot to farthest stylus, an offset angle of 27.5° and the standard spacing of $1\frac{11}{16}$-in. The fractional spacing is chosen rather than decimals to facilitate the rough adjustment by using a standard inch rule, where the points will fall into the indentations at the specified dimension.

The radial error is not much affected by the length of the arm, and short 12 in. turntable arms are candidates for conversion.

In order to permit equal tracking pressure of each point of contact, at least one and preferably both of the cartridges must be individually pivoted for the vertical plane, although of course, if one is tempted to put up with the inconvenience, two separate arms may be operated.

Random Production Errors

No record is produced which is actually on center. The magnitude of the combined error in good commercial practice can hardly be reduced under .010-.015-in. The staggered method of interleaved grooves can not operate satisfactorily because of the centering problem alone, since there is a large angle subtended between the two points of pickup. However, the radial method is the least susceptible, in fact practically immune to centering errors such as normally encountered. But there is another and more insidious danger ɔ watch against. In establishing a $\frac{1}{16}$-in. dimension between points ɔickup we must allow a tolerance. ɔt only is it quite unthinkable to le to align recording heads and n a lathe to .001-in. tolerance for each and every master, but the metal parts, especially stampers used to mold pressings are basically 0.032-in. copper as regards mechanical strength. In the modern fast cycle press and in handling they become stretched, so that $1\frac{11}{16}$-in. may become distorted around the circle. Furthermore, non-uniform cooling of pressings just removed will produce a small eccentric shrinkage on one side of the record and not the other. All these errors are of course capable of being cumulative to the effect of at least 0.015-in., and therefore we must have a mutual "lost motion" in the $1\frac{11}{16}$-in. spacing figure of ±.015-in. or thereabouts. However, since the record is started with pickups dropped in the spiralling lead-in groove, this does not mean that we shall have trouble getting into the correct grooves; it merely means instead that there is to be a "free" lateral motion of one cartridge with respect to the other. However, the business of "loose pivots," i.e., rattles, in vertically pivoted arms is well known to produce non-linear effects at some mid-frequency. The answer to the problem is the packing of the pivot points with viscous damping, so that the compliance of the cartridge needle is two or three times higher than the viscous compliance for frequencies at and below the undamped lateral resonance.

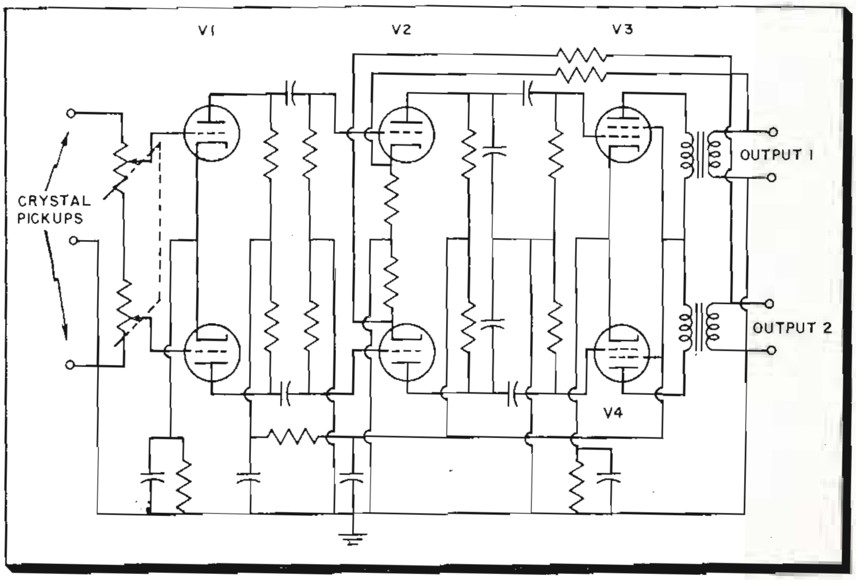
In bringing binaural into focus as a practical medium, the cost factor is particularly important. A first reaction might be that the cost would be almost doubled but this is not the case. Binaurally, power output per channel can be *less than half* that of an equivalent monaural channel for the same apparent loudness.

Using Twin Triodes

With the use of twin triodes the basic amplifier design may be doubled up (as in push-pull) without much additional cost. Since we certainly need no more than half the output power "per ear" the power supply is the same. The twin cathode, screens and plate supplies may be by-passed through common capacitors, since a moderate amount of crosstalk between channels is permissible. The only serious added cost will be that of the second output transformer, and means for reducing even that appear to be forthcoming.

In the "minimum" design of Fig. 2, there are only 16 one or half-watt resistors, 4 audio condensers and 4

Fig. 2: Minimum binaural amplifier design involves only 16 one- or half-watt resistors, 4 audio capacitors, and 4 tubes not including power supply



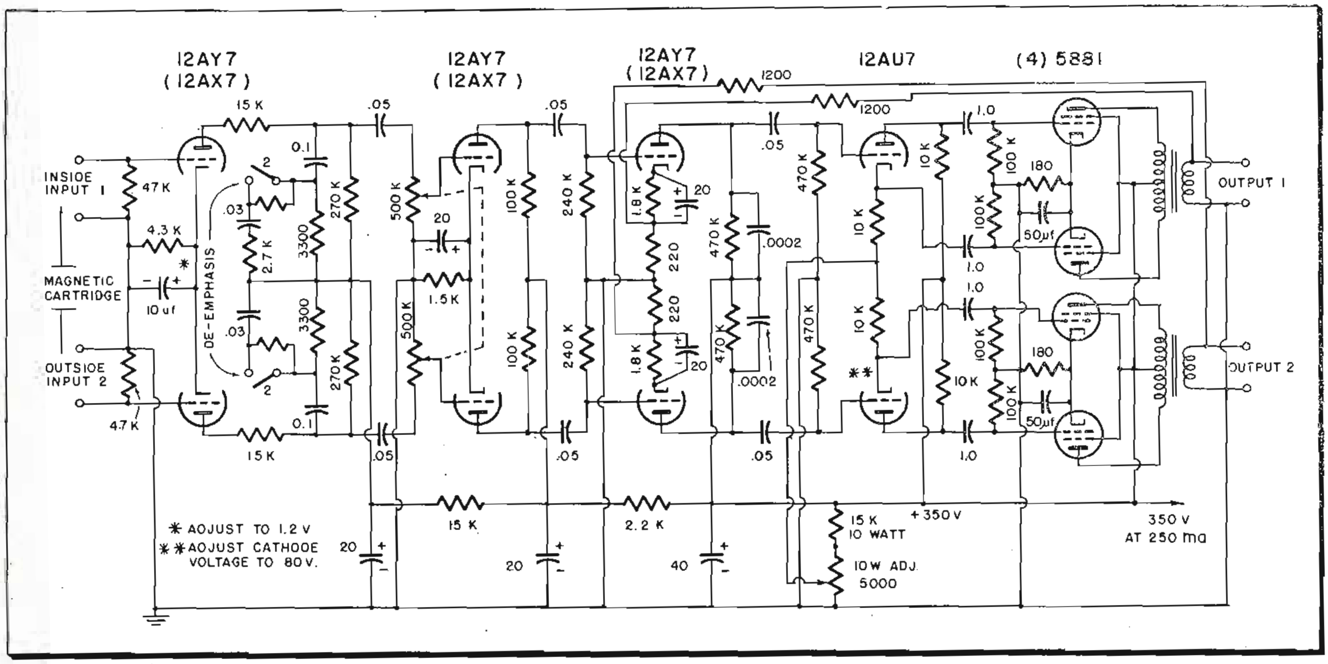


Fig. 3: Complete schematic of high quality binaural amplifying system. Power supply is separate unit

tubes, not including the power supply. No more decoupling or filtering is necessary than with a regular amplifier. The A-B comparison between binaural and monaural on such a minimum system with corresponding small speakers is perfectly astounding, probably because the cheaper monaural systems are so unsatisfactory in themselves. Yet it is hard to see where such an amplifier could cost more than a few dollars extra.

The opposite extreme would be something along the line of Fig. 3, where provision for magnetic cartridges is made, together with phase-splitting so that each output is balanced. Again the increased cost over that of a straight "push-pull" design is very nominal, if one is to compare it with a regular amplifier using four output tubes as a cost reference.

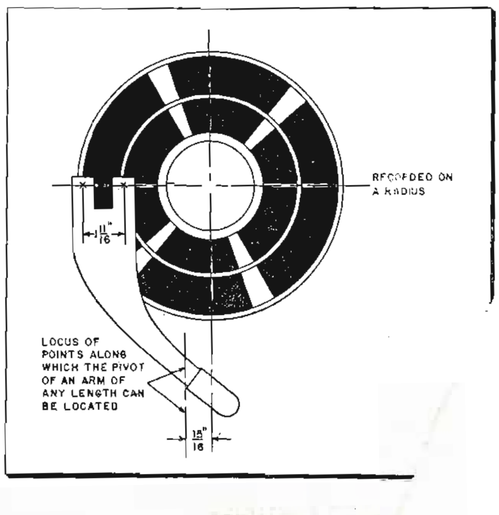
For equalizing the effective high frequency response of the channels in the room a condenser may be introduced across one or the other of the 220 ohm feedback re-introduction points in the 3rd stage of Fig. 3.

Test & Alignment

In addition to the necessity for an adjustment to permit re-setting the $1\frac{11}{16}$-in. dimension should cartridges be changed, there must also be a "fore and aft" adjustment provided so that there is no time delay error between channels,—so that they operate on the same radius. A means for locating to the required accuracy of 0.01-in. this longitudinal adjustment can be supplied through use of a test record signal. The Cook Series 30 test record is intended as a temporary standard, and in order to be palatable to non-technical users employs a slowly ticking clock as the source. The clock is fed into both channels in parallel simultaneously, in order to provide a synthetic binaural signal. When played on a binaural arm into a binaural reproducing system which has been adjusted for equal gain per "ear," the cartridges in the arm may be adjusted until the clock sound in the room appears to be neither to the right nor to the left, but dead-center. In order to prevent insofar as possible inadvertent errors, the record

(*Continued on page* 136)

Fig. 4: (Left) Photo of binaural tone arm playing back binaural disc. Fig. 5: (Right) Diagram showing how binaural arm is pivoted



Centralize Military Buying?

Nine-Point Plan to Cure Military Procurement Ills Proposed by Murray Fiebert, Mgr., Govt. Contract Div., CBS-Columbia, Inc.

THERE is increasing evidence that military procurement will become centralized, particularly in the buying of standard products, and eventually in procurement of all military items.

The tip-off is HR 8130 introduced into the House of Representatives in the Spring of 1952 and now in the Armed Services Committee. This bill would eliminate the Munitions Board and provide for a central supply agency for non-military items.

But more than this, Public Law 488, Section 638 requires the Secretary of Defense to issue regulations that will effect consolidated buying of certain items by the military.

Whether or not the end result—consolidated purchasing of military equipment through a centralized agency—is to the advantage or disadvantage of national defense and national economy is the 64-dollar question.

Arguments in Favor

Academic arguments are beginning to appear pro and con. TELE-TECH has been receiving correspondence on this subject and presents a particularly strong argument in favor of centralization of procurement functions. This argument is advanced by Murray Fiebert, Manager, Government Contract Division, CBS-Columbia, Inc., Brooklyn, New York, who gives nine reasons why centralization of procurement is desirable. These nine reasons are given in complete detail in the columns on the right.

Mr. Fiebert points out that, at present, the Army purchases through each of its seven Technical Services. The Air Force has its organizational setup with procurement offices in Dayton and several ›search and development in- ˡlations scattered throughout ›cuntry.

Navy procures through its ›nt bureaus in Washington and other locations. This, says ›bert, is a "maze of procure- organizations, enough to ›hly confuse the average con- He offers the solution con- ›ı the accompanying nine- ›ı.

Procurement Unification Plan

1 It is recommended that all procurement activities be transferred from the jurisdiction of the Chiefs of Technical Service and place directly under the jurisdiction of the Secretary of Defense. The Secretary of Defense, or an assistant, should be designated as the civilian in charge of the entire military procurement program. His authority would supersede that of the established military hierarchy.

2 Responsibility for implementing this procurement program would be placed in the hands of competent civil service employees trained for their assignments. This would obviate the necessity of using the services of military officers who are assigned on a temporary basis and transferred periodically. It would further release military personnel for purely military assignments.

3 Regulations and procedures emanating through the Secretary of Defense would be disseminated to all procurement officials and would be uniformly interpreted. Under present procedures, there are many instances where each Technical Service or Department develops a separate interpretation of a regulation.

4 It would make possible consolidation of functions which are presently duplicated. For example, procurement agencies have an Industrial Service Division, Small Business Division, Security Office, Contract Preparation Group, and Specification and Reproduction Center. These functions are identical in all Agencies, and can be consolidated. In some instances, Agencies are competing with one another. The Navy, Air Force and Army Industrial Service Divisions presently make separate facility surveys. This can be prevented by consolidation.

5 Consolidated bid lists can be posted at different locations for interested bidders, instead of lists pertaining to purchases of each Technical Service. Today a contractor must either subscribe to a commercial journal, pick up a Department of Commerce synopsis or arrange for a representative to personally visit an Agency in order to be informed of pending bids. It is an expensive operation and a duplication of effort to visit several Agencies simply to check bid availability.

Although some Agencies have field offices to disseminate information, this is not wholly satisfactory. The field offices do not always have complete specifications, bid forms, or more specifically lack technical personnel to discuss the job. Such personnel are generally only available at the Engineering Laboratory or Buying Office.

6 Security procedures would be standardized. At the present time, Central Intelligence Agency is supposed to handle overall security problems. The situation still prevails that a contractor will be cleared by one service and not by another.

7 Serious inspection bottlenecks would be broken. It has been consistently difficult for the contractor to obtain services of inspection personnel when material is ready for shipment. In many instances, companies have had to wait several weeks, after equipment has been produced, before inspectors visit their plant. This retards the defense effort and delays payment to the contractor. It also increases the Government's cost of equipment. Consolidation would materially improve the present setup. This becomes even more apparent when it is realized that in many areas an Army, Navy or Air Force inspector *will call simultaneously to conduct an inspection at the same plant.*

8 At times Services are at odds with other Services, in their efforts to obtain procurement responsibility for items which they feel belong in their jurisdiction. This produces unnecessary dissension and interferes with efficient performance. Unification of procurement would eliminate this type of service squabble. Employment of personnel who perform identical functions in each agency, i.e. hundreds of receptionists, messengers, clerks etc. would be eliminated thereby resulting in savings of millions of dollars to the taxpayer.

9 Considerable savings would be affected in overhead expense items. For instance, at the present time many agencies use different contract forms to make purchases. Such duplication would be eliminated. Printing and contract preparation functions would be combined. Reproduction equipment, IBM machines etc. can be pooled under an integrated procurement organization.

Characteristics of Precision Servo

Compared to radio-type pots, precision units feature higher torque. Finite resolution limitation of wire-wound element

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IN the electrical engineer's original thinking, potentiometer was a contraction of "potential meter" indicating voltage measurement, and potentiometers accomplished this by comparing the test potential with a known potential. It should be understood that this paper concerns potentiometers only insofar as they are used for voltage division, nor

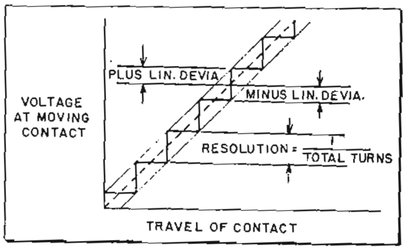


Fig. 1: Absolute theoretical accuracy of a wire-wound pot is limited to half of resolution

does it reckon with the fact that these same potentiometers can also be used as rheostats or variable resistors. The accepted contraction or nickname for potentiometers quite naturally is "pot," and for brevity, this term will be used throughout this discussion.

Precision pots are differentiated from the ordinary radio-type by their inherent features of better ac-

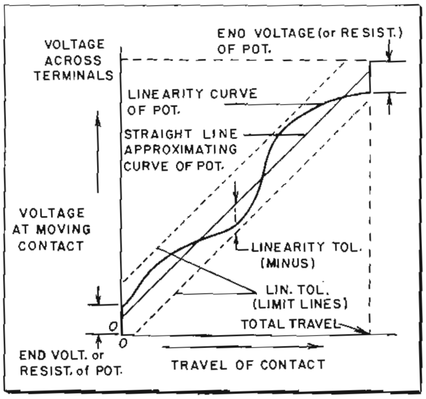


Fig. 2: Normal linearity is defined by the voltage output at the potentiometer slider

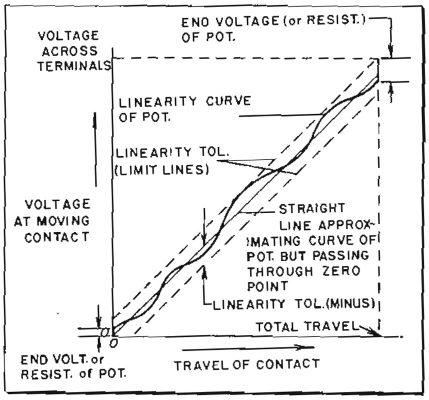


Fig. 3: For zero based linearity, line of zero error is adjusted to pass through zero point

curacy, freedom from electrical noise, longer life, lower torque and closer tolerances on physical dimensions. In present-day computing servo systems employing precision pots, all, or nearly all, of the electrical and mechanical characteristics govern the extent to which the pots may be applied and the results which will be obtained. This paper will discuss each of these characteristics and particularly point out those which, through a lack of understanding, can cause difficulty when pots are improperly engineered in circuits and systems.

Potentiometer Construction

It is hardly necessary to mention here that a pot consists of a resistance element having terminal connections at each end and a sliding contact which traverses this element from one end to the other. In current practice, the elements are of composition, deposited film, or wire-wound type. At the present stage of development, only pots of the wire-wound type are successfully manufactured with sufficient accuracy to fall into the category of what we are terming *precision* pots, although new work continuing in both composition and deposited film indicates that these types may soon approach or exceed the accuracies now obtainable with wire windings, and at the same time may introduce many other more desirable features.

A characteristic of a wire-wound element is that it produces finite steps of voltage, which are detectable as the range from zero to maximum voltage is traversed by the sliding contact. This is known as the resolution of the pot and is usually expressed in percentage . . . i.e. . . . resolution equals (1x100)/N; N being the total number of turns of wire.

Fig. 4: Proportional linearity has tapered tolerance limit, not applicable to wire pots

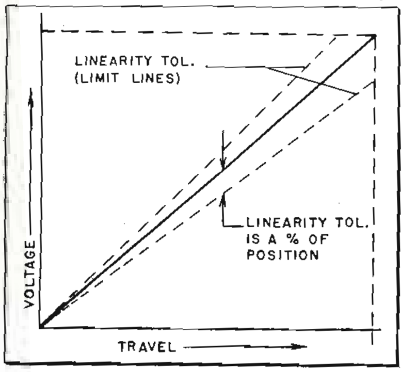


Fig. 5: Off-center brush arm introduces error because evenly spaced turns vary in length

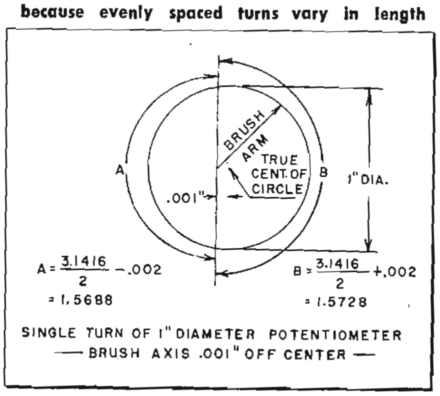
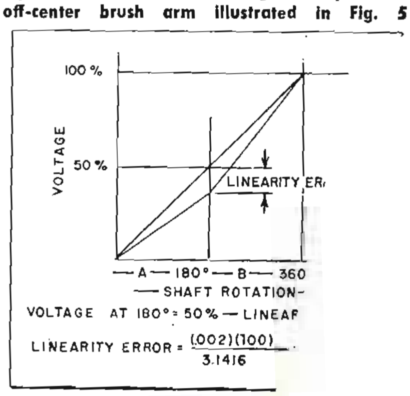


Fig. 6: Linearity error for single-turn pot with off-center brush arm illustrated in Fig. 5



Computer Potentiometers

accuracy, less noise, longer life and lower
indicates future use of deposited film

This finite resolution of the wire-wound pot is a condition which is never desirable, and which sometimes even prevents the satisfactory use of precision pots in certain types of circuits. Composition and film-type elements obviously have infinite resolution, and this is one of the reasons that further development in these fields may pay such big dividends. Better resolution in wire-wound pots is obtained simply by using more turns of wire about the mandrel, which in turn is accomplished either by using resistance wire of smaller diameter and hence crowding more turns onto a given length of mandrel, or by utilizing longer mandrels which can be coiled into a helical shape to conserve panel space. Other than these two approaches, resolution of a wire-wound pot can only be increased through a comparable increase in the physical size of the unit. To illustrate the wide range of resolution which is obtainable, consider the usual radio-type pot of up to 3 in. diameter and containing perhaps 500 turns of wire or ribbon, versus the precision-type pot of single turn design and equivalent diameter containing upwards of 5000 turns of wire; and lastly, the 40-turn Helipot of this same diameter containing more than 100,000 turns of wire.

Resolution Limits Accuracy

The absolute theoretical accuracy which can be expected of any wire-wound pot is limited by its resolution and, as illustrated in Fig. 1, this limit becomes one-half the resolution. If a theoretically perfect linear relationship between the voltage at the moving contact and the travel of re contact (or shaft rotation) were staresented by the dotted line in the cigure, it can be seen that the Theformed by each turn of wire differe criss-cross such a line and several re would be inherently posi- Mr. Fie negative excursions equal ment half the resolution. In actual thoroug of course, linearity accu- tractor." ny pot can seldom, if ever, tained i roach this theoretical limit, point pla of the practical reasons for this will be brought out after some consideration of the meaning of the term "linearity."

The word "linearity" itself, when referred to potentiometers, means, of course, a straight-line relationship between the voltage measured at the sliding contact and the rotation of the shaft. The amount that the output of an actual pot deviates from his straight line, in either a positive or negative sense, is the linearity error.

Linearity Definitions

Of the three more or less common linearity definitions, one can be said to apply strictly to potentiometer usage, while a second is more correctly associated with rheostat, or variable resistor usage, and the third can actually be applied to either pots or rheostats, and varies from the others only with respect to the meaning of the word "tolerance." The difference between potentiometer and rheostat interpretations of linearity is concerned principally with the orientation of the theoretical line of zero error, from which any deviations of the output of the actual pot are considered the linearity error. In the potentiometer definition, this theoretical line of zero error can be moved in space until it most nearly approximates the actual output curve of the pot under test. This interpretation was summarized by the radiation laboratories of M.I.T. as follows:

> "Potentiometer linearity tolerance shall be the maximum allowable deviation from the best straight line which can be drawn through the actual points of resistance on a resistance versus rotation graph. The tolerance shall be expressed in percent of total resistance."

While it is apparent that linearity accuracy and linearity tolerance of a potentiometer may be expressed in terms of resistance, it will be seen later that the actual measurement or test of linearity accuracy should be made in terms of voltage output at the slider, and tolerance thus means a percent of the total voltage across the element. This

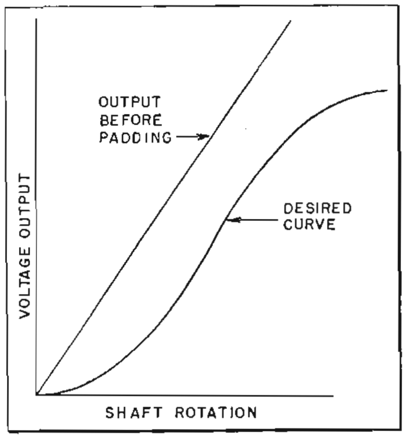


Fig. 7: Linear output of unpadded potentiometer

definition is known as "normal" linearity and is illustrated graphically in Fig. 2. It will be noted that the straight line representing theoretical zero error has been oriented in space to best fit the actual ouput curve of the potentiometer, and in so doing, this line does not necessarily pass through zero voltage at zero rotation, or total voltage at full rotation. The linearity tolerance limit lines would then define the area within which the actual curve of the potentiometer must remain to be in tolerance, and the tolerance itself is the distance above and below the line of zero error and is expressed in percentage of total voltage across the terminals.

Second Interpretation

The second interpretation of linearity is referred to as "zero based" and it specifically requires that the theoretical line of zero error pass through zero voltage output at zero shaft rotation, and sometimes also through total voltage at full shaft rotation. The latter situation adds, in effect, a fourth interpretation of linearity accuracy. The first form of zero based linearity is illustrated in Fig. 3, where the theoretical line of zero error has been adjusted so that it passes through zero voltage at zero rotation, but not through total voltage at full rotation. In this linearity definition, the tolerance is still understood to be expressed as a percentage of the total voltage or total resistance.

The third interpretation is usually referred to as "proportionality" or "proportional linearity," and this actually affects only the interpretation of tolerance itself, and it can apply to either normal or zero based definitions of linearity accuracy. Proportionality requires that the tolerance, instead of being a percentage of total voltage, be a percentage of the value at any position of the slider; that is, at one-third of the total shaft rotation the tolerance would be a percentage of the voltage output at that point, and similarly, for any other slider position. The result is a tapering of the linearity tolerance limit lines as illustrated in Fig. 4. Since it is apparent that the linearity tolerance reduces to plus or minus zero percent at one end of rotation, it is obvious that this interpretation cannot be applied with any reality to a wire-wound potentiometer containing finite steps of voltage change.

Uniformity of Mandrel

As mentioned earlier, linearity accuracy is theoretically limited to one-half the resolution in wire-wound pots, while practical considerations of design and manufacture actually limit maximum accuracies to much larger values. These considerations naturally include the characteristics of the resistance element itself, which depend upon the uniformity of the mandrel or card on which the wire is wound, the uniformity in cross-section of the resistance wire, the

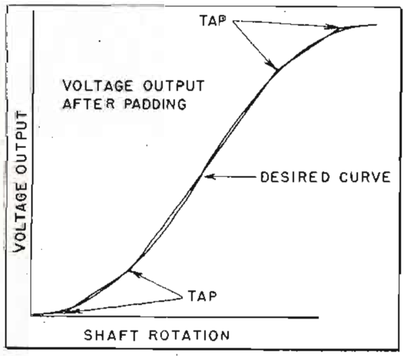


Fig. 8: Output of padded pot is broken into series of straight lines to get desired curve

resistivity of the alloy from which the wire is formed, and lastly, the accurate positioning of each turn of the wire in the coil. All of these variables are simultaneously controlled, at least to some degree, by automatic variable positioning of the individual wire turns as the coil is wound, and it is hence sometimes possible to obtain somewhat better accuracy in the winding itself than the characteristics of the resistance wire and mandrel might indicate.

However, even were it possible completely to control these factors in the winding of the element, and thus produce with regularity coils having accuracies equal to one-half the resolution, the pot manufacturer is still faced with the very practical problem of assembly of his product, which may have a radical effect on the accuracy of the completed unit. Figs. 5 and 6 give a better appreciation of the possible extent of linearity errors which might be caused by mechanical inaccuracies in the pot design or construction. This illustrates the situation of a single-turn pot of one-inch resistance element on a shaped card, which has been formed so that each turn of wire, while equally spaced from adjoining turns, presents a greater or lesser voltage change than its predecessor by the fact that the individual turns vary in length. Other manufacturers wind the resistance wire upon a mandrel of uniform diameter and circumference, but obtain the variable slope between voltage output and shaft rotation by varying the spacing between individual turns of wire and even, in some cases, splicing in resistance wires of different alloys or different sizes.

Greater Accuracy

A third approach is sometimes used where greater accuracy and smoothness is desirable and where the slope of the desired curve does not vary radically at any point. This method utilizes cams which have been shaped according to the desired curve and which are either introduced into the driver of the pot shaft, or which move the coil itself independent of rotation of the shaft. A fourth method, and one which is used widely in experimental set-ups where it is frequently desirable that the original output curve be modified to meet changing circuit requirements, involves the resistance or voltage loading or padding of the resistance element by means of tapped connections. In this approach the desired curve is actually approximated by a series of straight lines, which represent the linear resistance element between each set of taps. The slopes of these straight lines will be determined by the amount of voltage or resistance padding connected to the taps. This approximation of the desired function by resistance or voltage padding is illustrated in Figs. 7 and 8, Fig. 7 showing the linear output of the original potentiometer in contrast to the desired curve, and Fig. 8 how the output of the potentiometer has been broken up into a series of straight lines, each approximating the slope of the desired curve over the respective portions of that curve.

Functional potentiometers fill an important need which is continuing to grow in the application of pots to servo-computers. The use of these pots frequently greatly reduces or eliminates the need for extravagant gear trains or cam devices either to provide functional output or to correct for non-linear signal inputs.

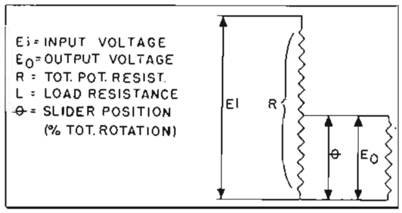


Fig. 9: High load resistance reduces slider current with its accompanying loading error

A problem which exists to some extent in all pots, regardless of the type of element, quite often causes difficulty in highly sensitive circuits. This problem is concerned with an electrical noise, consisting of rapid voltage fluctuations caused by varying resistance between the sliding contact and the resistance element, as the shaft of the pot is rotated. In wire-wound pots, a portion of this voltage fluctuation is inherent as a result of the steps caused by the turns, called resolution noise, while in all types of pots, most of the balance of the noise is caused by foreign material coming between the sliding contact and the resistance element. This is referred to as transient noise. It is obvious that nothing can be done to reduce or eliminate the fluctuation in wire-wound pots caused by the individual turns, and this is negligible in most cases anyway in comparison with the noise caused by interference of foreign material. This material is of two types, one being simply dirt of all kinds, and the other an oxide film which forms on the surface of the resistance wire itself. The elimination of the dirt is principally a question of sanitation during the fabrication and assembly of the pot and suitable dust-tight sealing of the pot enclosure to prevent the entrance of dirt after it is installed in the equipment. Even when these considerations are properly cared for, most pots will have a tendency to create their own internal dirt by the fact that the various parts will wear and deteriorate due to friction as the unit is operated.

(*Continued on page* 94)

E-C Glass Resistors

Extremely stable components show less than 0.2% resistance change in thermal cycling between −55°C and 200°C

By JAMES K. DAVIS
Corning Glass Works, Corning, N. Y.

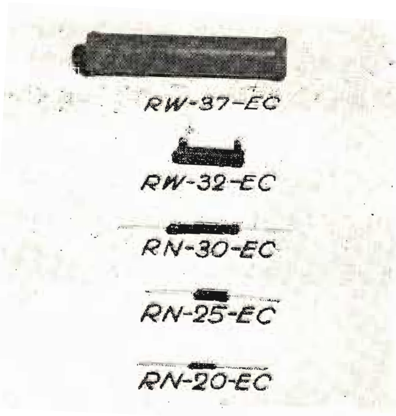


Fig. 1: Representative glass resistors range from 45-watt radial lead to ½-watt axial type

THE electrical and thermal stability of E-C glass resistors opens the door to reliable resistor operation at high ambient temperatures, high power levels, and at high frequencies. E-C glass resistors are film-type resistors developed by Corning Glass Works. The properties of the resistors are derived from the unusual properties of the E-C conductive coating bonded to a durable, heat-resistant glass. Although this coating is very thin—of the order of a wavelength of light—it is extremely tough, highly adherent, and is resistant to strong acids, alkali, and moisture. It is electrically stable over a wide temperature range, as is evidenced by the fact that it can be cycled in air from temperatures near absolute zero (—273°C) to a red heat without impairing its conductivity. All these properties are inherent in the film coating itself and are not imparted to it by protective coverings.

The construction of these resistors is briefly as follows. The resistive element is the E-C conductive coating, which is bonded permanently and integrally to a heat-resistant glass rod or tube. Resistances above a few hundred ohms are obtained by grinding a helical path in the conductive coating. Contact is afforded by silver terminal bands which are fired onto the coating at a red heat thereby insuring a permanent connection. A silicone varnish is usually applied over the resistor to give mechanical protection and to facilitate marking. Initial resistance tolerances of ±0.5% are possible, although standard tolerances will probably start at ±1%.

Representative Corning resistors are shown in Fig. 1. The resistors shown range from a ½-watt axial-lead unit to a 45-watt radial lead tubular power unit.

To assist in evaluation of the potentialities of these resistors, information is presented on the following properties: electrical stability, temperature and voltage coefficients of resistance, moisture resistance, and high frequency characteristics.

Fig. 2: Load life characteristics of two 10,000-ohm resistors at 40°C ambient, 200°C operating

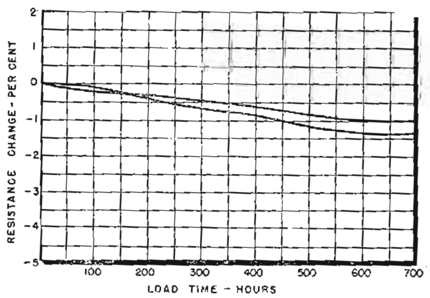
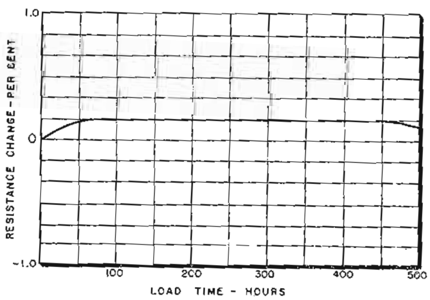


Fig. 3: Load life characteristics of two 50,000-ohm resistors at 40°C ambient, 125°C operating



Load-Life Data

Load-life data on two 10,000 ohm resistors operating at a surface temperature of 200°C. are shown in Fig. 2. The maximum resistance change in 700 hours at this temperature was less than 2%. The resistors are also stable under thermal cycling. Repeated cycling between 200° C and −55°C altered the resistance value by less than 0.2%. This electrical stability at 200°C makes it possible to operate at higher ambient temperatures and at higher wattage ratings than has been feasible heretofore. It also indicates potentialities in the direction of miniaturization.

Fig. 3 illustrates the electrical behavior of these resistors when operated down at conventional temperatures and power levels. This load-life data is for two 50,000 ohm resistors operated at 125°C surface temperature. The maximum change in resistance during the 500-hour test was less than 0.2%.

The temperature coefficient of resistance is less than 200 parts per million per degree C. Laboratory samples have been prepared with

(Continued on page 120)

TABLE I: E-C GLASS ACCURATE RESISTORS

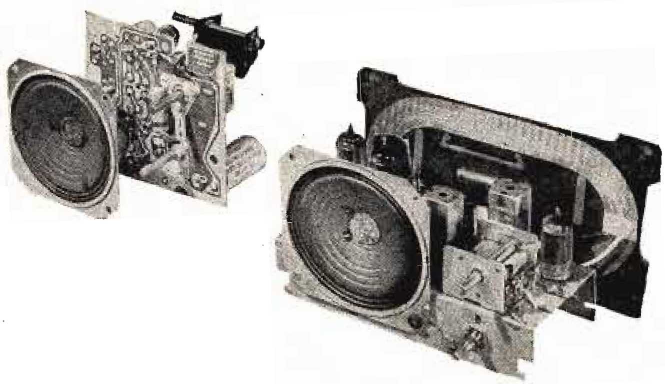
Type	Size (in inches) O.D. Length	Resistance (ohms) Min.	Max.	Power Rating at Ambient Of 120° C	40° C
RN-20-EC	11/64 x 19/32	10	10,000	1/2 W	1 W
RN-25-EC	19/64 x 15/16	10	40,000	1	2
RN-30-EC	19/64 x 2-1/16	20	100,000	2	4

TABLE II: E-C GLASS POWER RESISTORS

Type	Power Rating	Size (in inches) O.D. Length	Resistance (ohms) Min.	Max.
[illegible]	4 W	19/64 x 2-1/16	20	100,000
[illegible]	6	9/16 x 1-1/2	20	70,000
[illegible]	11	9/16 x 3	20	150,000
[illegible]	21	7/8 x 4	20	300,000
[illegible]	45	1-1/4 x 6	20	500,000

Plated Circuit

Economical manufacturing method

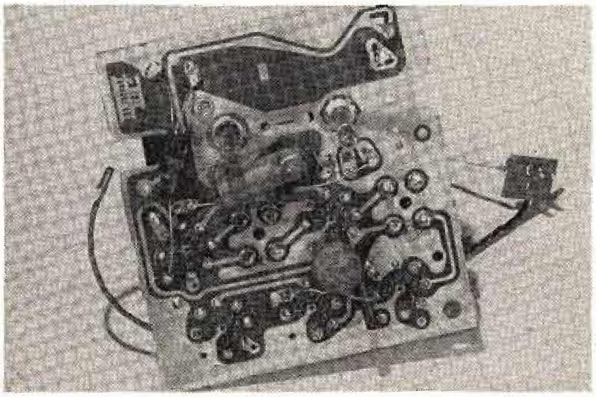


First mass-produced plated-circuit radio is Motorola's newest 1952 model shown on the left. Fabricated by machines using the "Pla-cir" process, it shows considerable size and weight reduction over the conventional 1951 model on the right, which contains the same number of tubes and essential components

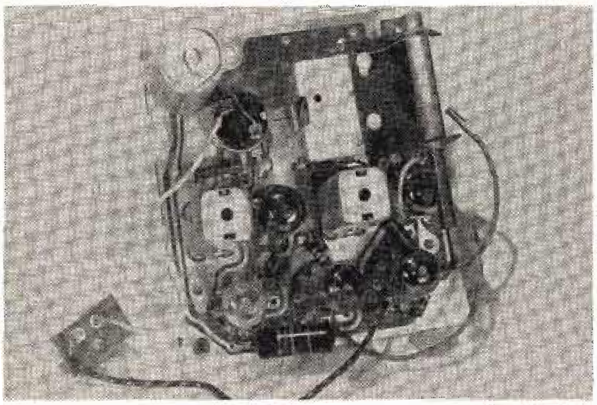
AFTER six years of research costing $1,000,000, Motorola has placed in operation a new mass production system of manufacturing radio receivers. The new printed circuit method, called "Pla-cir," replaces the conventionally bulky chassis with a compact and lightweight bakelite base, upon which the circuit is plated and components are mounted.

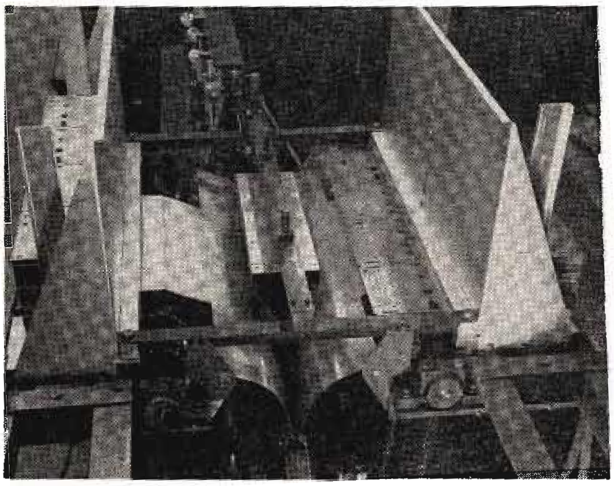
Production operations are essentially accomplished by machine. Punched bakelite strips are fed by conveyor through stations which prepare the surface, coat the strip with a conductive film, and print a resist material from a photographically-prepared stencil. A thin copper foil is then electroplated on the prepared base, and a subsequent operation removes the areas of resist and underlying conductive coating, leaving the desired circuit configuration.

Of particular interest is the fact that the circuit is continuous from one punched hole to the other, and through the hole to the other side of the base. Where it is not desired that copper plating run through the



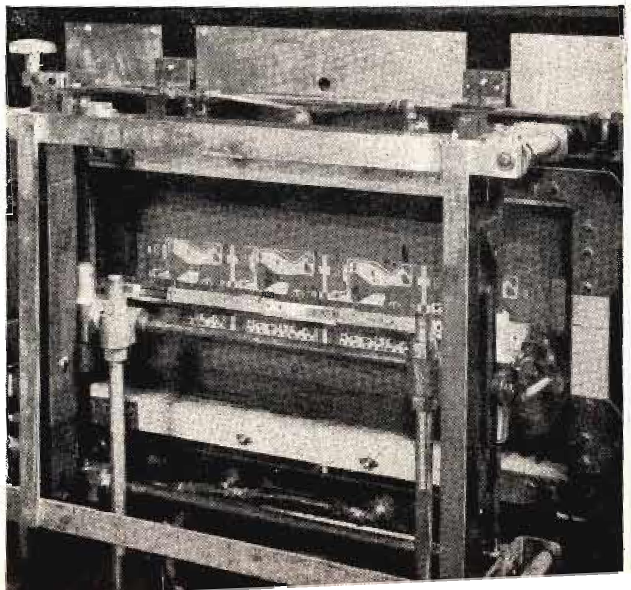
Top and bottom views of the plated-circuit chassis shows the copper layer configurations, spot-soldered connections, and components on the bakelite base





1 Starting point in the "Pla-cir" process is the criss-cross strip feed mechanism. The punched bakelite strips are transferred to an input drive conveyor

4 In the printer, each strip is passed between stencils and automatically printed with a resist. The arrival of a new strip ejects the printed unit.



Process for Radio Production

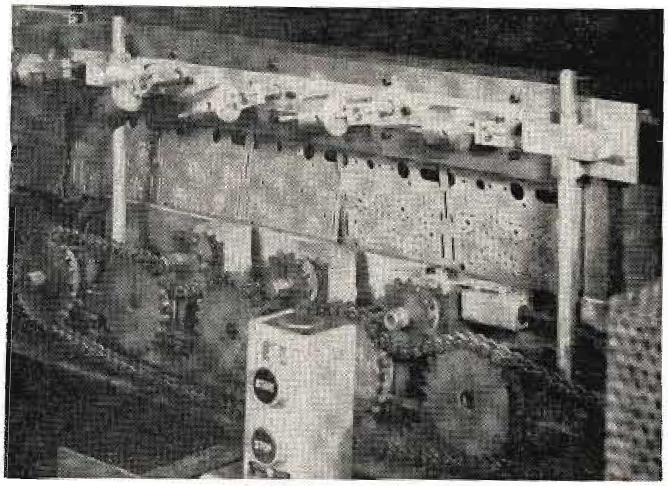
plates copper conductor on both sides and through base

hole to the other side, partially punched holes are made. Slugs are left in these holes until plating is finished, and pushed out later by dies. Holes are specifically located in the base layout to accommodate the mounting of tubes and other components.

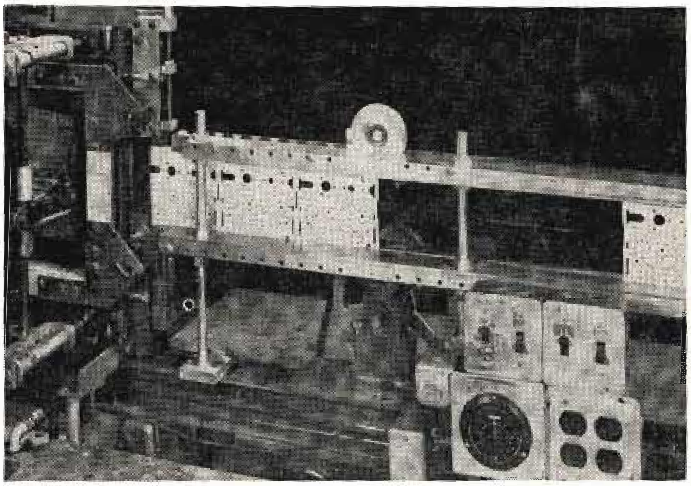
Automatic Spot Welding of Parts

Concurrent with automatic placement of components is the automatic spot soldering of parts, further aiding mechanization of assembly. This approach overcomes the limitations of other soldering methods which place solder on conductors on the opposite side. Clips for holding tubes are either soldered in terminal holes, spring-bite mounted in metal lined holes, or set in unplated holes with tangs soldered to adjacent terminal holes.

Although initially applied to flat shapes, the "Pla-cir" method may be used to make three-dimensional units. However, it is believed that plane bases are the most practical approach, because solid shapes can be formed by joining plane sections.

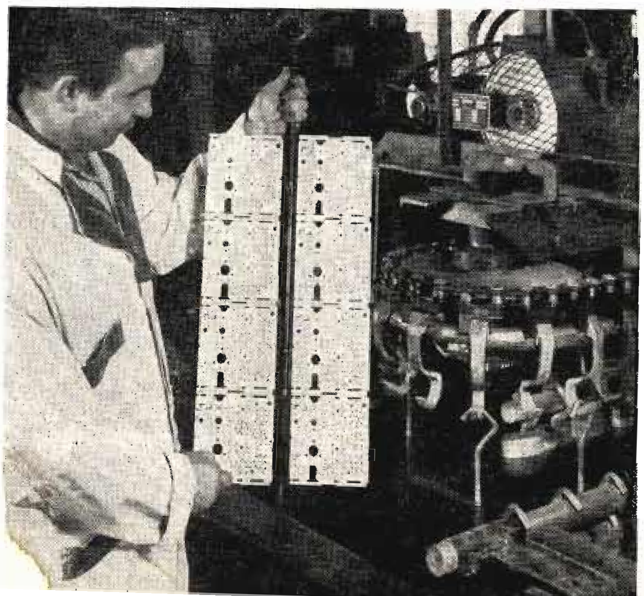


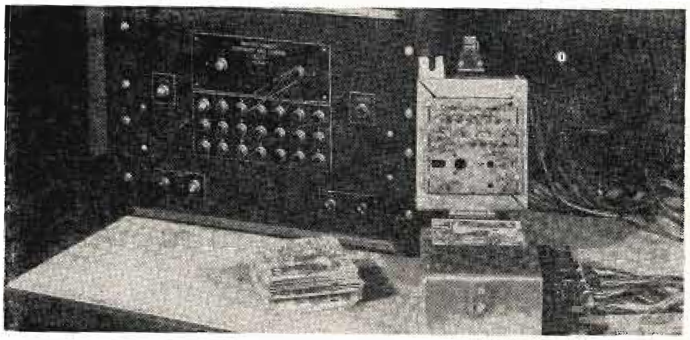
2 The input drive conveyor pushes the strips into cabinets which process the base surfaces



3 From processing, the strips are advanced to the printer by a wheel run at a higher speed than the input drive

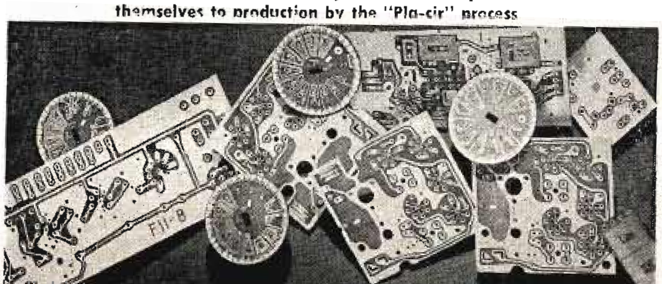
5 After printing, the strips are racked in pairs and electroplated. A later stage removes resist areas, leaving copper circuit pattern, including metal lining of holes through base





6 Finished and cut apart, the basic chassis is checked in two seconds by a stepped test set for leakage, shorts and opens

7 Wide variety of circuit shapes which readily lend themselves to production by the "Pla-cir" process



Resistance-Capacitance Loading of

New method of analyzing a current wave of any shape under various circuit conditions. Graphic approach

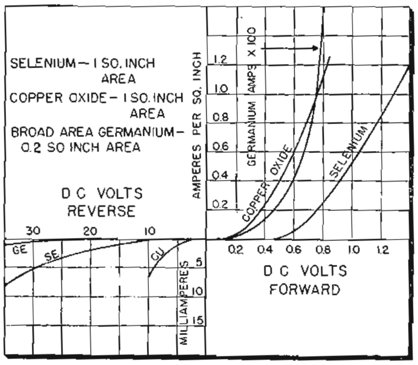


Fig. 1: Static volt-ampere characteristics of selenium, germanium and copper oxide rectifiers

By C. E. HAMANN,
Manager,
Application Engineering Section,
Rectifier Div.,
General Electric Co.
920 Western Ave., West Lynn 3, Mass.

IT is the common practice of the manufacturers of metallic rectifiers to assign output ratings in terms of dc values of voltage and current. This practice came about naturally because the principal purpose is to change ac to dc and the user is primarily interested in the dc output that will be delivered by a given rectifier.

The current rating usually is the value in average amperes which the rectifier will deliver safely when operated in a prescribed circuit into a load consisting of resistance only. For selenium, most manufacturers have agreed on a dc current rating of 320 ma/sq. in. in a single phase, full-wave bridge with resistance load. In fact, this rating has been tentatively standardized by NEMA.

Present-day applications frequently involve loads which contain a substantial amount of capacitance. The question naturally arises as to the effect on the heating of the rectifier and what derating should be applied to prevent any heating in excess of that which occurs under the prescribed conditions of resistance loading. Many manufacturers prescribe derating to 80% of normal dc rating when the load contains capacitance. This magic figure has come down through the years as a result of practical experience. Other manufacturers suggest that the rms value of current be held to the same value as occurs in resistance loading. This rule leans strongly toward the side of safety but will penalize the utilization of the rectifier by derating considerably more than is necessary to maintain normal heating.

We normally think of the rms current as a measure of heating. This is true where the resistance of the device remains a constant value. In a selenium cell the forward resistance is nonlinear. The resistance decreases as the current rises. In the expression I^2R, the value of R constantly changes as the forward current rises and falls in any particular shape of current wave. Depending on the shape of the current wave through the cell and the period of conduction, the I^2R loss may vary considerably, even though the rms current is held to the same value.

It is the purpose of this paper to show a method of analyzing graphically a current wave of any shape and relating the heating to that which occurs under the prescribed condition of "normal" rating.

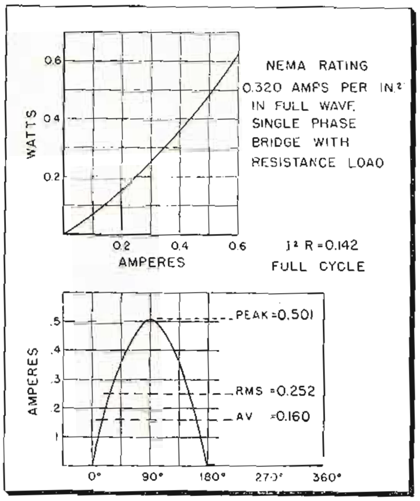


Fig. 4: Current wave and power in one arm of a bridge operating from sinusoidal ac supply

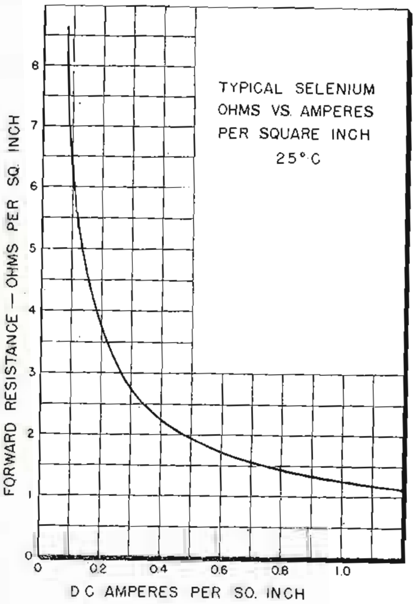


Fig. 2: Selenium current-resistance curve

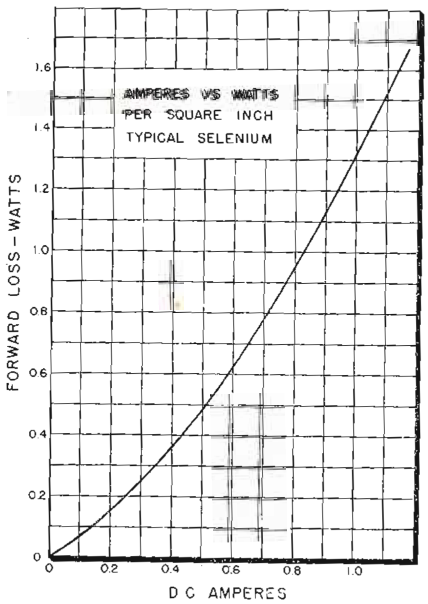


Fig. 3: Instantaneous current-power curve

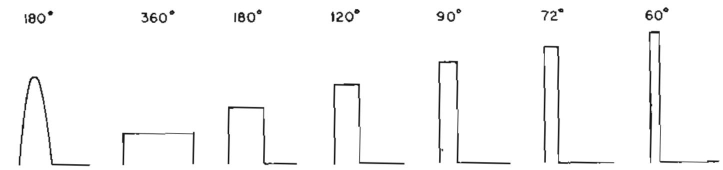
Volt-Ampere Characteristics

Fig. 1 shows the static volt-ampere characteristics of three types of metallic rectifiers. The rapid rise in current with respect to voltage indicates the nonlinear resistance characteristics apparent in all known types of metallic rectifiers, including the area-type germanium, the newest addition to the metallic rectifier family.

Fig. 2 shows the selenium amperes vs. ohms curve per 1 sq. in. of active area. Using the data from Fig. 2, a curve may be plotted showing the instantaneous values of amperes vs.

Selenium Rectifiers

evaluates rectifier heating and required derating increases utilization of maximum power capabilities



AMPERES AVG	0.160	0.193	0.166	0.152	0.143	0.134	0.126
AMPERES RMS	0.252	0.193	0.237	0.263	0.287	0.300	0.308
AMPERES PEAK	0.501	0.193	0.332	0.465	0.570	0.670	0.755
WATTS	0.142	0.142	0.142	0.142	0.142	0.142	0.142

Fig. 5: For 0.142 watts/sq. in., current waves with different conduction periods are graphically shown

the instantaneous values of watts (I^2R forward loss within the cell). See Fig. 3. Here we have a tool for analyzing any shape of current wave and determining the corresponding heating.

For example, Fig. 4 depicts the current wave in one arm of a bridge when operating from a sinusoidal ac supply into a resistance load at the NEMA rating of 320 ma/sq. in. The wave shape closely approaches a sine wave and the ratios of dc to rms to peak are very nearly the theoretical values. If 320 ma represents the output of the bridge, then any one arm of the bridge must pass an average current of 160 ma for the full cycle. This proves in this example to be 0.142 watts per square inch of cell area. Any shape of current wave can be analyzed in the same manner and the resulting watts compared with this established normal to determine if the forward heating is excessive. This method of analysis may be applied to any make of metallic rectifier, providing the ampere-ohms curve is prepared for the make under consideration.

Fig. 5 gives a graphic presentation of current waves with various periods of conduction. Again a value of 0.142 watts/sq. in. derived from the NEMA standard is used as a "yardstick" and in each case this value of watts is held at the same value for the full cycle. It is apparent that with shorter conduction periods and correspondingly higher peaks, the dc (average) current decreases and the rms current increases, with no change in the I^2R loss.

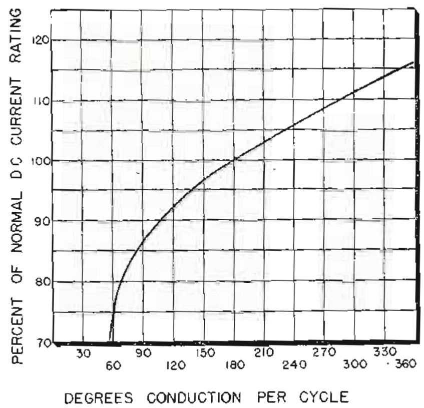


Fig. 6: Effect of conduction period on derating

Capacitance Loading

For any condition of resistance-capacitance loading, the reduction in length of the period of conduction will serve as a measure of the derating in dc (average) amperes necessary to maintain normal heating, as shown in Fig. 6.

We now have a logical means for derating providing we know the length of the period of conduction. The drop in capacitor voltage determines the point where conduction

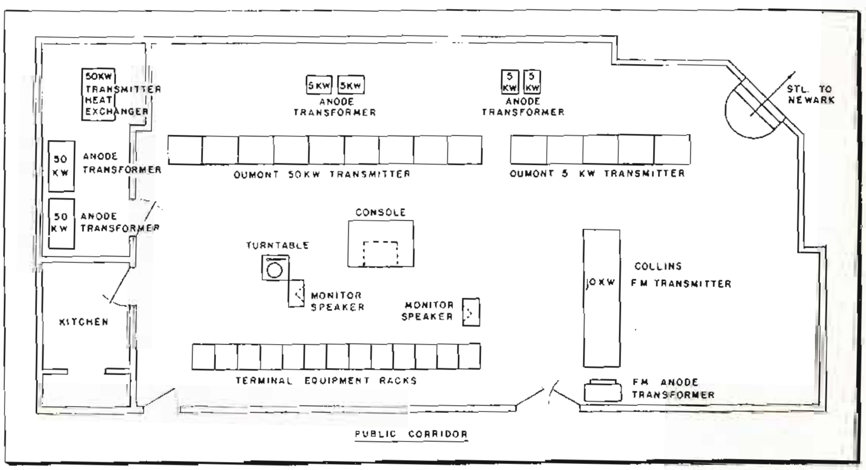
(*Continued on page* 134)

WATV Moves Transmitter Location to Empire State Building

TO provide broader telecasting coverage, WATV is moving its transmitter location to the Empire State Building in New York City. The channel-13 station joins five other TV installations and three FM presently operating atop the structure. Construction work is progressing, and should be completed at the beginning of 1953.

The accompanying diagram shows the layout of equipment on the 83rd floor. In addition to the 5-kw transmitter which will start operation immediately upon completion, a DuMont 50-kw unit is being installed in anticipation of FCC authorization of higher power. A microwave system provides the transmission link between the WATV transmitter and studios in Newark, N. J. Other features in the new installation include a 10-kw Collins FM transmitter and an Andrews 12-element skewed antenna on each of the four corners at the top of the mooring mast, 1200 ft. above street level. With an antenna gain of 5, the ERP will be 25 kw video, and 12.5 kw audio. When the 50 kw transmitter is put into operation, power will be raised to 178 kw ERP.

WATV equipment layout in Empire State Building



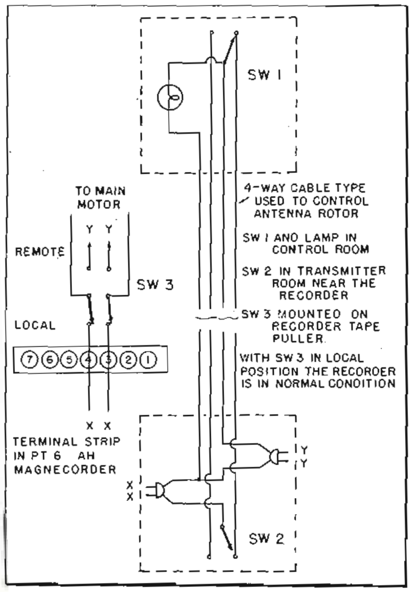
CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Remote Start-Stop System

J. M. SHERWOOD, Jr., Chief Engineer, WRCS, Ahoskie, N.C.

A Magnecorder PT 6 AH is located in our transmitter room, and announcers who are putting tapes on the air are in another room. A signal light is included in the remote start-stop system which we use to remind the announcer to



Announcer operated tape reproducers can be remotely controlled by engineer if necessary

stop the machine after the tape has been used. The engineer on duty cues in a tape well before it is to be placed on the air, *then forgets about it.* The announcer closes his switch and starts the tape when he is ready. Of course the engineer will leave the clutch mechanism engaged and ready to go as part of his cueing procedure. A plug type arrangement is used for coupling to the external switching circuit to facilitate using the recorder at other locations.

Eliminating Preamplifiers

J. DAVID BODELL, WCCM, 278 Essex Street, Lawrence, Mass.

We at WCCM are of the opinion that many stations now operating with turntable preamplifiers, can do without them. Our patience became exhausted with microphonic and noisy preamp tubes, hum, poor quality, constant trouble shooting, and messy turntable interiors. The trouble was traced to our preamplifiers and their associated pads, transformers, etc.

In an effort to end our troubles, the preamplifiers and everything else between the pickups and consoles—excepting the scratch filters—were eliminated. It was found that we still had plenty of gain, quality was faultless, no microphonics, operation was simplified. There was, however, a small amount of hum, but this was entirely eliminated by not grounding either side of the pickup lead-in wire.

$$$ FOR YOUR IDEAS

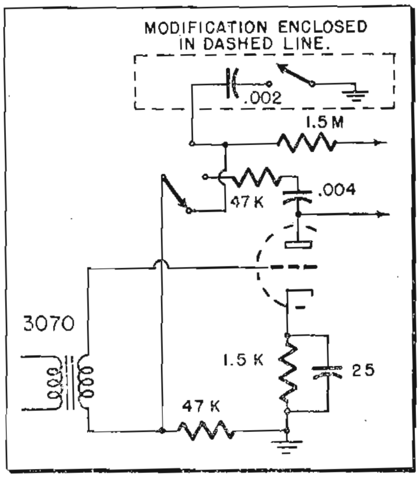
Readers are invited to contribute their own suggestions which should be short and include photographs or rough sketches. Typewritten, doubled-spaced text is preferred. Our usual rates will be paid for material used.

Improved Response from Paper Tape

L. H. CRUMBAUGH, KGER, Long Beach, Calif.

THIS system is adaptable to any of the PT-6 series of Magnecord amplifiers and has the following advantages: (a) flat response on *paper* tape at 7.5 i.p.s. to beyond 6500 cps, therefor important savings in tape costs where permanent tapes must be kept; (b) response better than so-called "class-A" remote circuits, (c) moderate boost available when used as remote amplifier; (d) *no* change in playback channel. The feedback around the first stage is altered in the "Record" and "Amplifier" positions of the functions switch.

6.5 KC response from paper tape with only 7.5 inches per second, can be easily obtained



Parts required are a SPST switch and a .002 uf condenser of good quality. The switch is panel mounted to indicate "Paper tape" and "Plastic tape". The condenser is in the circuit for paper tape. A further advantage to the busy control room technician is the fact that no extra step is involved in quick switching from "Record" to "Listen".

Electric Door Lock for Station Control Room

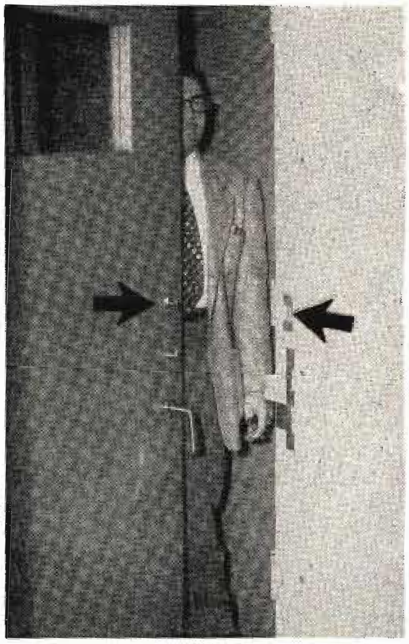
HERBERT G. EIDSON JR., Chief Engineer, WIS, Columbia, S. C.

STANDARD door locks usually operate on ac and hold the door unlocked as long as the controlling button is pressed. The person wanting admittance must wait until the energizing button is pushed. The button must be kept in this position until the door has opened past the locking position. During this time, there is a loud annoying buzz. Two improvements have been effected simply, and at little cost, by the use of a time-delayed circuit, and insertion of dc on the lock magnetic holding coil.

The illustration shows the opened door, and the arrow on the right points to the magnetic lock with roller. This is a catch, its lip being a roller. This catch remains in forward position (toward door) and is immovable when not energized. The door can be opened, when its coil within receives 6 v., the catch is free to be pushed into its brass case, which is done by the spring loaded brass piece protruding from within the door.

The schematic shows the circuit. As this station already was utilizing a heavy duty 24 v. dc supply to handle 30 relays, it was not necessary to build another to obtain this needed voltage for the new project. However, a 6 v. dc supply was built using a copper oxide rectifier with a rating of only two amps which required the use of a slightly higher voltage on the transformer secondary due to greater voltage drop within the copper oxide. Since the service is not continuous, no harm results from the slight overload.

When the spring loaded switch



Silent operating electric door lock with time delay eliminates need to "hold" operating button

(button) is pressed, 24 v. dc charges the 1000 µf capacitor through a 200 ohm resistor. The resistor is necessary to isolate the heavy initial load of the capacitor from the power supply. If this were not done, the many external relays which this supply feeds would drop out, for the voltage would drop to a very low value at the instant the button was pressed. The time-constant of the RC combination during charge is 0.2 sec., since TC is equal to RC, RC being in units, TC being in seconds. This means that the button has to be pushed and held for only 0.2 sec. When it is released, another RC circuit comes into operation. This is the original 1000 µf capacitor discharging 24 v. through the 10,000 ohms resistance of the relay. The theoretical time-constant of the circuit is 10 sec., but due to the relay falling out before the condenser has lost 36.8% of its initial charge, the practical TC becomes about four seconds. This means that when the button is released, the relay holds for 4 sec., the magnetic lock opens for the same amount of time thus giving a person entering plenty of time to open the door.

When the lock loses its magnetic energy, the door cannot be opened from either side unless the button is again pressed, or the small handle on the door is rotated from inside, thus mechanically by-passing the magnetic lock. This can also be rotated from the outside of the door, using a key. This is a safeguard in case of power, or equipment, failure or if the operator locks himself out.

Program Delay System

KEN MAXWELL, Chief Engineer, KLTI, Longview, Texas

RECENTLY, at KTLI, it became necessary to delay baseball broadcasts received from the network for a period ranging from 30 minutes to one hour before rebroadcast. The problem was solved through the use of two Webster Chicago tape recorders.

The Webcor is a dual track recorder which may be manually reversed, making switching of the reels unnecessary. Program from the network line is fed continuously to both recorders. The output circuits are fed through a matching transformer to the console input. Each machine records a complete "circle" down one side and back on the opposite track, then reproduces over the same route. The other machine records while the first is playing back and vice versa.

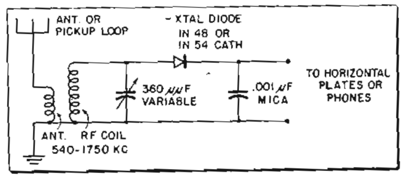
For example, a delay of one half hour is obtained as follows: Recorder #1 begins recording at the start of the program and records with the tape moving to the right. After exactly 15 minutes the tape is reversed so that it makes the return trip still recording. At 30 minutes the tape machine is switched to playback and the direction is again reversed. Simultaneously machine #2 starts recording. At 45 minutes both machines are switched in direction only. At 60 minutes both machines are switched in function and direction. This continues with changes in direction being made every 15 minutes and changes of function every 30 minutes.

Delays other than 30 minutes may be obtained by shortening or lengthening the time between reversals proportionally. The time between reversals in one half of the delay time. It was found necessary to remove the ground connection in the output cable to each recorder to prevent cross talk due to a loop in the ground circuit.

Trapezoid Pattern Indicator

GEORGE DODGE, Chief Engineer, WFOX, Milwaukee, Wis.

AN economical, trapezoid indicator can be constructed as shown in the illustration. It consists of a simple crystal receiver, the output of which is fed to the horizontal



Simple crystal receiver circuit turns oscilloscope into modulation and waveform monitor

plate of an oscilloscope. The vertical plates of the 'scope are connected directly to an r-f pickup loop or an antenna. With the 'scope set to accept proper frequencies a trapezoidal modulation pattern will be produced indicating the modulation depth. A further refinement would be to mount the receiver inside the oscilloscope making connections with coaxial cable. To obtain a clean pattern on the 'scope the RF signal used should be the minimum required to give a usable presentation.

Single Input-Output Connection

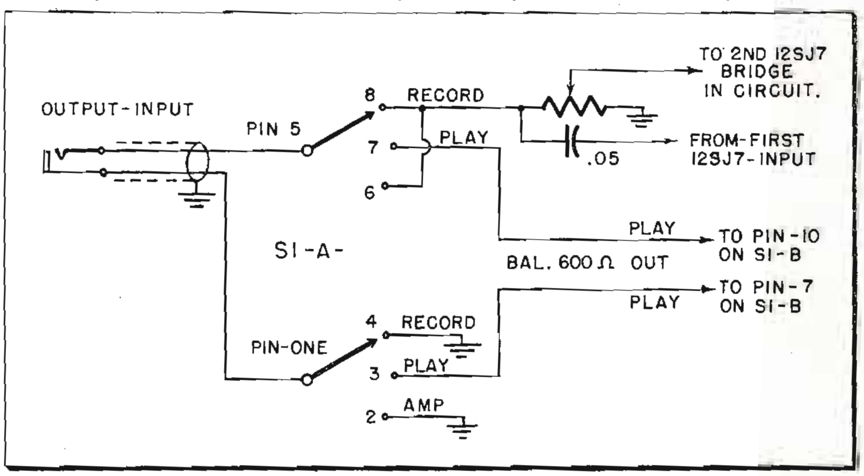
SAM DUDAS, WBRD, Fort Lauderdale, Fla.

TO avoid the necessity of changing jack connections when switching from "record" to "play" with the PT6J Magnecorder WBRD uses the circuit shown in the diagram.

The resistors and connection are completely removed from S1-A, mounted on a terminal connector,

(Continued on page 102)

Single input-output connection for Magnecorder simplifies "in" and "out" operation.



Telemetering and Direct Frequency

Communications engineering techniques applied to remote measurement systems. Comparative evaluations made of operation, accuracy and time of AM and FM instruments

By PAUL M. ERLANDSON
Southwest Research Institute
8500 Culebra Road
San Antonio, Texas

IN general, the methods of measuring the amplitudes of both dc and ac voltages and currents may be classified as follows:

Comparison with Voltage and Resistance Standards: Both voltages and currents are usually measured by direct comparison with secondary standards of voltage and resistance where extremely high accuracy is necessary. The most common instrument used for such comparison is the potentiometer. For ac measurements, a transfer instrument of a type giving equal indications for ac and dc voltage equivalents must be used. In general, accuracies on the order of 0.02% may be obtained, using relatively complex equipment. Measurement time is not as short as with direct indicating instruments.

Response of Calibrated Electromechanical Systems: Under this classification can be included precision instruments such as the Rayleigh balance for absolute current measurements, electromagnetic instruments such as galvanometers, electrostatic instruments, and thermal types. These are essentially direct-indicating instantaneous instruments. Typical accuracies which can be obtained are: precision dc galvanometer, 0.1%; laboratory standard dc voltmeter, 0.25%; portable ac voltmeter, 0.3%; switchboard voltmeter with scale over 5 in., 1.0%.

Many other methods of making amplitude measurements have been described in the literature. Since amplitude meters are not at present a major problem in instrument communications systems, emphasis here is placed on frequency system meters.

Frequency Meters

General methods of making frequency measurements may be classified as follows: Comparison with Frequency Standards; Comparison with Time Standards; Response of Calibrated Electromechanical Resonator; Response of Calibrated Electrical Circuits; Conversion to Amplitude Measurement.

Examples of each type of system are in practical use and are discussed here briefly.

Comparison with Frequency Standards: The CRT and stroboscopic methods are capable of high accuracy, and may be incorporated into completely automatic systems. In the CRT frequency meter, for frequencies of the same order of magnitude, it is usual to apply the standard to one set of deflection plates and the unknown to the other set. This method produces a Lissajous figure from which the frequency ratio can be estimated with essentially the accuracy of the standard frequency. If the frequency ratio is large, the lower frequency may be used to deflect the CRT trace in a circle and the higher frequency used to modulate an accelerating electrode, producing a gear-shaped pattern, or to modulate the control grid, producing a circle of dots or small arcs which may be counted to determine the ratio.

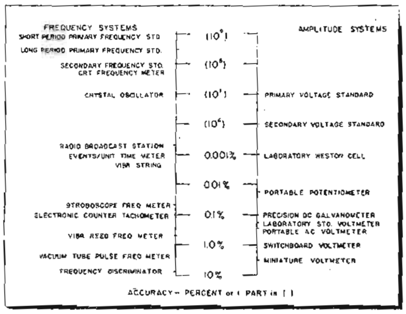


Fig. 4: Comparison of measurement accuracies obtainable in frequency and amplitude systems

The stroboscopic frequency meter gives direct indication of frequencies between 32 and 4186 CPS with an accuracy of 0.05%. An adjustable tuning fork with sliding weights calibrated in 100 steps drives a synchronous motor. The motor is geared to 12 pattern disks, each translucent and bearing 7 concentric rings with 2 in. black and white segments in each ring. Gear ratios are chosen so that successive disks vary in speed by the twelfth root of two. To measure a frequency, a discharge lamp which illuminates the disks is driven by the unknown. The tuning fork is adjusted until the pattern is stationary, whereupon the input frequency is read from the tuning dial. Although the primary range is only about 130:1, external frequency dividers can be used to extend it.

Comparison with Time Standards: The instruments described under this heading are basically similar and offer great promise for instrument communications. Further development work should reduce their size, weight, and relative complexity to a point where they will find routine use as process meters, with one meter used to handle a number of transducers. Since measurement of a frequency can be made in one half period, rapid controls can be operated by many audio frequency transducers through one meter.

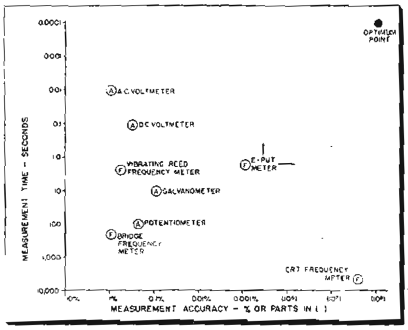


Fig. 5: Time-accuracy comparison for frequency (F) and amplitude (A) measurement systems

Counting Meter

The Events Per Unit Time Meter will count events occurring at rates from 50 to 100,000 per second with an accuracy of 1 unit and a short-term stability better than 1 part in 10^5. The events to be counted must be converted into voltage pulses. Indication is made directly in decimal digits on a bank of panel lamps. An associated mechanical register may be used to count as high as 10^{10}. Measurement of frequency is accomplished by an internal device which turns on the counter for exactly 0.1, 1, or 10 seconds. The instrument can be used continuously to count for one second, display an indication for one to five seconds and automatically recycle.

Measurement

PART TWO OF TWO PARTS

The High-Speed Chronoscope is an electronic clock which measures and indicates time intervals from 10 μ sec to 3 seconds, a ratio of 300,000:1, in eight ranges. Accuracy is about 1% of full scale. External information as to start and stop times must be introduced. A mechanical pointer is coupled to a motor-driven potentiometer which measures the charge lost from a stable capacitor through a stable resistor during the time the resistor is connected to the capacitor by an electronic switch.

The Chronoscope Calibrator is used with the chronoscope, allowing direct measurement of frequency by converting one cycle of an input signal into a single pulse of length directly proportional to the duration of the cycle. Conversion accuracy is stated to depend only on the incoming signal.

The Electronic Counter Tachometer measures frequencies from about 4 to 1600 CPS by counting impulses from an external source during a time interval of exactly 0.6 second as determined by a crystal oscillator. The output indication is in the form of lighted neon lamps, one for each decimal digit. Total accuracy is roughly 1 part in 10^3. A teledeltos paper record of the output can be made on a digital basis.

Electromechanical Instruments

Calibrated Electromechanical Resonators: One of the most useful properties of these devices is their availability as miniature secondary frequency standards. Further development may be expected to improve flexibility in broadband applications.

Vibrating-Reed Frequency Meters use steel reeds, mechanically tuned to definite natural frequencies and vibrated by an electromagnetic armature. The range of frequencies covered is from 15 to 1500 CPS, or 100:1. Adjacent reeds are usually different in frequency by 0.8 to 2%. Reeds can be tuned to within 0.2% of rated frequency but are normally tuned to within 0.3%. Accuracy is specified as 0.5% at room temperature. Corrections for temperature variations can be made and are on the order of 0.08% per 10° C. The direct reading requires moderate skill, and recording must be handled photographically. Physical size is relatively small. Input impedance is low unless auxiliary amplifiers are used.

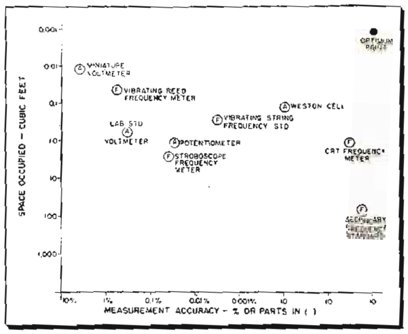


Fig. 6: Space-accuracy comparison for frequency (F) and amplitude (A) measurement systems

In Vibrating-String Frequency Meters, resonance cannot ordinarily be detected visually since the amplitude of string vibration is very small. Vibrotron units have been used in this manner—either as fixed-frequency elements sealed in vacuum envelopes to secure high Q or as instruments tunable over

(*Continued on page* 114)

Q-Meter Correction Chart for Distributed Capacitance

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THE Q-meter measurement of inductance and Q of coils that have distributed capacitance results in a measured inductance that is greater than the true inductance and a measured Q that is less than the true Q. The measured values of inductance and Q are apparent values designated as L_a and Q_a. The true constants of the coil are known as L_o and Q_o.

A simple chart has been developed that yields the ratio of L_o/L_a and Q_a/Q_o. Ratios of 1.0 to 0.65 are shown plotted against Q-meter capacitance for values of distributed capacitance from 0.5 μμf to 20 μμf. When L_o/L_a or Q_a/Q_o is less than 0.65, the distributed capacitance can not be assumed to be lumped across the terminals of the coil, and the equation on which this chart is based is not valid.

Example: A certain inductor resonates with 45 μμf of tuning capacitance and its apparent inductance is calculated to be 30 μh. The measured Q of the coil, Q_a, equals 198. The distributed capacitance (see Boonton Radio Corp. instruction book for 160A Q-meter) of the coil is found to be 5.0 μμf. From the chart we find the correction factor is 0.9. Thus the true inductance of the coil is,

$$L_o = 0.9 \times 30 \ \mu h = 27 \ \mu h$$

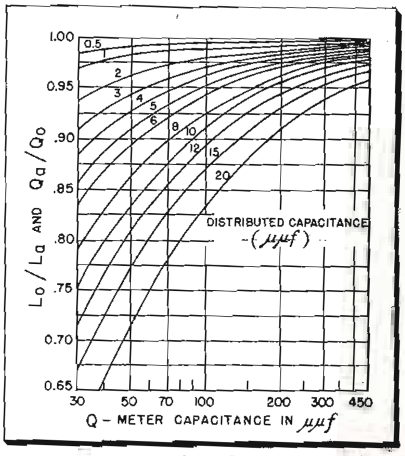
and the true Q equals,

$$Q_o = 198/0.9 = 220$$

Chart Functions

Although one function of this chart is to provide correction factors for distributed capacitance error, another is to inform and remind the engineer of the magnitude of error that exists when small values of tuning capacitance are used. Unless a specific frequency is required for the measurement of a coil, it is evident, from an examination of the chart, that for minimum distributed capacitance error, measuring frequencies should be selected that allow the coil to resonate with large values of Q-meter tuning capacitance.

It should be mentioned that this chart corrects only for distributed



Correction curves for Q-meter capacitance

capacitance error. At high frequencies the measured inductance is increased and the Q lowered by the internal series impedance of the Q circuit, while the input resistance of the Q voltmeter may reduce the measured Q at both very low and very high frequencies. A "Q-meter Correction Chart for Q Voltmeter Loading" is presented by the author in the Oct. 1952 issue of TELE-TECH.

Coupling Toroidal Coils

More widespread use of concentrated field coils has shown need for a simple method of coupling two or more coils together with precise, small coefficients of coupling

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In the design of today's electronic equipment more and more attention is being focused on the use of small size components. To this end, in many cases, toroidal coils are finding widespread use. They present many advantages in regard to size and electrical efficiency. It is perhaps unnecessary to recall that small size, high Q, and restricted fields requiring a minimum of shielding are the obvious advantages of this coil construction. These advantages are particularly evident in that part of the frequency spectrum where previous designs required large, heavy coils with very great care in regard to shielding. It is entirely possible with toroids to mount two such coils in close proximity with no shield between them and have negligible interaction.

But in spite of their widespread use, they are used very infrequently in the type of circuit where less than maximum possible coupling is required. It is common practice to use this type of construction where, as nearly as possible, unity coupling is desired. However, for such applications as i-f transformers and FM discriminators, where coupling in the order of critical is sought, this type of construction has found very little use. It is the purpose of this paper to present a method of obtaining such small values of coupling very precisely.

Coil Mutual Inductance

If we consider two coils coupled together, we may represent them as in Fig. 1. Here L_1 represents one coil having an internal resistance of R_1, and L_2 represents a second coil having an internal resistance of R_2. The mutual inductance between them is M and the leakage inductance of the first coil is L_1-M and the leakage inductance of the second coil is L_2-M. This is according to well-established transformer theory. For each, the inductance, with the other coil open, is L_1 or L_2, respectively. Our problem with toroids is that of making M small and precisely determined. Normally, if we use one core and wind two coils upon it we find that the coefficient of coupling with present-day core materials is in the order of 0.95; while in many cases, depending on other circuit parameters, the desired coefficient of coupling may be in the order of 0.01 to 0.1.

Common Core

Suppose we try to construct this configuration with toroids directly as in Fig. 2. L_1 and L_3 in this figure are two coils wound on a common toroidal core. L_2-L_3 is another coil wound on an entirely separate toroidal core. R_1 is the resistance of L_1 and R_2 is the resistance of the two coils L_2-L_3 and L_3 connected in series. L_1 will be made to have the inductance desired in L_1 of Fig. 1 and L_2 and L_3 together will have the inductance of L_2 in Fig. 1. The effective mutual inductance between L_1 and L_2 in Fig. 2 is M, which is the same value as M in Fig. 1, and the coefficient of coupling between L_1 and L_2 is, by definition, the quotient of M divided by the geometric mean of L_1 and L_2. If K_1 in Fig. 2 is the actual coefficient of coupling obtained between L_1 and L_3, resulting in a mutual inductance between these two coils of M_1, then we have the following:

$$M = M_1 \quad [1]$$

$$K\sqrt{L_1 L_2} = K_1\sqrt{L_1 L_3} \quad [2]$$

$$\sqrt{L_1 L_3}/\sqrt{L_1 L_2} = K/K_1 \quad [3]$$

$$\sqrt{L_3 / L_2} = K/K_1 \quad [4]$$

$$L_3 / L_2 = (K/K_1)^2 \quad [5]$$

$$L_3 = (K/K_1)^2 L_2 \quad [6]$$

$$L_2\text{-}L_3 = [1-(K/K_1)^2]\ L_2 \quad [7]$$

In practice, to obtain any desired value of coupling, Eqs. (6) and (7) give the values of inductance required, providing the actual coefficient of coupling which can be obtained is known. For a particular

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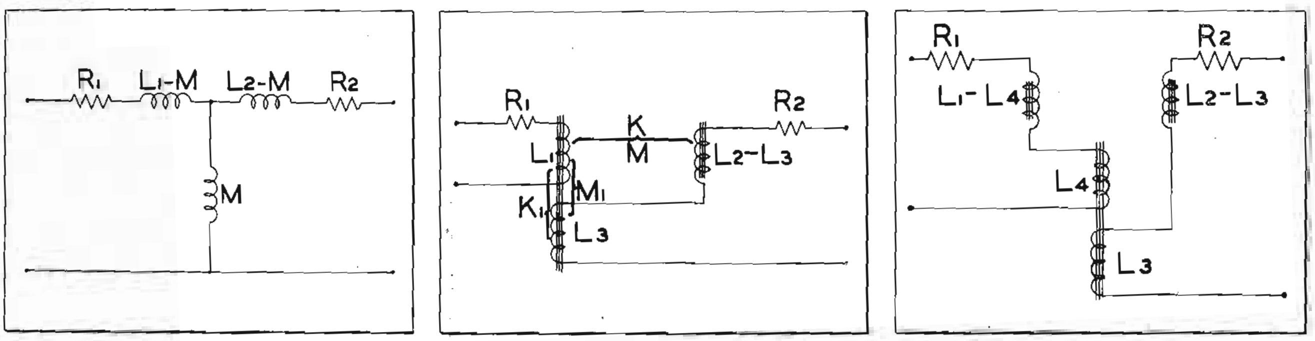
Figs. 1-3: (Left to right) Diagrams showing inductance-resistance conditions for two toroids in different circuit arrangements



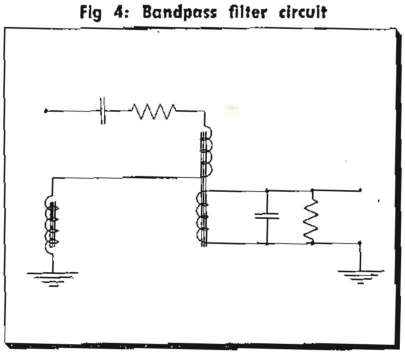
core the coil manufacturer can usually furnish this information and, of course, it is quite easy to determine experimentally. The design of the inductors themselves is usually a fairly simple problem for the coil manufacturer. In many cases, L_1 is a coil consisting of, perhaps, 200 turns. L_3 may be a single turn or, perhaps, three or four turns wound on top of L_1, and L_2 will be a coil of, perhaps, 200 turns. Such a combination may give, for example, an i-f transformer with dimensions of approximately ¾-in. cube. An FM discriminator transformer has been made using three toroids with two loops wound on one and connected in series with each of two other coils. It should be quite apparent that this method of coupling coils can be extended to any number of toroids coupled together, and is equally applicable to other types of construction, such as completely-enclosing core Universal-wound coils, coils with hypersil cores, and even coils wound upon standard E and I laminations.

Interchange of Coils

It should be equally apparent that, in a particular case, it may be necessary for L_1 of Fig. 2 to be the primary and L_2 of Fig. 2 the secondary or vice-versa, depending on the number of turns required in each of the two coils. If, in any particular case, L_2-L_3 should be found to be negative, it would indicate that L_1 and L_2 should be interchanged in their uses. In general, L_2 should be made to have the larger value of inductance, if there is a difference. In some cases, it may be desirable to use the configuration of Fig. 3. Probably this would be required only when extremely small values of coefficient of coupling are desired. In such cases, a change of one turn in L_3 of Fig. 2 can result in too great a change in mutual inductance.

The arrangement of Fig 3 gives a smaller value of mutual inductance per turn, so that these smaller values can be obtained more precisely. Furthermore, the core on

Fig 4: Bandpass filter circuit



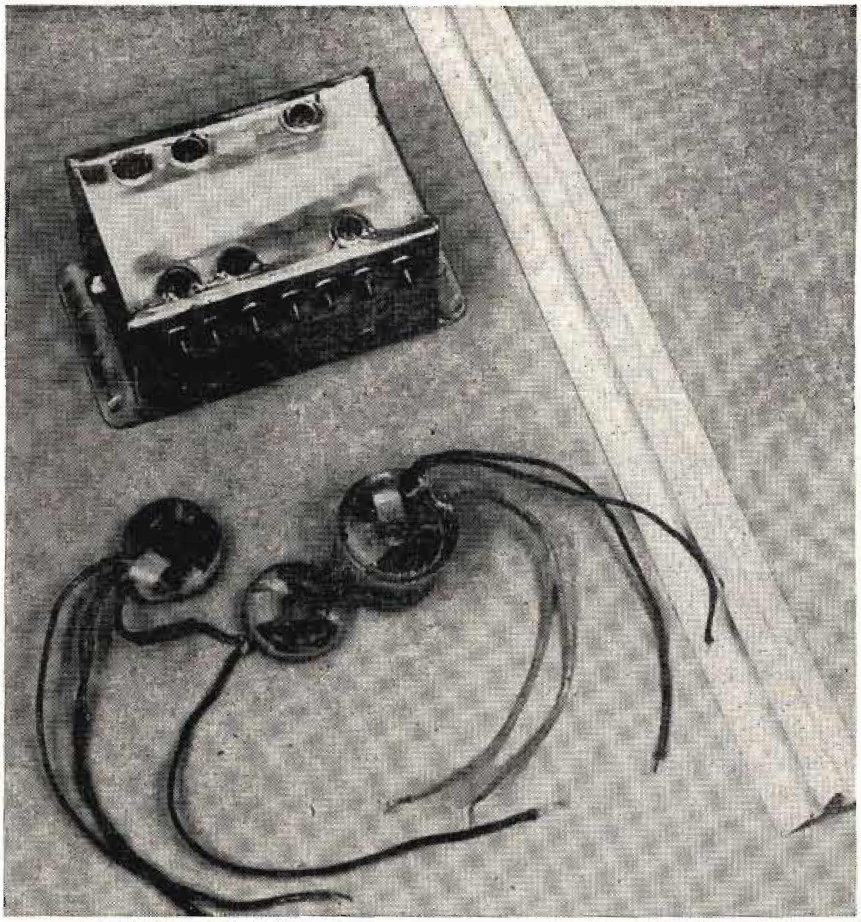


Fig. 5: Photo of bandpass filter (Fig. 4) showing various stages of construction

which L_3 and L_4 are wound can be different from the other two, so that still greater flexibility of design is obtained. The mathematical treatment of more complex cases follows that of the simpler case given above. In particular, the ratio of L_3 to L_2 and L_4 to L_1 in Fig. 3 can each be made equal to the ratio of K to K_1, rather than the square of the ratio of K to K_1, as was true with the arrangement of Fig. 2. Or, one of these ratios, say L_3 to L_2, might be made equal to the three-halves power of the ratio of K to K_1, and the other to the square root of the ratio of K to K_1. This would result in very small increments in mutual inductance for changes of one turn in L_3, so that the value of mutual inductance can be quite precisely predetermined.

Coupling Loop on Core

Fig. 4 is the circuit of a bandpass filter using this construction. Fig. 5 is a photograph of such a filter showing various stages of construction. The coupling loop in this particular case was wound on the core by the coil manufacturer when the coil was first made. The two coils, after all connections are made, are potted, using a thermosetting polyester resin. The canned unit contains three such assemblies with their associated capacitors and resistors. All the frequencies in this particular unit are in the audio region of the frequency spectrum.

Conclusions

The described method of coupling is very simple and precise. That it would give the desired results seems obvious, now that it has been in use for a period of time, but it does not seem to be generally known. This has been used with toroids in building i-f transformers, FM discriminators, bandpass filters, and other filter elements in the audio, supersonic and radio frequency portion of the spectrum up to about 2 MC. It has also been used with completely-enclosing core Universal-wound coils, where slug tuning was desired. In every case, greater uniformity of electrical characteristics has resulted during production runs. In one particular instance, previous design had used an iris between two coils which were completely enclosed otherwise. Rejections were very high. Since this method of coupling has been adopted, rejections are almost unheard of.

Voice Frequency Tone

Reliable system uses feedback-type selective circuits triggering in 300-3000 cps range eliminated by

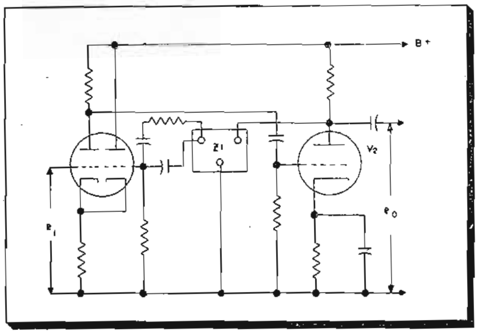


Fig. 1: Feedback-type selective amplifier limits tone frequency range to 300-3000 CPS

By C. L. ROUAULT
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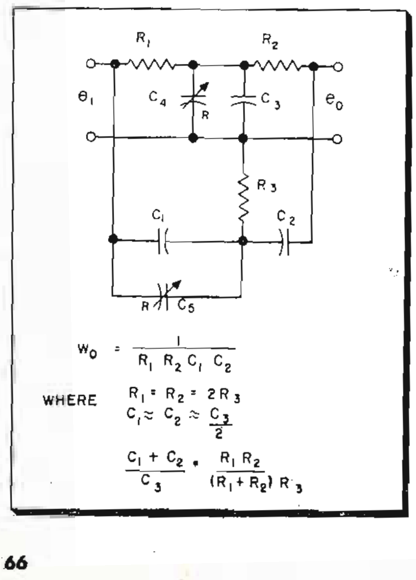
IN the radio communication field, the need for selective signaling devices has been recognized for the past several years, and many devices have been developed to satisfy the need. The devices which are described in this paper are the result of market analysis, experiment, and extensive field testing to make a system of voice-frequency, tone-signaling apparatus which substantially fills the need.

All such developments traverse a similar path, horse-sense analysis plus empirical ideas, through controlled experiment followed by formulation of a theory. When the process is repeated often enough, theoretical details are corroborated by experiment. The essential characteristics for a signaling system to be applied to radio communications systems were so developed.

1. The signals must be transmitted equally well over wire-line telephone-exchange facilities and r-f transmission paths.

Fig. 2: Network representation of amplifier



2. The signal should consist of audio tones in which only the frequency is used as a distinguishing characteristic.
3. The tone frequencies used must lie within the voice-frequency range 300-3000 CPS, in order to be usable over normal telephone circuits and to comply with International Radio regulations.
4. Because of the vagaries of r-f propagation, the signal should be completed in less than 0.5 second to insure reliable operation.
5. Since the tone signals must be in the voice band, there is a finite probability of simulation of the tone signals by voice. "Voice triggering" must be minimized by highly selective circuits and time-constants of the proper magnitude to comply with (4). Experimentally, it has been found that a circuit "Q" of approximately 200 and an integration time of the order of 0.1 second reduce the probability of "voice-triggering" to negligible values.
6. The intermodulation distortion of typical communication systems is very high so that the use of simultaneous tones should be avoided. The intermodulation process readily creates sum and difference frequencies which thereby generate false signals. When the investigation began this was only a subjective impression, later confirmed by measurements on typical systems. As a consequence, single or sequential tones should be used for selection.
7. Communication receivers of different manufacture tend to considerable uniformity at the output of the audio detector so the signal should be derived from this point. A further advantage of this point of "take-off" is the independence of volume control and squelch settings which would otherwise influence performance in a highly variable manner.
8. The coding system must be simple and direct; random codes must be avoided. This requires considerable elaboration and will be discussed when the selective calling system is described.
9. The devices should be as nearly all-electronic as possible.
10. The devices must function in the environments to which mobile communication systems are subjected.

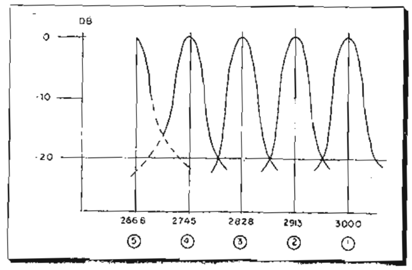


Fig. 3: Tone spectrum with 3% separation

Basic Elements

Selective Amplifier: The limitation of tone frequencies to the band 300-3000 CPS poses a difficult selective amplifier problem. For a solution there are several approaches, each of which have been described in the literature. It was finally decided to develop a feedback type selective amplifier, i.e., a linear amplifier employing frequency selective negative feedback (a parallel-T network).

From the literature reasonably useful theoretical analyses were obtained. For a very low-Q circuit the analyses were adequate, but for high-Q application considerable additional analytical work was necessary. As a feedback amplifier, the stability problem was complicated by the fact that a parallel-T network is not minimum-phase and the usual Nyquist criteria do not apply. The stability margins of the amplifier which has been developed are more than adequate to insure reliable operation under all conditions.

In Fig. 1, the selective amplifier is shown schematically. The A-circuit consists of $V1_a$ and $V2_a$, the β-circuit consists of Z_1 and $V1b_1$ with associated coupling networks. At resonance f_0, Z_1 attenuates 90 db or more, so the full forward gain (approximately 60 db) is attained from $V1_a$ grid to $V2_a$ plate. The Q of the selective circuit thus formed is approximately 200. The double-triode circuit is chosen for simplicity and

Signaling for Mobile Radio Systems

to signal mobile stations singly or by group. Voice using Q of 200, and integration time of 0.1 second

relative stability against changes in gain to filament and B+ voltage. This selective amplifier functions very satisfactorily over B+ variations of 100- 300 v. and filament variations 4-8 v. ac or dc.

Overall Performance

It is, of course, obvious that the overall performance of the entire device is proportional to the stability of Z_1. Z_1 is actually a slightly modified parallel-T network which is the result of the major part of the development effort. A large amount of painstaking trial and error plus analytical investigation may be summarized as follows (see Fig. 2):

1. The physical configuration of the assembly is extremely important. Shields and grounds must be properly located to minimize capacity from input to output of the network.
2. Even though there is an apparent gain in selectivity achieved by making the output impedance much greater than the input impedance, the most economical and efficient design is actually obtained by making the impedance equal.
3. The resistances must be wirewound, stabilized types, of as low a value as is consistent with the loading imposed on the circuit. The lower values of R minimize capacity troubles and make possible an unloaded termination.
4. The thermal stability is a function of the ratios $(C_1 + C_2)/C_3$ and $(R_1R_2)/(R_1 + R_2)R_3$. If the thermal coefficients of these ratios are balanced, the device will be stable. The range of variation of the individual coefficients is most important, so the only recourse is to statistical analysis. For the networks we have built to date the net coefficient is normally much less than the 15 ppm/°C maximum.
5. Each network must be tuned to a null which must exceed 90 db at f_0. We have consistently obtained stable 120 db nulls in factory test.

Stable Selective Amplifier

Stable selective amplifiers of the type described have been built to Q's as high as 700 and over the frequency range 300-20,000 CPS. For voice frequency tone signaling we have restricted the frequency range to 300-3000 CPS and have chosen a Q of 200. This choice of Q is determined by several considerations:

1. The rise time, $1/\pi\Delta f$, should be less than 0.1 second at the lowest tone frequency in use.
2. Within the audio band, the lowest value of Q consistent with reliable operation free of "voice triggering" has been experimentally determined to be approximately 200.
3. Experimentally, it has been found that 20 db rejection of the adjacent tone frequency is satisfactory.

These factors, plus the temperature drift consideration, establish a spacing of 3% as the most economical of frequency spectrum. The individual tone frequencies are obtained by using 3000 CPS as a base and counting downward. See Fig. 3.

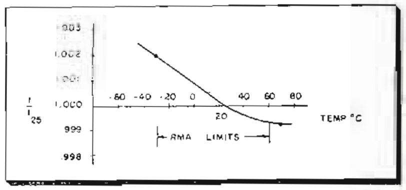
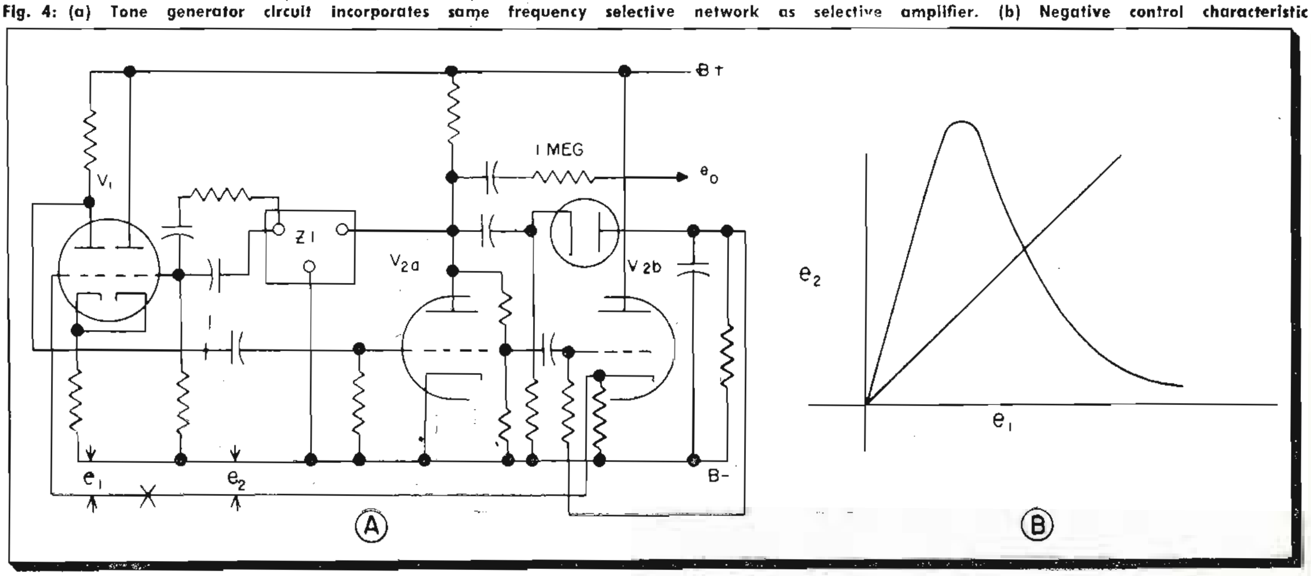


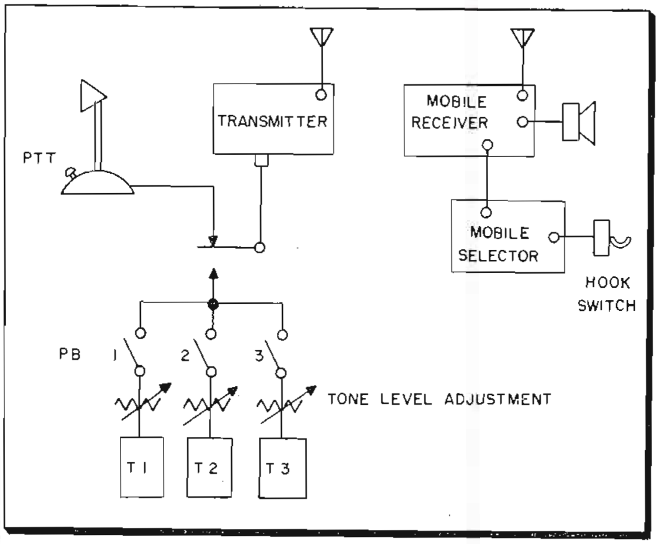
Fig. 5: Generator frequency-temperature curve

A stable selective amplifier is of little use unless the tone source is of equal or greater stability, particularly since it is necessary to assign a major portion of the system degradation to the devices employed in the mobile equipment.

Two kinds of errors arise in a frequency selective system—absolute and relative differences between the frequency generated and the frequency to which the selective amp-

Fig. 4: (a) Tone generator circuit incorporates same frequency selective network as selective amplifier. (b) Negative control characteristic





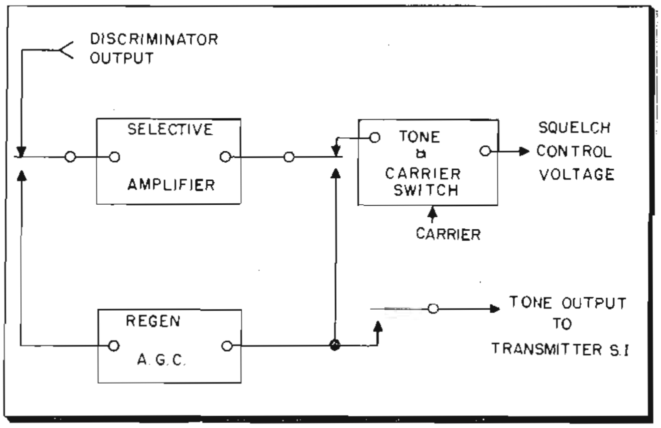


Fig. 6: (l) Selective dispatch system has only one adjustable control. Fig. 7: Duplex selector

lifier responds. The relative errors are a function of the thermal stabilities in different environments, but the absolute error may arise from entirely different considerations. If the selective circuits or the amplifiers differ then the processes of tuning, tube replacement, etc., may introduce large absolute errors.

Tone Generator

The tone generator which has been developed embodies a very satisfactory solution to the problems cited. It resembles to some extent the frequency-standard generator described by L. A. Meacham, and incorporates the fundamental ideas of Llwellyn. It is shown schematically in Fig. 4a. The salient points may be summarized as follows:

1. The amplifier, $V1_a$ and $V2_a$, operates in a linear manner. The interstage constants are essentially the same as those employed in the selective amplifier.
2. The frequency selective network is the same as used in the selective amplifier. It is operated from a voltage generator, into a cathode-follower $V1_b$, and is substantially unaffected by external circuits.
3. The regenerative feedback is controlled by an AGC circuit which yields a very satisfactory negative control characteristic. This circuit's characteristic is shown on Fig. 4b.

It will be noted that the output of the generator is a 1 meg. resistor which minimizes any effects of load impedance variation. The generator shown has proven extremely satisfactory for the purpose.

1. The absolute frequency error is negligible.
2. The frequency drift is negligible as a function of plate supply or filament supply voltage variation. In a typical instance, the frequency changed approximately 1 CPS out of 3000 when the plate supply voltage was varied from 80 to 400 v.
3. A typical variation of frequency as a function of temperature is given in Fig. 5. Since the selective amplifier is similar we have a good index of the thermal stability of the devices which incorporate these basic circuits.

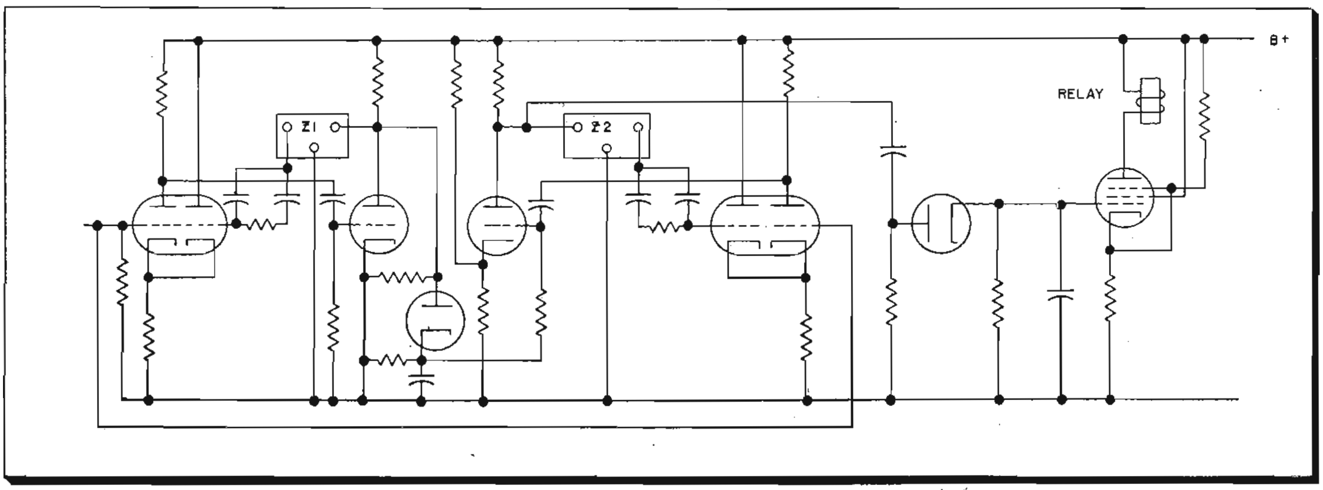
Sample Checks

In the course of testing this tone generator the agreement between theoretical and measured performance was found to be excellent. Due to the statiscal variation in components the values cited may be considered typical. Sample checks from time to time show no significant variations.

These two basic building blocks, the tone generator and selective amplifier, have been built in substantial quantities as parts of discreet pieces of equipment. To date no significant variations from pre-

(*Continued on page* 88)

Fig. 8: Mobile selector circuit has two selective amplifiers. First tone through first amplifier unblocks second-tone amplifier to operate relay



High-Efficiency Coolers for Power Tubes

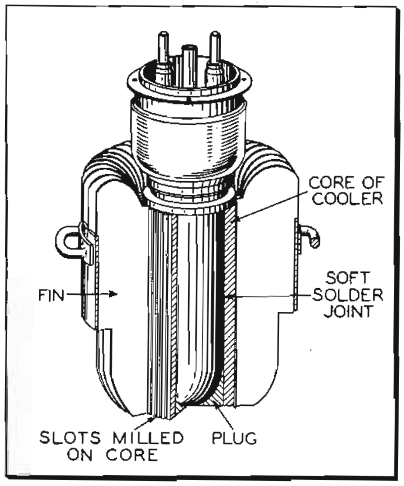


Fig. 1: Basic cooler design comprises thick-walled copper core, plug, and radial fin array

Heat transfer coefficient for transmitting tubes doubled with discontinuous fin structure in forced-air systems. New design prevents solder voids

By M. B. LEMESHKA & A. G. NEKUT
Tube Dept., Radio Corp. of America, Lancaster, Penna.

UNTIL recently there had been no significant change in the design of electron-tube coolers since their introduction in 1936. Now, however, a new design has been developed which reduces substantially both the weight and the air-flow requirements of coolers.

Because a portion of the power supplied to an electron tube is dissipated in the tube as heat, tube ratings are established which limit the temperature rise of the tube elements to a safe operating value. Forced cooling makes it possible to increase tube ratings beyond the values which would necessarily be assigned if natural cooling only were used. In addition, forced cooling permits a reduction in tube size, an important feature in the design of high-frequency tubes, even those having only moderate heat-dissipation requirements.

Additional Power

When forced or artificial cooling is employed, however, additional equipment and power are required. Equipment for forced-air cooling of the anode (where most of the power is dissipated) consists of (1) a metal-to-air heat exchanger (the cooler) and (2) the blower with its power source and appropriate ductwork. The main disadvantage of the conventional cooler is that its weight is usually many times that of the tube. Coolers for large power tubes may weigh up to 200 pounds. The conventional blower also may be large and bulky compared to other components of the installation, and its initial cost usually is considerable. It is advantageous, therefore, to reduce the required size of coolers and blowers as much as possible.

The basic design of most coolers now in use is illustrated in Fig. 1. The cooler consists of a thick-walled copper core, a copper plug, and a radial array of plane copper fins. The fins are fitted into longitudinal slots milled into the copper core and the parts are joined by means of silver-alloy brazing. The cooler is soldered to the copper anode of the tube after all assembly and exhaust operations have been completed on the tube structure. A soft solder, having a melting point of approximately 300 degrees Centigrade, is used because the high temperatures necessary for silver-alloy brazing would destroy the finished tube. It usually is not feasible to join the fins directly to the copper anodes of the larger tubes because of manufacturing considerations. In operation, air is forced between the fins of the cooler in a direction parallel to the core.

Cooler Design Factors

In seeking to reduce the air-flow requirements and the weight of coolers, the designer must take into account the following expression which gives the rate of heat loss from fin surfaces to an adjacent air stream:

$$q = h_c\ A\ \Delta t_m$$

where q = rate of heat loss from surface area of cooler in British thermal units per hour; h_c = film coefficient of heat transfer in British thermal units per hour per square foot per degree Fahrenheit; A = surface area of cooler in square feet.

Δt_m = mean temperature difference between the cooler surface and the air in degrees Fahrenheit.

For a given tube type, the rate of heat loss, q, is equal to the plate dissipation rating plus a fraction of the filament-power input and a fraction of the grid-dissipation power.

The mean temperature difference, Δt_m, depends upon the temperature of the incoming air and the maximum anode temperature rating of the tube. Because Δt_m is a *mean* temperature difference, it is determined not only by the rise in temperature of the air passing through the cooler, but also

Fig. 2: Discontinuous fin has edges of rib sections normal to air flow, increasing heat transfer

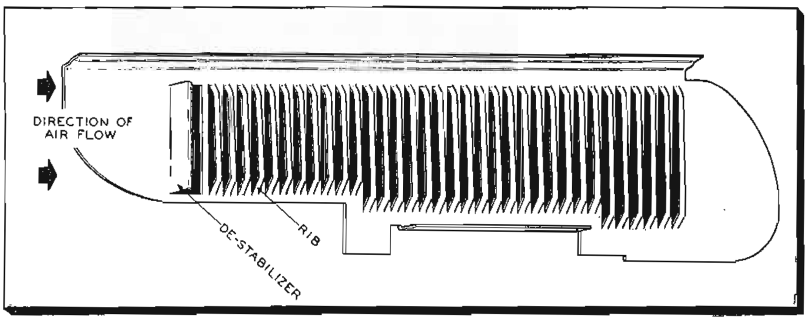
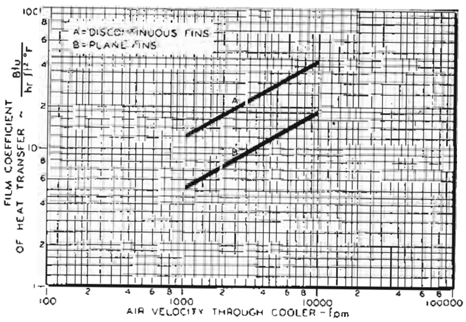


Fig. 3: Velocity-heat transfer characteristic



HIGH-EFFICIENCY COOLERS (Continued)

by the axial and radial temperature drops in the cooler core and fins. Methods for computing these temperature distributions have been published.[1] The maximum anode temperature rating of the tube is limited by the melting point of the solder used to join the anode to the cooler and also by the safe operating temperature of the anode with respect to gas evolution. It is evident, therefore, that the value of Δt_m cannot be increased arbitrarily by any large amount.

Heat Transfer

Any appreciable improvement in cooler performance or reduction in cooler weight, therefore, must be obtained by making changes in the film coefficient of heat transfer, h_c, and the surface area, A. It is usually possible to make appreciable gains in cooler performance by increasing the number of fins and decreasing their thickness, thus increasing A, the surface area. The usefulness of this approach is limited, however, by considerations of mechanical strength, especially in large-size coolers, by decreasing fin efficiency due to temperature drop along the fin, and by considerations of air-flow and pressure-drop.

Discontinuous Fins

Attempts to increase the film coefficient of heat transfer, h_c, by increasing the air velocity were not considered practical because the air pressure required across a cooler increases at least sixfold if the air velocity is to be raised sufficiently to double h_c. However, the use of another approach to the problem of increasing h_c which was described some years ago[2], led to the adaptation of a discontinuous fin structure for use in power-tube coolers.

Fig. 2 shows one form of the discontinuous fin with its ribbed structure. This discontinuous fin is made with a multiple punch-and-die set which divides a plane fin into a number of short sections, the leading and trailing edges of which will be normal to the direction of air flow. The width of the rib in the direction of air flow is generally made as small as possible. As can be seen from Fig. 3, for a given air velocity the film coefficient of heat transfer, h_c, for the new fin design is approximately twice that for the conventional plane fin. The significance of this increase in h_c can be noted from a comparison of the measurements made on two coolers. Both coolers were similar to that used on the RCA-5762 tube shown in Fig. 4 and the two were identical in size, weight, and number and thickness of fins. In both cases, 2.7 kw were dissipated in the anode as heat, and the amounts of air flow were adjusted so that the two anodes operated at the same temperature. As can be seen from the measurements given in Table 1, the conventional plane fin cooler requires an air flow of 275 cubic feet per minute, and the static pressure required to force this flow through the cooler is 1.81 inches water gauge. The new cooler employing discontinuous fins requires an air flow of only 130 cubic feet per minute, less than half the amount used in the conventional cooler, and the static pressure drop is 0.61 inches water gauge, approximately one-third that required for the conventional cooler. The product of air flow and static pressure, called the theoretical blower horse-power coefficient, is a criterion for comparing performance. It can be seen that the cooler employing discontinuous fins requires only 16 per cent of the theoretical blower horse-power needed for the plane-fin cooler. This reduced air requirement permits a reduction in size and cost of the blower required, and also makes quieter operation possible. In the case of the RCA-5762, weight reduction is relatively unimportant, because cooler weight is only 3-½ pounds; the advantage of the new fin design lies entirely in improved performance.

Weight Reduction

In other cases, however, it is desirable to increase h_c to obtain maximum weight reduction. Table II gives a comparison of the weights of both types of coolers for two tube types showing the reduction in weight ob-

Fig.4: RCA-5762 Power tube and cooler

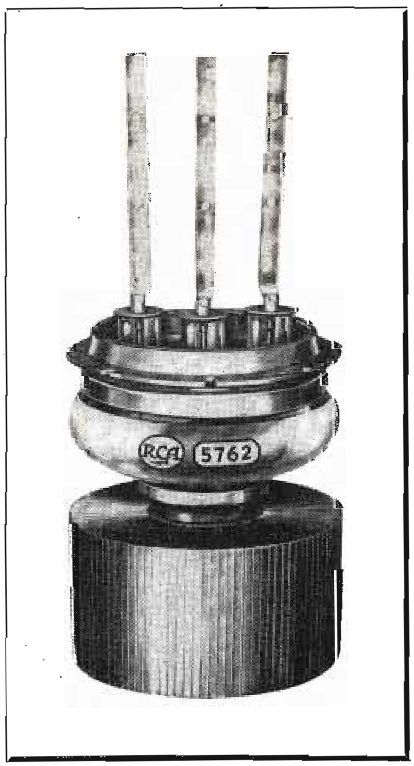
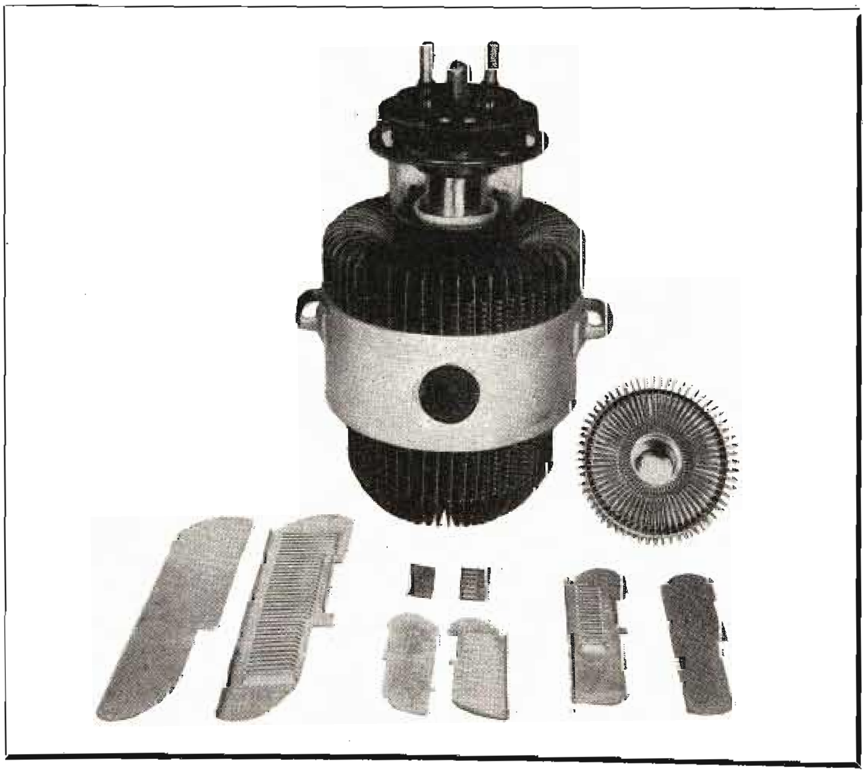


Fig. 5: Fin structure of several new cooler designs, including those listed in Table II



tained when the discontinuous-fin structure is used. Temperature and air-flow ratings remain the same for old and new coolers in this case. Several new cooler designs, including those listed in Table II, are shown in Fig. 5.

Theory of Operation

Some explanation can be given for the improved performance of the discontinuous fin compared with the conventional plane fin. Although the rate of heat transfer by forced convection between a solid and a fluid depends on many properties of the fluid, it is primarily a function of the thickness of a slow-moving layer of fluid immediately adjacent to the surface of the solid. For a given metal-air system and fixed air velocity, h_c is determined by this air-film thickness. A fin design which reduces this thickness makes possible an increase in performance and efficiency and a decrease in cooler weight. Fig. 6 shows the distribution of heat flow per unit area about a heated pipe of circular cross-section when placed in a unidirectional air stream. As can be seen, film conditions at the trailing and leading surfaces of the pipe are such that the heat flow is at a maximum there; heat flow from the sides is at a minimum. It may be postulated that analagous results are obtained with individual ribs of the discontinuous fin. Therefore, the leading and trailing surfaces of a pipe, bar, or fin are the most efficient heat-transfer surfaces. In the high-efficiency fin, the trailing and leading surfaces have been increased to a maximum.

TABLE I

PERFORMANCE OF SIMILAR COOLERS WITH DIFFERENT FIN STRUCTURES

Fin Structure	Air Flow cfm	Static Pressure in. of water	Blower Horse-Power Coefficient*
Plane	275	1.81	498
Discontinuous	130	0.61	79.4

Coolers: Similar to that on RCA-5762 except for fin structure.
Power Dissipation: 2.7 kw
Anode Temperature: 160 °C
* Air Flow X Static Pressure

When air was passed through the first test samples of discontinuous fin coolers, a series of loud, whistle-like tones were produced. The pitch could be changed by varying the velocity of the air. The changes in pitch occurred in discrete steps and were exactly reproducible as a function of velocity. Because these whistle-like tones are objectionable, the discontinuous fin in power tube applications must be made to operate quietly. It was noted with the sample coolers that the frequency of the tones corresponded to the harmonic sequence found in an open-ended organ pipe. In this type of organ pipe, a stable system of vortices is formed between the throat edge and the origin of the air stream directed upon the edge. This stable system of vortices in the air stream provides the periodic compressional pulses which produce a sustained tone when reinforced by a pipe length harmonically related to the frequency of the pulses.

TABLE II

COOLER WEIGHT REDUCTION

Tube Type	Initial Weight lbs	Redesign Weight lbs	Weight Saving lbs
RCA-889R-A	31.5	19.8	11.7
RCA-5671	195	90	105

To eliminate the tone it is necessary to destroy the stability of the system of vortices at the edge. The space enclosed by adjoining cooler fins appeared to be analogous to the open-ended organ pipe, and tests showed that the bottom rib served the same purpose as the edge in the throat of an organ pipe. For this reason, the specially shaped tab or "destabilizer" shown in Fig. 2 was inserted in the fin just before the bottom rib. The air stream flowing by this tab becomes very turbulent and has an irregular flow pattern, making impossible the stable system required to produce sound. After the "destabilizer" was incorporated, no whistling tones could be heard at any rate of air flow.

Thermal Bond Improvements

Another improvement in the design and fabrication of coolers made during this development is a novel method of mechanical assembly and brazing which assures that all of the fin-root area is thermally bonded to the core. In the old method of construction, axial slots were milled into the core tubing, as shown in Fig. 1. Brazing alloy foil and plane blanked fins were fitted into these slots and the entire assembly was placed in a fixture, which was then inserted into a brazing oven. The temperature controls governing the quality of brazing were necessarily indirect controls and no assurance that all of the fin-root area was thermally bonded to the core could be obtained without a destructive test.

In the new coolers, the fins form a lap joint with the core and a lap-and-lock joint with adjacent fins. In one method of fabrication used, the fin-and-core assembly is mounted on a rotating horizontal spindle and is heated to brazing temperature by oxyhydrogen burners in air. Complete visual control of the temperature is possible at all times. A rod of silver brazing alloy is inserted into a chamfered joint between fins and core at one end of the cooler. The brazing alloy melts and flows horizontally through the cooler between core and fins, displacing the brazing flux which had been applied prior to heating. When the alloy has emerged at the other end of the cooler, a perfect joint exists between the core and all points of the fin-root area. This new method provides assurance of improved quality of the thermal bond between the fins and the core.

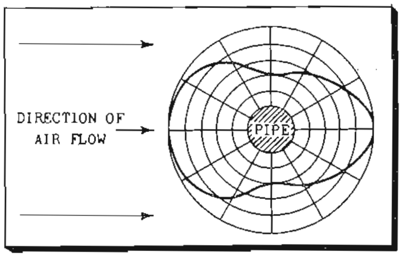


Fig. 6: Heat flow distribution in air stream

Thermal Path

The thermal path between the cooler fins and the tube anode is further improved by the addition of an excess-solder well to the core, as shown in Fig. 7b. The original core design is shown in Fig. 7a. Generally, a powertube cooler is thermally bonded to the tube anode by a solder joint. A quantity of solder is melted in the deep cup within the cooler core, the tube anode is inserted into the core, and the assembly is allowed to cool. This method has several shortcomings which seriously impair the quality of the thermal solder bond and result in excessive local anode temperatures or "hot-spots". These faults occur chiefly in the upper section of the core-to-anode joint and are caused by:

1. Voids developed during solidification of the solder.
2. Flux residue trapped in the thermally critical areas.

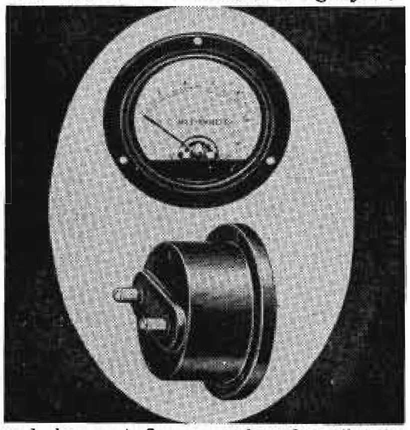
These sources of trouble were studied during tests in which glass tubes were substituted for cooler cores so that the flow and solidification of solder and flux could be witnessed. The voids developed as the solder solidified. They were caused by the contraction on solidification inherent in the solder (lead contracts almost

(Continued on page 112)

NEW EQUIPMENT for Designers and Engineers

Ruggedized Meters

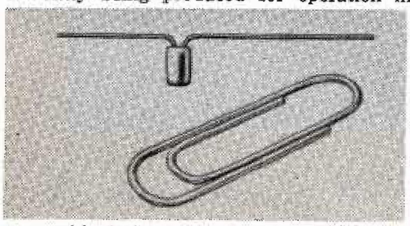
Shock mounted in a special low temperature rubber compound and bonded to the case, the meter movement is rigidly held



and does not flop around under vibration or shock in a new line of ruggedized meters. Jewels are mounted in a solid metal core and pivots are mechanically fastened on the inside of the moving coil. New type case has rear panel with screw type terminals to eliminate necessity of soldered connections. Case is permanently hermetically sealed at the factory; however, special case design and neoprene gasket permit opening and resealing of case with the use of simple tools. All internal parts, including resistors and multipliers are readily accessible.—**Hickok Electrical Instrument Co., 10606 Dupont Ave., Cleveland 8, Ohio.** —TELE-TECH

Selenium Diodes

Two new selenium diodes, type 1S1 and type 5U1 augment the line of eight types currently being produced for operation in



an ambient temperature range of 50 to 100°C. The type 1S1 is rated for a maximum input of 26 v. rms at 100 μamps output while the type 5U1 is rated for 130 v. The units are completely encapsulated within a thermosetting plastic. Type 5U1 is said to be ideal for obtaining a bias voltage in the order for 100 v. or more when connected directly to the 117 v. line. The output voltages available by the use of these diodes are 20 to 100 v. at currents of 100 μamps to 1.5 ma. The selenium diodes are extremely small in size, thereby facilitating wiring them into a crowded chassis.—**International Rectifier Corp., 1521 East Grand Ave., El Segundo, Calif.**—TELE-TECH

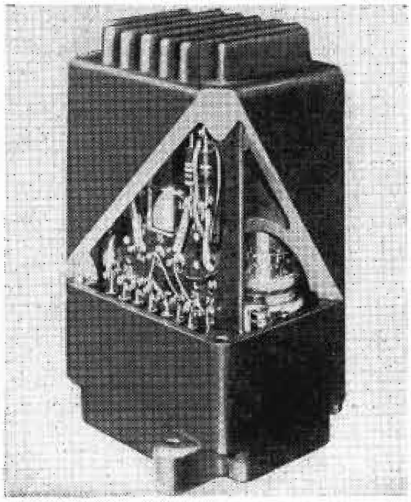
Electromagnetic Pick-Up

Model 3010 electromagnetic pick-up operates without physical contact when mounted near any moving magnetic material. It is an electrical impulse generating device that

produces a voltage output proportional to the rate of motion or speed of the magnetic object. It can be actuated by the keyway in a shaft, the teeth of a gear, the spokes of a wheel, a slot in the rim of a wheel or shaft, a screw head or pin on a moving part or any vibration or displacement of magnetic material in the field of the pick-up.—**Electro Products Laboratories, Inc., 4501 N. Ravenswood Ave., Chicago 40, Ill.**—TELE-TECH

Circuit Assemblies

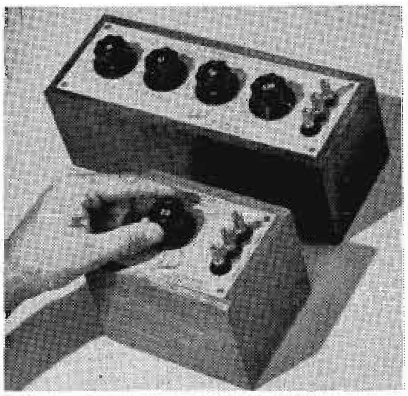
"Unistage" as a self-contained unit assembly in which 1 to 4-tube circuits may be constructed. The basic unit comprises: the die



cast aluminum housing; a terminal board having a large number of single and through terminals which are coded for easy assembly of components; the tube plate which allows the use of standard miniature and oval sockets; and the tube well or wells. Production and process engineering information is included. The manufacturer also custom-produces completed Unistage units with the specified circuitry.—**Technical Development Corp., 4036 Ince Boulevard, Culver City, Calif.**—TELE-TECH

Decade Inductors

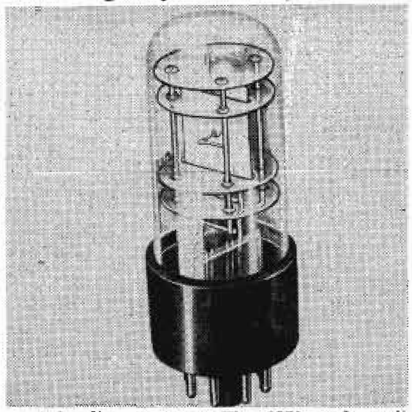
Inductance values guaranteed to within one percent are available with the new Lenkurt decade inductors. Four individual



units cover the ranges from 1 to 10 mh, 10 to 100 mh, 100 mh to 1 henry, and 1 to 10 henry. All four units are also available as a single unit to cover the complete range from 1 mh to 10 henry. Special ranges are available on request. Moisture resistant impregnated inductors are wound on molybdenum permalloy toroidal cores for high-Q and low external pickup. Each decade has complete electrostatic shielding. Full rotary switches for selecting inductance values have low contact resistance, laminated self-wiping contacts, and positive detents.—**Lenkurt Electric Co., 1116 County Road, San Carlos, Calif.**—TELE-TECH

Crystal

Typical application for the new G-9 and G-9J crystal is in establishing vertical and horizontal glide paths for airplane instru-



ment landing systems. The 1350 cycle unit can be divided by 15 and 9 to produce the 90 and 150 cycle standard frequencies. It is vacuum-sealed, wire-mounted with gold or silver plated crystal, octal base and 6V6GT envelope. The G-9 is available with frequency range from 4 KC to 300 KC; the G-9J from 1.2 KC to 10 KC.—**James Knights Co., Sandwich, Ill.**—TELE-TECH

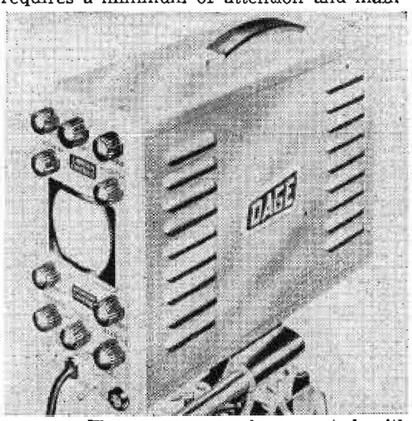
Triode

A new low microphonic subminiature triode, designated CK6247 (formally known as CK628), has a maximum noise output of

2.5 mv ac across 10,000 ohms in the plate circuit when the tube is subjected to vibrational acceleration of 15 g at 40 cps. The normal amplification factor rating is 60, and the mutual conductance rating 2500 μmhos with maximum allowable plate voltage of 275 v.—**Raytheon Manufacturing Co., Special Tube Section, 55 Chapel St., Newton 58, Mass.**—TELE-TECH

TV Camera

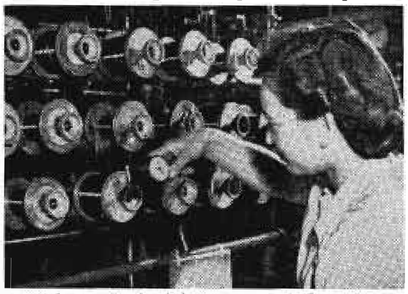
A portable, completely self-contained television camera has a simplified circuit that requires a minimum of attention and main-



tenance. The camera can be operated with any standard 16 mm lens, and is fitted for mounting. No special lighting, other than a normal room light, is necessary for operation. Once set for on-the-scene viewing, remote control is simply on-off power switching. The camera is equipped with a built-in view-finder.—**Dage Electronics Corp., 69 North 2nd St., Beech Grove, Ind.**

Tension Meter

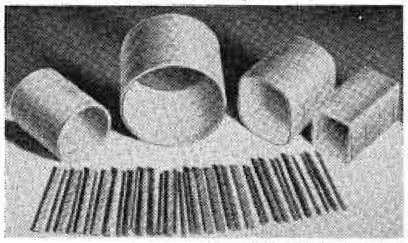
A new tension meter provides protection against improper settings during coiling, winding, forming, tinning, and lacquering



operations. It is trigger operated and can be quickly inserted into the moving wire which runs over ball-bearing pulleys of the meter. The manufacture of coils and filaments of greater electrical and mechanical uniformity with greater current carrying capacity and narrower limits of tolerance is said to be facilitated through its use.—**Saxl Instrument Co., Harvard, Mass.** —TELE-TECH

Paper Tubing

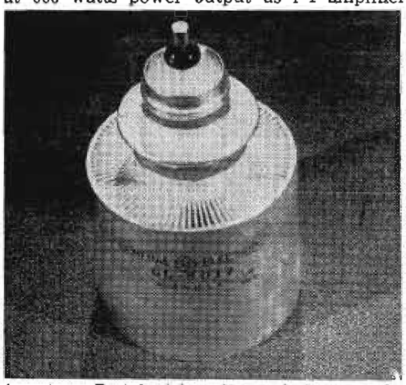
Square, rectangular and radiused paper tubes ranging in size up to 9 in. on either side and round tubes up to 9-in. inner



diameter are now available. Tubes are spirally-wound of dielectric kraft, fish paper, cellulose acetate or combinations to lengths as specified. Since they are produced on adjustable mandrils, any size from fractional-inch to maximum dimensions can be furnished without extra tooling charge. Acetate overwrap on kraft and fish paper tubes, varnish dip, or resinite impregnation can be had for special applications where increased dielectric properties and unusually high resistance to moisture and corrosion are essential.—**Precision Paper Tube Co., 2035 W. Charleston St., Chicago 47, Ill.** —TELE-TECH

Transmitting Tube

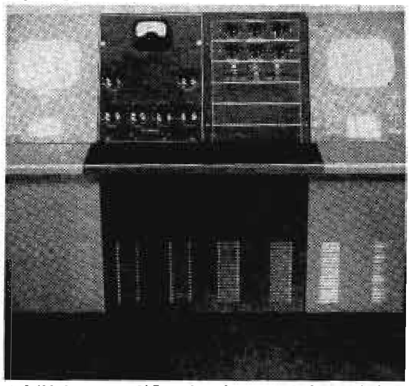
The third in a series of ceramic-and-metal envelope power transmitting tubes is rated at 660 watts power output as r-f amplifier



in class B television transmission service and 1,100 watts in class C telegraphy service. Unlike its predecessors, types GL-6019 and GL-6183 designed for UHF operation, the GL-6017 is a VHF tube. Forced air cooled and incorporating three electrodes, the GL-6017 can be used for grounded-grid operation. It may be operated in radio and other communications in class C grounded-grid service as a radio amplifier or oscillator. In television applications, it is particularly useful for operation in the 9 to 13 channel range (174-216 MC) but is rated for full output to 400 MC.—**General Electric Co., Syracuse, N. Y.**—TELE-TECH

TV Console

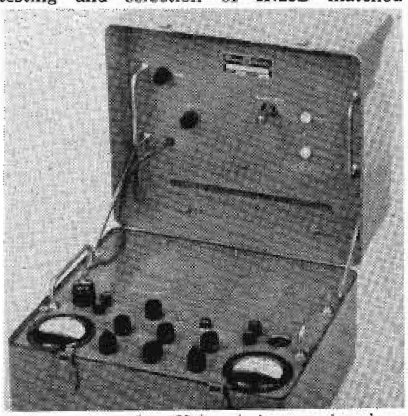
A two-section TV console (TC-4A) will provide centralized audio and video control and monitoring facilities. The left-hand audio-video section of the console contains the program switching controls, composed of one row of key switches for audio control, one row of pushbuttons for video control, a video clipfader control, and a tie switch which permits simultaneous audio-video switching from the video pushbuttons. This combined switching is accomplished by using relays and provides for eight inputs of audio and eight of video, with one output for each. The audio portion of the console provides for selecting among eight inputs, such as turntable, projector, studio, remote, or network, for transmission. The right-hand console houses all the remote controls necessary for basic programming. The two top panels control stabilizing amplifiers. One of these amplifiers is for network or remote signals, and the second is for controlling any signal to the transmitter. This second



stabilizing amplifier is also used for mixing sync and video signals. The third panel controls the film projectors and slide projectors. There is also room in this console section for additional control panels.—**Radio Corporation of America, RCA Victor Div., Camden, N. J.**—TELE-TECH

Crystal Test Set

The T104A crystal test is a portable, completely self-contained equipment for the field testing and selection of 1N23B matched



crystal pairs for X-band balanced mixer applications in the frequency range of 8500-9500 MC. Provision is made for testing pairs for crystal current balance, i-f impedance balance and leakage power (an indication of r-f impedance balance); the three characteristics for which test limits have been defined in the proposed JAN specification for 1N23B matched pairs. Specifically, the requirements are as follows: crystal current balance within 10% of the lower of the two readings; i-f impedance balance within 15 ohms; leakage power less than 10 %. The equipment consists of a 2K25 oscillator, a power-set attenuator, a frequency meter, a directional coupler for determining the leakage power test limit, two matched single-ended mixers for measuring leakage power, a balanced test mixer and the required power supply and switching circuitry. A vacuum tube voltmeter is included for the measurement of i-f impedance. Suitable switching permits the two indicators, a 0-1 MA meter and a null indicator, to serve multiple purposes. Critical circuit constants, however, are independent of switch position.—**Microwave Associates Inc., 22 Cummington St., Boston 15, Mass.**—TELE TECH

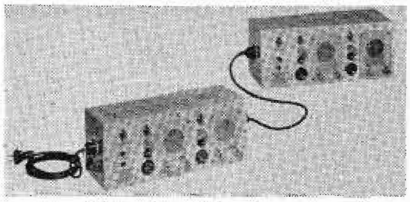
Square Wave Generator

Square waves at frequencies from 50 cps to 1 MC with a maximum rise-time of .05 micro seconds on all frequencies are

produced by type 150-A Square Wave Generator. Fixed frequencies are 50, 1,000, 10,000, 100,000, and 1,000,000 cps. Other frequencies are obtainable through the use of an external frequency-control capacitor for which terminals are provided. A pulse for oscilloscope synchronization is available. Output is controllable from 0-20 v. peak to peak and is constant at all frequency settings. Tilt and overshoot are negligible.—**New London Instrument Co., P.O. Box 189, New London, Connecticut.**—TELE-TECH

Cycling Timer

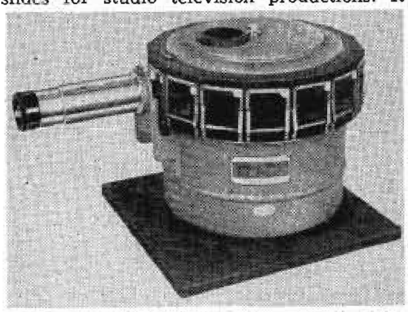
Set-up time required by the Add-A-Cycle Timer is reduced to a minimum through the use of plug-in adjustable timers, which



are supplied in six overlapping ranges, from 1.5-12 sec. to 15-120 minutes. Supplied as a basic unit with two plug-in positions, any number of timers may be cabled together and will cycle as a group, so that an unlimited number of time cycles may be obtained. Normal rating is 10 amps, 115 v., 60 cycles, but special ratings may be had upon request. For process timing the Add-A-Cycle is custom built in wall mounting cases with any required number of adjustable plug-in time cycles, which allows great flexibility and provides for easy servicing. Any cycle may be skipped without loss of time in the event any part of the process is temporarily out of use.—**Becker Equipment Co., 3020 N. Cicero Ave., Chicago 41, Ill.**—TELE-TECH

Slide Projector

A new automatic projector (TP-2A) presents either glass or cardboard-mounted slides for studio television productions. It



features a corrected, coated astigmatic 5-in. f3.5 lens to insure sharp, clear images; an indexed, rotatable turret accommodating 16 2-in. square slides which may be remotely controlled from the audio-video console; and built-in, forced-draft ventilating unit to cool the 100-watt lamp. Slides are arranged radially and detents accurately position the slides with reference to the lens. Operation of the projector is completely automatic, and the timing for each slide projected is controlled by pressing a button to rotate the turret. Approximate changing time is one second.—**RCA Victor Div., Radio Corp. of America, Camden, N. J.**—TELE-TECH

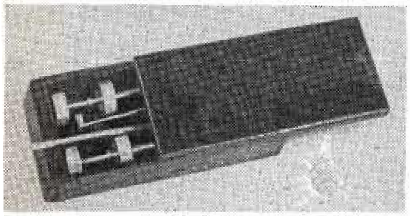
Telereader

Faster, more accurate measurements of film and oscillograph records are possible with the Universal Telereader. This unit

measures records ranging from 16 and 35mm film to 12 in. oscillograph paper up to 100 ft. long. It can handle either translucent or opaque records. Three interchangeable projection lenses are provided to permit record magnification of 2X, 4X and 11X. When used with companion instruments such as Telecomputing's Telecordex and summary punch, the Universal Telereader can print its measurements in decimal form on a typewriter supplied with the Telecordex, as well as recording such information into punched cards.—**Telecomputing Corporation, Burbank Calif.**—TELE-TECH

Setting & Locking Tools

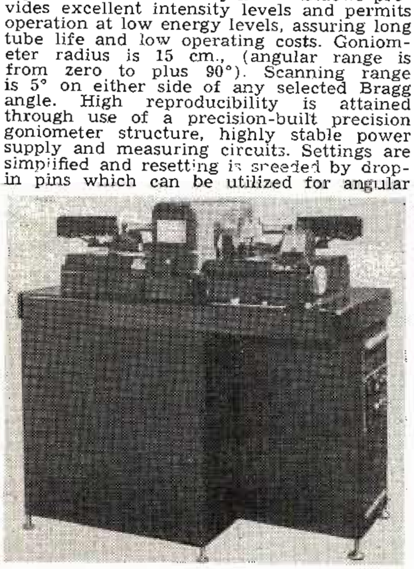
Tools for the setting and adjustment of adapters on synchros, resolvers and servo



motors are provided in a complete kit (K-101120). Four wrenches included are: Straight Pinion—K-101150; 90° Pinion—K-101170; Socket 13 Teeth—120 D.P.—K-101130; Socket 21 Teeth—120 D.P.—K-101140—**Kinetix Instrument Co., Inc., 902 Broadway, New York 10, N. Y.**—TELE-TECH

Crystal Orientation Unit

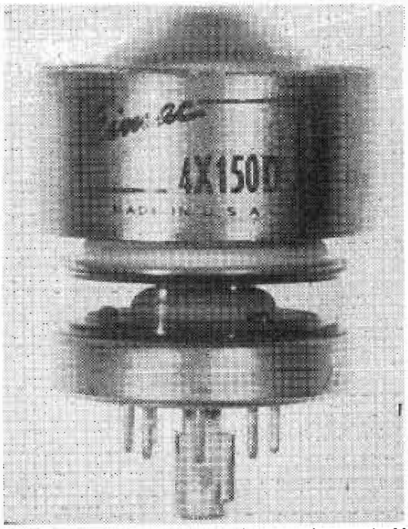
Measurements in quartz orientation can be held to tolerances of ±½ minute of arc with a crystal orientation unit. An improved x-ray tube with mica beryllium windows provides excellent intensity levels and permits operation at low energy levels, assuring long tube life and low operating costs. Goniometer radius is 15 cm., (angular range is from zero to plus 90°). Scanning range is 5° on either side of any selected Bragg angle. High reproducibility is attained through use of a precision-built precision goniometer structure, highly stable power supply and measuring circuits. Settings are simplified and resetting is speeded by drop-in pins which can be utilized for angular



positions which are used most frequently. Angles can be read direct on 3 drums. Special features of the new double quartz orientation equipment include: high capacity generator suitable for 25 KvP at 6 ma (normally operated at 5 ma); fixed kilovoltage; rapid settings for diverse cuts; operation on 200-240 v., 50 or 60 cycle, single phase ac self-rectification; air-cooled generator and x-ray tube; simple and rapid tube interchange; variable milliamperage; stable count-rate meter; and new high-output, line focus x-ray tube. The goniometer has been specially designed for quartz analysis and is direct reading. The fixed divergence slit measures 0.004 in., receiving slits for BT cuts measure 0.015 in. Gearing utilizes a precision hardened worm with a spring-loaded driver. Beam shutters are mechanical and are attached to the x-ray tube housing and the scatter shield. Crystal holder is built with carboloy bearing faces held to plus or minus 0.0002 in. with respect to the center line. Geiger counter is special design proportional unit of high sensitivity.—**North American Philips Co., Inc., 750 Fulton Ave., Mount Vernon, N. Y.**—TELE-TECH

Power Tetrode

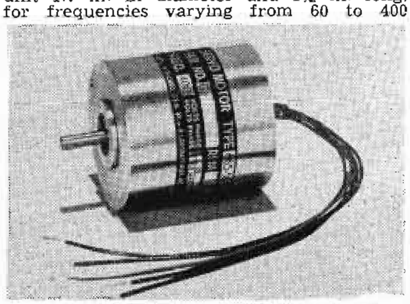
A radial-beam power tetrode (4X150D) has a heater rating of 26.5 v. at 0.57 amps. which makes it ideal for use in 28 v.



electrical systems. Size (two and one-half inches in length) and shape of the 4X150D is identical to the Eimac 4X150A and can be used with the Eimac 4X150A air-system socket. Like the 4X150A it is used as an oscillator, amplifier or frequency multiplier into UHF and has a plate dissipation rating of 150 watts in Class-C telegraphy or FM telephony service.—**Eitel-McCullough, Inc., San Bruno, Calif.**—TELE-TECH

Servo Motor

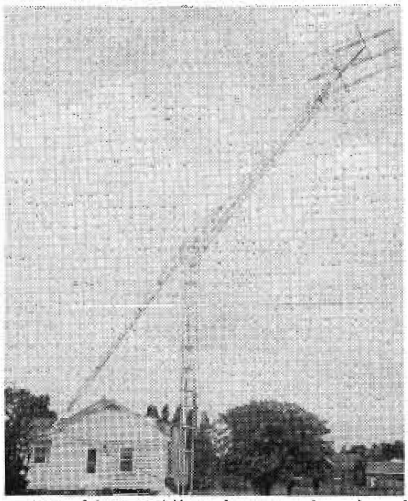
The G-M Precision motor is a small servo unit 1.7 in. in diameter and 1¾ in. long, for frequencies varying from 60 to 400



cycles, and in 2, 4 or 8 pole construction. One motor has even been supplied for 800 cycle use. Stall torque is approximately 2 in. oz., and in some instances well above that figure. Housings are stainless steel or aluminum. Output shaft can be supplied to suit, with or without integral pinion. The extreme precision required in these motors involves tolerances as small as ±0.0001. These motors can be supplied to meet rigid military specifications with regard to humidity, temperature, range, vibration and altitude.—**G-M Laboratories Inc., 4300 North Knox Ave., Chicago 41, Ill.**—TELE-TECH

Tower

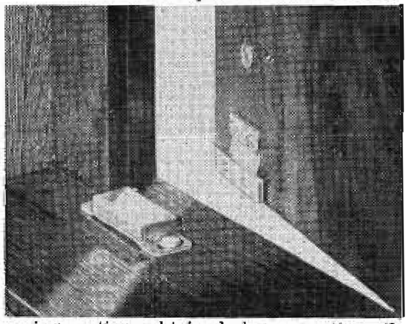
The "Fold-Over Tower" makes use of standard Rohn Tower sections and a "Fold-Over" Kit which consists of a short base



section, hinge section, boom and reel and cable mechanism. Hinges near the mid-section facilitate raising and lowering by merely turning the crank on the reel.—**Rohn Mfg. Co., 2108 Main St., Peoria, Ill.**—TELE-TECH

Magnetic Door Latch

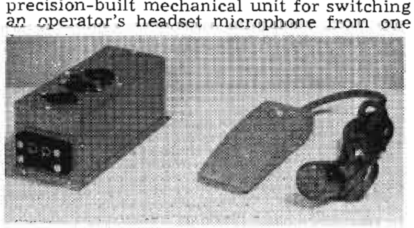
A new magnetic door latch will keep warped or sagging doors shut. Cabinet doors open and close easily due to an exclusive



spring action obtained by mounting the striker plate on a phosphor bronze leaf spring. Opening the door is easier because this spring tips the striker plate slightly away from the magnetic pull of the catch. The spring action also absorbs any closing impact. Even sagging or warped doors are kept firmly closed by the 3 lb. holding power of the Alnico permanent magnet. The magnet is permanently kept at the peak of its efficiency curve by means of a fixed air-gap. The device is said to last indefinitely because there are no working parts to wear out or get out of order.—**Heppner Sales Co., Round Lake, Ill.**—TELE-TECH

Microphone Control Switch

Model DFS-100 microphone control is a precision-built mechanical unit for switching an operator's headset microphone from one



communication system to another. The microphone control unit is operated by a "Micro-Switch" foot switch so that the operator's hands are free for logging or other functions. The circuit features a gang switching arrangement activated by solenoids energized by the closing of the foot switch. A load resistor is provided across the transmitting connections of the incoming circuit to prevent interruption of the connection while transmission is being made over the second communication system.—**American Radiotelephone Company, Inc., 3505 4th St. No., St. Petersburg, Fla.**—TELE-TECH


STANDARD ELECTRONIC COMPONENTS
For the past quarter of a century CINCH Components have filled the requirements developed by the rapid changes in the Electronics industry. Today, judged by demand and performance, CINCH is producing the STANDARD metal plastic assembly.
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Cinch components are available at leading Electronic jobbers—everywhere
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1026 South Homan Ave., Chicago 24, Illinois
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.

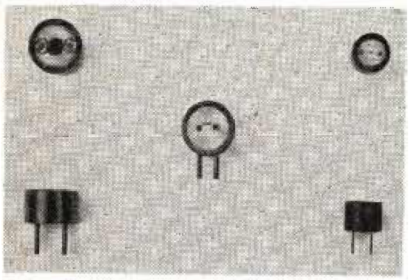
Ruggedized Meters

A new laboratory type instrument, available as a dc voltmeter, ac voltmeter and dc milliammeter, has been ruggedized for field

service. This instrument features 5 full-scale ranges, a range and scale changer which automatically changes meter electrical characteristics to correspond to the selected scale, a mirror scale for laboratory precision, 3-way binding posts, and a military type, ruggedized movement. Available singly and in sets of four, these units facilitate simultaneous measurement of 2 or more circuit characteristics.—**Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif.**—TELE-TECH

Photo Tubes

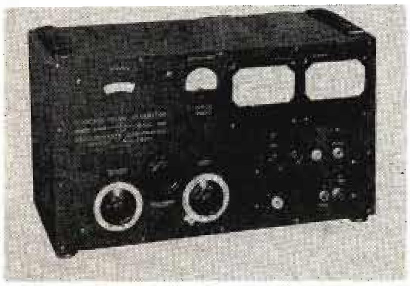
Particularly suitable for film sound pick-up and electric eye applications, two types of photo tubes are available. Lead sulphide



cell has peak spectral response at 1.5 microns, cuts off at 3.4 microns, and has time constant of 125 μsec. It has no response in the ultra-violet region. Cadmium sulphide type has peak response at 5300 A°, is sensitive to X rays, and has a time constant in the order of milliseconds. There is no response in the infra-red region in the cadmium sulphide cell. Also available are germanium junction-type power rectifiers with rms rating of 1.2 amps, 130 v. input. —**Lectro Max, Inc., 15 S. First St., Geneva, Ill.**—TELE-TECH

UHF Signal Generator

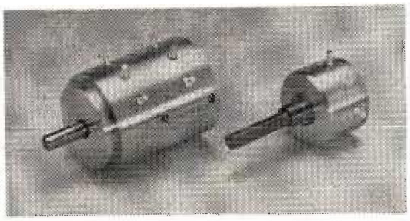
Standard signal generator, Model 84-TV, with frequency range of 300 to 1000 MC has output voltage continuously variable from 0.1μ v. to 1 v. across a 50 ohm load. The output impedance is 50 ohms and the VSWR is 1.3 to 1 or better. Provision is made for operating the filament of the oscillator tube from an external dc supply to remove residual hum. Modulation, continuously variable from 0 to 30%, may be obtained from an internal 400-cycle oscillator. Provision is also made for applying external modulation within the range of 50 to 20,000 cycles. Percentage modulation is indicated by a panel meter. Instrument is suited to



making direct gain measurements of r-f amplifiers and testing mobile communications receivers in the UHF range. It may also be used to drive slotted lines or other impedance measuring devices. Low harmonic content permits measurement of characteristics of UHF filters, traps, antennas, and matching networks.—**Measurements Corp., Boonton, N.J.**—TELE-TECH

Potentiometers

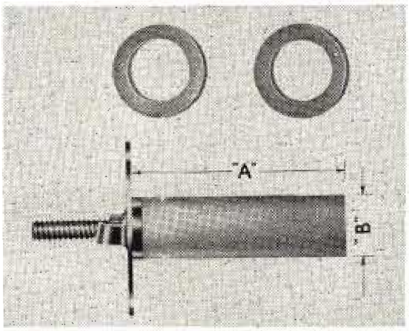
Type DS-6, ganged, 1⅝ in. dia. and type RAS-2, 1¼ in. dia. are two illustrative types of custom designed precision poten-



tiometers. Both linear and non-linear pots are designed to customer's requirements. Taps and special winding angles anywhere up to 360° continuous winding can be incorporated.—**Cornell Electronics Corp., 40-22 Main Ave., Douglaston, N.Y.**—TELE-TECH

Coil Forms

Small permeability-tuned ceramic coil forms designed primarily for high frequency applications, conform to government specifi-



cations. The form itself is made of Grade L 4 ceramic (JAN. 1-10). The base is silver-plated brass while the core is brass or iron. Nylon rings are provided to separate coils if more than one is wound on the same form. Small holes in these rings can be used to secure leads.—**National Co., 61 Sherman St., Malden, Mass.**—TELE-TECH

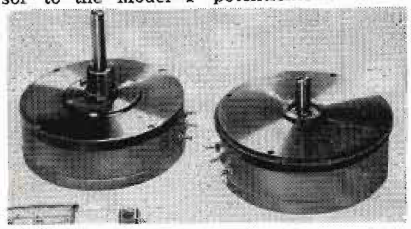
Selenium Rectifiers

A series of selenium rectifier power units has been announced that supply 115 or 230 v. dc from existing ac power lines. Starting

at 125 watts capacity, the series includes 42 standard models. Units are available for use with either 115, 230, or 440 v. 60 cycle ac. Key features are instantaneous operation, high overload capacity, and ease of installation. All units are housed in ventilated cabinets, fabricated of heavy gauge steel, and designed for wall mounting. Knockouts are provided for conduit entry, at several convenient locations. Fuses and terminal connections are readily accessible by means of hinged covers.—**Opad-Green Co., 71-24 Warren Street, New York 7, N. Y.**—TELE-TECH

Potentiometer

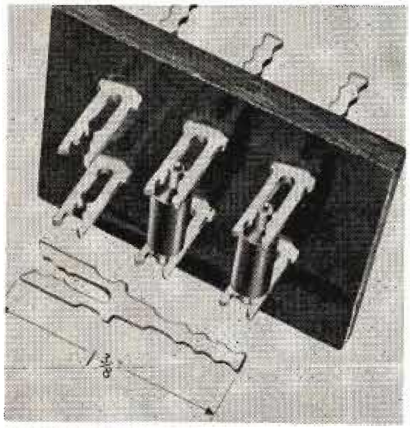
Model L/LS Series is an improved successor to the Model F potentiometer. These



new potentiometers are 3 in. in diameter instead of 3$\frac{5}{16}$ in. This series is superior to the Model F in that the design is more flexible and better adapted to the use of servo lids and ball bearings. It is gangable up to eight sections and more readily phaseable at the factory. Electrical characteristics are similar to its predecessor.—**Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif.**—TELE-TECH

Diode Clip

New diode clip permits easy insertion and removal of diodes. They require no rivets or other fasteners for mounting. The clip



is simply pressed into a hole on the diode board. Spring tension holds the diode securely in the clip, and a special plating assures excellent surface contact. Other advantages include greater ease in removing defective diodes, faster assembly of diode boards, and quicker initial check-out of finished equipment. They also facilitate preventive maintenance tests and the keeping of performance records on individual diodes. —**Computer Research Corp., 3348 W. El Segundo Blvd., Hawthorne, Calif.**—TELE-TECH

Wideband Directional Couplers

These new wideband directional couplers are available in three models, 137 and 138 for the frequency range 30 to 1500 MC, and 139 for the frequency range 10 KC to 1 MC. Using these couplers, with suitable additional instrumentation, reflection coefficient can be determined directly, thus simplifying several important transmission-line measurements: (1) With a continuously-displayed indication of reflection coefficient, load-matching is made an extremely rapid and simple operation since the effect of adjustments can be seen immediately; (2) Load impedance can be measured in terms of characteristic line impedance and reflection coefficient with the result that any impedance can be accurately

measured; (3) Magnitude of power delivered to a specific load can be measured regardless of the length of intervening line and the degree of mismatch between line and load.—**Sierra Electronic Corp., 817 Brittan Ave., San Carlos, Calif.**—TELE-TECH

MICROWAVE RECEIVERS

WIDE BAND • HIGH SENSITIVITY

POLARAD SCORES AGAIN

The first . . . the only MICROWAVE RECEIVERS to cover wide frequency ranges.

1,000 to 10,750 mc.

Microwave receivers of high sensitivity, wide tuning range and selectivity. Image rejection is greater than 60 db. Gain stability better than ± 2 db, permits application as a field intensity meter. Extra large dials enable frequency to be clearly read to an accuracy of 2%. Video bandwidth is 3.0 mc. Input power required is 105-125 v, 50/1000 cps.

- Single Dial Tuning
- Low Noise Figure
- Tracked R.F. Preselection, Triple-Tuned
- Linear db Output Indication
- AM-FM Reception
- Video Output — 10 v Pulse across 100 ohms
- Audio — BFO
- Recorder Output
- Provisions for Using external Attenuators in I.F. Channel
- Frequency Calibration Accuracy — 2%
- Separate Audio & Video Channels
- AFC
- Calibrated Tuning Meter

Polarad
Electronics Corporation

100 METROPOLITAN AVE. • BROOKLYN 11, N. Y.
STagg 2-3464

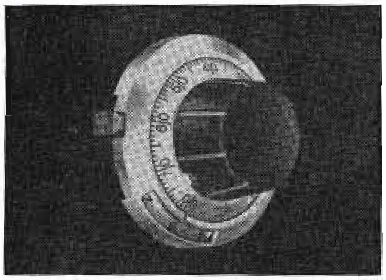
Oscillators

High stability and accurate, quickly resettable tuning circuits are features of models 200AB and 200CD oscillators. Model

200AB, for general audio tests, offers a frequency range of 20 cps to 40 KC and a full watt output. Model 200CD, for wide-range measurements at lower power levels, provides constant voltage output from 5 cps to 600 KC. Both instruments are adjusted and calibrated to meet exact frequency and performance specifications. An output amplifier provides complete isolation of the load, and changes in output load do not change oscillator performance. Frequency stability is better than ±2% including warmup, and hum voltage is less than 0.1% rated output.—**Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.**—TELE-TECH

Potentiometer Dial

Model RA Duodial gives a continuous indication of the sliding contact position in a multi-turn potentiometer. The outer



"secondary" dial, whose numerals appear in the opening, indicates which of the helical turns the slider is on. The inner (primary) dial, connected directly to the potentiometer shaft, is calibrated from 0 to 100 and indicates slider position within any given turn. No backlash error is possible in the RA because of the direct coupling of knob, dial, and shaft. This together with the fact no worm gears are employed, permits use of the Duodial with potentiometers that are driven by power devices attached to rear shaft extensions.—**Helipot Corp., South Pasadena, Calif.**—TELE-TECH

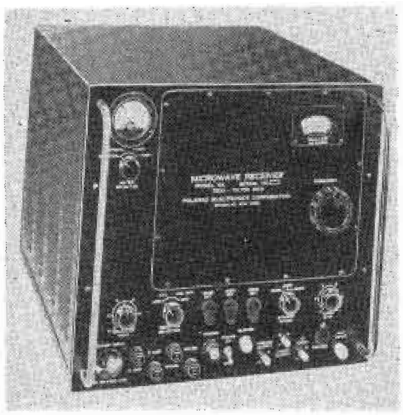
Dummy Loads

High power dummy loads which have a peak power rating equivalent to rigid waveguide accommodates power levels up to the breakdown level of the waveguide size for which they are intended. They have a built-

in metallic taper in the broad faces of the guide which provide for uniform power dissipation over the total finned area, reducing "hot" spots. Dummy loads are available with an average power dissipation equal to or greater than any existing radar system today and for the peak power rating of rigid waveguide. They are available in all waveguide sizes from 1 x ½ to 3 x 1½ in.—**Airtron, Inc., 20 E. Elizabeth Ave., Linden, N. J.**—TELE-TECH

Microwave Receivers

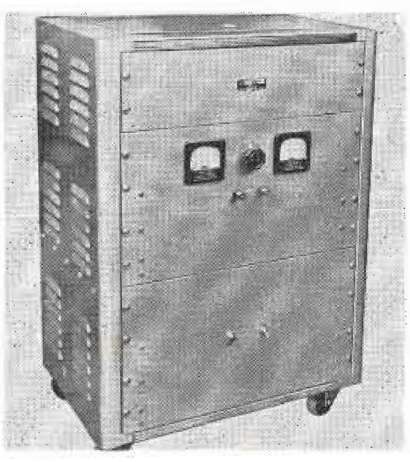
A series of four microwave receivers are available covering the frequency range from 100 to 10.750 MC. Triple tuned r-f preselection insures high image rejection. High order of gain stability permits application as a field intensity meter. Frequency stability permits accuracy of reading of better than 2%. Receivers include linear db indication, single dial tuning, low noise figure, AM-



FM reception, and AFC. The video bandwidth is such that a 1 μsecond undistorted pulse of 10 v. will appear across an output impedance of 100 ohms. Model RL covers the range from 1000 to 2100 MC; Model RS, 2000 to 4500 MC; Model RM, 4400 to 8400 MC; Model RX, 7000 to 10,750 MC.—**Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn, N. Y.**—TELE-TECH

Regulated Power Supply

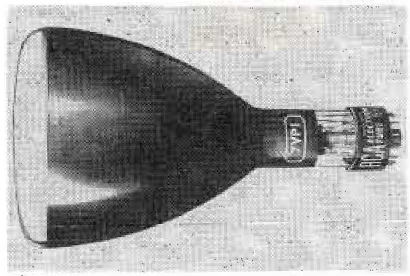
Newest in a standard line of electronic regulated power supply units, is the model AEC-1030, which was designed to produce a regulated 115 volt ac output at frequencies other than 60 cycle. The frequency range is 3600-4000 cycles, with other frequency ranges available on request. Frequency calibration and stability is better than 2% under normal temperature conditions. Regulations



from 0-3 amp load is ±5%. The set operates from 115 volts ac, 50-60 cycle line. The unit is assembled with standard 19 in. panels and equipped with voltmeter and ammeter. Available in either standard rack mounting or fully cased for bench use. —**American Electroneering Corp., 5029 W. Jefferson Blvd., Los Angeles 16, Calif.**—TELE-TECH

Oscillograph Tube

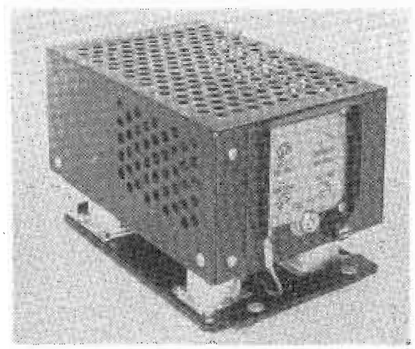
Using electrostatic focus and electrostatic deflection, the Type 7VP1 for general applications has a medium-persistence, green-fluorescent screen. This tube supersedes the 7JP1, and replaces the older type where high-voltage is not more than 4000 v. Heater rating is 6.3 v., 0.6 amp. Bulb diameter is 7 in., length 14.5 in., and weighs 3 lbs. Base



is medium-shell diheptal 12-pin. Maximum voltage ratings are: accelerating, 4000 v., grid no. 3, 2000 v., grid no. 1, negative bias 200 v. and positive peak 2 v.; heater-cathode 125 v. Maximum circuit resistance values are: grid no. 1, 1.5 meg; deflecting electrode, 5.0 meg.—**Tube Dept., Radio Corporation of America, Harrison, N. J.**—TELE-TECH

Static Converter

The Type E-1 static converter, 400-cycle regulated power supply will operate at altitudes up to 60,000 ft. Input voltage is 110-120 v., 380-420 CPS, single phase. Output is 300 v, dc, 0-400 ma. Regulation is ½% for no load to 300 v, or for 105-125 v. line



variations. Ripple is less than 80 mv, and power consumption is 300 watts. Within 1%, voltage output remains constant from −65°C to 85°C. Dimension are 9 x 5⅝ x 5$\frac{5}{16}$ in., and weight is 8.5 lbs. Price is $125.—**Mercury Electronic Co., Red Bank, N.J.**—TELE-TECH

High-Vacuum Rectifier

Model GL-6087 full-wave, high-vacuum rectifier is designed for use in aircraft power supply units of moderate current requirements. It may be used as a replacement for the 5Y3GT. The tube may be used in applications which are subject to altitudes as high as 60,000 ft. It will withstand a peak impact acceleration of 700 G in any direction. Through use of a unipotential cathode which is internally connected to the filament, excessive surge voltages across the filter input capacitors during the warm-up

period are avoided. Maximum ratings include a peak inverse plate voltage of 1400 v. at altitudes up to 60,000 ft. and a steady-state peak plate current of 375 ma per plate. In typical operation, the dc output current is 125 ma.—**General Electric Co., Tube Dept., 1 River Road, Schenectady 5, N. Y.**—TELE-TECH

The ONLY COAXIAL CONNECTOR with All of these Features . . .

Quick Connect-Disconnect

Basic elements of the Type 874 connector: inner conductor, outer conductor and supporting polystyrene bead. The overlapping portion of the connection is a uniform coaxial section

Identical Connectors

— No male-female parts

NEW Adaptors

from Type 874 Connectors to male and female versions of the Type N, Type C, Type BNC and UHF Connectors for easy use with other equipment

Low VSWR *less than 1.05 to 4,000 Mc*

Unparalleled convenience in use and excellent electrical uniformity at all frequencies from 0 to 5,000 Mc, make the Type 874 Coaxial Connector the ideal laboratory connector. Intended for the laboratory rather than for the field, it is designed for quick connect and disconnect instrument-use and not as a system connector with locking junctions and pressurizing.

★ *Complication of male and female assemblies is completely eliminated — all Type 874 Connectors are identical and plug smoothly into each other — connections can be broken quickly and conveniently — no intermediate elements needed*

★ *Strong friction grip is made by multiple spring-loaded contacts — no special tools or locking required*

★ *Reflections are small — they can be neglected in most measurements — VSWR is less than 1.05 to 4,000 Mc.*

★ *External fields from connector are negligible*

★ *Characteristic impedance 50 ohms — the Industry and Armed Forces standard*

★ *Basic connector is inexpensive; only $1.25*

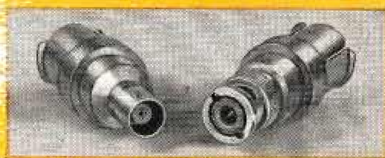
★ *Type 874 Connectors are made in several models for mounting on panels or for connecting to solid outer connector or flexible coaxial lines. They all accept Type 274 banana plugs for low-frequency use*

★ *Type 874 Connectors are also available in G-R Coaxial Elements and systems of all kinds, including such items as slotted lines, attenuators, thermistor mounts, stubs, tees and many other line elements.*

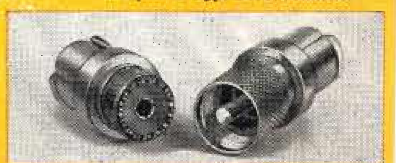
The excellent electrical characteristics of the Type 874 Connector, along with the variety of measuring instruments available, make this very flexible equipment ideal for measurements in the v-h-f and u-h-f bands

G-R Type 874-QNP & -QNJ Adaptor to Type N Connector

G-R Type 874-QCJ & -QCP Adaptor to Type C Connector



G-R Type 874-QBJ & -QBP Adaptor to Type BNC Connector



G-R Type 874-QUJ & -QUP Adaptor to UHF Connector

GENERAL RADIO Company

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WASHINGTON
News Letter

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

THAW REALLY STARTS—The FCC Commissioners and staff have carried on at full speed the processing of the uncontested applications for television stations, both VHF and UHF, since October 20, without consideration of those applications which will require hearings and decisions on the granting or denial of channels. Paper work by the applicant stations and by the FCC was thus reduced to a minimum to permit the Commission to approve speedily the uncontested applications.

750 TV APPLICATIONS, 300 UHF—The new policy has enabled the FCC to sanction video stations in many communities which did not have TV service. More than 750 station applications, including around 300 UHF, constituted the backlog of the FCC at the press deadline of TELE-TECH and, while the applications were continuing to flow in during October, the Commission cut back the backlog by its speeded-up processing of uncontested station applications.

FCC AIDED BY INDUSTRY'S ENGINEERS—The television engineering experts of the manufacturing and telecasting industries have given the FCC substantial assistance in the Commission's problems in its formulation of rules on television-receiver engineering standards. The problems which the industry experts have endeavored to solve with the best engineering standards feasible have been on VHF and UHF oscillator radiation, interference resulting from television sweep circuit radiation, spurious receiver responses and radiation from tuners and adapters being developed to enable existing VHF sets to receive UHF video signals.

RTMA COMMITTEE TESTS RADIATION—The engineering committee of the Radio Television Manufacturers Association has completed tests on 1952 television receivers to see whether they have met the radiation standards recommended by RTMA, and made its report to the FCC late in October. The RTMA engineering group also was slated to submit recommendations on UHF receiver standards on radiation during the early part of November.

ALMOST COMPLETE OVERHAUL—Through its own research and development programs and close cooperation with the communications-electronics industry in the design and production of equipment for military needs, the U. S. Army Signal Corps since the end of World War II has almost completely overhauled its procurement items to give the military forces the most improved and modernized equipment available and, at the same time, has effected substantial economies, reducing expenditures by millions of dollars.

KOREAN ELECTRONICS SURPASSES WORLD WAR TWO—The Signal Corps' progress has meant that the military forces in the Korean fighting have radio and electronic apparatus and systems which are to a major degree superior to those used in combat operations during World War II. Emphasis in the modernization and improvement of the apparatus has been to make the equipment lighter in weight, more rugged and efficient and able to withstand all ranges of climate and temperatures. The electronic-radio manufacturing industry has contributed many most valuable suggestions for expediting production and improvement of the equipment for the combat troops.

THEATER TV—By the end of this year the American Telephone & Telegraph Co. plans to supply the motion picture industry with useful costs data on broadband microwave radio relay systems for the transmission of color video programs to film theaters. This has narrowed down the areas of disagreement between the A.T.&T. and the motion-picture industry on future plans for theater television.

NEW MOBILE FIELD—With equipment suitable for mobile radio service in the 450-460 megacycle band becoming available in quantity, and with the new FCC rules for that frequency range providing greater flexibility in frequency assignments, this band is seen as the next spectrum operating space for many of the mobile radio services which have reached saturation in operation in the heavily used VHF frequencies.

NEW ASSIGNMENTS—Five radio services—the domestic public, remote pickup broadcast, industrial, land transportation and public safety, such as police and fire departments—are slated to receive new frequency assignments in the 450-460 mc band as soon as the FCC rules for such allocations are finalized during early November.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington, Editor

TELE-TECH's NEWSCAST

WCEMA to Celebrate Tenth Birthday

Plans to celebrate the tenth anniversary of the West Coast Electronic Manufacturers' Association, including the declaration of an "Electronics Week," Nov. 10-14, are announced by Leon Ungar, WCEMA president.

Formed in 1943 when the rapid growth of the industry during World War II showed the need for such an organization, the WCEMA currently comprises more than 100 corporate members representing the largest radio-electronic manufacturers in the West.

Highlighting the celebration will be the dinner at the newly-completed Hotel Statler in Los Angeles, Thursday, Nov. 13.

Present at the dinner will be industrial, civic and governmental leaders, including the past presidents of the WCEMA.

The WCEMA, which also sponsors the annual Western Electronic Show and Convention, is a trade organization whose members employ more than 32,000 workers along the West Coast. It is comprised of two councils, the Los Angeles Council and the San Francisco Council.

AES Convention Program

The fourth annual convention of the Audio Engineering Society will be held in conjunction with the Audio Fair at the Hotel New Yorker in New York City, Oct. 29-Nov. 1. According to lastest information received, the technical papers listed below supplement the program on pages 89 and 106 of the Oct. 1952 issue of TELE-TECH.

"Constant-Current Operation of Power Amplifiers," H. T. Sterling, Waveforms, Inc., and A. Sobel, Freed Radio Corp.
"Some Consideration Regarding Volume Production of Electronic Musical Instruments," G. H. Hadden, Minshall-Estey Organ, Inc.
"Intermodulation Measurements," H. H. Scott, Hermon Hosmer Scott, Inc.
"Comparative Study of Methods for Measuring Nonlinear Distortion in Broadcasting Audio Facilities," D. E. Maxwell, General Electric Co.
"Attenuator Types and Their Applications," C. F. Scott, Daven Co.
"Network Transformations." L. Norde, Hammarlund Mfg. Co.
"Binaural Sound Reproduction at Home," H. T. Sherman, Sherman Studio.

UHF 15KW KLYSTRON

Full-scale model of GL-6241, GE's new 15 KW klystron developed by Varian Associates of San Carlos, Calif. on display at the recent National Electronics Conference in Chicago. John E. Nelson of Schnectady, N. Y. points out features of new tube which measures 4½ ft. long. and weighs 200 lbs. WHUM-TV of Reading, Pa., will be first UHF station to employ this tube type.

12TH TV TECHNICAL TRAINING PROGRAM AT RCA

Foreign broadcasters attending the 12th TV Technical Training Program sponsored by RCA Engineering Products Dept. examine UHF filter and diplexer system at Camden plant. E. T. Griffith explains details to (l to r) Jose Tores, Havana, Cuba; Eduardo Cabrera, Caracas, Venezuela; J. P. Diaz-Delgado, Havana, Cuba; and Jose Marcano, Caracas, Venezuela. 94 broadcast engineers attended this course and nearly 800 have attended previous courses.

New Computing Center

Armour Research Foundation's computing services have been unified in a new Computing Center. It is set up as a section of the Electrical Engineering department, with David Rubinfein as supervisor. The new section's computing services will be available to business and industry as well as to the Foundation. Additional equipment has been ordered to enlarge the facilities of the Center.

Coming Events

Oct. 29-November 1—Audio Fair, Sponsored by AES, Hotel New Yorker, New York, N. Y.

Nov. 5-7—IMS, 16th Annual Time and Motion Study Clinic, Sheraton Hotel, Chicago, Ill.

Nov. 7—IRE, Microwave Professional Group Symposium on Microwave Circuits, Auditorium, Western Union Telegraph Co., 60 Hudson St., New York, N. Y.

Nov. 21-22—IRE, Kansas City Section, 4th Annual Regional Papers Technical Conference, President Hotel, Kansas City, Mo.

Nov. 24, 25—AIEE Electronic Instrumentation in Medicine Conference, Hotel New Yorker, New York City.

Dec. 3-5—Third annual IRE Professional group on Vehicular Communications, Washington, D. C.

Dec. 10-12—IRE-AIEE Computers Conference, Park Sheraton Hotel, New York, N. Y.

Jan. 14-16—IRE-AIEE Meeting on High Frequency Measurements, Washington, D. C.

Feb. 4-6—IRE-AIEE Western Computer Conference, Hotel Statler, Los Angeles, Calif.

Feb. 5-7—West Coast Audio Fair, Los Angeles, Calif.

March 23-26—IRE National Convention, Grand Central Palace & Waldorf-Astoria Hotel, New York, N. Y.

April 18—Cincinnati Section, IRE, Seventh Annual Spring Technical Conference.

April 26-30—SMPTE 73rd Convention Hotel Statler, Los Angeles, Calif.

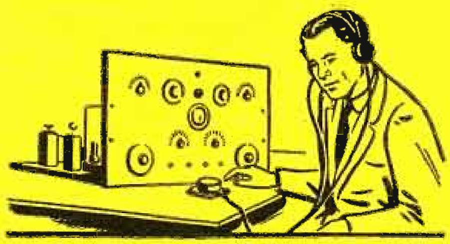
April 28-May 1—NARTB 1953 Convention, Biltmore Hotel, Los Angeles, Calif.

May 18-21—Electronic Parts Show, Conrad Hilton Hotel, Chicago, Ill.

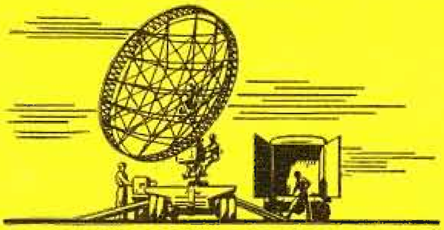
AES: Audio Engineering Society
AIEE: American Institute of Electrical Engineers
IRE: Institute of Radio Engineers
IMS: Industrial Management Society
NARTB: National Association Radio and Television Broadcasters
RTCM: Radio Technical Commission for Marine Services
RTMA: Radio-Television Mfrs. Assn.
SMPTE: Soc. of Motion Picture and TV Engineers

As old as
RADIO
yet as young as
ELECTRONICS...

AEROVOX
CAPACITORS



1922 At the very dawn of radio—30 years ago, Aerovox came into being to meet capacitor needs. Pioneer radiophone transmitters and earliest radio receivers specified Aerovox capacitors. Such collaboration has continued down through the first three decades of radio-electronic progress.



1952 Today, giant atom-smashing betatrons . . . radar gear spotting unseen targets . . . transoceanic radio-guided rocket bombs . . . world-wide radio communications . . . electronic computers reducing thousands of calculation man-hours to mere seconds . . . the modern miracle of television—for all facets of the Electronic Age, Aerovox capacitors are still engineered to customer specifications.

Indeed, from tiny precision "ceramics" and metallized-paper "space-savers," to giant power-handling "oils" and "micas," Aerovox remains the time-proven source for ALL capacitor needs.

Sub-miniature vitrified ceramic terminal end-seal Type P123ZN Aerolene-impregnated metallized-paper tubular capacitor.

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"Cinerama" Picture and Sound Heighten Realism

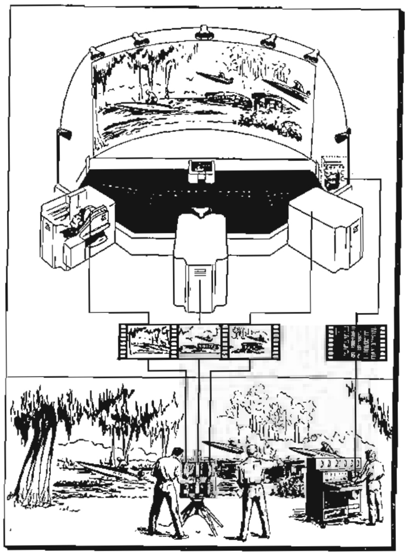
An unconventional motion picture projection system called Cinerama — a combination of the words cinema and panorama — was revealed to the public for the first time on Sept. 30 1952, at the Broadway Theatre in New York City. An enthusiastic audience applauded the realistic effect produced by the panoramic display and stereophonic sound.

The concave Cinerama screen, 64x23 ft., is six times larger than an ordinary screen, and covers 49 ft. across the front of the theatre in a 146° arc. Three separately located 35-mm projectors 48° apart throw a tri-panel picture on the wide-angle screen, each synchronized projector covering about one third of the total area. Although this display is not stereoscopic, a three-dimensional effect is achieved because the viewer observes a much wider sweep of picture than is customary. The semicircular screen, made of 1100 strips of perforated tape, gives the illusion of depth by the stimulation of peripheral vision. That is, part of the picture is seen out of the "corner of the eye" similar to the way the eye usually sees objects off to the side of its central focus.

One small defect noted was the slight jitter of one projected panel relative to the adjacent picture panel. Also, color brightness in highlight areas was not exact for all three picture panels. However, these minor shortcomings are far overshadowed by the vivid effect produced.

In conjunction with Cinerama, which was invented by Mr. Fred Waller, a Reeves stereophonic sound system is employed. Eight loudspeakers are mounted around the theatre to produce the effect of sound coming from the action on the screen, or from the side or behind the audience. Six sound tracks on a single strip of magnetic film, as originally recorded by six strategically placed microphones, are used.

It is conceivable that a system similar to Cinerama will eventually be used in TV. Perhaps it will take the form of a semicircular CRT whose display would be projected on a second screen of opposite curvature.



Three Cinerama cameras record scene, which is later projected on curved screen. Six mikes record sound on magnetic film, and booth at right controls playing through eight speakers. Center booth controls projector synchronization

1953 IRE Fellow Awards Made to 49 Members

The Institute of Radio Engineers has bestowed the membership grade of fellowship on 49 prominent radio engineers. Presentation of the awards will be made during the IRE Convention at the annual banquet in the Waldorf-Astoria Hotel, New York City, March 25, 1953.

Edward W. Allen, Jr., Chief Engineer, Federal Communications Commission, Washington 25, D. C.

Jean P. Arnaud, Head, Microwave Dept., Direccion General Fabricaciones Militaros, Cabildo 65, Buenos Aires, Argentina.

Benjamin B. Bauer, Vice-President, Shure Brothers, Inc., 225 W. Huron Street, Chicago 10, Ill.

J. W. Bell, Plant Manager, Smith & Stone, Ltd., Georgetown, Ontario, Canada.

Leonard J. Black, Professor, Electrical Engineering, University of California, Berkeley, California.

H. G. Booker, Professor, Dept. of Engineering Physics & School of Electrical Engineering, Cornell University, Ithaca, New York.

William E. Bradley, Director of Research, Philco Corp., C & Tioga Streets, Philadelphia, Pa.

John L. Callahan, Assistant to Director, Radio Research Laboratory, RCA Laboratories Division; Assistant to Vice-President in Charge of Research and Development, RCA Communications, Inc., 66 Broad St., New York 4, New York.

K. A. Chittick, Manager, Television Receiver Engineering, RCA Victor Division, Camden, New Jersey.

Arthur A. Collins, President, Collins Radio Co., 855 35 St., N.E. Cedar Rapids, Iowa.

Edward U. Condon, Director of Research & Development, Corning Glass Works, Corning, N. Y.

W. W. Eitel, president, Eitel-McCullough, Inc., San Bruno, California.

Harry Faulkner, Deputy Engineer-in-Chief, British Post Office, Alder House, Oldersgate St., London, E.C. 1, England.

Enoch B. Ferrell, Switching Research Engineer, Bell Telephone Laboratories Inc., Mountain Ave., Murry Hill, N. J.

Warren R. Ferris, Electronic Scientist, Naval Research Laboratory, Washington 25, D. C.

Lyman R. Fink, Manager, Engineering, Receiver Dept., General Electric Co., Electronics Park, Syracuse, New York.

Lawrence R. Hafstad, Director of Reactor Development, Atomic Energy Commission, Washington, D. C.

F. Hamburger, Jr., Professor, Electrical Engineering, Johns Hopkins University, Charles & 32 Sts., Baltimore 18, Md.

Lewis B. Headrick, Manager, Cathode-Ray Tube Development, RCA Victor Division, New Holland Pike, Lancaster, Pa.

Philip J. Herbst, Technical Administrator Standard Products, Engineer, RCA Victor, Division, Camden 2, N. J.

John Hessel, Chief, Radio Communications Branch, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

Hans E. Hollmann, Scientist, U. S. Naval Air Missile Test Center, Point Mugu, Calif.

T. A. Hunter, President, Hunter Manufacturing Co., Iowa City, Iowa.

Eric J. Isbister, Engineering Dept. Head for Radar, Sperry Gyroscope Co., Division of Sperry Corp., Great Neck, L. I., N. Y.

Edward C. Jordon, Professor of Electrical Enigneering, University of Illinois, Urbana, Ill.

Frank G. Kear, Partner, Kear ana Kennedy, 1302 18th Street, N.W., Washington 6, D. C.

Ronold W. P. King, Gordon Mackay Professor, Applied Physics, Cruft Laboratory, Harvard University, Cambridge, Mass.

Royce G. Kloeffler. Head, Dept. of Electrical Engineering, Kansas State College, Manhatten, Kansas.

Edmund A. LaPort, Chief Engineer, RCA International Division, 30 Rockefeller Plaza, New York 20, N. Y.

Russell R. Law, Research Engineer, RCA Laboratories Division, Princeton, N. J.

William A. MacDonald, President, Hazeltine Electronics Corp., 58-25 Little Neck Pkwy., Little Neck, L. I., N. Y.

Jack A. McCullough, Vice-President, Eitel-McCullough, Inc., San Bruno, Calif.

J. A. Morton, Technical Staff, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey.

Allen B. Oxley, Chief Engineer, RCA Victor Co., Ltd., 1001 Lenoir St., Montreal, P.Q., Canada.

Albert Preisman, Consulting Engineer, Vice-President in Charge of Engineering, Capitol Radio Engineering Institute, 3224 16 St., N.W., Washington 10, D. C.

John C. R. Punchard, Chief Engineer, Communications Equipment Div., Northern Electric Co., Ltd., 250 Sydney St., Belleville, Ontario, Canada.

Jan A. Rajchman, Research Engineer, RCA Laboratories Division, Princeton, N. J.

J. A. Ratcliffe, Reader, Physics, Cambridge University, Cambridge, England.

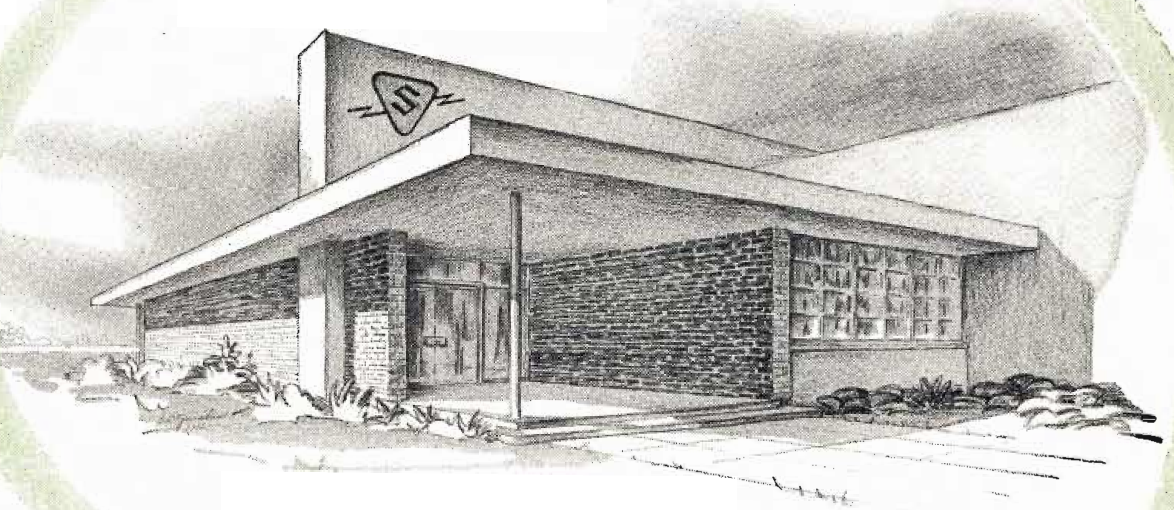
Stephen O. Rice, Technical Staff, Bell Telephone Laboratories, Inc., 463 West St., New York 14, N. Y.

Walther Richter, Consulting Electrical Engineer, 5426 N. Kent Ave., Milwaukee 11, Wisconsin.

A. A. Roetken, Technical Staff, Bell Telephone Laboratories, Inc., Murray Hill, New Jersey.

William M. Rust, Jr., Chief, Geophysics Research Sec., Humble Oil &

(Continued on page 86)



Sylvania to Serve West Coast Electronics Market from California Location

Sylvania has announced that construction is under way on a modern, completely equipped Electronics Division plant and laboratory in Mountain View, California.

This up-to-date facility of 35,000 square feet is being made available to West Coast manufacturers as a source of electronic components including semiconductor devices, microwave components, and special purpose tubes.

A research and development laboratory will be included to handle design and applications problems on these and other related products.

The addition of this California location to Sylvania's existing electronics facilities marks another step in the company's long-term plan to provide the finest quality products and fastest service to all markets.

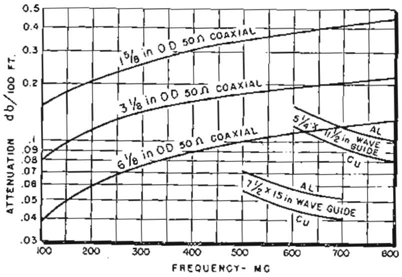
For complete information on Sylvania Electronic Products, write Dept. E-2911 Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

SYLVANIA

ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; RADIO TUBES; TELEVISION PICTURE TUBES; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

Waveguide Transmission Lines for UHF

The advent of UHF telecasting poses the problem of selecting the most desirable type of transmission line system to feed the broadcasting antenna. Primarily, the choice lies between two media: well-established coaxial cable, and waveguide which is still in the developmental stage. The overall objective of transmission line design is to maximize the system's power output, and this is accomplished better by waveguide than coax—but not without introducing several new problems.



Attenuation characteristics of coaxial ccbles compared to aluminum and copper guides at UHF

The two basic criteria which affect the utilization of transmission lines are losses and reflections. If power is reflected, the vswr is raised, which reduces the power-handling capacity of the line. Furthermore, if reflected energy is not absorbed by the transmitter, it can give rise to a ghost on the TV receiver. Power losses or attenuation, needless to say, are an expensive waste of r-f power. Economic and structural problems are other salient considerations in choosing the most desirable type of transmission line.

Discussed below are the pros and cons of using waveguide, as compared to coax, in the UHF region.

PRO

Attenuation at UHF is considerably less for waveguide than coax, as shown in the accompanying chart. Copper losses in coax are enhanced by the skin effect, heating the conductors and reducing the power handling to about one-half of the VHF rating.

Reflections and impedance instability are often caused by center conductor eccentricities in coax—a factor with which waveguide does not have to contend. Since the amount of dielectric support of the center conductor is limited by capacity and impedance considerations, the conductor is susceptible to lateral movement with resulting drop in impedance and rise in vswr. For example, a 1/8-in. shift in 1 5/8-in. coax yields a vswr of 1.05. A 0.4-in. shift can drop the impedance of this same 50-ohm line to 20 ohms. On the other hand, a stable vswr of 1.01 is attainable with waveguide.

Unwanted higher mode is an ever-present menace above 750 MC when 6 1/8-in. coax is used, the line approaching a point where it can operate as a waveguide. The TE_{11} mode may be uncoupled to the radiating system or combine with the desired coaxial mode to yield partial cancellation and, hence, reflection. Mode suppressors may be developed, but they would add to the cost and complexity of the installation.

Capacitance of coax dielectric bead supports, which may be considered as distributed at VHF, must be looked upon as lumped elements at UHF. Another problem in coax design is that undercutting the beads to reduce reflections raises the cost. So a major advantage of waveguide is—no center conductor.

CON

Manufacturing methods and tolerances are presently a serious deterrent to large-scale waveguide production. RTMA has established three commercial sizes:

7 1/2 x 15 in.—470- 750 MC
5 3/4 x 11 1/2 in.—640- 960 MC
4 7/8 x 9 3/4 in.—750-1120 MC

These may be made by sheet metal techniques, deep drawing, or by stretching and forming available piping, but the best method is somewhat undecided. Also, the RTMA proposed standard of ± 0.015 in. tolerance is very tight for deep-drawn and extruded stock.

Structural problems such as added weight, wind loading and differential thermal expansion are introduced when guide is mounted on the antenna tower. This can mean that stronger, and more expensive, towers would be required.

Choice of materials is still not thoroughly resolved. Low-attenuation copper requires some reinforcing; strong steel guide might prove too heavy; and lightweight aluminum has slightly more attenuation than copper-clad steel.

IRE Fellows

(Continued from page 84)

Refining Co., P. O. Box 2180, Houston 1, Tex.

Jorgen Rybner, Professor, Telecommunications, Royal Technical University of Denmark, Oester Voldgade 10 G. Copenhagen K. Denmark.

Daniel Silverman, Exploration Research Director, Stanolind Oil & Gas Co., P. O. Box 591, Tulsa, Oklahoma.

Archie W. Straiton, Professor, Electrical Engineering Research Laboratories, University of Texas, Austin, Tex.

Irven Travis, Director of Research, Burroughs Adding Machine Co., 511 N. Broad St., Philadelphia, Pa.

Bertram Trevor, Engineer, RCA Laboratories Division, Princeton, N. J.

Harry W. Wells, Research Staff Member, Carnegie Institution of Washington, D. C., Broad Branch Rd., N.W., Washington 15, D. C.

Charles J. Young, Research Section Supervisor, RCA Laboratories Division, Princeton, N. J.

Powered Metal Processing

Increasing interest in the techniques used in manufacturing odd-shaped magnetic cores made of pressed powdered iron focuses attention on the primary methods of making powdered metal. According to F. J. Stokes Machine Co., the atomizing, reduction and electrolytic deposition methods account for 90% of powdered metal production in the U. S.

Atomizing is principally used for metals with low melting points, such as lead, tin, aluminum and brass. The melted metal is poured in a thin stream into a high-speed stream of air, gas or water-spray, creating a shower of droplets which strike a collector as tiny solid particles. A variation of this economical method draws heated air and melted metal through an atomizing nozzle.

Reduction is the most widely used method for copper, iron and tungsten. Oxides of the metal are derived from ores by roasting or chemical means, and then ground to powder in a ball-mill. This is reduced to metal in a hydrogen atmosphere furnace, although certain iron oxides are reduced by carbon dioxide from coke. The resulting particles are spongy, and are said to have good "green strength," i.e., they knit together to form a good mechanical bond after pressing.

Electrolytic deposition is similar to electroplating, except that high amperage is used to create gassing and produce a powdery or brittle deposit instead of a solid coating. Copper, mechanically vibrated from the cathode, costs about the same as in the reduction process. Iron powder made by deposition is more expensive, but increased purity and softness enhance conductivity. Iron may be flaked off and ground in a ball-mill. Annealing is often required to reduce brittleness.

Making powdered iron parts at Lenkurt Electric

New Name and Building

Concurrent with ground-breaking for a new building, Waveline, Inc., has announced the change to its present name from the former Microwave Equipment Co. However, the firm will retain the same address as before, P. O. Box 470, Caldwell, N. J.

RESEARCH — DEVELOPMENT — PRODUCTION —

OF

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MAGNETRONS — GAS DISCHARGE TUBES — WAVEGUIDE COMPONENTS
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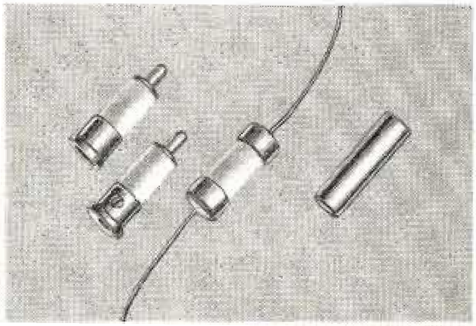
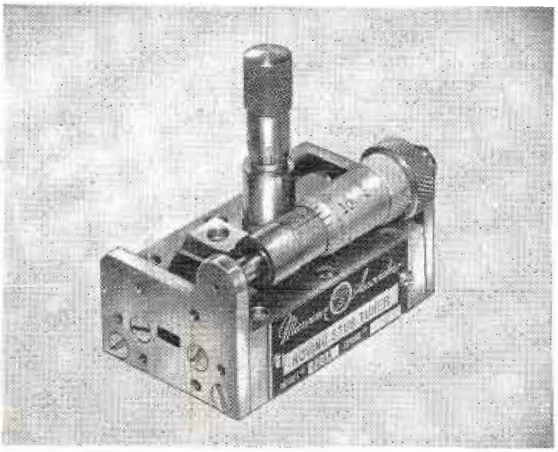
MICROWAVE ASSOCIATES, Inc. combines specialized production techniques with the latest research in vacuum tubes, microwave gas discharge phenomena and solid state physics. Our excellently equipped and capably staffed Boston plant can fill many of your microwave component needs. All of our production is to exacting military and commercial specifications.

LOOK FOR THE TRADEMARK

SEMICONDUCTORS

MICROWAVE is establishing new production facilities to supply a complete semiconductor line including 1N21B, 1N21C, 1N23B, 1N25, 1N26, and special millimeter wave silicon diodes. Production will commence shortly on — n-p-n TRANSISTORS under license to The Western Electric Company.



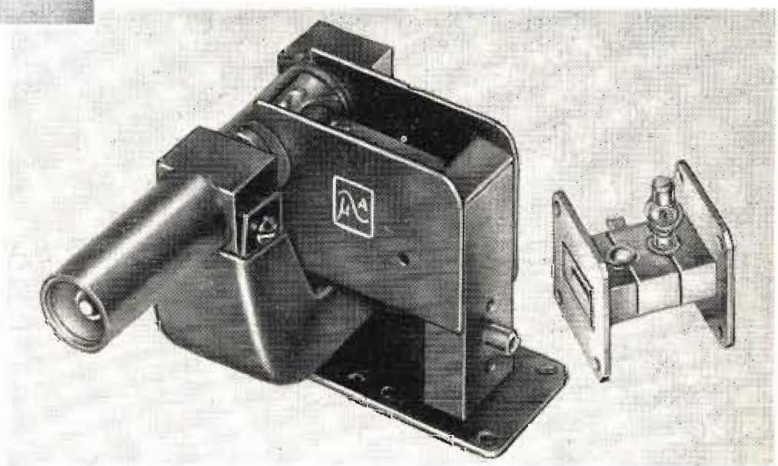


WAVEGUIDE COMPONENTS AND TEST EQUIPMENT

Our competent MICROWAVE component group specializes in the 3 cm and millimeter region producing duplexers, mixers, attenuators, roving stub tuners, frequency meters, standing wave detectors, dry and water loads and other excellent components.

MAGNETRONS AND GAS DISCHARGE TUBES

The seasoned MICROWAVE tube engineering and production teams are now producing several magnetron types including the popular 2J42 and 2J42A. High level TR microwave gas discharge switching tubes are available for several bands. Our research personnel in this field are always ready to assist in special microwave tube design problems.



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VOICE SIGNALING

(Continued from page 68)

dicted performance have been encountered. Application has been made to the following systems.

It is often necessary to signal mobile receivers by group, or service function. Investigation indicated that a maximum number of 10 such groups need be signaled.

The audio signal to perform this function in the receiver is derived from an attenuator which bridges the output of the discriminator. It is thus free from variations due to operator adjustment of volume controls, etc. A short audio signal is applied to a vacuum tube switch which is sensitive to presence of tone and carrier. Simultaneous presence of tone and carrier closes the switch and opens the audio circuits; the carrier then holds the circuit closed. Release of the carrier opens the circuit and reblocks the audio circuits.

The variations inherent in mobile receivers make essential an audio signal approximately 10 db greater than that required to operate marginally with all conditions at normal design centers. This 10 db margin accounts for filament and B+ variations, r-f signal level changes, tube and component variations, and temperature drift.

A typical Selective Dispatch system block diagram is shown in Fig. 6. The audio tone selected by the push-buttons is introduced by the C contact in the microphone circuit. Closing the PTT picks up a relay

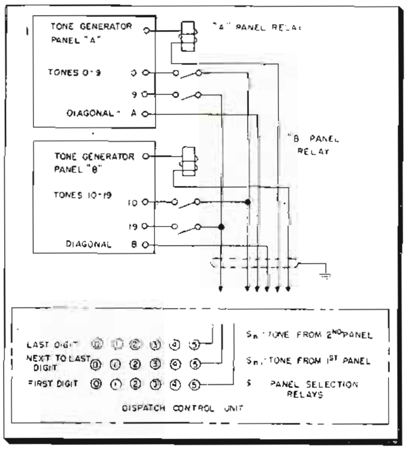

Fig. 9: Diagonal call digit-code system

which holds in for approximately 0.5 second and then releases. The tone level is adjusted to rated deviation of the system by the *only* adjustable control in the entire system.

The selective dispatch system has been typically used for alerting Volunteer Fire Department receivers which are on the police frequency. Until a fire call is sounded the receivers are silent, then the tone signal opens the receiver and keeps it open as long as required. It has been used to split taxi fleets into area groups, public utility systems into functional groups; any system in which delineation by function improved efficiency and utilization of the radio frequency channels.

Duplex Selective Dispatch

The similarity between the circuits of the tone generator and the selective amplifier would imply that a tone generator could be made from a selective amplifier by com-

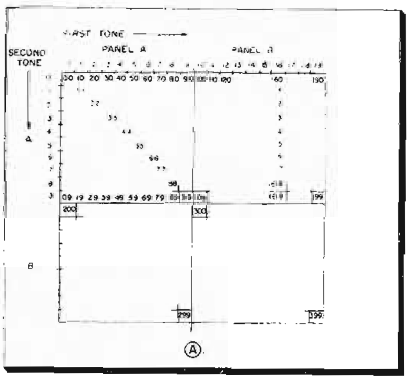

Fig. 10: (a) Tone generator panel arrangement

pleting the regenerative feedback path through an AGC circuit. In the Duplex Mobile Selector, the path is completed to and from the regenerative AGC by relay contacts. The relay is energized momentarily by closing the PTT circuit, at the same time the microphone circuit is interrupted and the tone generated is fed into the speech input circuits at proper level. The microphone circuit is interrupted for only one-half second maximum, a negligible amount of lost time. See Fig. 7.

Tone Signals

This arrangement permits tone signals to be transmitted in both directions and hence a closed system. Skip signals are particularly annoying to low-frequency station operators since station antenna are usually high-gain and well-located. It is not at all uncommon for such stations to suffer continuous interference periods lasting for days. The Duplex Selective Dispatch system permits all receivers in a

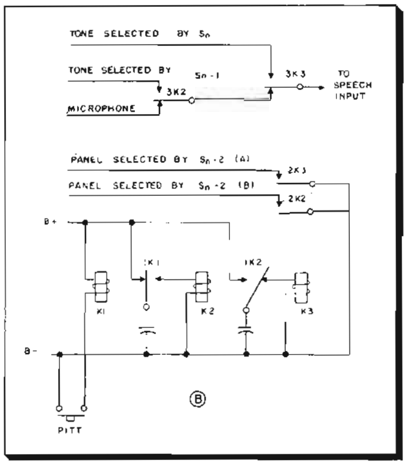

Fig. 10: (b) Tone selection relay system

given system to be silent except when traffic originating in that system is on the air.

Typical applications which come to mind are utility systems which are subject to substantial interference, taxi systems which operate on frequencies whose congestion is unbelieveable, and to keep the list of uses under control, Mobile Relay systems.

Selective Calling

In contrast to the previously described group selective system, the selective calling system is an individual selection out of the entire fleet. As nearly as possible, the basic ideas which underlie the telephone system are used, even to the point of "busy signal" if such is required.

The Mobile Selector contains two selective amplifiers, one is always open and the second is blocked. Two tones are transmitted in proper order of the frequencies to which the selective amplifiers are tuned by the plug-in selective networks. The first tone is amplified by the open selective amplifier, whose output is then applied as an unblocking signal to the second selective amplifier. The second tone is then amplified by the second selective amplifier and applies an operating signal to a vacuum-tube relay stage. The relay then closes alarm, voice coil, or other circuits as required. The possible modes of operations are limited only by the discipline which may be enforced on the fleet. The simplified schematic of Fig. 8 shows the selector.

The distinguishing feature of the Selective Calling system we have designed is the logical method by which the tones are selected and transmitted. There are some 80 tones available in the audio band,

(Continued on page 90)

VOICE SIGNALING

(Continued from page 88)

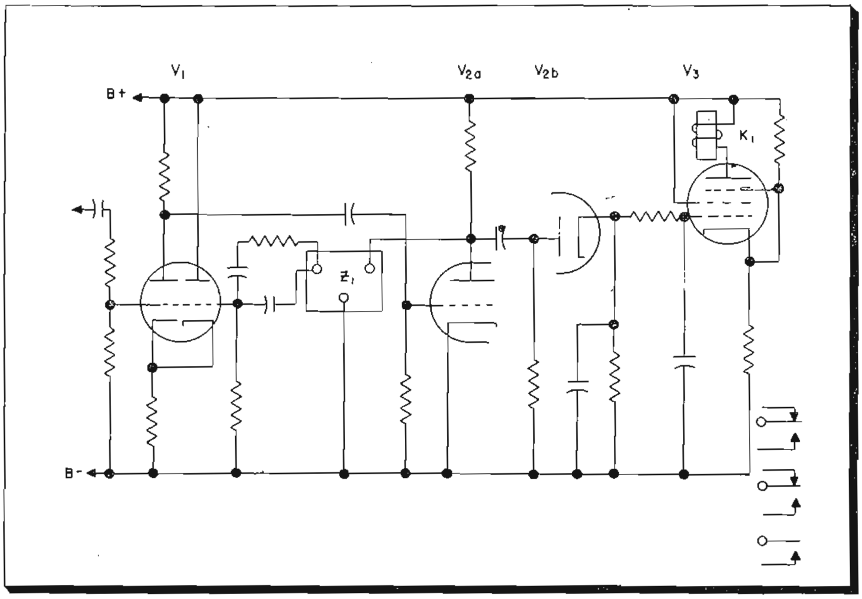

Fig. 11: Tone-operated switch combines selective amplifier and vacuum tube switch

which would yield some 6400 calls. At first glance it would seem resonable to number the tones and establish arbitrary correlation, such as Car 31—Code 16 4. Such a random code is neither logical nor readily expandable, besides requiring a translation directory in constant use by the operator.

We felt that an approach which leads to a logical direct code must be developed to satisfy all requirements. This is the method:

1. The number of push-button rows in the dispatch selector is the same as the number of digits in the call number.
2. Two of the rows of 10 push-buttons select tones in decimal combination out of a block of ten tones, hence each block contains 100 calls. This establishes the last *two* figures of the call number.
3. The first push-button row selects the particular block of 100 calls, i.e., it establishes the *first* significant figure of a three digit code. In case the code is a four digit one, then the combination of the first two rows establish the first two rows establish the first *two* significant figures of the code.
4. What is called a diagonal call occurs when the last two digits of the call are the same—it implies that the same audio tone must be transmitted twice in succession. Since this is an unworkable combination a simple artifice is employed. Whenever any push button in the next-to-the-last row is depressed, the tone corresponding to that push button is automatically removed from the corresponding position in the last row, and a diagonal digit is inserted. This corresponds to multiplying by eleven. Fig. 9 shows the fundamental idea just described.

Dispatch Control Unit

The basic building block of the dispatching system is the dispatch control unit described and panels of 11 tone generators. Since the two tones are transmitted in sequence, the first significant figures of the code may be described in terms of the order in which the panels of eleven tones are picked up. This is accomplished by placing on each panel a relay with 10 A-contacts. Energizing this relay connects the tone generators to the 10 tone-lines for the hold-in period of the relay. This may best be explained by tracing the operation for a typical number.

Typical Operation

Suppose we wish to call 168 (Fig. 10a):

The digit 1 indicates the panels pick up B A.

The digit 6 indicates selection of the 6th tone in panel B.

The digit 8 indicates selection of the 8th tone in Panel A.

Closing the PTT picks up K1 (Fig. 10b), K1 picks up K2 which holds in for 0.3 seconds and Panel B is switched into circuit.

K2 relaxes and K3 picks up (for approximately 0.2 second) switching into circuit panel A.

The similarity of these ideas to those embodied in telephone-type panel-dial-switching systems has been pointed out as an important consideration. As a matter of interest, the code selection may be readily performed via a dial telephone.

Not obvious is the fact that all tones but the one in use at a given instant are shorted to ground, thus eliminating crosstalk in tone circuits. Since all of the tone panels feed the line in parallel thru the relays previously mentioned it is clear that a great economy in circuits is possible even though as many as 80 tones may be used. The number of tone circuits remains constant.

The Selective Calling system has shown itself to be extremely reliable in actual use over a long period of time. The design has shown itself to be conservative and readily adaptable to variety of receivers.

Tone-Operated Switch

The combination of a selective amplifier and a vacuum tube relay circuit to form a tone-operated switch for individual switching functions has proven to be a very important use. Schematically, one of these is shown on Fig. 11.

The outstanding features of the tone-operated switch are flexibility and simplicity. Switches have been used singly and in combination to perform a wide variety of control and signalling functions. The primary use at the present time is in conjunction with Civil Defense. In this use Civil Defense receivers are tuned to the local public safety frequency and held silent until an alarm is sounded. When an alarm is sounded the relay is energized and alarm sirens, lights, etc., are energized.

One distinctly unusual use has been control VHF equipment over 500-mi. carrier telephone circuits using 750 CPS as the control frequency. The stable high Q of the circuits has resulted in operation free of voice-triggering and of excellent reliability.

We have surveyed the development and application of a voice-frequency tone signaling system which results from reduction-to-practice of feedback-type selective circuits. These circuits are stable, reliable and economical. The resulting devices are readily adaptable to a wide, and as yet not completely explored, variety of applications.

MICROTORQUE*

Jewel Bearing

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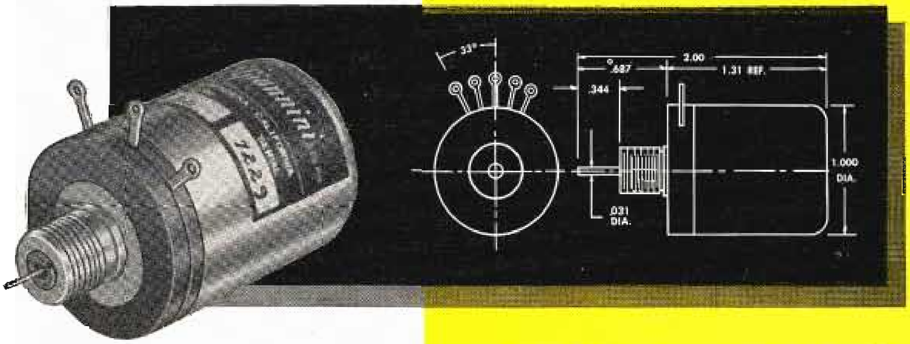

A Simple Solution to Remote Indicating

The Giannini Microtorque* is an extremely low torque, instrument-quality potentiometer with an electrical output proportional to the angular position of the shaft. Its compact, light-weight, rugged and dust-proof construction means flexibility in applications. It may be directly connected to altimeters, temperature and pressure instruments; used in automatic flight equipment or in industrial laboratory installations where remote indication is required.

The Microtorque* is designed to have an extremely low starting torque and a negligible operating torque. The low mass of the moving parts makes the Microtorque* useful in those applications where an extremely low moment of inertia is essential. The Microtorque* is a proven instrument with proven performance.

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Jewel bearing construction offers watch-like precision, a high degree of shock resistance, and unusually low friction coefficient.

PLATINUM WINDINGS

The non-corrosive characteristic of platinum allows a light brush pressure to maintain efficient contact. This, in turn, virtually eliminates brush friction. Platinum, too, prolongs instrument life and assures dependability. One of the outstanding features that make the Microtorque* a truly low torque instrument-quality potentiometer.

SPECIFICATIONS

LINEARITY: ± 0.5% of total resistance.

MAXIMUM OPERATING SPEED: 100 rpm.

ACCELERATION: Will withstand 50G steady state acceleration in best axis.

VIBRATION: Will withstand 0.06" double amplitude sinusoidal vibration from 10 to 55 cps in best axis.

AMBIENT TEMPERATURE: Will function mechanically from −54° C. to + 71° C.

MOMENT OF INERTIA: 2×10^{-4} oz-in.^{2} (approx.)

TEMPERATURE COEFFICIENT OF RESISTANCE: .0006/° C. Max.

Following Microtorques* are available from stock in quantities of six or less:

RES. OHMS	STARTING TORQUE IN OZ	TURNS OF WIRE TYPE 2	TURNS OF WIRE TYPE 9	CURRENT**	PRICE***
250	.006	350	450	57	$45.00
1,000	.004	500	650	28	$40.00
2,000	.004	700	750	20	$40.00
5,000	.003	900	1200	14	$40.00
10,000	.003	1,000	1300	10	$40.00
25,000	.003	1,000	1300	7	$45.00

**Must be de-rated for ambient temperature over 60° C.

***Prices apply to quantities of six or less. For quotation on larger quantities or specialtypes, please write.

Above Microtorques* are available in the following two types:
Type 2: 270° + 10° − 0° Electrical Rotation, Mechanical Rotation. Limited by internal stops.

Type 9: 354° Min. Electrical Rotation, Mechanical Rotation. Continuous. Brush does not short ends of coil.

Giannini also produces potentiometers of various types, including non-linear functions, and tapped windings.

For information on this and other fine instruments write Dept. P. G. 1

Giannini INSTRUMENT-QUALITY POTENTIOMETERS

*MICROTORQUE—*T.M. REG. 1952

G. M. GIANNINI & CO., INC. PASADENA 1, CALIF. EAST ORANGE, NEW JERSEY

2nd Annual Computer Meet to be Held Dec. 10-12

Following the pattern of last year's successful meeting in Philadelphia, the Second Annual Computer Conference and Exhibition will be held in New York City's Park Sheraton Hotel, Dec. 10-12, 1952. Jointly sponsored by the Institute of Radio Engineers, American Institute of Electrical Engineers, and the Association for Computing Machinery, the three-day conference features input and output equipment used with the many different computing systems.

At-the-door registration fee is $3.50, while advance registration is $3.00. Cost of the Proceedings of the 1952 conference is $4.00 when ordered after Dec. 6; $3.50 in advance. All checks should be made payable to Ralph R. Batcher. Further information and registration cards may be obtained from Mr. A. C. Holt, IBM, 590 Madison Ave., New York 22, N. Y.

Listed below is the advance technical paper program of the 1952 Joint AIEE-IRE-ACM Computer Conference:

Wednesday, December 10

"Recording Techniques for Digital Coded Data," by Arthur W. Tyler, Eastman Kodak Co.
"Converters for Teletype Tape to IBM Cards," by G. F. Nielsen, International Business Machines Corp.
"Punched Card to Magnetic Tape Converter for UNIVAC," by E. Blumenthal & F. Lopey, Eckert-Mauchly Div. of Remington Rand Inc.
"Devices for Transporting the Recording Media," by Richard L. Snyder, Jr.
"Buffering Between Input-Output and the Computer," by Alan L. Leiner, National Bureau of Standards

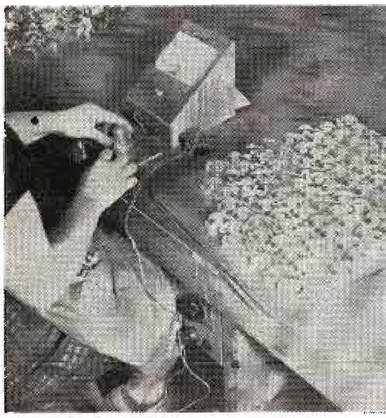
Thursday, December 11

SEAC INPUT-OUTPUT SYSTEM
"SEAC Input-Output System," by Sidney Grunwald, NBS
"Input-Output Devices Used with SEAC," by James L. Pike, NBS
"Auxiliary Equipment to SEAC Input-Output," by Paul A. Mantek, NBS
"Operating Experience," by Ernest Ainsworth, NBS
UNIVAC INPUT-OUTPUT SYSTEM
"The Uniservo-Tape Reader and Recorder," by H. F. Welsh and H. Lukoff, Eckert-Mauchly Div. of Remington Rand Inc.
"Input Devices," by L. D. Wilson and E. Roggenstein, Eckert-Mauchly Div., Remington Rand Inc.
"Output Devices," by E. Masterson and L. D. Wilson, Eckert-Mauchly Div., Remington Rand Inc.
RAYDAC INPUT-OUTPUT SYSTEM
"RAYDAC Input-Output System," by Walter Gray and Kenneth Rehler, Raytheon
"System Design," by Louis Fern, Raytheon
"Operating Experience with RAYDAC," by Frank Dean, Raytheon
IBM 701 INPUT-OUTPUT SYSTEM
"Type 701 Input-Output Organization," by L. D. Stevens, IBM
"Type 726 Magnetic Tape Reader and Recorder," by W. S. Buslik, IBM
"Magnetic Tape Techniques and Performance," by H. W. Nordyke, IBM

Friday, December 12

"Survey of Analog-to-Digital Data Converters," by H. E. Burke, Consolidated Engineering Corp.
"Survey of Mechanical Type Printers," by J. Hosken, A. D. Little, Inc.
"Survey of Nonmechanical Type Printers," by Lt. R. J. Rossheim, George Washington U.
"Anelex Printer," by Leo Rosen, Anderson-Nichols Co.
"Eastman Printer," by Russell G. Thompson, Eastman Kodak Co.
"Ferranti Input-Output Equipment," by Bryan W. Pollard, Ferranti Ltd., London
"Garment Tag Equipment," by O. G. Hessler, Sears Roebuck and Co.
"Numerically Controlled Machine Tool," by William Pease, MIT
"Summary and Forecast," by Samuel N. Alexander, NBS

IMPROVED ION-TRAP TEST



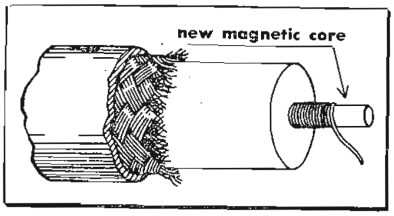
Close-up of ion-trap test position at Round Lake, Ill. plant of Heppner Mfg. Co. Faster and more accurate indications of the strength of the ion-trap magnetic field are now obtained by placing trap over motor-driven alternator, and then reading output voltage on meter. This method eliminates any magnetization effects on the testing apparatus.

TELE-TECH'S Guide to Latest UHF Receiving Tubes

Description	6AF4 RCA, Sylvania, GE UHF Miniature triode oscillator List Price: $3.90		6AJ4 GE UHF miniature triode amplifier and grounded-grid amplifier List Price: $6.00	6AM4 GE UHF triode grounded-grid mixer List Price: $6.00	6AN4 Sylvania UHF triode grounded-grid amplifier or mixer List Price: $3.90	6BZ7 CBS-Hytron UHF twin triode amplifier for cascode operation List Price: $3.05		6T4 Sylvania UHF miniature triode oscillator
Heater Voltage (v.)	6.3		6.3	6.3	6.3	6.3		6.3
Heater Current (ma)	225		225	225	225	400		225
Bulb	T-5½		T-6½	T-6½	T-5½	T-6½		T-5½
Base	Min. but. 7-pin		Min. but. 9-pin	Min. but. 9-pin	Min. but. 7-pin	Min. but. 9-pin		Min. but. 7-pin
Basing Design	7DK		9BX	9BX	7DK	9AJ		7DK
Mounting Position	any		any	any	any	any		any
Max. overall length (in.)	2⅛		1¾	1¾	1¾	2-3/16		1¾
Max. seated length (in.)	1⅞		1½	1½	1½	1-15/16		1½
Max. diameter (in.)	¾		⅞	⅞	¾	⅞		¾
Characteristics	Class A_1 Amp.	950 MC osc.	Class A_1 Amp.	Mixer	Amp.	Class A amp. (each section)		Osc.
Plate Voltage (v.)	80	100	125	150	200	150		80
Cathode Bias Resistor (ohms)	150		68	100	100	220		150
Amplification Factor	15		42	85	70	38		13
Plate Resistance (ohms)	2270		4200	9500	7700	5600		1800
Transconductance (μ mhos)	6600		10,000	9000	9000	6800		7000
Plate Current (ma)	16	22	16	7.5	13	10		18
Grid Voltage (v)		—4	—9	—5		—11		—15
Grid Resistor (ohms)		10,000						
Plate Current (μa)		400	10	10		10		50
Maximum Ratings, Design Center Values		950 MC osc.				(each section)		
Plate Voltage (v.)		150	150	150	300	250		200
Plate Dissipation (watts)		2.25	2	2	5	2		3.5
Cathode Current (ma)		28	20		30	20		30
Heater-cathode voltage (v.)		80	80	80	100	200		200
Plote Input (watts)		2.5						
Grid Voltage (v.)		—50						
Grid Current (ma)		8						8
Grid Circuit Cathode Bias (megohms)		0.5						
Interelectrode Capacities ($\mu\mu$f) Unshielded						UNIT #1	UNIT #2	
Grid to Plate	1.9				1.7	1.15	1.15	1.8
Input	2.2				2.2	2.85		2.4
Input (grounded grid)					4.8		4.95	
Output	0.45					1.35		0.45
Output (grounded grid)					1.8		2.27	
Plate to Cathode			0.18	0.16	0.17	0.15	0.15	
Heater to Cathode			1.7	1.8	2.8	2.2	2.3	
Cathode to Grid and Heater			4.4	4.4				
Plate to Grid and Heater			2.4	2.4				

Delay Cable

Delay cable type HH-1500 features a flexible, low-loss magnetic core which nearly triples the inductance of the cable assembly,



while substantially maintaining the dimensions and the attenuation characteristic of conventional high-impedance cables, such as RG-65/U. The nominal electrical characteristics are as follows: characteristic impedance, 1500 ohms; capacitance, 49$\mu\mu$f/ft. delay, 0.073 μsec/ft.; attenuation, 6.0 db/100 ft at 1 MC; dc resistance, 7.0 ohms/ft.; and max. operating voltage, 2000 v. rms. The cable is built around a flexible magnetic core whose diameter is 0.115 in. and which carries a closely coiled inner conductor of #32 AWG wire. Over the helix is a spacer of "Flexit" polyethylene whose outer diameter is 0.285 in. and which serves as a core for the braided outer conductor. The cable is covered with a polyvinyl chloride jacket of 0.405 in. outside diameter.—**Columbia Technical Corp., 5 E. 57 St., New York 22, N. Y.**—TELE-TECH

Miniature Twin Diode

Type 5726 miniature twin diode for detectors is a "premium" version of the 6AL5W, and is suitable for mobile and aircraft use.

Tungsten heaters are internally connected in series for fail-safe operation. Heater rating is 6.3 v., 0.3 amp. Resonant frequency is 700 MC. Using the small-button miniature 7-pin base and T-5½ bulb, its maximum overall length is 1¾ in., seated length 1½ in., and diameter ¾ in. Shock impact tests show 700 G max., and vibration 2.5 G max. As a half-wave rectifier, peak inverse plate voltage is 360 v. max., peak plate current/plate 60 ma, and dc output current/plate 10 ma.—**Tube Dept., Radio Corporation of America, Harrison, N.J.**—TELE-TECH

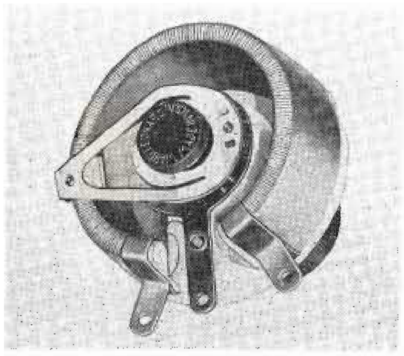
Degasifying Furnace

Degasifying Furnace for the radio tube and metallurgical industry. It can be used for small metal parts which have to be sur-

face cleaned and degasified for further processing. It is constructed as a complete unit with the gas drying tower and flow control gauge mounted on the furnace top and the temperature regulating transformer placed anywhere. The furnace has a 24 in. long heating chamber, while the diameter of the heating chamber can be made to the work required in the range from 1 to 12 in. Maximum temperature is 1600°C. Gases for surface cleaning and degasing in use for this furnace are hydrogen, nitrogen, or any other inert gas. Operation of the furnace is as follows: Hydrogen passes through chamber to drive out air. Then the furnace is heated. A load of parts is put into the heating chamber, while a new load is inserted into the heating chamber.—**Eisler Engineering Co., 750 S. 13 St., Newark 3, N. J.**—TELE-TECH

Ring Type Rheostats

New 25 and 50 watt Vitrohm ring type rheostats feature contact arm and drive shaft assembly that furnishes smooth, close con-



trol with no backlash. A balanced spring steel contact arm that maintains uniform contact pressure is interlocked directly to a Mycalex insulating hub molded to the drive shaft. Both core and base are molded of high density, low porosity and high dielectric strength ceramic. High stability resistance wire, wound toroidally on the core, is held secure by vitreous enamel. Bulletin 1110 ring rheostats are designed for rheostat or potentiometer use in control equipment. Watt ratings are based on 300°C rise in 40°C ambient. Resistance values for the 50 watt size range from 1 to 7500 ohms. Standard resistance tolerance +20, −10%.—**Ward Leonard Electric Co., Mount Vernon, N. Y.**—TELE-TECH

Cathode-Ray Tubes

Line of "tight tolerance" industrial cathode-ray tubes makes possible high precision measurements. Presently available are Types AWP, 5 ADP and 5 XP-A. Among the important features are: reductions by 50% in critical tolerances for deflection sensitivities and grid cutoff; improved perpendicularity between "X" and "Y" deflection plates by 300%; greatly improved sensitivity on both axes without reduction in useful scan and flat face plates to reduce parallactic error. The new tubes are improved over previous tubes so that characteristics such as deflection linearity, pattern distortion, modulation, line width and light output are now specified.—**Tube Div., Allen B. Du Mont Labs., Inc., 750 Bloomfield Ave., Clifton, N. J.**—TELE-TECH

Solderless Terminal

Solderless terminal for intricate control panel wiring is known as the reinforced "Ampli-Bond" terminal. Design assures that no underlying conducting surface will be exposed even if the insulating sheath is pierced. This is accomplished by means of an insulated metal ring near the base of the insulation support sleeve. The ring gives all necessary strength to combat vibration and sharp bending, but does not communicate with the electrical connection farther up the barrel. Terminals are available in the 12-10 and 16-14 HD sizes, but in the near future they will be available in smaller wire sizes. They are color coded for easy identification. —**Aircraft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa.**—TELE-TECH

FOR MORE INFORMATION

on New Equipment for Designers and Engineers

See pages 72-74, 76, 78

Computer Potentiometers

(Continued from page 54)

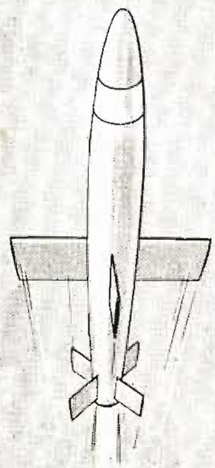
Two steps are taken to reduce the noise caused by formation of oxide films on the wire, the first being, naturally, to select the resistance wire alloys which are least susceptible to corrosion or oxidation. This is not always possible since it is sometimes necessary to base the selection of the wire alloy on other considerations, such as temperature coefficient and resistivity. It can be said generally that nichrome V, a nickel-chrome alloy which does not contain any iron, probably has the greatest resistance to corrosion and oxidation of any of the high-resistivity commercially available resistance alloys. The platinum alloys offer even better characteristics in this respect, but unfortunately are of considerably lower resistivity and higher temperature coefficient. Manganin wire, which is often highly desirable because of its very low temperature coefficient and almost negligible thermal emf against copper, unfortunately oxidizes very rapidly even under ideal conditions, and is generally not recommended for use in precision types of potentiometers, where the contact pressures must be kept low for long life and minimum torque. Some consideration has actually been given in certain cases to the use of a hermetically-sealed pot containing inert gas, where alloys susceptible to oxidation must be used.

Most precision pot manufacturers today apply a light film coating of an oxide inhibitor or lubricant to the resistance elements during the assembly process. These coatings are quite successful in delaying the formation of oxide films, and also in reducing electrical noise by smoother operation of the sliding contact. However, these inhibitors tend to dry out, and the best of the lubricating materials available today cannot be counted upon to remain effective for more than six months or a year.

A third variation of dynamic electrical noise is actually random emf's generated due to the heat of friction caused by the sliding contact moving over the coil. This is known as the Tribo effect and its reduction or elimination is sometimes effected by proper selection of sliding contact materials to match with resistance wire alloys. For some alloys, the greatest reduction can be attained by the use of contacts made from the same alloy, while in others such choice actually leads to higher

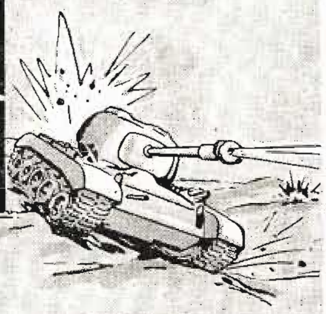
(Continued on page 96)

We've been solving automatic control problems for 37 years

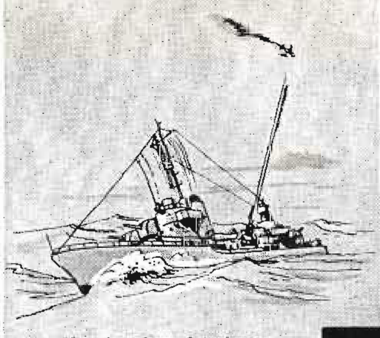


Controlling guided missiles in flight

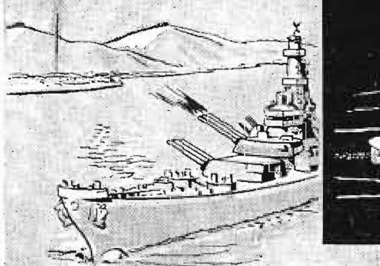
Knowing your whereabouts under all circumstances



Stabilizing the guns on bouncing tanks



Shooting down jet planes from the unstable decks of ships



Hitting inland targets from battleships

Take one part of the fantastic, mix thoroughly with Ford's engineering and production ability, and you've got the answer to another "impossible" automatic control problem. That has been the sum and substance of the Ford Instrument Company since 1915.

Stabilizing a gun on a bouncing tank or a ship's plunging deck; governing the unique movement of a torpedo; keeping a pilot informed of his whereabouts at all times and in all weather — Ford found the answer!

From the more than 16 acres of floor space that make up the engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electro-mechanical and electronic instruments that bring us our "tomorrows" today! Research, development, design and production are being applied to control problems of both Industry and the Military.

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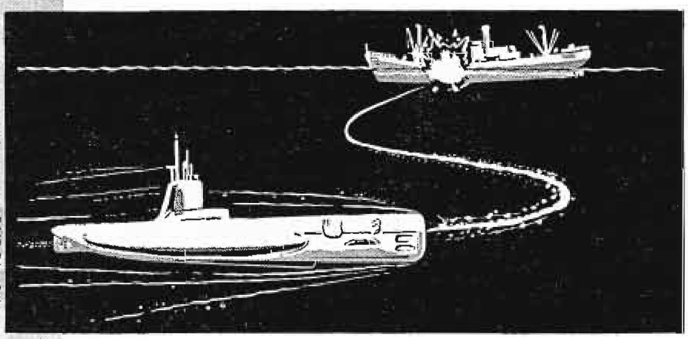


Directing torpedoes against surface craft

An opportunity for able engineers

Build a future for yourself as an engineer at Ford. If you qualify there's a lifetime opportunity on automatic equipment design with the top name in automatic control. Write for our informative, illustrated brochure.

emf's. Since this Tribo effect is due to friction-generated heat at the contact, it is natural that the effect will vary in direct proportion to the speed of contact movement.

An additional source of error is sometimes unknowingly introduced into potentiometer applications by the method in which the pot is employed in its circuit. With a constant potential impressed across the coil of a linear pot, the voltage output from the slider will not vary linearly with respect to its position along the coil if current is drawn through the slider. This characteristic is commonly referred to as "loading error." The error varies with slider position, being zero at both ends of rotation, and having a maximum value at approximately two-thirds rotation from the end of zero voltage. Fig. 9 illustrates a typical circuit employing a pot wherein the voltage is impressed across the complete coil of the pot and the sliding contact feeds into one end of a load. Unless this load is sufficiently high to reduce the slider current to negligible values, loading error will result. The position, as well as the magnitude of maximum error, varies with the relative resistance of the load to the potentiometer resistance. With a load resistance ten times that of the pot, the maximum error is about 1.45% of the applied voltage, and occurs at 66.9% rotation. With a load of one hundred times the pot resistance, the maximum error is reduced to 0.15% and occurs at 66.7% rotation. Depending upon the linearity accuracy which is desired, then, the load resistance should be one hundred times that of the pot, or greater. If both the potentiometer and load resistance are fixed values, and give a ratio less than this, it is possible to reduce the resulting error by resistive padding, while if the signals from two potentiometers are being compared, the loading error can be cancelled by loading the two proportionately.

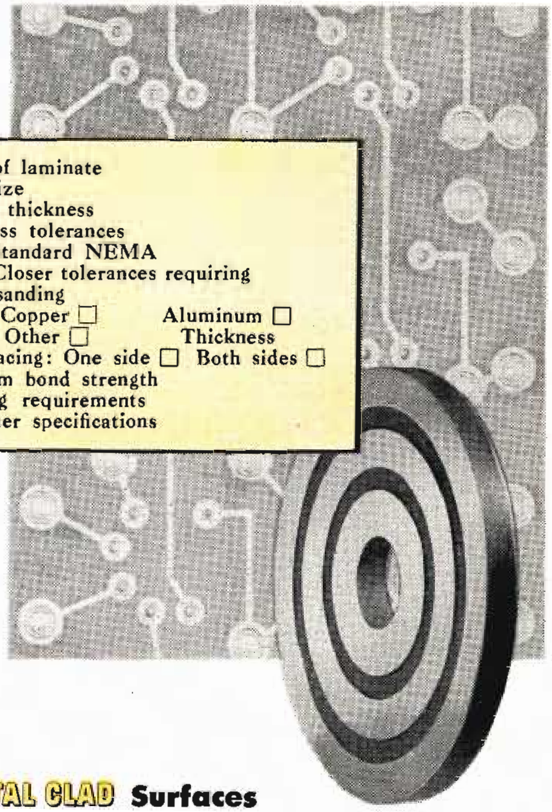
It should be recognized that, since the slider contact is in a position to suffer the greatest wear through operation, its life, and hence that of the pot itself, will vary somewhat in proportion to the physical length of the resistance element. It can be seen that any given slider contact could last through many more revolutions if it were travelling over a coil only a few inches than it could over a coil of many feet. Generally, wire-wound precision pots available today, with elements of from five- to ten-inch lengths, can be expected to perform satisfactorily over from 1,000,000 to 3,000,000 cycles under

(*Continued on page* 98)

Information Wanted...

about your uses for

C-D-F METAL CLADS



Grade of laminate
Sheet size
Overall thickness
Thickness tolerances
- a. Standard NEMA
- b. Closer tolerances requiring sanding

Metal: Copper ☐ Aluminum ☐
Other ☐ Thickness
Metal facing: One side ☐ Both sides ☐
Minimum bond strength
Punching requirements
Any other specifications

Did you know that C-D-F supplies a full range of metal clad laminates in both Dilecto and Teflon grades? With mounting interest in printed circuits it pays to consider the respective advantages of these new C-D-F materials . . . it also pays to line up all the Information Wanted facts and discuss your specific application with your C-D-F sales engineer (Offices in principal cities). He's a good man to know!

Dilecto METAL CLADS

Printed circuits depend upon stable, uniform core material and Dilecto has years of proven insulation service (Dilecto is a laminated thermosetting plastic made only by C-D-F from paper, cotton, glass or asbestos fabric base, or a mat base). Normally phenolic or melamine impregnating resins are used for METAL CLAD sheet stock. There are many grades of Dilecto, but only the better electrical grades are supplied with metal foil surfaces. Outstanding is C-D-F grade XXXP-26, a hot punching grade with high insulation resistance, low and stable dielectric losses and excellent moisture resistance. Green color. New C-D-F Catalog GF-53 gives complete data on Dilecto grades. Write for your copy today.

Teflon* METAL CLADS

Glass fiber cloth is first coated with Teflon resin and laminated into C-D-F GB-112T sheet stock. This base withstands high heat (200°C. maximum operating temperature) with the dissipation factor and dielectric constant extremely low over a wide frequency range. No adhesive film is needed to bond metal to the Teflon laminate, thus the inherently good electrical properties of the core material are maintained. GB-112T has practically zero water absorption, so a METAL CLAD with this core offers consistent high insulation resistance with excellent stability of dielectric loss properties.

METAL CLAD Surfaces

Copper foil (usually .00135" or .0027" thick) is bonded on one or both faces of the sheet grade of Dilecto selected. The foil used is a special grade of electrolytic deposition copper particularly adaptable for cementing onto laminated materials. An adhesive film is placed between the metal and the Dilecto, and cemented during the pressing and curing cycle. When closer tolerances are required C-D-F sands the Dilecto to the required thickness before bonding. Aluminum, silver, or other alloys of various metals may be supplied.

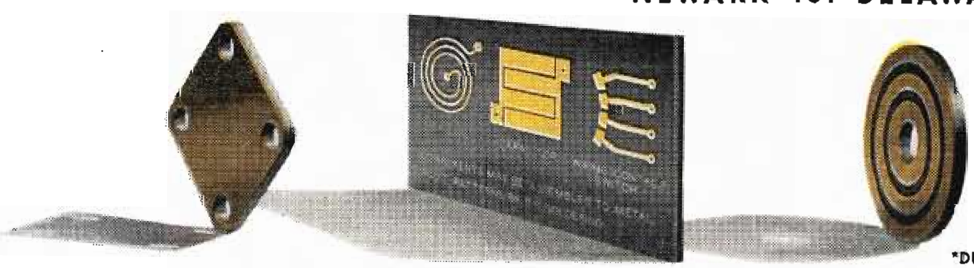
Better Bond Strengths

One of the most important physical properties of a metal clad product is its peel strength, the pounds pull required to separate the foil surface from the core material. Working with years of laminating know-how, C-D-F has been successful in obtaining the following average test values for its METAL CLAD sheet stocks:

	Lbs. pull per 1" width
XXXP-26 plus .00135" copper	5 to 8
XXXP-26 plus .0027" copper	7 to 10
XXXP-26 plus .0015" aluminum ..	9 to 12
GB-112 Teflon plus .00135" copper ..	6 to 9

Sheet sizes: Dilecto grades — 38 x 38", 38 x 42"
Teflon grades — 16 x 36"

Continental-Diamond Fibre Company
NEWARK 101 DELAWARE



*DU PONT TRADE MARK

Write for new C-D-F General Catalog GF-53, new C-D-F Teflon folder T-52, and talk METAL CLADS with your C-D-F sales engineer.

normal conditions, and at rotational speeds under 100 rpm.

The lower torque requirements of precision pot design are due largely to the lighter contact pressures and sometimes to higher-quality bearings. These lighter contact pressures are actually used because of the finer resistance-wire sizes employed, and also to minimize wear on the sliding contact. Single-section precision pots will be found to have starting torques in the neighborhood of one or two in.-oz., as contrasted with anywhere from five to ten in.-oz. for the usual radio-type pot. There are, on the market today,

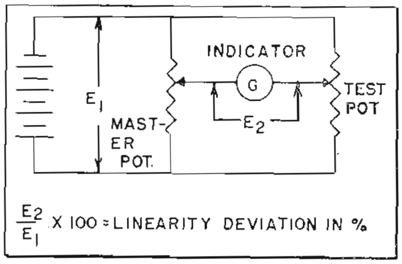


Fig. 10: Production test circuit compares voltage output of test unit with master pot

several designs of miniature ultra-low torque single-turn precision pots which find ready application in many computing systems designed to employ miniature servo motors. The small coil diameter of these miniature pots reduces the torque arm of the slider contact and further, the contacts are operated at extremely light contact pressures. These factors, combined with the use of either jewel or miniature ball bearings, reduces the starting torque in some instances to as low as .005 of an inch-ounce, and the running torque is usually almost negligible.

Precision pots, both single and multi-turn, which are now available in mass production quantities, will be found to have reliable accuracies of from 0.05% to 0.5%, depending upon size and resistance values, and several special multi-turn designs now becoming available, will have accuracies sometimes as high as ±0.01%. In these ranges, the problem of reliable and rapid calibration in production tests becomes extremely important, when it is appreciated that the test equipment should generally be at least ten times as accurate as the pot under test.

Production testing can best be accomplished by comparing the voltage output curve of the test unit

(*Continued on page* 101)

NEW 27EP4 PROVIDES GIANT-SCREEN TV AT A PRICE YOU CAN AFFORD!

TUBE PLUSSES ARE:

- Extremely short length, for compact cabinet construction.
- Aluminized to give you a bright, sharp picture at 16,000 v!

DESIGNERS and manufacturers now can plan production of that deluxe TV with super-size picture! Distributors will order your new set in volume, for 27EP4 cost—only *one-third* that of a 30-inch type—permits, for the first time, real giant-screen TV at a sensible retail level.

Over 400 square inches of picture, or ¾ the viewing area of a 30-inch round tube! Compact, because of the 90-degree deflection angle—so short that tube length is the same as picture width, 24 inches! Means a trimmed-down, practical cabinet.

Filter-glass face, *aluminized* for maximum brightness and contrast at moderate voltage—16,000 v, no more than a 21-inch standard tube requires for top-quality viewing!

Get all the facts without delay. Phone, wire, or air-mail *Tube Department, General Electric Company, Schenectady 5, N. Y.*

27EP4

Picture width	24 inches
Picture height	18½ inches
Deflection angle	90 degrees
Tube length	24 inches
Recommended operating voltage	16,000 v
Focus	magnetic
Screen	Filter glass, aluminized

GENERAL ELECTRIC

162-1A6

America's

TOP SHOWS

depend on Houston-Fearless Equipment

All Star Review

JIMMY DURANTE, rotating star.

NBC Television Network

"In 98% of all U.S. Television Stations"

There are many good reasons why Houston-Fearless television camera pedestals and dollies are standard equipment in a vast majority of television stations. They are skillfully designed to give complete mobility to the camera, engineered to withstand constant usage, and built to give dependable performance at all times.

They embody 26 years of leadership in manufacturing camera and film processing equipment for the motion picture studios of Hollywood and throughout the World. You can rely on Houston-Fearless for quality and dependability.

Write for catalog on television equipment.

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"WORLD'S LARGEST MANUFACTURER OF MOTION PICTURE PROCESSING EQUIPMENT" curacy, or actual calibration is known. This is accomplished by mechanically synchronizing the test and master units and applying voltage across both units from a common source. The differential voltage between the two sliders may be amplified and either presented on a crt or recorded. The schematic circuit of such a test setup is illustrated in Fig. 10. If the accuracy of the master pot is sufficiently greater than that of the unit under test, it is satisfactory to plot this error curve direct and note its maximum deviation from an assumed line of theoretical zero error. If it is necessary to utilize a master whose accuracy does not greatly exceed that of the test unit, it is possible to plot the positive and negative deviation curve of the master and then simply compare it with the curve presented by the two pots operating in synchronism.

Precision Design

Both single- and multi-turn precision potentiometers are now produced by a number of manufacturers with design features which are specifically intended for servo work. Basically, these features are concerned with higher precision of mechanical design and assembly. The higher costs involved in demanding the use of ball bearings in the precision servo pots, are not always justified by the improved results which might be obtained. It will be found in many cases that Oilite, or even the simple brass or bronze sleeve-type bearings, may permit comparatively low operating torques and even allow mechanical tolerances approaching those of ball bearings, with consequent slight reductions in cost and great reduction in delivery time. A second feature which identifies a precision-type pot as being intended for servo usage, is the flange-type of mounting which contrasts with the customary, single-hole, threaded-bushing type of mounting long employed for the ordinary radio-type component.

In very brief summary, potentiometers have recently come into their own in servo computer work because of the great strides that have been made in the improvement of accuracy, both mechanical and electrical. The precision potentiometer today offers, in many instances, greater accuracy and reliability than can be obtained by any other equivalent component or method. Nearly all of the current trend in new potentiometer design is directed toward making pots more suitable for servo work.

CUES for BROADCASTERS

(*Continued from page 61*)

and reconnected as shown. The output impedance is a balanced 600 ohms, and depending on the position of switch S1-A the jack is providing either an output signal or is receiving an incoming signal for recording.

Five Dollar Opera!

A LITTLE known service of the British Broadcasting Corp. is its world wide transcription organization. In the United States, programs such as "Hamlet" or "The Marriage of Figaro" can be obtained on a transcription for only $5! For educational or university stations there is no charge save that of mailing.

Almost every conceivable type of program is covered in the 77,000 discs which were sent out last year. The service is different, in that, instead of the usual murder stories and blood and thunder productions more unusual and generally speaking, less public appeal types of program are made available by this service. Many station managers wondering what programs to use should consider checking with the BBC office in New York at 630 Fifth Ave.

Spring Speed Changer

ROBERT C. BEESON,
KCOG, Centerville, Iowa

ONE of our Presto 10 A turntables was damaged recently. The thumbnut which holds the motor engaged became stripped. The only quick repair job we could make was to install a spring to pull the motor into the engaged position. This was accomplished by lifting the platter out of the frame. The metal tab which actuates the Microswitch was removed from the motor suspension unit and the switch was shorted. (We have mercury switches to operate the turntables.) A 2 by 2 in. corner brace was bent so that it nested on the motor suspension with one leg hanging down between the motor and the turntable frame. The corner brace was drilled, stretched open and the hinged end secured to the frame of the turntable on the side opposite the motor.

A spacer block makes changing speeds easier. The spring holds the motor suspension against the speed adjustment screws and the table is left in "neutral" to prevent flat spots in the rubber tire. Changing speeds no longer requires loosening and tightening the thumbnut.

Identifying Reels of Recording Tape

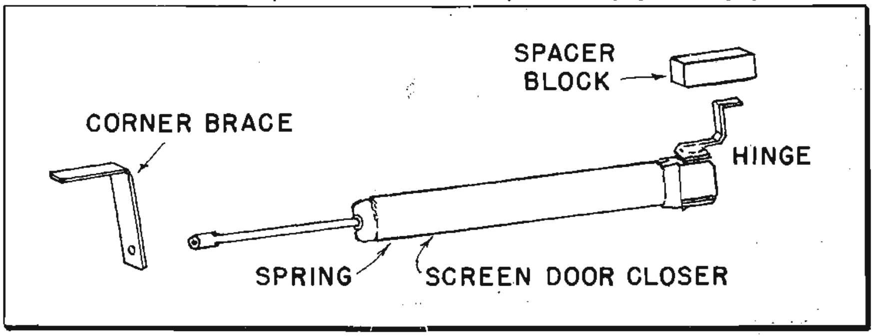
ROBERT M. HARVEY, Brown Radio Products, Inc., Nashville 3, Tenn.

TO prevent errors in programming, accidental erasure or misuse, it is vital to identify the various reels of recording used at a station or recording studio.

For temporary identification, use a "Phano" glass marking pencil to mark desired information directly on either plastic or metal reels. These pencils are available in several colors at office suppliers. A cloth, moistened with rubbing alcohol, will quickly remove markings made with them. Take care not to allow any alcohol to reach the tape because it will damage the oxide coating. And *don't* try carbon tet on plastic reels; it will etch into the surface of the reel.

For permanent use, or where a professional appearance is desired, the white self-adhesive labels available at stationers, are fine. One brand, the "Kum-Kleen," manufactured by the Avery Adhesive Label Corp., Monrovia, Calif., is available in a variety of sizes and shapes. These labels are supplied several to a small backing sheet, making them handy for use in a typewriter, or with pen or pencil. The surface of the reel should be clean and dry for best results. These labels will stay on almost indefinitely, but may be peeled off quickly when desired.

Screen door closer repairs Presto turntable and provides easy speed changing.



NEW 7" REELS OF audiotape* give you EXTRA VALUE

at no extra cost!

GUARANTEED SPLICE-FREE

SPLIT-SECOND TIMING
with New 2¾" Hub

Timing errors are virtually eliminated by this improved reel design which minimizes tension and speed changes throughout the winding cycle. Ratio of O.D. to hub diameter is the same as on the standard NAB aluminum reel.

PERFECTED ANTI-FRICTION PROCESS. Reduces head wear—eliminates annoying tape "squeal" – prevents "tackiness" even under extreme temperature and humidity conditions.

MAXIMUM UNIFORMITY OF OUTPUT. All 7" and 10" reels of plastic-base Audiotape are guaranteed to have an output uniformity *within* ± ¼db – and reel-to-reel-variation of less than ± ½db. What's more, there's an actual *output curve* in every 5-reel package to prove it.

With Audiotape, all of these extra-value features are *standard.* There's no extra cost – no problem of separate inventories or variations in tape quality.

For there's *only one* Audiotape – the finest obtainable anywhere. Test it – compare it – let Audiotape speak for itself.

The new 7-inch plastic reel with large diameter hub for greater timing accuracy is now being supplied on all orders unless otherwise specified. Because of increased hub diameter, maximum reel capacity is slightly over 1200 feet. Older style Audiotape reels with 1¾" hub and 1250 feet of tape will continue to be furnished on request at the same price.

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VHF and UHF Receivers

(*Continued from page* 38)

Plans are underway for tuners which may give 18 to 20 of mixed VHF and UHF channels chosen to suit the particular locality. This becomes entirely practical when the local oscillator operates in the VHF region and the UHF mixer operates with an equivalent local oscillator signal obtained from harmonics of the local oscillator. Surprisingly large harmonic powers are available from conventional VHF tube sources, e.g. one section of a 6J6 oscillator, by using a germanium or silicon diode as the harmonic generator. Of various types, the 1N34, 1N34A and 1N82 appear to be the most satisfactory, producing powers of 60 milliwatts at 500 MC and 30 milliwatts at 900 MC. This arrangement, in combination with the new silicon diode, type 1N82, provides a very stable-frequency harmonic oscillator-mixer combination.

Tuner Electrical Design

It may be of interest to summarize the basic sections of UHF tuners by dividing them into two groups:

a. The fundamental oscillator continuously tunable type,
b. harmonic generation of the local oscillator frequencies together possibly with selector switch tuning.

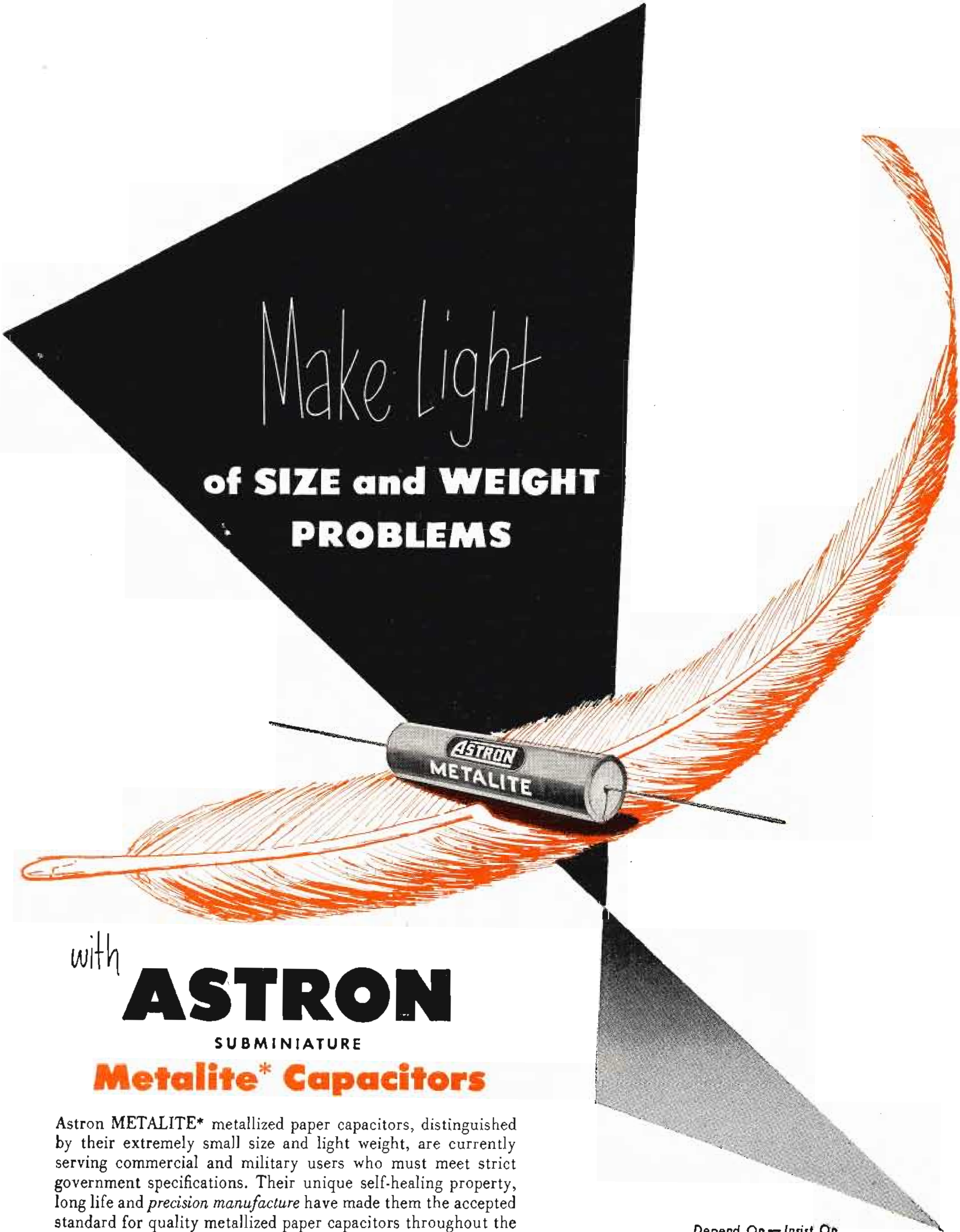
Fig. 2 shows the block diagram for these two basic groupings.

Both types require a high pass filter between the antenna and the first UHF tuned circuit in order to reduce interference from VHF, FM, shortwave and broadcast stations. Such a high pass filter should cut off as sharply as possible below 450 MC. Next is the radio frequency circuit, preferably double-tuned, so as to carefully match the antenna to the input impedance of the r-f amplifier tube or the mixer. Following this should be a radio frequency amplifier tube with its output tuned circuit coupled to the mixer. Next, the mixer crystal with the output i-f circuit and the local oscillator with or without the harmonic generating crystal and tuned circuit. Both the r-f and mixer tuned circuits should provide as high a discrimination against nearby local television channels as possible in order to avoid cross-modulation. Then, the image selectivity will also be adequate.

A first stage of good quality radio frequency amplification is most desirable: (1) to reduce the local oscillator coupling to the antenna; (2) to improve as far as possible, the noise factor, thereby increasing the useful range of the transmitter; (3)

(*Continued on page* 106)

Make Light of SIZE and WEIGHT PROBLEMS



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Export Division: Rocke International Corp., 13 E. 40th St., N. Y. C.   *In Canada: Charles W. Pointon, 1926 Gerrard St. East, Toronto* provide increased image rejection and, also; (4) reduce cross-modulation at the mixer.

Suitable r-f amplifier tubes at acceptable prices are not presently available. However, as is shown in Table II, some types have possibilities: (1) Planar grid triodes, similar to the rocket-tube type 5768 as described by B. F. Tyson[5], if designed and fabricated in such a manner as to be low in cost; (2) small modified travelling-wave tube suggested by Robert Adler of Zenith[6]; and (3) pencil type triode.

It is necessary to emphasize the requirement of low fluctuation noise in r-f amplifier tubes, since silicon diode mixers of the 1N82 type have already low noise factors, making it possible even without an r-f stage, to have a noise factor as low as 13 db.

Mixer

The silicon diode type 1N82 has good conversion efficiency and low noise factor. The beam deflection type of tube as described by E. Herold[7], is an unusual mixer with a low noise factor and very low oscillator coupling but somewhat expensive.

Oscillator

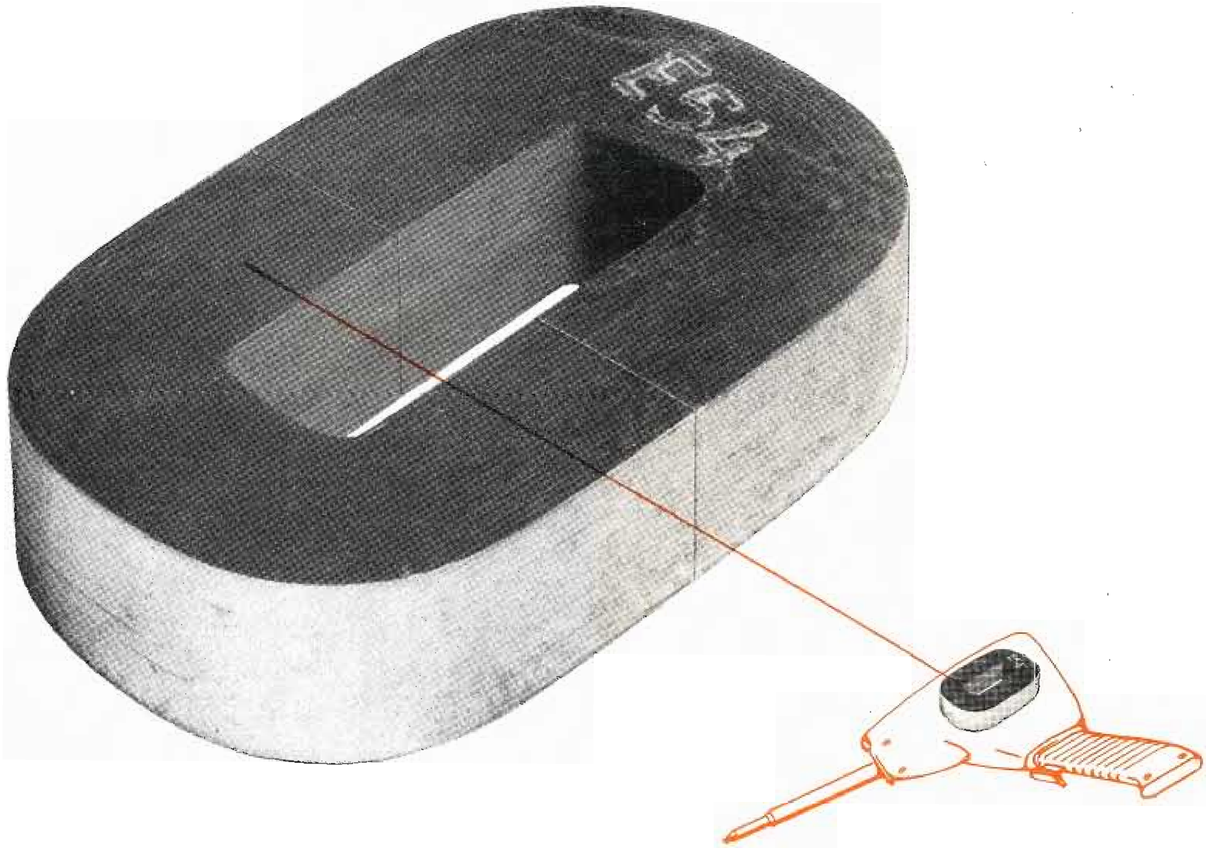
Oscillator design for the continuously tunable type can use one of several presently available UHF oscillators such as the 6T4 and the 6AF4. The stability of the oscillator is largely influenced by the circuit design and it appears that a modified butterfly type, as used by DuMont, provides good stability together with rugged mechanical design. For the harmonic generation type of circuit, a conventional VHF oscillator tube such as the 12AV7, provides ample power for the 1N34 harmonic circuit and a frequency stability better than a straight UHF oscillator throughout the whole band.

I-F Amplifier

If no r-f amplifier is to be included; and so far no commercial prototypes for the whole range—470-890 MC has an r-f stage—then it is particularly important to have a quiet first stage of intermediate frequency amplification. This stage should have the lowest possible noise factor[9] to make full use of a silicon mixer, since the i-f voltage at the output of the mixer is lower than the r-f signal voltage applied to it.

The procedure in designing the front-end for best noise factor is to first calculate the coupling network between the mixer and the grid of

(*Continued on page* 108)



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In designing their new Versa-Tool soldering gun, Phillips Manufacturing Company wanted a power unit that would provide instantaneous heat for off-on operation, yet operate on household voltage. A transformer was needed to build adequate amperage. But it had to be small, to fit into the handle . . . lightweight, for balance . . . reasonable in cost, to insure competitive pricing of the assembled unit.

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Because Hipersil Cores have greater flux-carrying capacity, Phillips engineers were able to cut size and weight of the transformer, effecting considerable savings in coil as well as core costs. But, better still, because the two-piece cores simplified assembly, manufacturing costs were slashed.

Hipersil Cores can cut cost, size and weight in all types of electrical and electronic transformers. Available in a wide range of sizes and shapes for low or high-frequency applications. Greater flux-carrying capacity, compact construction, plus the savings they effect in your manufacturing costs make them the best transformer cores on the market today. For more technical information on applying Hipersil Cores to your product, write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70628

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the cascode[8] i-f tube in order to provide the proper impedance match with the desired 4½ MC i-f bandwidth. Figure 3 shows the sequence. The output impedance Z^1_2 at i-f of the crystal mixer is about 400 ohms and, therefore, the i-f coupling transformer design to match into Z_1 can be readily completed. Next, the input impedance Z_3 at radio frequency of the crystal mixer must be measured with the above network complete, so that the tuned circuits and high pass filter between the antenna and the mixer can be correctly matched. Then the best signal transfer from the atenna impedance Z_5 to the crystal mixer can be obtained.

The highest Q circuits consistent with the required 6 MC r-f channel width should be used so that the cross-modulation and image response are suitably reduced. The aim in controlling cross-modulation should be a reduction of 20 db in a signal located three or four channels away from the desired signal.

It is also important that the antenna be carefully matched to the transmission line in order to obtain the best overall noise factor. Any tube fluctuation noise transferred to the first tuned circuit together with thermal noise in this circuit can then be absorbed by the antenna (actually radiated) and avoid standing waves of input circuit noise at the first tuned circuit.

Thus far we have discussed some of the requirements of composite VHF and UHF receivers. Let us now consider UHF reception on standard VHF receivers.

Converter Design Considerations

Of necessity, a UHF converter must operate with a different intermediate frequency than that of the associated VHF receiver, otherwise it would be necessary to make actual wiring changes in the VHF receiver.

Utilization of the double superheterodyne principle is forced upon all designers of UHF converter units in order that the output signal may operate into one of the standard VHF channels. The choice of the channel could be fairly broad extending from channel 2 to channel 13. This choice sets the frequency of the pre-i-f amplifier which amplifier is also necessary to provide separation between the UHF mixer and the VHF receiver.

It has been found that there is an optimum range of frequencies for this pre-i-f amplifier. The frequency must be less than ⅓ of the lowest UHF channel, or, as pointed out by Yuan Pan,[10] the spurious responses

(*Continued on page* 110)

from harmonics of the local oscillator can be quite serious. This places the maximum usable i-f frequency below channel 7, and, for the vast majority of conventional VHF receivers, leaves the highest frequency choice as channels 5 or 6, or 76 to 88 MC. As you know, it is necessary to have a choice of two channels so that in a given location, the VHF receiver may be switched to the one, either 5 or 6, which has the lowest VHF interference.

In the design of the *tuner* section of a converter, the possible tuning arrangements are the same as in combination U and V receivers, such as continuous tuning and selector switching. However, the local oscillator must operate on a different frequency from that of a complete receiver, since the output of the converter must have the sound and picture frequencies in the same relative position as broadcast. That is, the sound frequency must be higher than the picture frequency in the pre-i-f amplifier. Therefore, the local oscillator in the converter must operate on the low side of the UHF incoming signal, e.g. on the highest channel, 884 to 890 MC, the local oscillator frequency is 802 MC when using channel 6 for the first i-f. One incidental result is a larger frequency ratio for the oscillator. In this example, 802 down to 388 MC. ($889.75 - 87.75 = 802$ MC and $475.75 - 87.75 = 388$ MC.)

Due to the simultaneous use of two local oscillators, one in the converter, the other in the VHF receiver, very careful shielding of the converter assembly is essential to reduce interference possible from the harmonics of one local oscillator beating with the harmonics of the other, together with harmonics of the intermediate frequencies. In addition, a high pass filter at the input to the tuner section and a low filter at the pre-i-f output of the converter are advisable.

1. R. R. Law, W. B. Whalley and R. P. Stone, R.C.A. Review, December 1948, page 643. G. H. Brown, J. Epstein and D. W. Peterson, R.C.A. Review, June 1948, page 177.
2. G. H. Brown, R.C.A. Review, December 1948, page 565.
3. W. B. Whalley, "Simplification of Television Receivers," Sylvania Technologist, Vol. III, No. 1, pp. 9-12, January 1950, and IRE Proceedings, December 1950.
4. W. B. Whalley, C. Masucci, N. P. Salz, "An Analysis of the Germanium Diode as Video Detector," Sylvania Technologist, Vol. IV, No. 2, pp. 25-34, April 1951.
5. B. F. Tyson and J. G. Weissman, Electronics, October 1951; Sylvania Technologist, July 1951, page 50.
6. Robert Adler. Electronics, October 1951.
7. E. W. Herold and C. W. Mueller, Electronics, May 1949, page 76.
8. Henry Wallman, Alan B. MacNee and C. P. Gadsden, "A Low-Noise Amplifier," Proc. I.R.E., Vil. 36, No. 6, June 1948.
9. D. O. North, RCA Review, October 1940.
10. W. Y. Pan, RCA Review, September 1950, page 381.

High Efficiency Coolers

(*Continued from page 71*)

4 per cent in volume on freezing). During solidification of the solder within the glass core in a test sample, a void was seen to form at the upper surface of the solder joint and then to extend longitudinally downward more than half the length of the core. The width of the void channel was about 10 per cent of the anode circumference. In addition, cross-sections of power tubes made with conventional coolers showed that 10

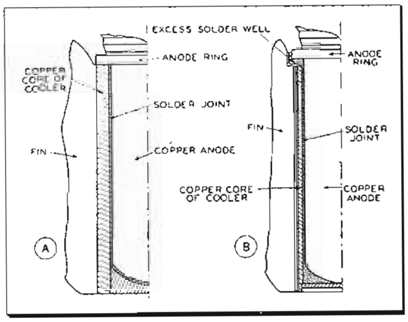

Fig. 7: (a) Initial copper core-anode-fin structure and (b) modified structure with solder well

to 20 per cent of the core area was not soldered to the anode.

The second source of trouble was observed when the test anode was inserted into the glass core at the start of the soldering operation. A layer of viscous flux residue normally floats on the molten solder in the core. When the anode is inserted into this liquid, a mixture of flux and solder is forced into the narrow passage between the anode and the core. Because of the high viscosity and surface tension of the flux residue, a relatively long time is required to allow the flux globules to rise to the top of the core via the very narrow clearance passage. On solidification, therefore, a quantity of corrosive flux residue having negligible heat conductivity is trapped in the critical area, particularly near the top of the cooler. This condition causes local overheating of the anode and destructive corrosion of the anode wall, and may result in early tube failure. The use of the excess-solder well, however, eliminates both faults. This well acts as an additional container into which the initial flux-rich solder is flushed, and out of which flux-free solder is supplied to the critical heat transfer area during solidification. Sections made of coolers employing the excess-solder well show the solder bond to be complete and without flaws in the thermally critical area.

1. I. E. Mouremtseff, "Water and Forced Air Cooling of Vacuum Tubes," Proc. I.R.E., Vol. 30, pp. 190-205; April 1942.
2. R. H. Norris, W. A. Spofford, "High-Performance Fins for Heat Transfer," Trans. ASME, Vol. 64, pp. 498-496; July 1942.

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Type MT and MTD electrolytic capacitors, "Chieftains" of the Sangamo line, are built to provide longer life, greater dependability, and better electrical characteristics in television and other electronic applications. Their small physical size makes them a "natural" for application in tight spots beneath a chassis, and the bare tinned-copper wire leads make them easy to mount.

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Direct Frequency

(*Continued from page* 63)

ranges as high as 4:1. With temperature compensation in sealed units, accuracy can be as high as 1 part in 10^5. With tunable units, accuracies have as yet been limited to about 0.01%. Frequencies from 200 to 60,000 CPS, a range of 300:1, have been covered by separate units.

Frequency Meters

Calibrated Electric Circuits: Units operating on this principle are not inherently capable of high accuracy since a relatively large number of components must be standardized. However, their low cost and simplicity are major advantages, and extremely sensitive null indicators can be used. Automatic systems need not be complex.

A Wien-Bridge Frequency Meter has been described having a frequency range from 25 to 10,000 CPS, or 400 : 1. A manually tuned dial is used to vary two gauged resistances in the bridge. Either a simple current instrument or a vacuum tube null detector may be used as the indicator. By choice of suitable components, an overall accuracy of 1% might be obtained.

The manually operated Parallel T Frequency Meter may be constructed using three gauged resistances and three fixed capacitors. The overall accuracy is probably limited to about 1% by component stability. An external null indicator is required.

Frequency to Amplitude Conversion

Conversion to Amplitude Measurements: Since errors due to these methods are the sum of those occurring in conversion from frequency to amplitude and those incurred in normal amplitude measurements, the systems will be most useful in instrument communications where very poor channel facilities exist. They have the advantage of being essentially fast response, direct reading, and relatively straightforward.

In the Hard-Tube Capacitance Frequency Meter, two vacuum tubes are used to charge and discharge a capacitor on alternate half cycles. The discharge current is measured directly by a milliammeter which can be calibrated in CPS. Useful range is from about 20 to 5000 CPS, about 250:1, and accuracy is on the order of 0.5%. This circuit can probably be improved.

The Gas-Tube Capacitance Frequency Meter employs two gas tubes and two diodes and uses a microam-

(*Continued on page* 116)

Jackson TELEVISION Channels 63% Savings WITH TINNERMAN SPEED NUTS®

● Engineers at Jackson Industries, Inc., Chicago, Ill. are "on the beam" when it comes to maintaining TV quality at production line speeds. They found the SPEED NUT way of attaching their new Tri-Lok television chassis to the cabinet picked up a neat 63% production savings! This attachment was one of their toughest fastening problems . . . to solve it Jackson found a standard Tinnerman part tailor-made and engineered for the job!

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SPEED NUTS eliminate the tapping operation required in threading the angle brackets, making hole alignment easier, faster! Now Jackson has adapted this part into their standards along with a 63% savings in time and materials-handling!

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meter to measure a fraction of the charging current through two capacitors in the cathode circuits of the gas tubes. Frequency range and accuracy are about the same as for the hard-tube frequency meter. Both of these meters are affected by the harmonic content of an input wave form.

The Vacuum-Tube Pulse Frequency Meter measures frequencies automatically by converting sine waves into constant voltage pulses which are allowed to charge a capacitor in the input circuit of a vacuum tube voltmeter. Thus, variable input frequency is actually converted to a variable voltage amplitude. Actual indication is on a linear scale microammeter. Typical frequency range is 25 to 60,000 CPS, or about 2400:1. Accuracy is about 2%. Conventional chart-recording instruments can be used with the meter.

Use of Discriminators

Discriminators are used in communications to convert variations in frequency directly to variations in amplitude. These circuits normally consist of a transformer, resistors, capacitors, and linear or square law rectifiers. One limitation of these devices has been the relatively narrow frequency ratio over which linear operation is possible; one recent analysis has shown substantial linearity over a range of about 1.3:1. Accuracy depends on component stability, and might be on the order of 1 to 5% with commercial parts.

Vibrating-String Discriminators may be used as a frequency selective filter, and the linear portion of its response curve can serve as a high stability discriminator. Since amplitude response is involved, accuracy may be estimated at 1%; however, further development work may prove this estimate too conservative. The frequency ratio obtainable will depend on stabilities obtainable with low Q units but may be as low as 1.1 : 1.

Conclusions

A few general conclusions may be drawn from the foregoing discussion, considering some of the data as presented in Figs. 4, 5 and 6.

Fig. 4 shows a rough comparison of some frequency and amplitude standards and meters. Many ingenious basic principles are represented, and many roads toward improvement exist. The major points of interest concern the greater accuracy of frequency systems.

Fig. 5, showing the approximate

(*Continued on page* 118)

GLOBAL MICROWAVE

(*Continued from page* 41)

coincides with the shortest eastern bombing route from the Soviet Union to the U. S.—highlighting the air-warning service which can be readily included. It is no wonder that industry leaders, the North Atlantic Treaty Organization and U. S. Government officials are seriously considering this plan. (See Aug. TELE-TECH, p. 33; also Oct. 1952, p. 66 et seq.) On April 14, 1952 it was officially presented to representatives of the State Dept., Defense Dept., FCC and National Bureau of Standards.

Sen. Karl Mundt, co-author of the act establishing the Voice of America, has said that groundwork had already been done to "provide a financial set-up to implement this program."

It is conceivable that in five years a U. S.-Europe-Near East Network can be placed in operation—a significant step in the unification of the free people of the world. Eventually, UNITEL could be extended to cover South America, Africa, Scandinavia, and other areas shown in Fig. 1.

Differences in TV standards are not considered an imposing obstacle. As was shown in Paris-to-London telecasts, scanning rate conversions may be accomplished, but with some loss in picture quality. Present audio and video recording techniques are adequate to take care of any rebroadcasts necessitated by time differences around the world. A suitable system of video recording on magnetic tape will be an even greater aid. Ultimately, it is hoped that a single international standard will be adopted.

Finances

The cost of this monumental undertaking is impressively high, but not insuperable. According to UNITEL's planners, the basic mountain-top regional TV and FM broadcast equipment can be installed for about $250,000. An additional service such as multi-channel microwave would add $25,000 to this figure. Existing commercial equipment for an unattended microwave relay station should run close to $70,000. The estimate for the entire technical set-up for the Japanese Network is $5,500,000. Similar installations for countries the size of Turkey or Egypt should cost under $10,000,000. The bill for the trans-Atlantic NARCOM system has been estimated as $50,000,000 to $100,000,000, or about the cost of one large ocean liner.

Raising the necessary funds will require perseverance, and more important, a program of informing government and industrial leaders of

(*Continued on page* 122)

Direct Frequency

(*Continued from page* 116)

time required for measurements having various accuracies, is significant. Galvanometers and electromechanical voltmeters, as well as the vibrating-reed frequency meter, are limited in response time by their mechanical features. Manually operated devices are obviously slow. The events-per-unit-time meter and similar systems are potentially capable of higher accuracy and higher speed than presently available through use of better crystals and arbitrarily shorter time intervals.

Fig. 6 shows the approximate space required for various measurement accuracies. Since the frequency systems high on the graph are essentially narrowband devices, it is clear that a need exists for a small, relatively simple frequency meter analogous to a voltmeter. The need for better standards of amplitude measurement has already been mentioned.

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Peak Rectified Current.........20 ma
Max. Surge Current (1 sec).....80 ma
Ambient Temp. Range..—50 to 100° C
Max. RMS Applied Voltage....26 volts
Max. RMS Input Current.....3.75 ma
Max. DC Output Voltage......20 volts
Voltage Drop at Full Load.......1 volt
Reverse Current at 10 V RMS...2.4 *ua*
Frequency, Max. ....100 Kc

Also available in 2U1, 3U1, 4U1

TYPE 1T1

Output 20V - 200 *ua*
Specifications at 45° C

Max. Reverse Current....6.0 *ua* at 26V
Rated Forward Current........200 *ua*
Shunt Capacitance at 200 KC. 0.000057 *uf*

Maximum Ratings

Peak Inverse Voltage.........60 volts
Max. Average Rectified Current..200 *ua*
Peak Rectified Current.........2.6 ma
Max. Surge Current (1 sec).....10 ma
Ambient Temp. Range..—50 to 100° C
Max. RMS Applied Voltage....26 volts
Max. RMS Input Current......500 *ua*
Max. DC Output Voltage......20 volts
Voltage Drop at Full Load......1 volt
Reverse Current at 10 V RMS...0.6 *ua*
Frequency, Max. ....200 Kc

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E-C GLASS RESISTORS

(*Continued from page* 55)

temperature coefficients of less than 30 ppm/°C. The voltage coefficient is also small—10 ppm/v. or less.

E-C glass resistors are highly resistant to moisture attack. The base resistive element without any protective covering was not affected by 250-hour exposure to 95-100% relative humidity at 40°C. The resistance change induced by this treatment was less than 0.5%.

These thin film resistors have excellent high frequency characteristics. Measurements of effective resistance at 200 and 400 MC made on a limited number of resistors by the Components and Materials Branch of Squier Signal Lab. indicate that the high frequency properties of these resistors are at least equivalent to those of characteristics proposed for VHF resistors in ASE SA Project #331.

Facilities for mass production of ½, 1, and 2-watt E-C resistors are being set up by Corning under an Industrial Mobilization Contract with the Bureau of Ships. Dimensions, resistance range and power ratings for typical resistors are shown in Table I. The ½, 1, and 2-watt power ratings are at 120°C ambient (i.e., approximately 200°C operating temperature). When operated down at the conventional ambient of 40°C, these power ratings can be doubled. The maximum resistance values attainable at the present time in these three sizes are 10,000, 40,000 and 100,000 ohms, respectively.

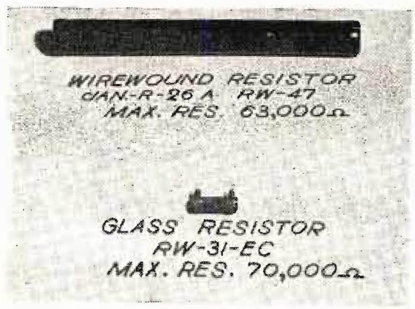


Fig. 4: Comparison of glass and wire-wound resistors shows small size of the glass type

New Line Being Developed

A line of E-C glass power resistors is being developed at the request of the Signal Corps Engineering Labs. One of the interesting aspects of these E-C power resistors is that high resistance values can be attained in relatively small physical size. This is shown in Fig. 4, where the size of the smallest 63,000 ohm JAN-R-26A wire-wound power resistor is compared with that of an E-C glass power resistor of the same resistance value. Other characteristics of E-C glass resistors of interest in power applications are their low inductance, good thermal shock resistance, and the large possible savings of critical materials normally used in resistance wire.

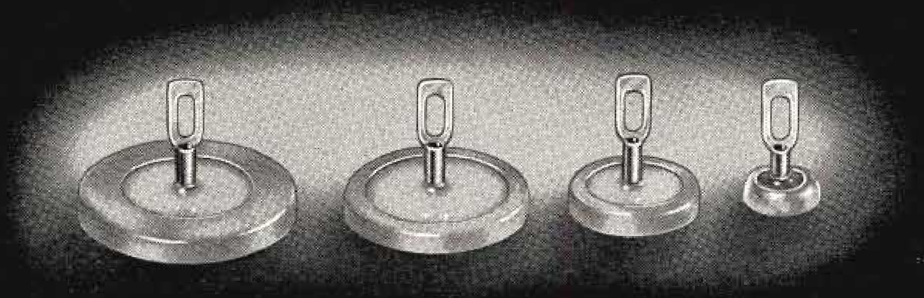
Table II shows approximate dimensions, power ratings, and resistance values of typical E-C power resistors.

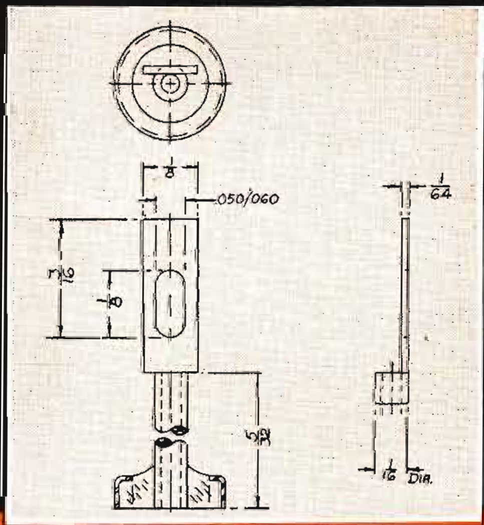
Special Types

Special types of air-cooled and water-cooled units with power ratings into the kilowatt range are finding increasing application as dummy-load resistors. Good stability and high-frequency characteristics are primarily responsible for their use in these applications.

To summarize, it is believed that the development of E-C glass resistors is a significant step in the direction of higher quality electronic components.

This paper was first presented at the AIEE-IRE-RTMA Symposium on Progress in Quality Electronic Components, May 5-7, 1952, Washington, D. C.





.050/060
DIA.

Global Microwave

(*Continued from page 118*)

the manifold advantages of a unified telecommunications network. Wherever possible, capital should be obtained from private sources, as was done in Japan. Grants to underdeveloped countries may be made by the United Nations, as they did in Afghanistan. For projects such as NARCOM, the obvious military applications should encourage NATO to initiate construction. And in other countries, loans from international banking sources or subsidies from the U. S. through the Mutual Security Agency may be sought.

UNITEL is a logical step in the technological trend of forging one world containing free men who understand one another. UNITEL means a bolstered defense against Soviet aggression. It means opening new markets to American industry. The need is critical. The time is now.

Subminiature Amplifier

(*Continued from page 47*)

for amplifiers that will operate satisfactorily at temperatures of 200° F. or above, the type of glass used in tube envelopes becomes important. At least one tube manufacturer is already supplying all premium subminiature tubes with hard glass envelopes. These have a maximum bulb temperature rating of 482° F. The life expectancy for these tubes, when operated within ratings and with a bulb temperature of 392° F., is 1000 hours. When operated with a bulb temperature of 176° F., the life expectancy is 5000 hours.

Reliability Key Objective

Work is continuing on the miniaturization of equipment, with reliability remaining the key objective. An effort is being made to establish the best balance between minimum size of designs versus their versatile use in similar systems, so that fewer varieties of spares are required for stocking by the military. Progress is being made on the miniaturization of transformers and improvement of their application in high temperature amplifiers. Studies are being made of the application of transistors and of the use of hybrid electronic-magnetic amplifiers to our systems. New methods are being applied to hermetically sealed enclosures. Because miniaturization is such an extensive and important effort to the aircraft industry, a considerable amount of our engineering manpower is being used on these problems.

Phase Shift

(Continued from page 39)

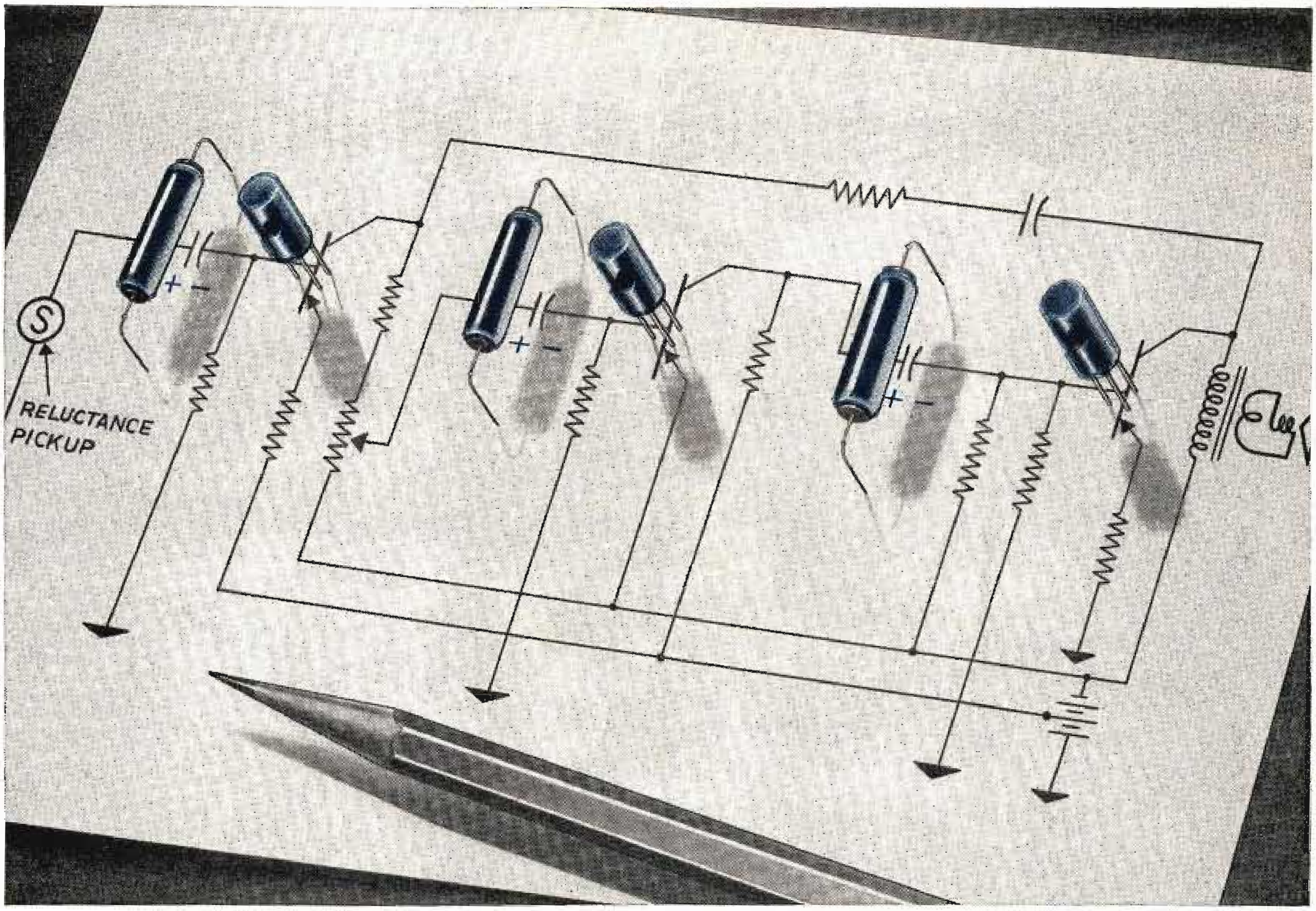
crt face. The vertical signal is now placed through an appropriate attenuator, through the unit to be tested, and from there into the vertical deflection circuit of the oscilloscope. For $n = 1$, the arrangement of Fig. 3a results.

With phase shift at the test frequency we will now get a pattern in which the crossover points are displaced from those of the reference conditions. Measurement of the displacement measures the phase shift. That is, $a\text{-}a'/a\text{-}b = \sin\theta/\sin(360/2n)$ in Fig. 2. Where the angles are sufficiently small $\sin\theta = \theta$, so $a\text{-}a'/a\text{-}b = 360/2n$. There is still an ambiguity, since the same pattern will be seen with 30, 75, 120, ... 345°. This is quickly resolved by means of a coarse measurement using a value of 1 for n.

For work with small phase shifts, it is highly satisfactory to use a value of 12 for n. This makes the distance between adjacent crossover points 15°, and assures a linear relationship between phase shift and displacement. Since 15° occupies the same space on the scope that 180° does when $n = 1$, the accuracy of reading is increased by a factor of 12.

The technique described here is quite satisfactory for use in the audio frequency range. For work above this range, considering the frequency response of typical horizontal deflection amplifiers used in oscilloscopes, it is necessary to apply the higher frequency to the vertical deflection amplifier. The suggested upper frequency limit for this measurement system is 50 KC for the horizontal signal and 1 MC for the vertical. However, it should be noted that the test set-up has been used successfully up to 250 KC and 3.5 MC, for the horizontal and vertical, respectively.

For laboratory use, separate oscillators (Fig. 3b) are the simplest solution. In general, a two-hour warm-up period makes the drift of one oscillator with respect to the other a negligible problem. For production line use, however, where only a small number of spot frequencies are to be checked, the use of more elaborate equipment such as single frequency oscillators and frequency multipliers, may well be warranted. See Fig. 3c. Alternatively, some means might be employed to synchronize one oscillator at a subharmonic of the other. This could easily be done by means of a countdown circuit, the output of which is used to synchronize the second oscillator.



TRANSISTORS . . . TANTALYTIC CAPACITORS

teamed in 100-milliwatt tubeless amplifier

General Electric engineers at Electronics Park, Syracuse, have developed a new tubeless audio amplifier circuit that utilizes three junction transistors and three Tantalytic capacitors.

Although still experimental, this 3-stage amplifier promises significant advances in miniaturized equipments. It has a power output of 100 milliwatts—less than 10% distortion—and a power gain of 70 db.

Tantalytic capacitors were a "natural" for interstage coupling in the circuit because of their small size, large capacitance and low leakage current. They match the transistors in ruggedness and long operating life. And they will operate over a wide temperature range (−55°C to +85°C with at least 65% capacitance at −55°C). Other features include light weight, long shelf life, and hermetic sealing.

If you have a capacitor application where you need small size and superior performance, it will pay you to investigate Tantalytic capacitors. They're available in polar and non-polar construction and in ratings from 175 muf at 5 VDC to 12 muf at 150 VDC. For additional information use the convenient coupon below.

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GENERAL ELECTRIC

Loop Antenna

(*Continued from page 44*)

The swr vs. frequency of a 12-loop antenna for channel 11 is given in Fig. 12. The swr is less than 1.1 over the required band, and is less than 1.2 between 187 and 208 MC, which indicates that the matching of the antenna is not critical. The azimuth

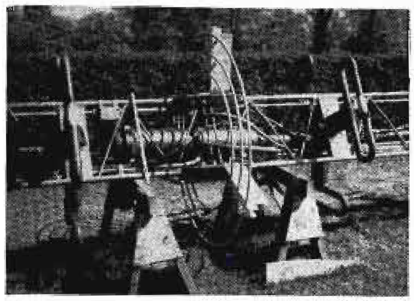

Fig. 10: Isolating ring and balun

pattern, shown in Fig. 13, is omni-directional within ±½ db.

The 16-loop antenna in Fig. 1 will safely handle the transmitter powers required to produce an ERP up to 316 kw. The only change required in the 12-loop antenna is to substitute RG-19/U cable for the RG-17/U cables or to use teflon insulated RG-17/U cables.

Close-in Coverage

It is sometimes stated that most of the difficulties encountered in receiving a satisfactory signal within a mile or so of the transmitting antenna are due to the fact that this region receives power from the side lobes of the high gain antenna. In an urban area it is difficult to separate the effect of reflections from many buildings from the effect, if any, of the pattern of the antenna. Fig. 14 shows a calculated close-in coverage

(*Continued on page 128*)

Fig. 11: Photograph of television diplexer unit

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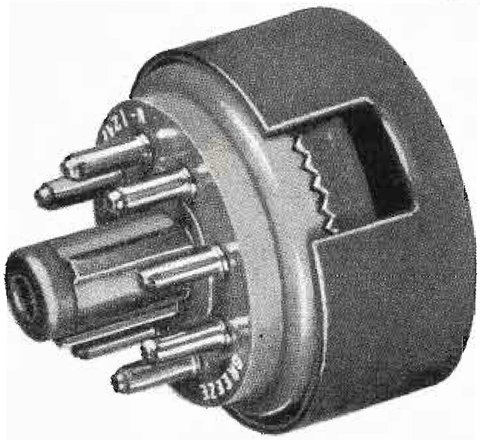
Quick as a Fox!

Two Special Purpose Connectors *by* BREEZE MARK

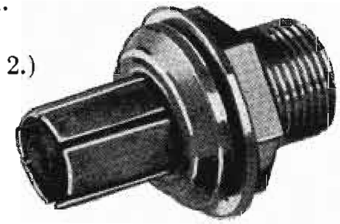


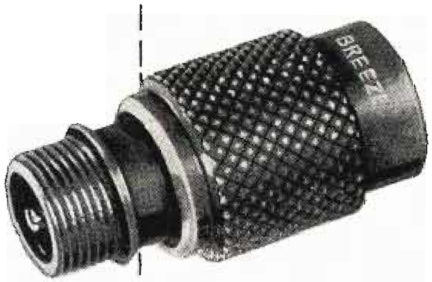
Battery Connectors

8-pin type for both A and B batteries used in all types of field communication equipment. "RUGGEDIZED" for extra security and long service life: polarizing stud is ALL METAL and all metal parts are cadmium plated and sealed with an iridite sealer. Cable may be brought out at any desired side position and locked. Handy bail makes removal from inaccessible places easy.

Quick Disconnect

Simply push male and female members together and lock. To disconnect with minimum resistance, pull back sleeve on plug shell and disconnect. Exceptionally low disengaging force required (less than 6 lbs., excepting pin friction). Vibration proof, moisture-proofed with synthetic rubber insert. Meets AN pin pattern and voltage requirements, in accordance with MIL C-5015. Plug shell and coupling sleeve are aluminum alloy, cadmium plated and iridite-sealed. (Federal Spec. QQP – 416, Type 2.)





Receptacle Types: Round flange single hole panel-mounted, square flange for 4 bolts, or specially flanged to specification. All contacts silver plated.

We invite your inquiries on any problems concerning connectors. Our wealth of engineering experience in this specialty is at your service.

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CORPORATIONS, INC.

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for a 16-loop array with 18.5 kw of transmitted power as compared to the same power into a half-wave dipole. It can be seen that there is a very high field strength in the immediate vicinity of the theoretical nulls of the antenna pattern. Hiehle[2]

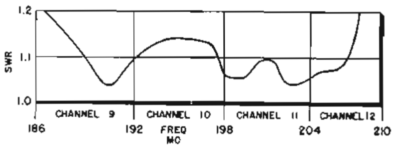


Fig. 12: SWR of 12-loop antenna for channel 11

has shown that for a 12-bay antenna 500 ft. above ground that the field strength is high at distances as close as 200 ft. from the antenna base. For very high (a mile or more) antennas, the antenna can be phased to tilt the beam. This may easily be accomplished, by successively advancing

(*Continued on page* 130)

Fig. 13: Horizontal radiation pattern of the loop antenna is omnidirectional within ±0.5 db

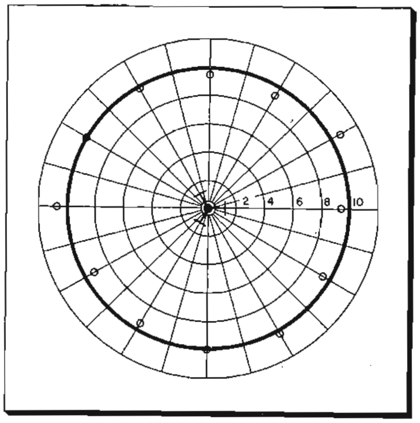
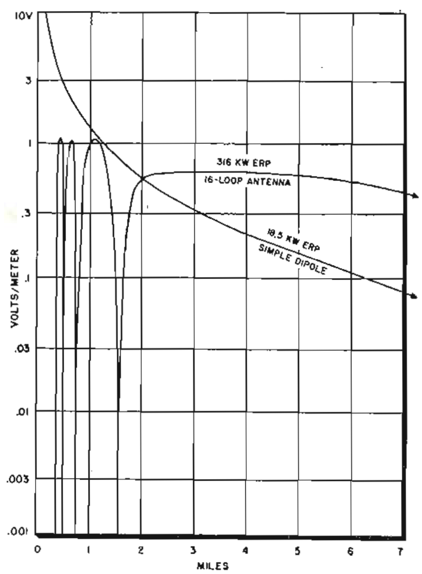


Fig. 14: Calculated close-in coverage of 16-loop array compared to dipole; 500-ft. height



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One-third the size of existing tubes.

These exclusive new Westinghouse heavy-duty, high-voltage rectifiers permit more efficient design of mobile equipment where reduced weight and space are desired.

They are one-third the size of existing tubes with comparable ratings!

This advanced design permits the tubes to carry peak currents of 900 ma. (average currents of 150 ma.) without overloading. The high-wattage thoriated tungsten filaments require only three seconds' heating. Filament terminals may be operated either up or down.

Designers should evaluate these and other unique advantages of the Westinghouse WL-6102 and WL-6103 rectifiers. For further information write Westinghouse Electric Corporation, Electronic Tube Division, Dept. B-111, Elmira, N. Y.

Maximum Ratings

	WL-6102 Oil Immersed	WL-6103 Air Cooled
Peak Inverse Voltage	40 KV.	20 KV.
Peak Current	900 MA.	900 MA.
Average Current	150 MA.	150 MA.
Filament Voltage	5.25 V. (5.0 V. Center)	5.25 V. (5.0 V. Center)
Filament Current	7.6 AMP (7.2 AMP. Center)	7.6 AMP. (7.2 AMP. Center)
Height	2-13/16 IN.	2-15/16 IN.
Diameter	2-1/16 IN.	2-1/16 IN.
Weight	3½ OZ.	8½ OZ.

Typical Operation

Single Phase, Full-Wave

	WL-6102	WL-6103
Full Transformer Secondary Voltage (RMS)	28,300 V.	14,100 V.
DC Output Voltage to Filter	12,700 V.	6,300 V.
DC Output Current	.300 AMP.	.300 AMP.

3-Phase, Half-Wave

	WL-6102	WL-6103
Transformer Secondary Voltage (RMS)	16,400 V.	8,200 V.
DC Output Voltage to Filter	19,100 V.	9,500 V.
DC Output Current	.450 AMP.	.300 AMP.

Westinghouse WL-6102
Oil Immersed 40 KV Rectifier:
Only 2¾" high,
Weighs only 3½ ounces

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ET-95005

the phase of loops with height[3]. This is convenient to do for the feeder to each loop in the array is a matched 50 ohm line.

Changing Minima

The minima can be filled by changing the phase of one loop. If the antenna has an odd number of radiators, changing the phase of the center radiator by ± 90° eliminates all nulls because the field from this radiator is always in quadrature with the field from the other radia-

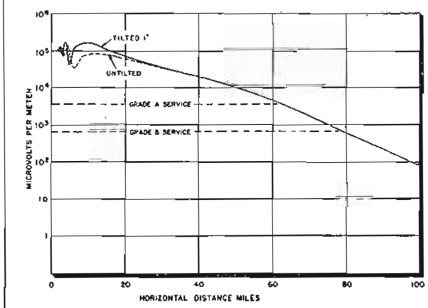


Fig. 15: Field strength of 16-loop array

tors. If the antenna has an even number of radiators, changing the phase of one radiator near the center ±90° also fills in the nulls, but less completely than with an odd number of radiators. For all practical purposes the results are the same. Fig. 15 shows the calculated[4] field strength for a 16-bay antenna 2000

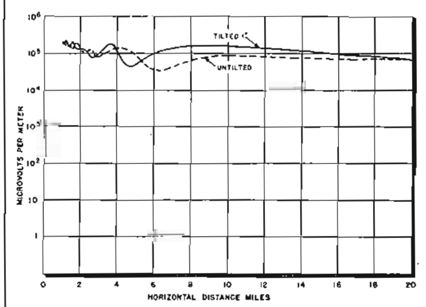


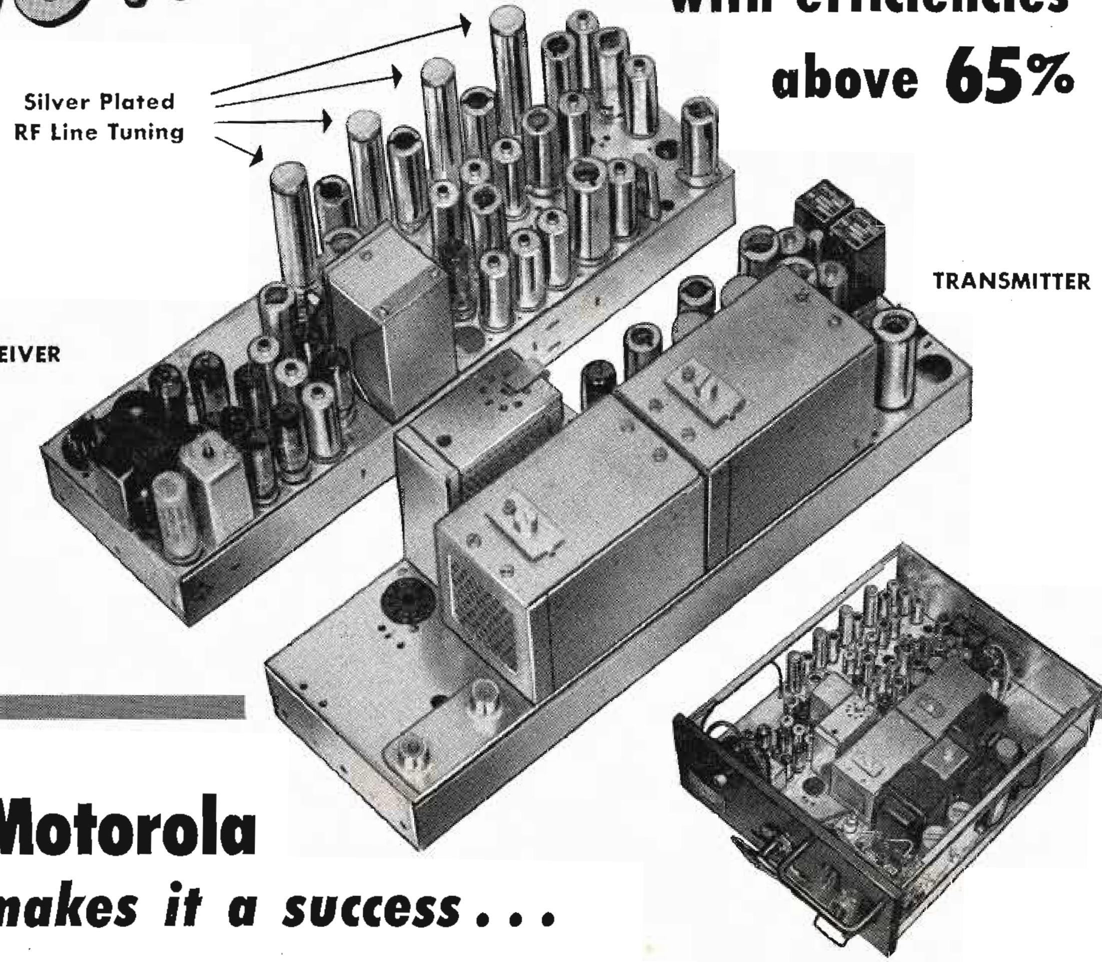
Fig. 16: Close-in field of the 16-loop array

ft. above ground with the beam tilted down 1° with the ninth loop from the bottom fed at +90° relative to the other loops. Grade A service (FCC definition—71 db above 1μv/m or 3.5 mv/m) extends beyond 60 mi. Grade B service (FCC definition—56 db above 1μv/m or 0.6 mv/m) extends out to 80 mi. Fig. 16 is an enlargement of Fig. 15 and shows the field strength at distances between 1 and 20 mi. Also shown on these figures are the field strengths when the beam is horizontal. By varying the angle of tilt it is possible to

At 460 M.C.

18 to 20 Full Watts

with efficiencies above 65%



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By use of silver plated line sections, high standards of selectivity protect the receiver from high power U.H.F., TV intermodulation.

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favor some distances over others. On the above example the region between 5½ and 20 mi. gets more signal than if the beam were not tilted.

With this feeding arrangement the pattern is roughly "cosecant" (field strength independent of distance) out to about 20 mi. The gain is decreased only a few per cent so that high gain is retained for outlying areas where it is needed the most.

An 8-loop array for channel 7 has been installed and in operation in Buenos Aires since Sept., 1951. The overall swr from 174 to 180 MC was uder 1.1, and video and sound carrier swr were 1.05 and 1.07, respectively. The antenna is 450 ft. above ground, and good reception has been reported 140 mi. away.

1. A. G. Kandoian and R. A. Felsenheld, "Triangular High Band TV Loop Antenna System," Communications, pp. 16-18, August, 1949.
2. M. E. Hiehle, "Engineering a Super-Gain TV Antenna," Television Engineering, pp. 16-18, 27-28, May, 1951.
3. Kandoian, Sichak, and Felsenheld, "High Gain with Discone Antennas," PROC of the National Electronics Conference, Vol. 3, pp. 336-346, 1947. Reprinted in Electrical Communications, June, 1948.
4. Figure 6, Part II, "Estimated Field Strength exceeded at 50 per cent of the potential receiver locations for at least 50 per cent of the time at a receiving antenna height of 30 feet"—Sixth FCC Report and Order, FCC52-294, Released April 14, 1952.

TV Prompter

(*Continued from page* 47)

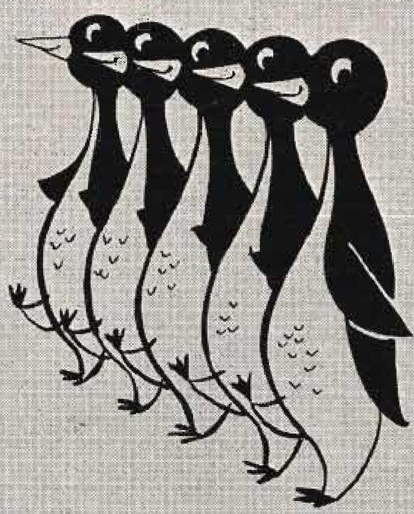
eyes would not be seen roaming back and forth.

The floor director operates it by turning the top handle at the proper speed to suit the announcer. The line being read is always kept opposite the pointer, located on the upper left hand corner, so he has no difficulty keeping his place.

The mounting brackets consist of two boxes, one fitting inside the other. The larger box mounts permanently on the pedestal, while the smaller one mounts permanently on the back of the prompter. The prompter is mounted by putting the two boxes together, a hole is drilled through both boxes on either side where a pin goes through holding it in place. In this way they can be changed from one to another or taken off completely in just a few seconds.

Because each announcer prepares his own copy for use it is advisable to have several prompters on hand. The copy can be prepared for the machine in a lot less time than it would take to memorize it.

The prompter is 24-½ in. wide and 12 in. long, with a roller on top and bottom. A 24-in. roll of white paper, using black crayon pencil to write with, makes it very easy to read.



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Selenium RC

(*Continued from page 59*)

starts. Hence, for a known ripple frequency, the period of conduction can be related to the RC (time constant) of the load.

In Fig. 7, the degrees of conduction are plotted against RC of load for 60 cycles, full wave, giving a ripple frequency of 1/120 second. The

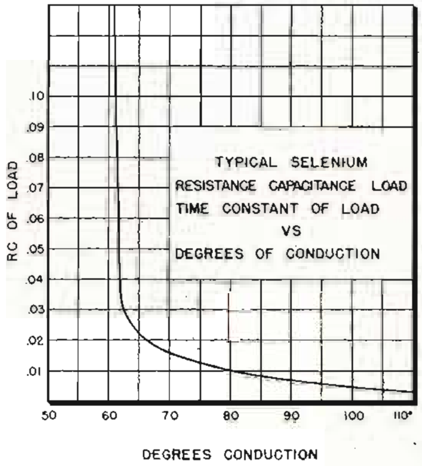


Fig. 7: Relation of RC to conduction period

value of RC for any case is the product of load resistance in ohms and capacitance in farads. When the value of C approaches zero, conduction approaches 180°. For values of RC greater than 0.03 seconds, the change in conduction is very slight and does not appear to fall below 60° for any reasonable values of RC.

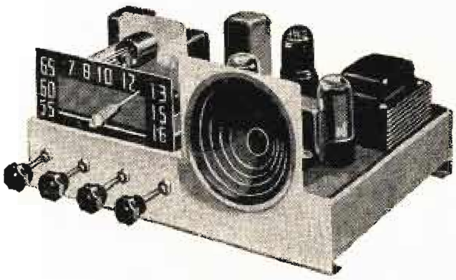
As stated, this particular curve applies only to full-wave, single phase operation from a 60 cycle source. However, it covers the situations most frequently encountered. Other curves would have to be derived for half-wave operation or for frequencies other than 60 cycles.

It should be emphasized that this entire discussion is based on steady state conditions and does not take into consideration the high transient currents occurring during the initial charging of the capacitor. This is a story within itself and not within the scope of this paper.

West Coast Audio Fair Feb. 5-7, 1953

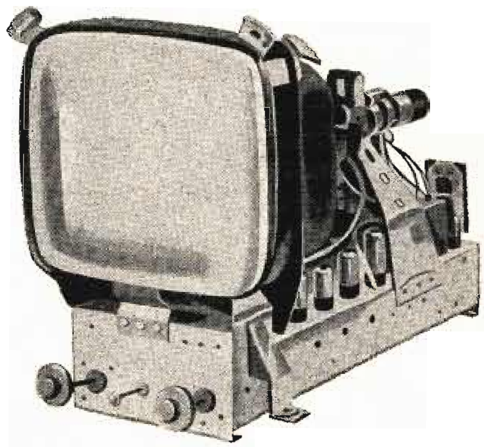
"The Audio Fair—West Coast" is being planned for Feb. 5, 6 and 7, next year, at one of the large Los Angeles hotels, with operating exhibits in individual suites all on one floor. W. L. Cara, 4245 Normal Ave., Hollywood 29, Cal., has been appointed manager of the fair, and will be assisted by a six-man committee comprising two distributors, two representatives, and two manufacturers.

FOR RADIO



AND

TV



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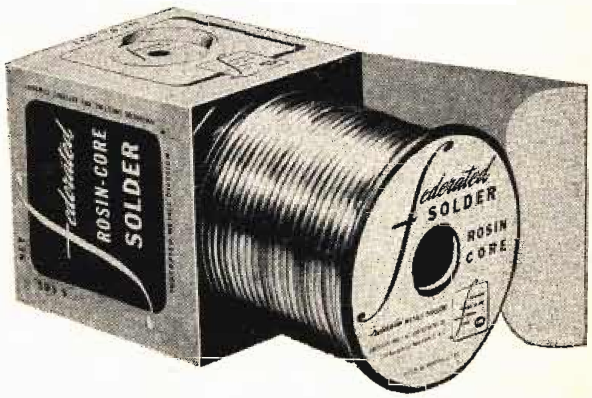

For any soldering job that demands freedom from corrosion and conductive flux residue . . . for ease of working and unequalled consistency . . . there is nothing better than Federated Rosin Core Solder.

Each Rosin Core Solder composition, of which there is a variety for different purposes, is a tin and lead alloy with a rosin flux that is effective but not corrosive. Because the rosin residue is chemically inactive, current leakage at radio and television frequencies is prevented.

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Binaural Sound

(*Continued from page 50*)

is made not in the 12-in. size, but as a 10-in. disc, where the diameter of start of the test grooves corresponds closely to a zero point in the radial error cycle.

No better method than cut-and-try has been discovered yet for cutter alignment on the recording lathe, and such alignment then has to be done in conjunction with a playback turntable whose adjustment has been made on the basis of the Series 30 record as a standard.

The difference in frequency response between inner and outer diameters of pressings is a subject which is well explored and about which much has been written. Additional pre-emphasis is often and may here be applied at inner diameters to compensate somewhat in advance for translation loss. Unfortunately, there is an engineering proclivity toward making hard and fast rules for "shop practice," to cover all such points as diameter equalization and reference pre-emphasis. The trouble is that rules do not take into account the varying character of program material. The method which is satisfactory for a piano — velocity microphone pickup is not applicable to a bright orchestral picked up with a wide-range condenser. With material which is originally bright there is a severe limit on the amount of effective pre-equalization. Fortunately in a binaural system the two channels are not necessarily matched for frequency response, and in Fig. 3 it will be found that in the de-emphasis circuit (plate) of the first stage of the "inside" channel a 2.7K resistor is used to leave pre-emphasis in effect above about 3300 cps.

A general development probably not too far away is the "half-mil" point which can only be associated with cartridges having extremely low motional impedance. When such cartridges become available in manufacture, the inside-outside range and distortion of LP's in general will be vastly improved, and the binaural translation loss factor will be negligible. As for present practice, it has been found generally acceptable to maintain approximately a 50 µs (3300 cps turnover) differential between inner and outer binaural bands in the original recording. Depending upon the program material the outside band might be 50 or 100 µs pre-emphasis, and the inner band 100 µs or 100 µs + 50 µs, correspondingly.

Assuming that binaural recordings are pressed in high grade plastic, the most serious surface

(*Continued on page 138*)

noise will be that of ticks and pops. Such noise here, however, will take on a random left-right character and as such is distinctly objectionable because of the directional effect. Hence the recorded level must not be lowered in an attempt to permit full "curve" equalization of bright original material.

When experimental recordings were made using 6-in. microphone spacing and earphone playback, phasing was of course necessary. But contrary to what might at first be expected, phasing of playback *speakers* is unnecessary for material recorded indoors (rather than outdoors.) With any spacing of microphones in excess of ear spacing, phase becomes random in view of the acoustics of both the original room and the playback room. However, in playing back material which was recorded in the open, with no confining walls, phasing may well become desirable, especially if the acoustical environment of the playback speakers is on the "dead" side.

Fig. 6: Close-up of binaural recording shows the two bands of grooves

By now, most of us are well aware of the fact that a real distinction exists between standard monaural and binaural systems. Any comparison is unfair at the start because the two media are not comparable on any real basis. The extension of the aural medium by addition of dimension, direction and perspective is important not only for vitalizing the musical catalogs we are building but also for extending useful repertoire into fields such as plays and other documents, where the third dimension communicates enough additional information to make the difference between failure and success.

Of commercial necessity we have had to rule out earphones as the playback mechanism, albeit their rigorous binaural nature. We thus descend into a morass of conjecture relating to position of loud speakers, acoustical reflection characteristics of side and back walls, shape of room, etc., all applied to the room in which playback occurs. Here none but the broadest rules may be drawn, since even mass-produced living

(*Continued on page* 140)

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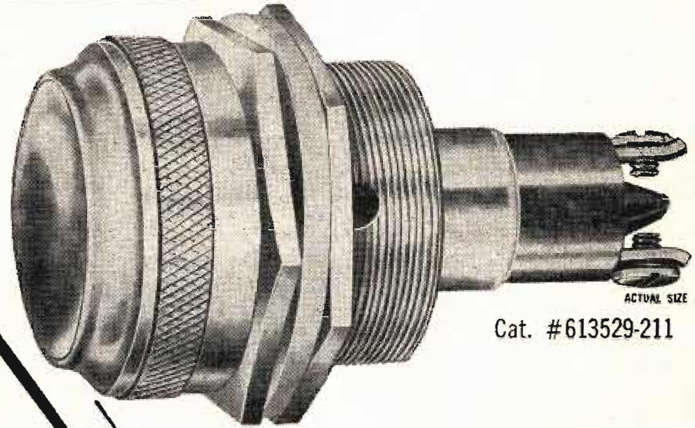

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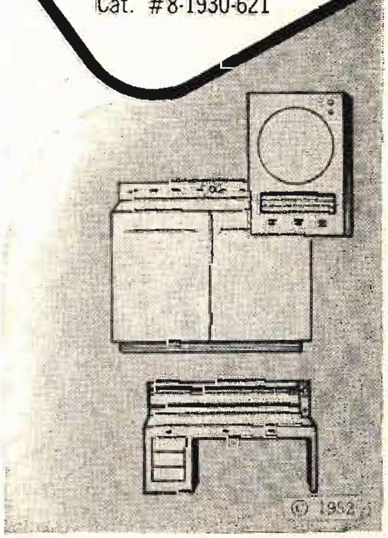

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rooms are decorated and carpeted differently.

In the case of standardization of recording characteristic curves a basic truth was finally recognized, wherein it is obviously both ineffectual and impossible to standardize the *recording curve.* What we try to standardize is the *playback curve* only. Thus in developing techniques for binaural recording insofar as microphone placement is concerned, the basic truth must always be kept in mind—that playback (on the average) will take place using 2 speakers separated perhaps 12-15 ft. against a wall in a room of corresponding size and fairly random acoustics.

As binaural disc as a medium develops, there will no doubt be a great deal of expert activity in the realm of "where to put the microphone" and "studio acoustics," and there will be many interim pet theories expounded. Without a conclusive amount of experience at this point, we can only suggest a few directions in which *not* to go. For instance, the business of about-facing the band on stage and playing into microphones in opposite corners of the stage wings is extraordinarily unnatural in effect. Wall reflections abuse the reality, and treatment of the walls to inhibit reflections pulls the teeth out of the binaural head. The bright synthetic modern studio acoustic appears definitely out from the binaural standpoint. In general, any studio or hall which has been treated with the idea in mind of creating an "even" frequency distribution of energy per square foot,—the "mix 'em up" philosophy,—is lowest on the binaural scale.

And the one unhappy malpractice which has been in vogue for 20 years of broadcast and recording,—that of the small and odd-shaped, acoustically odd and unnatural control room is absolutely fatal for producing binaural. Note is taken of various broadcast and recording company executives who, for very good reasons, insist on listening to their records in an audition room about the size and shape of an "average" living room with similar acoustics. Yet the records are produced and balanced in a studio control room which is about as far away as one could get from the living room prototype, both in size, shape, proportion, acoustics, and relative position in the room of loudspeaker and listener.

For binaural records, it would be better in these control rooms that earphones be used, for making binaural productions will probably become much more of an *art* than the regular monaural ever was.

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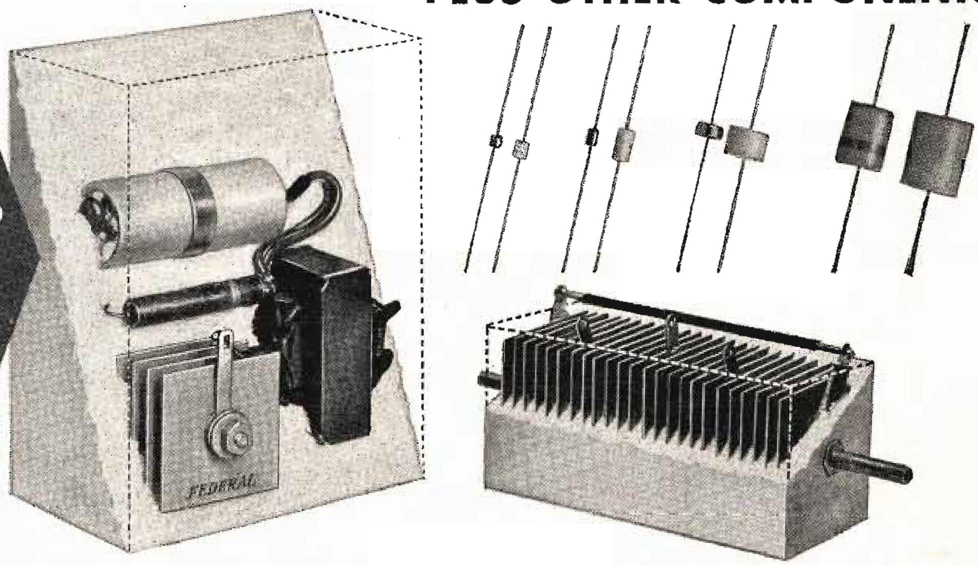

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PERSONAL

Dr. Urner Liddel has joined the central office staff of Bendix Aviation Corp. in Detroit as a director of product development. Before joining Bendix, Dr. Liddel was Chief, Physics Branch, AEC; and, prior to that, Director, Physical Sciences Division, ONR.

Dr. Robert E. Samuelson has been appointed chief engineer of the Motorola Research Laboratory in Phoenix, Ariz. He was formerly head of the Communications Research Section.

SAMUELSON

MELOY

Thomas Meloy, president of Melpar, Inc., Alexandria, Va., a subsidiary of the Westinghouse Air Brake Co., has been appointed director of research of the Westinghouse Air Brake organization.

W. M. Jones has been named manager of the Electronics Div. of Thompson Products, Inc., Cleveland 3, Ohio.

John Bodnar has been appointed manager of potentiometer sales by the G. M. Giannini & Co., Pasadena, Calif. Formerly an engineer with RCA, he also served as sales engineer for the Brush Development Co.

Charles W. Ketteman, Jr. has joined the California Electronic Services Co. as president and general manager.

A. G. Roth has joined the staff of Heppner Manufacturing Co., Round Lake, Ill., specialists in electro-magnetic and magnetic devices.

F. D. Meadows has been appointed general sales manager of the Dage Electric Company and the Dage Electronics Corp. of Beech Grove, Ind.

Control Room Layout

In the article "Television Control Room Layout" (Oct. 1952 TELE-TECH, p. 48), which was presented by R. D. Chipp at the 1952 Sixth Annual NARTB Conference in Chicago, the text and caption for Fig. 4 should read "Video control booth is on left" instead of "Announce booth is on left."

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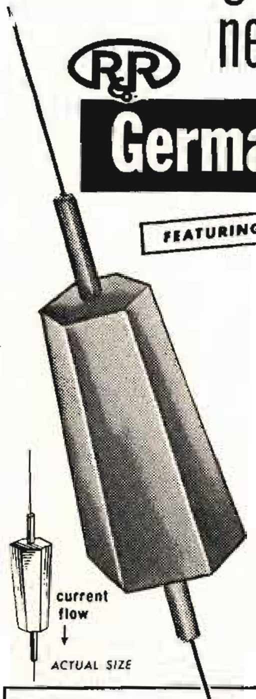

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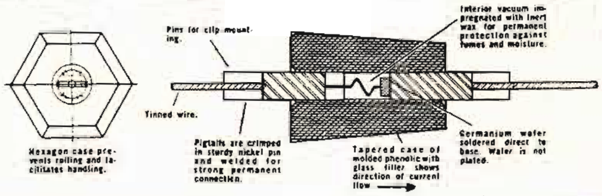

CODE NO	MINIMUM CURRENT AT 1 VOLT FORWARD MA	MAXIMUM CURRENT AT 10 VOLTS REVERSE MA	MAXIMUM CURRENT AT 50 VOLTS REVERSE MA	AVERAGE‡ RECTIFIED CURRENT MA	MINIMUM INVERSE PEAK VOLTS	MAX. CONT OPERATING INV VOLTS
1N48	4.0	—	0.833	50	85	70
1N51	2.5	—	1.667	25	50	40
1N52	4.0	—	0.150	50	85	70
1N63	4.0	—	0.050	50	125	100
1N64	Minimum DC current in 44 MC test circuit is 100 μa				20	16
1N65	2.5	—	0.200	50	85	70
†1N69	5.0	0.050	0.850	40	75	60
*1N70	3.0	0.025	0.300	30	125	100
1N75	2.0	—	0.050	50	125	100
†1N81	3.0	0.010	—	30	50	40

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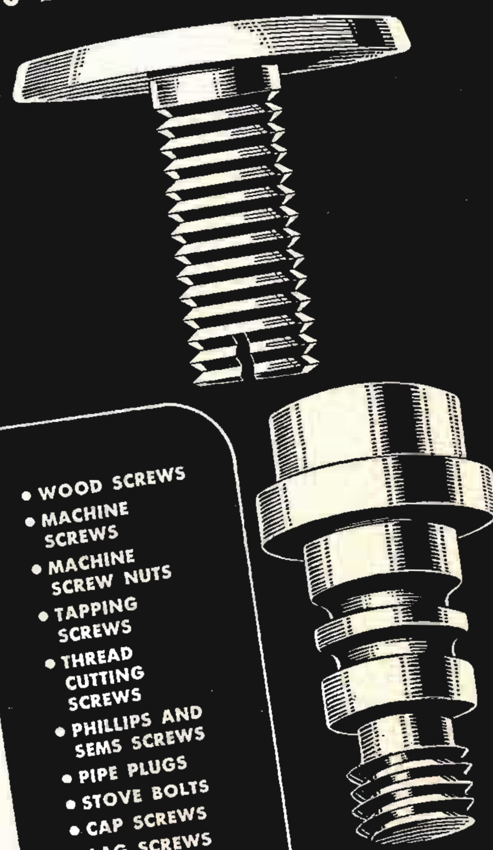

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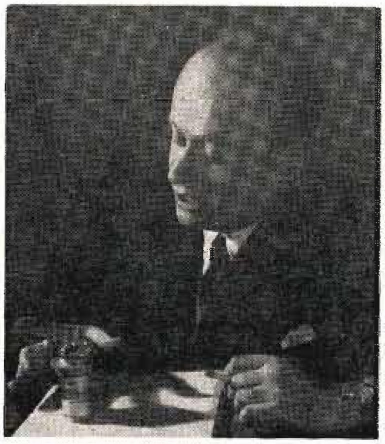
Col. S. K. Wolf is an associate professor in the School of Commerce, Accounts and Finance at New York University. Prior to this he has been sales manager, Wire & Radio Transmission Systems at Federal Telephone and Radio Corp., where he was engaged in the sale of systems engineering, promotion, and installation of microwave wire communication systems, aviation communication, navigation, and blind landing systems. He was also assistant general commercial director of International Standard Electric Corp., manufacturing and sales unit of the International Telephone and Telegraph Corp., where he was engaged in the sale and promotion of their products throughout the world. He distinguished himself in the military service as a Colonel of the U.S.A.F., and was also deputy director of the Radio and Radar Division of the War Production Board, and Director of the Communications Division of the Munitions Board. Col. Wolf is active in the directorship of various companies including Reeves Soundcraft Corporation, Cinerama, Inc., Audio-Video Corp., and Bergen Wire & Rope Corp.

Col. Sidney K. Wolf

Emile Labin was associated with the International Telephone and Telegraph Corp. for sixteen years in various executive capacities concerning research and development telecommunication apparatus and systems. He has been technical director of the Federal Telecommunication Laboratories where he was in charge of coordination and supervision of important commercial and military electronic developments. Prior to this in 1941, he directed the beginning of this organization for IT&T following his pioneer communication work with International Telephone and Telegraph Corp. in France. Mr. Labin is well



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AIEE Symposium on Science and Reproduction of Music

The American Institute of Electrical Engineers is sponsoring a symposium on "The Science of Music and Its Reproduction", beginning November 7, 1952, in Room 502, Engineering Societies Building, 33 West 39 Street, New York City, N. Y. from 7 to 9 PM. Each lecture will be approximately one hour and a half in length followed by a period for discussion. The tuition fee for the complete symposium (necessary to cover operating expenses of the Basic Science Div., AIEE) will be $3.50 for members of AIEE, IRE, ASME, ASCE, AIME, ANA, AMS, AES, and AIP; and $5.00 for non-members. Single lectures will be $1.00 for members of aforementioned societies and $1.25 for non-members. Advance registration through J. J. Anderson at AIEE Headquarters, 33 West 39 Street, New York 18, N. Y. Following is a list of dates and topics that will be presented.

Nov. 7 "Recordings from the Nineteenth Century to the Present", E. T. Canby—Record Critic, Audio Engineering; P. Miller—Music Director, New York Public Library

Dec. 11 "The Physics of Music and Hearing"; W. E. Knock—Bell Telephone Laboratories

Jan. 15 "Performance Criterial of Loudspeakers"; F. H. Slaymaker—Stromberg-Carlson Co.

Feb. 20 "Some Notes on Modern Techniques of Recording and Reproducing"; C. J. LeBel—Audio Devices Inc.

Mar. 12 "The Relation Between Frequency Response and Transients in the M. S. Corrington—Radio Corporation of America

Apr. 16 "Component Integration of Sound Systems"; H. H. Scott—Hermon Hosmer Scott Inc.

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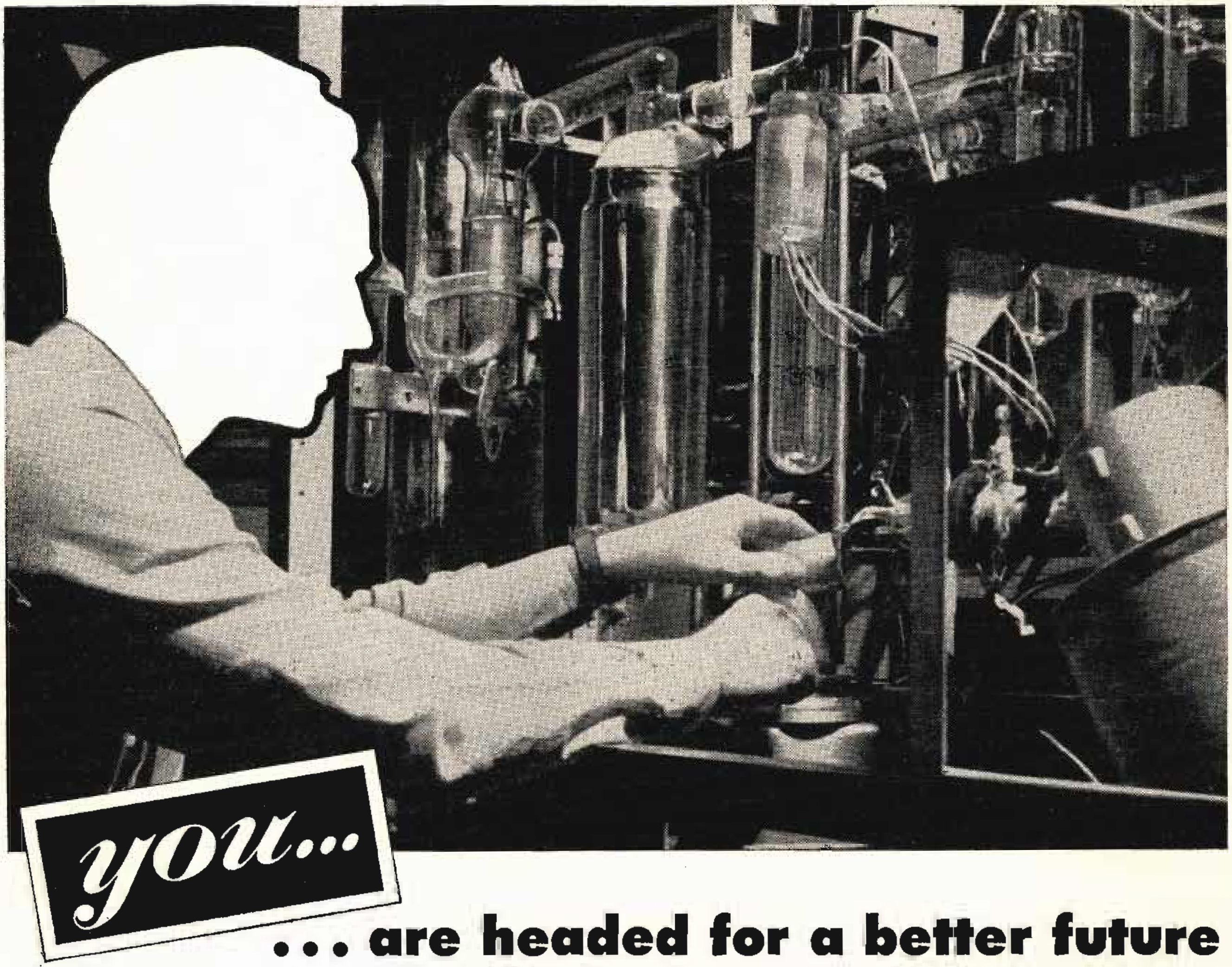

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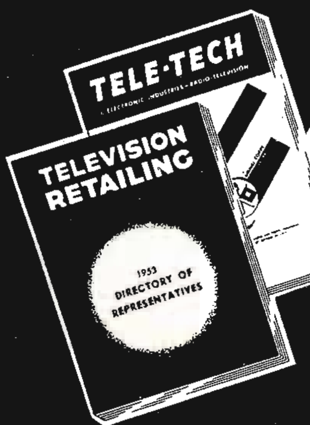

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Steel Assoc Joseph R 41 W Main St a

Bridgeport

Reynolds Co Harrison 211 State St BR 5-9634 a,b

Canaan

*Holliday-Hathaway Co Box 797 CA 8-7215 b

East Haven

Steele Assoc Joseph R 22 Green Garden HO 7-5864 a

Hartford

*Gibson Engineering Co 119 Ann St b
Hatton & Co Arthur T 955 Asylum Ave 5-2159
*Kahn & Co 541 Windsor St 46-7431 b

Manchester

*Gates Alexander W 46½ Summer St 3761 a

Meriden

*Lavin Assoc Henry Box 196 7-4555 a,b

New Haven

Gerber Sales Co 42 Church St

Ridgefield

*Hustis Assoc Walter C Box 52 8-7477 a

West Hartford

Pettigrew & Co R S 62 LaSalle Rd HA 3-5804 b

DISTRICT OF COLUMBIA

Washington

*Burlingame Assoc 2017 S St NW DE 8000
Jodon Francis Rl 1124 Warner Bldg RE 7-1635 b
Lee Assoc S S 832 Southern Bldg
*Lienau & Co Chas W 509 Investment Bldg ST 2460
*MacDonald S K 217 Riggs Bank Bldg CO 3938 a,b
Maclen Corp 9 & Kearny Sts NE LA 6-4445 b
Massey Associates #1 Thomas Circle NW NA 1957 a,b
Rich Industries 1025 Connecticut Ave ST 5141 b

FLORIDA

Fort Myers

Lynch Arthur H & Assoc Box 466 5-6762 a,b

Jacksonville

*Cole Harry A 534 10 Ave 5-2971 a,b

Lutz

*Wallace Assoc Stanley K 39-1493 a,b

Tampa

.Minthorne Co Leonard L 409 E Cass St 2-8631
*Wallace Assoc Stanley K 207 W Alfred St 2-73313

Winter Haven

*Taylor Co Morris F 940 Lake Elbert Dr 2-2684 a

GEORGIA

Atlanta

*Adair Clark 1426 High Point Pl NE VE 3053
*Burwell Co Henry W 1133 Ponce de Leon Ave NE EL 7517 a,b
*Cartwright & Son J M 4030 Club Dr NE CH 2483
*Duckett Sales Co Grady 1145 Peachtree St NE AT 6916 a,b
*Fausett & Son F 777 Pinehurst Ter SW RA 3104 a,b
Glenn & Larson 172 Simpson St NW WA 4906
*Hollingsworth & Still 407 Whitehead Bldg MA 5878 a,b
Lewis Co Carl A 627 Peachtree St NE VE 1457 a
*Miller Assoc James 1036 Peachtree NE EL 0919 a,b
*Murphy & Cota 1409 Peachtree St NE EL 3020 a,b
Rogers & Assoc C B 1000 Peachtree St NE EL 1733 a,b
*Smith Co Maitland K 317 Forrest Ave NE WA 6094 a
Thornwell E A 217 Whitehall St SW WA 3548 b
*Wallace Assoc Stanley K 2151 Beecher Rd SW RA 8463

Decatur

*McCorvey Co V Avis 212 Mimosa Dr CR 6167 a,b

ILLINOIS

Chicago Area

American Mfrs Agency 208 N Wells St RA 6-6311 a,b
*Arnold Co A W 1321 Rosedale Ave ED 4-6457 a
*Bauman & Bluzat 2753 W North Ave HU 6-6809 b
*Beebe Jack 5707 W Lake St Co 1-5778
*Beier Co Leroy W 6518 W North Ave BE 7-2420 a,b
Berggren & Assoc 2015 S Michigan Ave CA 5-1450 a,b
Bomke Sales Co 605 W Washington Blvd RA 6-1630 b
*Booth Claude R 4000 W North Ave CA 7-2810 b

Bruning Co A H 208 N Wells St DE 2-2769 a
*Caine Sales Co 3020 N Cicero Ave SP 7-4022 b
Carroll & Carroll 3223 W Armitage Ave DI 2-9878 b
Chambers Co Larry A 565 N Washington St FR 2-9095 a
Champion Earl T 6459 N Sheridan Rd AM 2-3565 a
Cole Co G McL 4753 N Broadway LO 1-7611
Cozzens Warren B 220 Kedzie St (Evanston) DA 8-4800 b

*Crossley & Assoc 4501 N Ravenswood UP 8-1141 b
*Cumming & Assoc Bruce 228 N LaSalle AN 3-5837 a,b
Cushing Co L G 605 N Michigan Ave DE 7-6456 b

Darmstader S B 520 N Michigan Ave SU 7-3925 b
*Olethert Co Russ 2323 W Devon Ave AM 2-4068
*Dolin Sales D 1200 N Ashland Ave BR 8-1515 b
*Ellinger Sales Co 6540 Northwest Hwy RO 3-1570 a,b
Ellis Co Arthur J 1607 Howard St AM 2-2708 b
*Engle Co Karl D 4724 N Sheridan Rd UP 8-6363 b
Eschner Co 9 S Clinton St CE 6-1538 b
Everett Associates 6744 N California AM 2-3702 b

*Felleisen & Assoc 612 N Michigan WH 4-4822
Fistell Harry 1838 S Halsted St SE 3-3076 a

Gaskins T 1005 S Aurora Ave (Wheaton)
*Gassner & Clark Co 6349 N Clark St b
*Gebhard Co Harry W 5129 W Devon Ave RO 3-3636 b
*Gianaras Sales Co 2345 Devon Ave AM 2-2100 b
*Golten Co Jerry 2750 W North EV 4-5959 b
Granat Gary 330 S Franklin St WE 9-4595 a
*Green & Assoc Loren F 4949 W Diversey Ave NA 2-2370 a,b

Haines E Ralph 949 Lake St (Oak Park) EU 6-4476 a
*Halinton Co Harry 5500 W Devon Ave RO 3-2132 a,b
Hefter & Assoc E G 612 N Michigan DE 7-1160 a,b
*Higgins Co Royal J 7345 Cottage Grove HU 3-7630
*Hill R M & Gray G E 4524 W Madison ES 8-7050 a,b
Horlacher William A 7070 N Clark St RO 4-9487 a,b
Hower & Pretat 4 N Cicero Ave CO 1-3146 b

*JKM Inc 510 N Dearborn WH 4-6345 a,b

*Jones Mel 2800 Milwaukee Ave EV 4-2646 b

KaDell Sales Assoc 2406 W Bryn Mawr LO 1-3042
*Kahan I J 333 N Michigan Ave FR 2-1478 a,b
Kelburn Eng'g Co 600 W Jackson Blvd DE 2-2828 b
*Kleker Co Jerome H 177 Sunset Ave (Glen Ellyn) GL 2297 a,b

Langhaus Co Marvin 333 S Clinton St WA 2-4595 a
Linz Co W M 1335½ Touhy Ave RO 4-5118 a
*Lund-Hansen Co 1900 Montrose Ave LO 1-2551 a,b

McBride Sales Co J J 14107 Merchandise Mart DE 7-3575 a,b
*McCarthy Co L C 9 S Clinton St AN 3-2104
Magnuson Edward G 4258 W Irving Park Rd KI 5-4426
*Magnuson R J 4258 W Irving Park Rd PA 5-1170 a,b
Memac Sales Co 9 S Clinton AN 3-5728 b
Miles Paul H 333 N Michigan Ave FR 2-7100 a
Monson Sales Corp 919 N Michigan Ave WH 4-0393 a

*Newman-Krasse Co 3352 N Central Ave PE 6-6776 a,b

*Petitt Co G 549 W Washington St RA 6-0582

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Plastic Tubing Sales Co 5215 N Ravenswood UP 8-6820 b
Quackenbush Al 2629 N 77 Ct GL 3-3446 a
*Ridley Assoc 1551 N Austin Blvd TU 9-2940 b
*Ritter Sales Co 612 N Michigan Ave SU 7-7759 a,b
*Rose & Co J K 2323 W Devon Ave AM 2-5584 a,b
Ryan Co Gerald G 549 Washington Blvd ST 2-7665 a,b
*Saffro Co 800 N Clark DE 7-5092 a,b
*Sarkis & Co Henry 6560 Sheridan Rd HO 5-1481 b
*Smith Co Oren H 221 W Huron St SU 7-7919 a,b
*Stemm R Edward 5707 W Lake St CO 1-1566 a,b
*Stemm Royal A 21 E Van Buren St WE 9-4840 a,b
Stone C H 205 W Wacker Dr RA 6-7725
*Strauss Mae 425 Surf St
*Sullivan Ralph T 542 S Dearborn
*Tatro & Assoc Frank B 6022 N Rogers Ave JU 8-0333 b
*Taylor Co R F 308 W Washington St AN 3-1808 a,b
Victoria Sales Co 7522 Sheridan Rd RO 4-5400 a
*Warner Co Dayton L 7345 Cottage Grove AB 4-0262 a
*West Jack 6747 N Octavia Ave RO 3-1393 a
*Wilson Wesley L 2750 W North Ave CA 7-7600
Withers & Ropek 2400 W Madison MO 6-3498 b

Springfield

Kloppenburg H M 1316 S College St 4323 b

INDIANA

Angola

*Clancy & Co Joe Wilder Rd 8063-X a,b
Law Instrument Co 519 W Gilmore St 217 b

Fort Wayne

*Bieberich Walter W 2817 Plaza Dr K-2928 a,b
*Central Sales Co Central Bldg EA-6251 a,b
*Fisch Bud 419 W Sherwood Terr HA 1089 a,b
*Hoemig Sales Co 1730 Clover Lane AN 2083 a,b
*Macnabb Vernon C Box 326 EA 4945
*MacPherson Co B L 601 Ft Wayne Bank Bldg AN 9460 a,b
*Southern Sales Co 1605 Lincoln Tower AN 5278 a,b
*Valentine Forrest C 912 Wayne Bk Bldg AN 9122 a,b

Indianapolis

Blind & Co Harrison J 1616 Cord St BE 0191 a,b
Chatfield C E 503 Illinois Bldg PL 1838 a,b
*Crandall & Assoc R M E 56 St CH 8373 a,b
*Cunningham & Mitchell Co 6101 College Ave GL 3222 a,b
*DeVoe Co Leslie M 4010 Washington Blvd HU 1395 a,b
*Nulsen Marvin E 5376 E Washington St IR 7664 a,b
*Pheasant Charles E 18 N Bolton Ave BL 6176 a
*Schulz Co Edwin A 721 Sherwood Dr BR 1993 a,b
*Whitesell & Assoc Robert O 2208 E Washington St MA 8517 a,b
*Wright Eng'g Co 4241 Melbourne HU 8800

Marion

*Nulsen Co Marvin E 2015 S Washington St 835 a,b

IOWA

Cedar Rapids

*Vrbik Jerry 309 Guaranty Bldg 4-0833 a,b

Des Moines

Silverman Jack 1117 Grand 87661 a

KANSAS

Merriam

*Koenig G L 6859 Antioch Ave

Wichita

Harris Co Municipal Airport 62-2731 b
Standard Products 650 E Gilbert 2-1431 a

KENTUCKY

Louisville

*Wright Eng'g Co 912 S 2 St JA 0295
Cobb Sales Co 1629 Portland Ave CL-9406 a

LOUISIANA

New Orleans

Corrigan Jr Charles E 504 Delta Bldg RA 5644 a
Moore Co Earl K 562 Sizeler Ave CE 9890 a,b
Redmann Stephen M Box 1325 UP 3767 a

MARYLAND

Baltimore

Dave Bros 3851 Boarman Ave LI 9644
Goodman Co S W 32 W Biddle St VE 2240 a
*J-H Electronic Sales Co Box 6844 VA 4441
*Wilkinson R L Maxalea Dr TO 7800

Silver Spring

Densham & Peel 3205 Medway St LO 5-5144
*Lienau & Co Chas W 10203 McKenney Ave JU 7-5888 a
*Taylor Co Morris 8416 Georgia Ave SH 4002 a,b

MASSACHUSETTS

Beverly

Kelly & Co W T 90 Lothrop St 65 b

Boston Area

*Akeroyd A E 2311 John Hancock Bldg HA 6-2433 a,b
*Anderson Sales Co 172 State St CA 7-4832 a,b
*Burlingame Assoc 270 Commonwealth KE 6-8100
*Chamberlin Harold A 31 Milk St HU 2-7022 a
*Coakley Sales 11 Beacon St CA 7-0050
Electrical Apparatus Co 1200 Soldiers Field Rd ST 2-7440 a,b
Garner Frank W 110 Arlington St LI 2-7428 a,b
*Gerber Sales Co 739 Boylston St CO 7-0061
*Gibson Eng'g Co 1018 Commonwealth AS 7-5074 b
*Goss Co J 1430 Mass Ave (Cambridge) EL 4-7799 a,b
*Greene Dan 2311 John Hancock Bldg HA 6-1432 a,b
*Hannigan Co Walter T 43 Leon St GA 7-2650 a,b
*Hannigan Co Walter T 120 Dedham St (Newton Highlands) BI 4-4196 a,b
*Harris Co Stanley A 318 Harvard St (Brookline) LO 6-6400 a,b
Hart Co F H 68 Market St (Lynn) NA 1-0381 a,b
Herman Norman 55 Lawrence Ave (Roxbury) GA 7-2198 a,b
*Holliday-Hathaway Co 238 Main St (Cambridge) EL 4-1751 b
*Hooker Samuel C 397 Highland Ave (Winchester) WI 6-2745 b
How Inc J D Statler Office Bldg HU 2-4638 a,b
*Lavin Assoc Henry 82 Curve St (Needham) NE 3-3446 a,b
*MacInnis Norman R 1430 Mass Ave (Cambridge) EL 4-5573 a
Mosher Co R D 49 Colby St (Needham) NE 3-0793W a
Nickerson Clayton S 206 Somerset Ave (Winthrop) OC 3-3276
Nowlin William G 459 Statler Bldg LI 2-9690 b
Parker Blair H 610 Atlantic Ave LI 2-9214 a
*Perron & Co Ray 131 Clarendon St KE 6-1370 a,b
*Pray Sales W B 18 Brewster Rd (Wellesley Hills) WE 5-3199M
Scott Co Michael 90 Edmunds Rd (Wellesley Hills) WE 5-0102 a,b
*Reynolds Co Harrison 313 Washington St (Newton) DE 2-4620 a,b
*Segel Co Henry P 143 Newbury St KE 6-3012 a,b
*Sturgeon P R 25 Huntington Ave KE 6-5580
Thacher Bros 458 Statler Bldg LI 2-3769 a
*Waters Inc R A 4 Gordon St (Waltham) WA 5-6900 b
*White Sales Co 1116 Great Plain Ave (Needham) NE 3-3676 b

Concord

Geist & Assoc Henry J 35 Main St CO 1054

Lincoln

*Stevens & Co K C Box N LI 6-0408 b

Scituate

Hendrickson Wm A Lawson Park 652 a,b

Springfield

Rodgers Assoc 104 Catalpa Terrace 6-7037 a

MICHIGAN

Detroit Area

Adams Co R A 17636 Edinborough Rd KE 1-7000 a
Armstrong-Beitel-Merkle Co 15850 Third (Highland Park) TO 8-0044 a,b
Bureaw & Co KC 246 Madison Ave
Carrier & Gable 414 Murphy Bldg WO 1-1786 b
Eynon-Dakin Co 9900 Freeland Ave TE 4-7700
*Fitzner Co B J 8803 Michigan Ave LU 4-0180
*Hagerty-Scott Co 2737 W Grand Blvd TR 3-7430 a,b
Haggerty Sales Co 1507 W Saratoga Ave (Ferndale) LI 2-0811 a,b
Hill Co Buryl R 19481 James Couzens Highway VE 8-3460 a
Koehler-Pasmore Co 11833 Hamilton TO 8-3322 a,b
*Lee W S 13715 Gratiot St
*Liddle Edwin F 18925 Grand River VE 7-5310 b
McCaffry Co J A 13104 W Lincoln (Huntington Woods) LI 4-1380
*Merchant R C 4829 Woodward Ave TE 1-1677 a,b
*Milsk Co Robert 19367 James Couzens Hwy BR 3-2930 a,b
Moore Sales Co 418 Savannah W TU 3-0218 a
*Nordstrom & Co R L Davis Bldg (Birmingham) JO 4-6129 a,b
Satullo Co 7635 E Jefferson LO 8-1508 b
*Scott T T 2737 W Grand Blvd
*Shaffer Co G 16267 James Couzens Hwy UN 3-1227 a,b
Sterling Co S 15310 W McNichols Rd BR 3-2900 b
Stevens Fred J 15324 Mack Ave TU 1-2277 b
*Thorpe Jack M 4390 Haverhill TU 5-4438 a,b
*Walton Co H E 76 Kercheval TU 1-5858 a,b
*Zaffina Co L F 14611 Alma Ave WA 1-4442 a,b

Jackson

*Brotherson R 744 Audubon 2-9654
Jordan E H 218 N Wisner St 2-0694 b
*Wilson Sales Gerald 403 2 St 4-3692 a,b

MINNESOTA

Minneapolis

Bartleson Bill 4605 Blaisdell Ave LO 7628 a,b
Eiler Equipment Co 637 Sexton Bldg MA 8881
Elliott Equipment Co 712 Portland Ave GE 1805
Foster Mel 1036 Lumber Exchange Bldg GE 5622 a,b
Franklin Co Merrill 338 E Franklin Ave GE 1805 a,b
Heimann Co 1215 Harmon Pl MA 5457
Hill Co Fred B 256 First Ave N MA 8353 a,b
Kirkeby Marvin H 437 Oliver Ave S GE 4945 a,b
Oszman E W 2445 Nicollet Ave FI 5579 a,b
Pinkney & Hine 552 Plymouth Bldg LI 0523 b
Richardson & Co H M 9 E 22 St GE 4078 b
Warner Co A J 5022 29 Ave S DR 1895 a,b

St. Paul

*Aaron & Assoc I I 1951 University Ave MI 0027
Benson Co E R 2651 University Ave MI 5197
*Laub-Dale Co 1951 University Ave NE 7911

MISSOURI

Clayton

*Maynard Co L W 139 N Central DE 3723 a

Jefferson City

*Padan Co Ward Box 569 5-1023 a

Kansas City

*Bettis Co Maury E 406 W 34 St LO 0772
Everett Assoc 1629 E 31 St AR 9539 b
*Farris Co R W 406 W 34 St LO 7495 a,b
*Fry & Co W E 406 W 34 St JE 5236 a,b
*Kay Sales Co 3760 Broadway LO 7640 a,b
*Larrabee Co Fred H 6033 Main St DE 2804 a
*McGary Co Wm T 313 Reliance Bldg VI 5252
*McGrade Co E W 5326 W 71 St HE 2606 a,b
Melton Co E L 2901 E Meyer Blvd JA 0467 a,b
Pommerenk Co H C 4700 Roanoke Parkway LO 2296 a,b
*Roes & Co H A 2601 Cherry St HA 2036 a,b
*Schmitz Co J D 917 Porter Bldg LO 9824 a
*Scholz Co Paul G 210 W 8 St HA 7111 a
*Schryver Sales Co Clyde H 4550 Main St WE 4660
*Somers & Co F C Grand Ave Bank Bldg GR 1355 a,b
*Terwilliger P D 9304 High Drive TR 3230
*Thibau Co A R 402 Mfrs Exchange Bldg VI 7057
*Young & Myers Co 8147 Delmar Blvd a,b

Kirkwood

Winslow Design & Sales Co 20 Hillcrest Pl 1289 b

Overland

*Scholz Co P G 2455 Ashland Ave WI 2773 a

St. Louis

Beneke Co Jules 575 Arcade Bldg CE 1677 a,b
*Borghoff Co 4018 Greer Ave FR 0142 a,b
Bullivant F J 1913 Washington Ave CH 6510
Harris-Hanson Co 5506 S Kinge Hwy SW 5584 b
*Kathrinus & Co 1218 Olive St CE 6300 a,b
Levin Mfg Agency Sidney M Box 405 WI 2869 a
*Lowell Theodore B Box 21 MU 7803 a,b
Mayerson-Follman Co 2342 Olive St MA 5839 a
*McGary Co William T 6635 Delmar Blvd DE 6430 a,b
Rose Equipment Co W L 317 N 11 St CH 7247 a,b
*Wellman Co W N 4114 Sarpy Ave LU 3734 b
Wells-White Co 6625 Delmar Blvd PA 7622 b
*Young & Myers Co 8147 Delmar Blvd a,b

University City

Jaques L E 8112 Tulane Ave CA 5349 a,b

NEW JERSEY

(Northern Area)

•Border Barrett 10 Highwood Ave (Tenafly) EN 3-2354 b
•Brennan F X 38 Lackawanna Plaza (Montclair) 3-2461
•Cerf & Co Art 744 Broad St (Newark) MI 2-6734 a
Detwiler L K 443 Broad St (Newark) HU 5-9000 b
Engel G. Curtis Box 569 (Ridgewood) 6-7878 b
•Finlay Robt 104 Brookside (Ridgewood) RI 6-7218 a,b
Gawler-Knoop Co 178 Eagle Rock Ave (Roseland) CA 6-4545
Lawton Co 12 Foster Rd (Tenafly) EN 3-3979 b
Lerman Leonard S 1093 Salem Rd (Union) UN 2-9406 a
Miller Harry 1180 Raymond Blvd (Newark) MA 4-0788 a,b
RSA Co 68 Hudson St (Hoboken) HO 2-5281 a,b
•Ryan Assoc John L 263 Edgemont Pl (Teaneck) TE 6-1075 a,b
Sanford L C 202 Woodland (Rutherford) 2-0979 b
•Schenck LeRoy 31 Clinton St (Newark) MI 2-7613
•Schwartz Adolph One Exchange Pl (Jersey City) DE 3-2424
•Simberkoff Sales Co 68 Hudson St (Hoboken) HO 2-5211 a,b
Smith Co MacIntosh Bldg (West Orange) OR 6-6818 b
Weir R Donald Box 153 (Netcong) NE 2-0221 b

NEW JERSEY

(Southern Area)

•Bittan-Boenecke 210 N 6 St (Camden) WO 4-8650 a,b
Braddock Edward Browning Lane (Haddonfield) HA 9-0087 a,b
•Foley Andrew A 640 Federal St (Camden) WO 3-2693 b
Gatty Sidney H 11 N Clermont Ave (Margate) 2-1361 a
•Keefe Electronic Sales Co 201 N 6 St (Camden) WO 4-3970 b
•Kriegner Sales Co 300 S Broadway (Camden) WO 3-5951 b
•Maguire & Co J A 408 Linden Ave (Riverton) RI 9-1742 b
•Muggleworth James C 506 Richey Ave (Collingswood)
•Schottenberg Ray T 152 Merion Ave (Haddonfield) HA 9-6347 a
•Willou Sales Eng'g Co Finance Bldg (Camden) LO 3-6413

NEW MEXICO

Albuquerque

Gates Franklin Y 110 Harvard Dr SE
Kittleson Co 106A Cornell Dr SE 2-9581
Miller Co Gerald B 302½ W Central Ave 3-1998

NEW YORK STATE

Albany

Carse Electric Corp 100 State St 3-3628 b

Binghamton

•Holliday-Hathaway Co 124 Chenango St 3-1511

Buffalo

Eyre Phillip B 1124 Prudential Bldg b
•Farber Assoc Maury 1210 Hertel Ave RI 2423 a,b
Fillmore & Fillmore 647 Elmwood Ave SU 3355 b
•Jackson Co Robert W 833 Ellicott Sq Bldg MA 3306 b
Keller Industrial Products 33 E Hazeltine Ave RI 3938
Lamb Robert F 1807 Elmwood Ave BE 3757 b
Mitscher Co R W 487 Ellicott Sq Bldg WA 2517 a,b
Shea S E 735 Ellicott Sq Bldg WA 3240
Wink Willis 235 Hendricks Blvd AM 6426 a,b

De Witt

•Taylor Co Frank W Box 222 SY 72-5198 a,b

Fayetteville

•Andrews Martin P Mott Rd 65-8405 b

Hamburg

Cooper-Morgan Inc Box 152 EM 3405 b

Kenmore

McTaggart L J 116 Eisemann Ave RI 1009

Liverpool

•Wadsworth Mfg Assoc 509 Balsam St 697043 b

Manlius

Ferguson Bill 117 Fayette St MA 2-3301

Orchard Park

•Ball Assoc 58 E Quaker St ID 4416 a,b

Rochester

Gislason Gilbert 617 Case Bldg LO 8323 b
Holliday-Hathaway Co 182 Mayflower Dr MO 3143
Johnson Agencies H C 111 Mt Hope Ave HA 1090 b
Keller Industrial Products 217 East Ave HA 3255 b
Kopple Assoc John J 520 East Ave
•LeRoy Gordon C 29 Bancroft Dr CH 3872 a
Ossmann & Assoc Edward A 3 Juniper St CU 7640 b
•Richter William 3 Juniper St CU 7635 b
Schmitz A W 82 St Paul St HA 3090
•Wolfe-Marsey Sales Co 74 Park Ave MO 6228 a

Syracuse

•Allen Leonard D 2401 S State St
•Andrews A R 521 Cumberland Ave
•Burlingame Assoc 712 State Tower Bldg 2-0194
Martin C L Box 1224 BA 662 b
•Swank Wally B 2310 Bellevue 76-8056 a,b
Wulfetange Jr J F 326 State Tower Bldg 3-8013 b
•Zimmerman W H 647 S Warren St 3-6405 a

Troy

Hinsdill Elec Co 225 River St AS 2-0700

Next

on the schedule of directories . . . compiled from original sources as a special service by Caldwell-Clements . . . will be the

1953 DISTRIBUTOR DIRECTORY

to be published in the January 1953 issue of

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NEW YORK CITY METROPOLITAN AREA
(Exclusive of N. J. territory)

*Aaron Paul D 120 Liberty St BE 3-6063 b
Adelman Co Leon L 25 Chittenden Ave TO 7-1145 a
American British Technology 57 Park Ave MU 9-2595
Audio & Video Prod Corp 730 5 Ave PL 7-3091
*Baum Sydney H 70-15 Fleet St (Forest Hills) BO 3-8101
*Be-Esco Associates 395 Broadway CA 6-0029 a,b
Berger G E 109-01 72 Rd (Forest Hills)
Bialek Assoc Samuel 205 E 42 St MU 4-1655
*Biggs & Co J Alan 4 Fisher Ave (Tuckahoe) 3-9287
*Bittan Co D R 53 Park Pl BA 7-2789 a,b
Bittan Associates Harry 120 Liberty St CO 7-6879
*Blair Steinberg Co 395 Broadway WO 4-7321 a,b
Block & Co Wesley 116-15 15 Ave (College Point) FL 3-2828 b
Bloom Associates Hy 8 W 18 St OR 5-7565 a
*Bressler Jules J 1780 Broadway PL 7-2689 a,b
*Breuer Co R E 250 W 57 St CO 5-0440 b
*Brown Assoc Jack 25 Beaumont Circle (Tuckahoe) SP 9-7330 a
*Burlingame Assoc 103 Lafayette St DI 9-1240 a,b
*Camber Marty 1700 York Ave EN 9-4222 b
*Carduner Sales Corp 164 Duane WA 5-0900 a,b
Christie & Co R S 175 5 Ave GR 7-4226 b
Cooper-DiBlasi 259 W 14 St WA 9-3920 a,b
*Diamond Simon 75 W St WH 4-2970 b
*Egert & Fields Co 11 Park Pl WO 4-0996

Ellis Harold R 366 Madison Ave VA 6-3417 b
•Erde S S 130 Lafayette St WO 2-7261 a,b
•Forrest Bernard J 256 Greenwich St CO 7-1712 b
•Forshay John M 27 Park Pl BA 7-4977 a,b
Frazer & Hansen 120 Bdwy WO 4-3454 a
•Freed & Co Leo 420 Lexington Ave LE 2-4771 b
•Friedman Co A 39 Burkewood Rd (Mt Vernon) 4-4866 a,b
•Furman Nat 395 Broadway WO 4-7324 a
Geist & Assoc Henry J 60 E 42 St MU 7-1550 a,b
Geld B W 1777 Grand Concourse TR 8-6084 a,b
Ginsbury Sylvan 8 W 40 St PE 6-8239 b
Goldman & Co Louis R 251 W 42 St BR 9-8872
Gray Harold 21-10 33 Rd (Long Island City) AS 4-8641
Gross Assoc Adolph 45 W 45 JV 6-4545 a,b
•Hess Assoc Art 15 Park Row DI 9-2074
•Hicks W M 29-27 Bridge Plaza N (Long Isdand City) ST 4- 7124 a,b
•Holliday-Hathaway Co 270 Park Ave MU 8-5858 b
Howley Sales Co 318 Beach 31 St (Far Rockaway) 7-7588 a
•Hughes Co Kenneth E 17 W 60 St CI 5-8831 b
•Hy-Art Co 136 Liberty St WO 4-5087 b
•Jacobs & Assoc Jack 1800 E 12 St (Brooklyn) DW 9-4374 a,b
•Joseph Ben 509 5 Ave MU 2-8945 a,b
•Kaelber & Mack 1270 Broadway PE 6-2203 a,b
Kahgan Jack J 40 Exchange Pl BO 9-8350 b
•Kopple Assoc John J 60 E 42 St MU 2-1118 b
•Land-C-Air Sales Co 42 Oak Ave (Tuckahoe) 3-5500 a,b
•Landis Sales Co Cliff 81-11 Roosevelt Ave (Jackson Hts) IL 8-1344 a
•Levison Melvin S 5 Waverly Pl OR 4-4464 a,b
Masin Co O F Wolf's Lane (Pelham) PE 8-4580 b

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Miller Ben 401 Broadway WA 5-3964 b
*Mingins Sales Co 107-37 71 Ave (Forest Hills) BO 3-1643 a,b
*Minthorne Co Leonard L 15 Moore St BO 9-6272
Morse Sales Irv 150 Broadway CO 7-2913 a,b
Newhope Corp 6 E 39 St LE 2-7372 a,b
*Newman Charles 53 Park Pl CO 7-4129
Nief Assoc Paul W 7 Greenridge Ave WH 8-1454 a
*Pickett James M 205 E 66 St TR 9-9520 a
Progressive Marketers 41 Union Sq OR 5-0775 a,b
Rockbar Corp 211 E 37 St VA 6-3463 a,b
*Ross Milton 550 5 Ave GR 6-0653 b
Roye Sales Agency 11 Warren St CO 7-1148
Rutt William 401 Broadway CA 6-7545 a,b
Sachs M A 15 E 26 St MU 3-9356 a,b
*Saftler Perry 53 Park Pl RE 2-5333 b
Scheffler & Yurman 391 Fulton (Brooklyn) UL 5-2896 a
*Schmitt Co F Edwin 136 Liberty St WO 2-6550 b
*Shaw Co S A 92 S Central Ave (Hartsdale) WH 8-5015 a,b
*Shulan & Co Wally 136 Liberty St WO 2-0365 b
Skidmore & Co W K 20 Vesey St RE 2-2888 a,b
Smith-Benny Sales Co 11 W 42 St CH 4-1642
*Smith Howard F 259 W 14 St CH 2-2398 a,b
Snyder Milton C 205 E 42 St MU 4-1313 b
*Sonkin David 10 Fiske Pl (Mt Vernon) MO 8-9809 a,b

(Continued on page 158)

(Continued from page 156)

•Spellman F C 206 E 4 St (Brooklyn) SO 8-0180 b
•Sprung Joseph 254 W 31 St LO 5-1820 a,b
Stang Robert A 79 Storer Ave (Pelham) PE 8-0120 a
•Sussman & Co Jules 130 Lafayette St WO 2-7261 a,b
•Taylor Co B B 241 Sunrise Highway (Rockville Ctr) RO 6-1014 b
•Tobias & Co D F 30 Church St CO 7-4350 a,b
Turney & Beale 40-08 Corp Kennedy St (Bayside) 4-4000
Weber Assoc Jack 154 Nassau St WO 4-0152 a
Welsl Jr Edwin 90 Peconic Dr (Massapequa) 6-2619 a
•Willgold Electronic Sales Corp 7806 Empire State Bldg LO 4-2525 a,b
•Woolf Assoc Irving W 135 Liberty St RE 2-9673 a

NORTH CAROLINA

Charlotte

Glenn & Larson 123 Brevard Ct 4-3994 b
Highsmith & Co James L Box 1011 5-6436 b
Ranson Wallace & Co 116½ E 4 St 4-4244 a,b
Wallace Assoc Stanley K 2908 Hutchinson Ave 5-6664

Goldston

Laykand F H Box 787

Greensboro

•Atcheson & Adams 429 W Gaston Box 2158 6838 a,b

Hendersonville

•Erickson Co Herb Box 179 5645 a

Wilmington

•Manufacturers Sales 4924 Oleander Dr 5749 a,b

OHIO

Canton

Henger Fairfield Co 400 4 St NW 5-6833

Cincinnati

Beedle Equip Co Roselawn Center Bldg JE 2640 a,b
Henger Fairfield Co 124 E 7 St MA 4749
Herrick Co G L 2087 Sherman Ave JE 7542 b
Laing Co W C 3253 Lambert Pl EA 1435
•Wahl Co A C 9448 Winton St (Greenhills) JA 3912

Cleveland Area

Ambos Jones Co 1085 The Arcade CH 1-7470, a,b
Baehr Albert M 11621 Detroit Ave LA 1-8468 a,b
•Baier & Co Arthur H 2138 Lee Rd FA 1-5644 a,b
Brandes C O 4900 Euclid Ave HE 1-0414
•Brauer & Assoc Walter J 16531 Lakewood Hts Blvd LA 1-7268 a,b
Crain Brennan Assoc 521 Citizens Bldg DH 1-0779 a
Dannemiller Assoc J R 1791 Oakmont St EV 1-5100 b
•Daugherty Co F A 1120 Croyden Rd HI 2-3311 a,b.
•Dietrich Co Earl S 320 Hanna Bldg CH 1-7770 b
•Dolfuss Jr Chas H 2108 Payne Ave PR 1-2062
•Edwards-Lohse & Co 2123 E 9 St TO 1-5753 a,b
Elliot Co Howard C 3165 Whitethorn Rd (Cleveland Hts) YE 2-8639 a
Harrington-Fishel Co Engineers Bldg SU 1-6612
Henger-Fairfield Co 1812 Columbus Rd CH 1-1018 a,b
Herrick Co G L 15326 Lorain St WI 1-4406 b
Hoskins Neil K 210 S Franklin St (Chagrin Falls) CH 7-6136 a
Jay Eng'g Co 5413 Pearl Rd SH 1-3300
Jubell Associates 2036 E 22 St MA 1-0229 b
Landfear Co J M 2188 Lee Rd FA 1-4533 a,b
•Lehner J C 4301 Daisy Ave SH 1-0903
•Midwest Sales Co 3219 W 117 St WI 1-2700 a,b
•Morrow Co Les A 3123 W 117 St CL 1-5700 a
•Moss Co Chas R 16956 Van Aken Blvd (Shaker Hts) WY 1-6018 a,b
Odell Co M P 2536 Euclid Ave TR 1-2623 b
•Olsen Co John O 16201 Shaker Blvd WY 1-2624 a,b
Roth Sales Co Mike 4397 Groveland Rd 1-6800 a,b
•Rauer Frank W 4144 Marvin Ave ME 1-8350 a
Satullo Co 1125 Fidelity Bldg PR 1-1552
Scheffler & Yurman 603 Caxton Bldg SU 1-8644
•Scott & Steffen 1836 Euclid Ave MA 1-1286 a,b
Staff Co R A 1213 W 3 St MA 1-4063
•Valentine Forest C 6408 Euclid Ave EN 1-4343
White & Co C E 637 Bulkley Bldg MA 1-8410 b

Columbus

Henger Fairfield Co 101 N. High St AD 7510
•Lehner Co J W 367 Brynhild Rd LU 5260 a
•McFadden William E 150 E Broad St MA 3363 a,b
•Pugh Co C L 4500 Dublin Rd KI 4855 a
Roth Sales Co Mike 64 Park St (Canal Winchester) 7-7280
•Weller Rahe Co Box 212 (Worthington) FR 2-7819 a

Dayton

•Bear Corp Neal 4052 Riverside Dr TA 1545
•Boehme Associates B-4 Talbott Bldg FU 8188
Crossley & Assoc Alfred 410 W 1 St MI 8721
Grimm A N 1731 Ruskin Rd OR 1496
Henger Fairfield Co 1034 U B Bldg AD 6724
Jay Eng'g Co 1517 E 3 St MI 9668
Magee Edward E 5741 Paddington Rd b
Odell Co M P 2676 Salem Ave OR 4441
Ohmer George H 36 Spirea Dr WA 3761 b

Lima

Hecht Co Fred J 1832 Wendell Ave 20133 b

Maumee

Henger Fairfield Co 1130 Key St 3-3211

West Richfield

•ANB Specialties Co Box 518 0150 a,b
•Bear Corp Neal 100 a,b

OKLAHOMA

Tulsa

Aymond Co Edward F 730 N Evanston 9-3241
Crabb E L 2208 N Sheridan Rd 8-4893
Kilepera Co M F Box 1012

OREGON

Portland

*Burcham Co Don H 917 SW Oak St BR 3830 a
Hawthorne Electronics 700 SE Hawthorne Blvd VE 5585 b
*Lee Co Dave M 2712 NW Raleigh St BE 2241
Lynn & Brooks 9931 NE Mason St
Merritt Co Ron 1515 SW 5 St BR 0045
Minthorne Co Lenoard L Weatherly Bldg KE 0718 a,b
Northwestern Agencies 2941 NW Quimby AT 0858 a,b
*Weber Co Dale 234 Sherlock Bldg AT 5403 a,b

PENNSYLVANIA

Philadelphia Area

*Bell Tom Jacksonwald Ave (Easterly) RE 5-6837
*Bierbaum John W 835 W Sav Fund Bldg PE 5-3738 b
*Biggs & Co J Alan Box 450 (Doylestown) SU 4591 a,b
Blumenstein Assoc 5040 City Line Ave TR 7-4116 a
*Brookfield R F 55 Cricket Ave (Ardmore) MI 2-0824 b
Conneen Geo M 16 Trent Rd AR 6052W a
*Connor Co Dan J 1036 Broad St Sta Bl LO 4-2870 b
*Cordray W Henry 18 W Chelten Ave VI 8-0447
Densham & Peel 250 S 17 KI 5-1947 a
*Edmunds E J 5344 Irving St GR 2-7484
*Estersohn Harry 7135 Germantown Ave WI 7-1816 a,b
*Fairbanks Howard J 1733 Academy Lane (Havertown) GR 2-2467
*Friedman Martin 1006 Western Sav Fund Bldg PE 5-4778 a,b
Hilliard Assoc. Box 246 (Jenkintown) OG 3249 a,b
Hopkins Bros Inc 120 N 7 St LO 3-8367
*Houck James W Box 4941
*Jacobs Jack 238 Shelmire St CH 3161J
*Jeffries S A 105 Forrest Ave (Narberth) NA 8-8500 a,b
Lawton Co 836 Mason Ave (Drexel Hill) SU 9-2146
*Leban & Graham 218 Lloyd Lane AR 5515J a
*Lewis Herman 1622 68 Ave LI 8-1281 a
*Lowery Inc L D 50 E Wynnewood Rd (Wynnewood) AR 9100 a,b
*Macdonald Inc S K 1531 Spruce St KI 5-1205 a,b
*Maguire & Co J A 593 Drexel Bldg MA 7-1670 b
Massey Assoc 1411 Walnut St LO 4-2650
*Naudain L Parker Broad St Sta Bldg RI 6-3185 b
*Newson Jr C H 150 Terminal Ave WI 7-8742 b
Orsi Co John F Box 346 (Bryn Mawr) CO 6-2698 b
*Paragon Sales Co 111 S 22 St RI 6-6599
*Quinlan D G 4700 Frankford Ave JE 3-0650
*Randall Co Ken 121 N Broad St LO 4-2151 b
*Relinger Albert R 8018 Winston Rd WI 7-4935
Slubin & Co Lewis 1067 Drexel Bldg WA 2-6740 b
Snyder Co V A 1526 Broad St ST 4-9141
*Stratton Co C H 2601 N Broad St RA 5-7912 a,b
*Tech Representation 506 Wyndmoor WH 8-3152 a,b
*Trinkle Wilmer S 2 Roberts Block TU 1075 a,b

Pittsburgh

Airgood Joseph M 742 Berwin Ave LE 1-3539 b
Burke Elec Equip Co 416 Maple Ave PE 1-5357
Clark Co Russell F 1404 Clark Bldg AT 1-8089 a,b
Groetzinger Co H W 410 E Genl Robinson AL 1-6280 a,b
Kaufman Sales Jerry Plaza Bldg AT 1-0206
Levine Albert 11 Jonquil Pl LO 1-7027 a
Ludgate Assoc John P 345 4 Ave AT 1-1805
*Macdonald Inc Samuel K 715 State Theatre Bldg AT 1-2253 a,b
Mates Hyman 5510 Hobart HA 1-8998
*Olsen Co John O 1404 Swantek St AC 1-4932 a,b
*Podolny James H 4716 Coleridge St HI 1-0800 a,b
Ransford Co H E 2601 Grant Bldg GR 1-1880 b
Shaw S J 7308 Church Ave LI 1-4727 a
Squires Co M B 1202 Grant Bldg GR 1-5566
Stover & Co S H 5495 Penn Ave EM 1-7553 a
*Tanner & Covert 600 Grant St 1-0131 a,b
*Tydings Emmet J 1565 McFarland Rd FI 1-5100 a

TENNESSEE

Chattanooga

Johnson Jesse P 3535 Dell Trail 4-4026 a

Knoxville

Hough Co A B 3601 Chapman Hwy SW 2-1383 b

Memphis

*Cartwright & Son J M 1336 Madison Ave 2-1914 a,b
Moody Co Joe Box 1492 2-1067 a

TEXAS

Dallas

*Anderson Co Geo E 1901 Griffin St RI 5981 a,b
*Aymond Co Edward F 4308 Maple Ave LO 1970 b
*Berthold Sales Co 4411 Maple Ave LO 6336 a
*Branum Co 309 Reserve Loan Life Bldg RI 4995 a,b
*Campion Sales Co Jefferson Tower YU 9902 a,b
*Corry Co Hal F 3111 Knox St JU 9172 a
*Crockett-Lund & Co Reserve Loan Life Bldg RA 5764 a,b
Delzell G W 643 Coombs Creek Dr FE 6081 a
Engineering Products Co 5005 W Lovers Lane EL 1179 b
Folson Sam W 1102 Windomere YU 9560 a
Green Co John A 6815 Oriole Dr DI 9918 a,b
*Guenther John B 7322 Marquette Ave EM 6286 a,b
Heidenreich Max 1801 Federal St DI 0464 a,b
Lipscomb Assoc Earl 3561 Marquette EM 7989
*Maynard Co John M 4507 Shenandoah LA 1587
*McKinney Sales Co Jack F 1330 N Industrial Blvd ST 1997 a,b

(Continued on next page)

Continued from preceding page

•Schoonmaker Co J Y 2011 Cedar Springs ST 3335 a,b
•Smith Co J Earl 505 N Ervay St RA 2966 a,b
•Texport Co 5004 Ross Ave TE 6735 a,b
Wilks Co Ernest I 1212 Camp St RI 4059 a
•Yount Jack 1431 Pleasant Dr EX 0988 a

Ft. Worth

Harris Co 716 Dan Waggoner Bldg 0738

Houston

Calmes & Assoc D 4605 Locust St MO 5-1704
Everett Assoc Box 13058
Harrison Equipment Co 1422 San Jacinto St
•Klicpera Co M F Box 3113 JA 8459 a,b
•Smith Co J Earl 6610 Salem St
•Willison Co G G 1821 W Alabama JU 1634 a,b

Waco

Brockenbrough & Sanders 316 Professional Bldg 4-0441 a

UTAH

Salt Lake City

•Bewen Co Ronald G Box 2215 MU 900
Gates Co 200 S Main St 9-1101 a,b

VIRGINIA

Alexandria

American Eng'g Equip 122 N Fayette TE 6-1718 a,b
Brown & Assoc W A 3834 Mt Vernon Ave OV 6100 b

Richmond

Simpson & Son Paul M 717 Byrd Park Ct a,b

WASHINGTON

Seattle

•Backer Co Jas J 2321 2 Ave MA 8811 a,b
•Barcham Don H 2430 Warren St GA 7398
Carlson Co Fred W 2307 5 Ave EL 6630 a,b
•Haight Co Fred H 2217 4 Ave MA 3750 a,b
Jensen Co Verner O 2616 2 Ave EL 6871 a
•Lee Co Dave M 2517 2 Ave
•Marsh Agencies 2601 1 Ave MA 8762 a,b
Merritt Co Ron 217 9 Ave N SE 4948 a,b
Naylor Co Lee B 1250 1 Ave S EL 2968 a
Norris Co George D 3013 1 Ave EL 1344 a,b
•Northwestern Agencies 4130 1 Ave S EL 8882 a
•Parsons & Co C B 119 Belmont Ave N MI 3800 a,b
Porter Co Burt C 4310 Roosevelt Way ME 6828 a

•Stoum Co S N 1612 Broadway FR 7515 a,b
•Wedel Co Frank 3215 Western Ave GA 0222 a
•Widdekind M K 2718 1 Ave W AL 6740 a,b

WISCONSIN

Milwaukee

•Aaron & Assoc I I 829 N Marshall St BR 6-8515 a,b

Dickinson & Assoc E A 744 N 4 St BR 2-0517 b
Knaak Co L B 704 E Pleasant St DA 8-3434
Loeb Eugene R 5052 N Shoreland Ave WO 4-2155 a

WYOMING

Laramie

Cluphf Stan 555 N 12 St 4075

News of MANUFACTURERS' REPS

Dan J. Connor Co., manufacturers' representatives of Philadelphia, Pa., has opened a branch office in the Medical Science Building, 1029 Vermont Avenue N. W., Washington, D.C. Everett M. Gordon, previously with the firm's home office, will be in charge.

Warren Wire Co., Pownal, Vermont has appointed the D. G. Quinlan Co., Philadelphia, Pa., to cover eastern Pennsylvania, southern New Jersey, and the states of Maryland and Delaware.

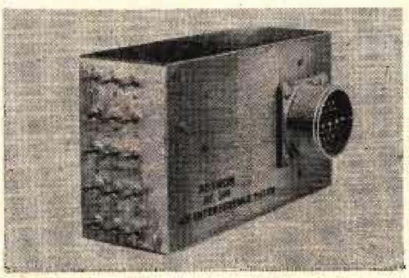
Sintercast Corp. of America, Yonkers 2, N. Y., has appointed J. W. Mull, Jr., to cover the Indiana, western Ohio and northern Kentucky territory.

Microwave Equipment Co., North Caldwell, N. J. has appointed the John B. Tubergen Co., Los Angeles, Calif., to represent its line of waveguide instruments and accessories in the southern California area.

James B. Lansing Sound, Inc., Los Angeles, Calif., has appointed the Leo B. Naylor Co., 1250 First Ave., South, Seattle 4, Wash. to represent its speakers, systems and components in Oregon, Washington and British Columbia.

New Astron Service

Astron Corp., 255 Grant Ave., East Newark, N. J., manufacturers of metallized paper capacitors and standard R-F noise supression filters is now offering the services of its noise suppression laboratory together with its enlarged engineering staff to manufacturers with specific noise suppression problems in Armed Services equipment, and in equipment for the Electronic Industries.



Model 314 K-F Interference Filter

Astron has specialized in the research and development of filters for high temperature and high altitude applications. Model 314 shown above is a typical unit. Present designs provide for noise attenuation from 14KC to 1000 MC in a wide variety of circuits, and in aircraft applications, use of metallized paper capacitors permits a smaller and lighter unit.

Advertisers — November, 1952

BULLETINS

TV Transmitters

"TV Transmitters" is the title of the new 12-page bulletin just released by Standard Electronics Corporation, Newark, N. J., a subsidiary of Claude Neon, Inc. Bulletin TTS-61 presents the electrical and mechanical specifications on the S-E 500 watt visual — 250 watt aural basic unit with Add-A-Unit design amplifiers which provide complete transmitters of 5, 10, and 20 KW output.

Crystals

A complete new catalog of crystals has just been issued by the James Knights Company of Sandwich, Illinois, manufacturers of stabilized quartz crystals. Forty-five different crystals are listed.

Airborne and Ground Station Equipment

A four page brochure presenting airborne and ground station equipment and Accessories for Radio Telemetering has been published by Applied Science Corporation, Princeton, N. J., Post Office Box 44. The folder features large illustrated charts showing building block accessories in complete PW or PDM systems for airborne equipment.

Tubes

Products of Raytheon Manufacturing Co., Waltham, Mass., are shown in a new, illustrated, three-color catalog. A brief history of the company and a photo layout of its various plants are followed by detailed descriptions of the products of each of Raytheon's four divisions; receiving tube, power tube, equipment and television and radio. A page is devoted to an outline of the concern's research activities.

Triode

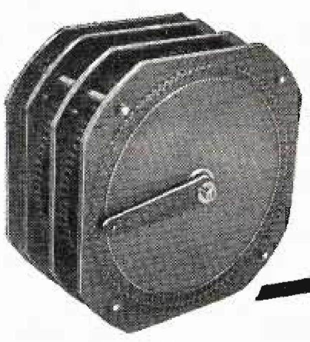
A new data sheet describes the Los Gatos brand type 254 Medium-Mu Triode manufactured by Lewis and Kaufman, Inc., 52 El Rancho Ave., Los Gatos, Calif. The tube is illustrated, given outline dimensions and general electrical characteristics.

As We Go to Press . . .

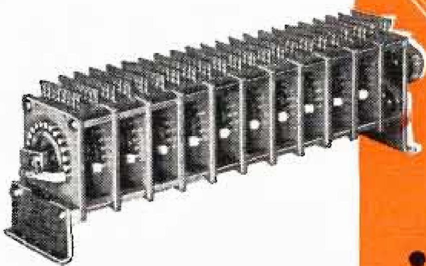
Editors TELE-TECH (telegram)

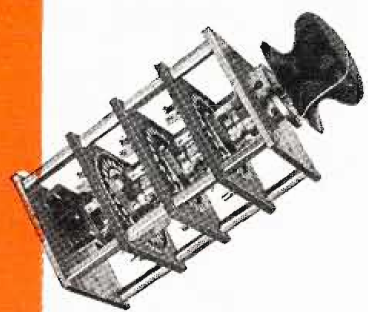
KBTV DENVERS SECOND TV STATION BEGAN REGULAR PROGRAMMING ON OCT 12TH WITH THE PROGRAMS OF CBS AND ABC. DURING THE PAST WEEK KBTV HAS BEEN RUNNING SERIES OF ENGINEERING TEST PROGRAMS ON CHANNEL 9 WITH ITS INTERIM POWER OF 12000 WATTS ERP. RECEPTION REPORTS HAVE INDICATED COVERAGE FAR BEYOND ALL EXPECTATIONS REPORTS OF EXCELLENT RECEPTION AT CHEYENNE WYOMING COLORADO SPRINGS AND ACROSS THE CONTINENTAL DIVIDE AT GRANBY COLORADO AND MANY OTHER POINTS INDICATE SERVICE WILL BE EXTENDED TO AN AREA WITHIN A RADIUS OF 100 MILES. THIS COVERAGE IS ATTRIBUTED TO THE IDEAL TRANSMITTER LOCATION ON LOOKOUT MOUNTAIN WHICH IS 2500 FEET ABOVE DENVER. TV RECEIVER SERVICE MEN REPORT VERY LITTLE ADJUSTMENT IN RECEIVERS AND ANTENNAS NECESSARY TO RECEIVE THE CHANNEL 9 SIGNAL. THE ROCKY MOUNTAIN ELECTRICAL LEAGUE OFFICIAL INDUSTRY SOURCE OF SET TABULATIONS REPORT 57964 SETS IN THE AREA AS OF OCT 1ST. THIS IS AN INDICATION OF THE MARKETS ENTHUSIASM FOR TV SINCE THE FIRST TV STATION (KFEL-TV) BEGAN OPERATION ONLY THREE MONTHS AGO. PREDICTIONS ARE THAT UP TO 100000 SETS WILL BE SOLD IN THE AREA BY JAN 1ST 1953.

JOE HEROLD
STATION MANAGER KBTV



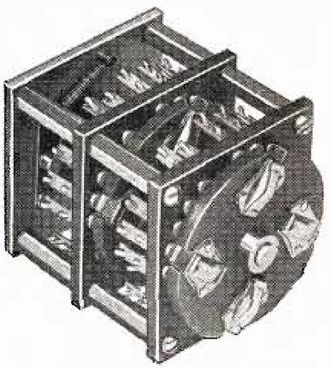
Quick Switches

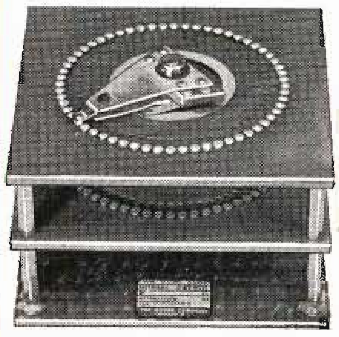




are a

DAVEN
SPECIALTY





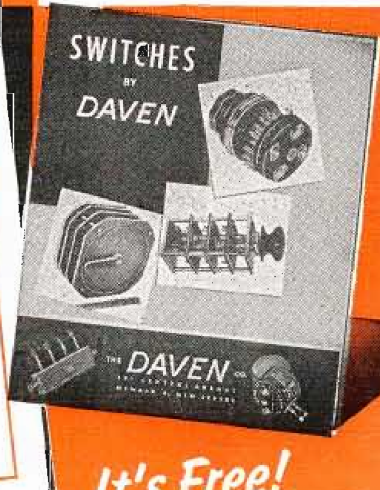
And the "specialty of the house" is double-barreled . . . first, choose from hundreds of standard units to satisfy your needs—for quick switch delivery . . . second, Daven can effect quick 'switches' or changes from standard units to special switches, by using components at hand. Standard parts can be adapted for your switch. That too makes for speed, dependability, economy. Write for more detailed data.

Here's Why Daven Switches Excel

- Low and uniform contact resistance.
- Minimum thermal noise.
- High resistance to leakage.
- Trouble-free operation and long life.
- Roller-type positive detent action.
- Depth of unit not increased by addition of detent.

Standard Daven Switches may be the answer to many of your problems. Therefore, check this list below for many of the popular types that are readily available.

Type	Operation	Maximum No. of Positions (per pole)	Maximum Poles per Deck	Deck
G1A	Make before break	24	1	1 3/8"
C1A	Make before break	31	1	1 3/4"
C2B	Break before make	15	1	1 3/4"
D1A	Make before break	47	1	2 1/4"
D7A	Make before break	14	4	2 1/4"
D8B	Break before make	7	4	2 1/4"
D9A	Make before break	9	5	2 1/4"
E3A	Make before break	47	2	2 3/4"
E8B	Make before break	12	4	2 3/4"
E11A	Make before break	15	6	2 3/4"
F1A	Make before break	60	1	3"

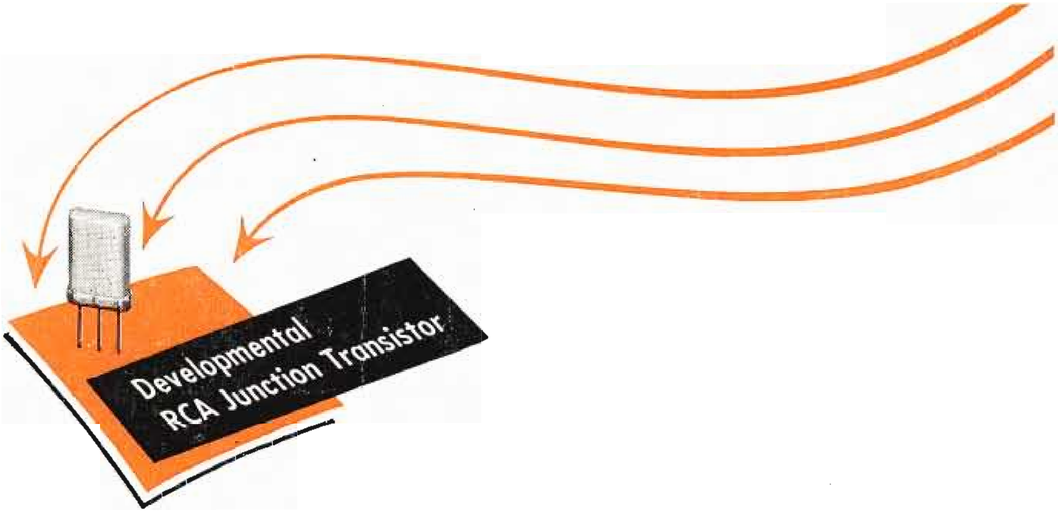


It's Free!

Your copy of Daven's complete, new bulletin on switches. Write for it today.

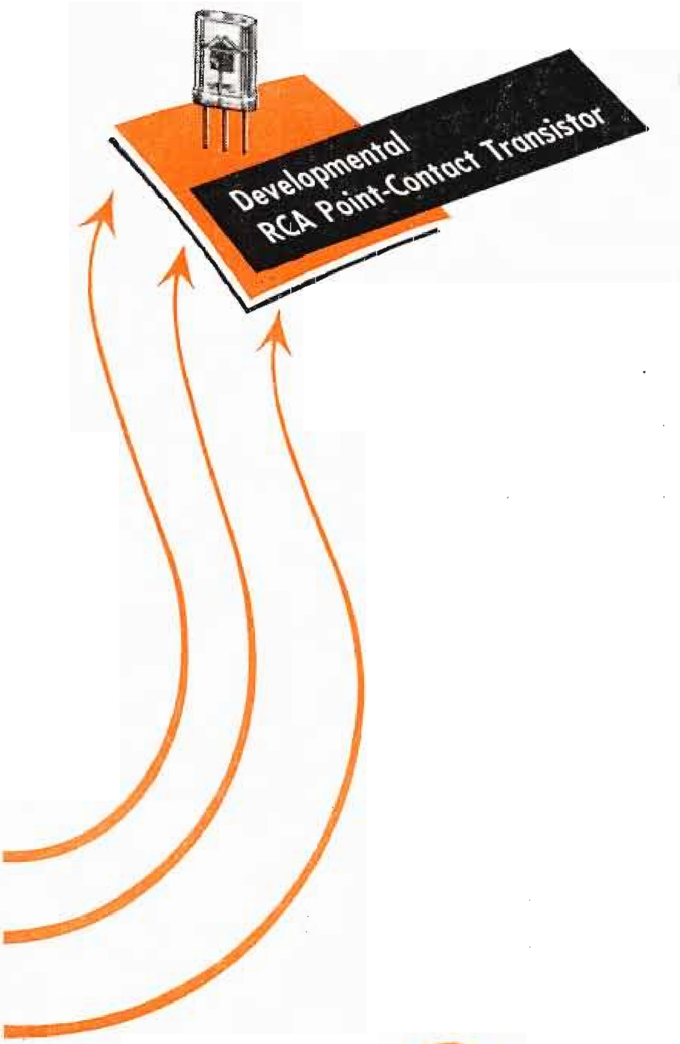
THE DAVEN CO.

179 CENTRAL AVENUE • NEWARK 4, NEW JERSEY



An RCA progress report

...on *Transistors*



MORE THAN FOUR YEARS AGO, RCA embarked on a research and development program to determine the practicability of transistors in the field of electronics. The early work was concerned with the principles, designs, and applications of point-contact transistors; and later was expanded to include junction transistors and other similar semiconductive devices.

As an important recent result of the studies on point-contact transistors, RCA Tube Department engineers have made in the laboratory experimental point-contact transistors which oscillate at frequencies above 200 megacycles, one of which exceeded 300 megacycles. This achievement opens the way to the use of transistors in FM radio and in VHF television, in addition to their previous potentialities for low-frequency applications including audio and switching uses.

This work has also led to considerable success in developing junction transistors for audio and radio amplifier applications. A point of particular significance is that much progress has been made in the development of practical assembly techniques.

Point-contact types are now being sampled to equipment manufacturers and government agencies as a part of our development program. It is anticipated that junction transistors will be available for similar sampling in the near future.

Although much remains to be done, promising results have been attained in controlling the characteristics of both types of transistors; pilot production runs are being made.

Meanwhile RCA is pushing forward its development program to assure its customers that the commercial transistors of the future will be made to the same high standards of quality and dependability as the RCA electron tubes of today.

RADIO CORPORATION of AMERICA

ELECTRON TUBES **HARRISON, N. J.**

TMK. ®

Today's news tonight!

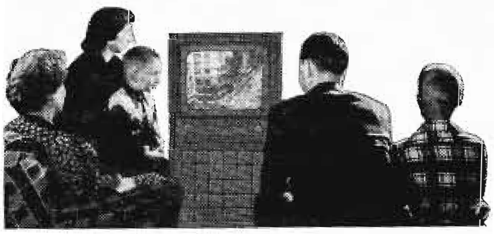
KTTV Staff Uses B&H Equipment To Make Deadlines

Station KTTV is attracting Los Angeles viewers with a daily "live" news reel. The popularity of this feature depends on getting on-the-spot movies of local events . . . editing and preparing them for showing the same evening . . . and making that showing a *finished* production.

To do this successfully, day in and day out, requires highly competent staff teamwork, plus the finest equipment. The staff at KTTV who work with Bell & Howell camera, projector and editing equipment have found it perfect for the job!

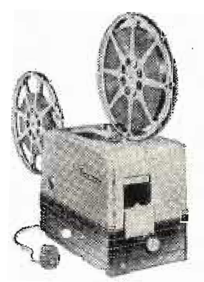
Shooting a street scene with a Bell & Howell 16mm "70" Camera


KTTV News Unit at work in the Film Editing Room. Man in center splices film at B&H Film Editor

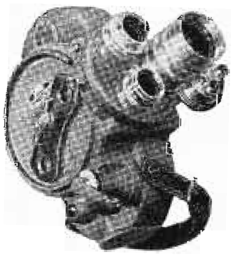


Filmosound 202 16mm optical and magnetic recording projector that enables you to make your own sound movies . . . without costly processing or professional equipment. The 202 records voice and music directly on SOUNDSTRIPE* film, plays back the sound immediately. Recordings can be changed in whole or in part, are permanent for the life of the film. Light, compact and easy to use, the 202 projects silent and optical sound films as well as magnetic recordings.

*SOUNDSTRIPE *is a magnetic iron oxide striping applied to any 16mm movie film.*



←—— Matched For Your TV Needs ——→



16mm 70-DL Camera. This newest member of the famous B&H 70 series is built with precision . . . versatile enough for most any TV job. The 70-DL operates at 7 precise, governor-controlled film speeds—the 204° open segment shutter giving 1/40 of a second exposure at exact sound speed (24 frames). Takes single or double-perforated film. Three-lens turret assures you of the right lens for any shot . . . instantly. Also has positive viewfinder with matching objectives and parallax correction, critical focuser, and hand crank.

Guaranteed for life. During life of the product, any defects in workmanship or materials will be remedied free (except transportation).

You buy for life when you buy . . . **Bell & Howell**

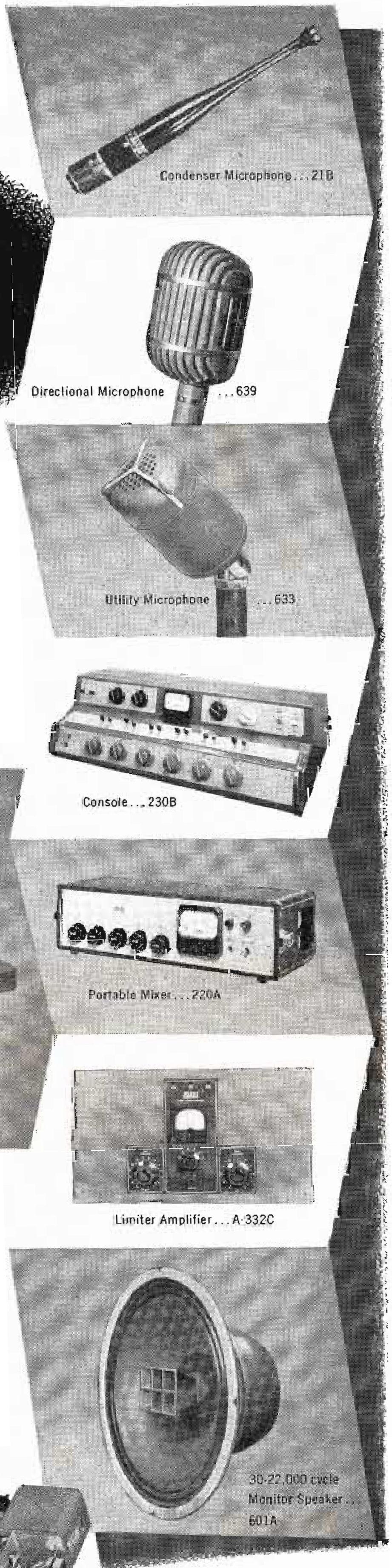
BELL & HOWELL COMPANY
7174 McCormick Rd., Chicago 45, Illinois

Please send me your booklet on TV equipment and how to use it to improve my TV services.

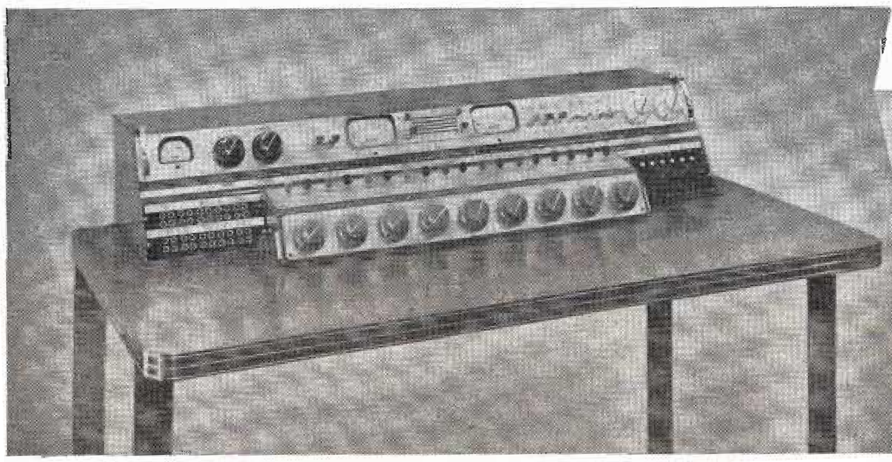
Name.............................. Address..............................

City.............................. Zone........ State..............

ALTEC = AUDIO



For audio equipment, smart broadcasters place their confidence in the Altec Lansing Corporation. Experience has shown that Altec equipment is always better; its quality unsurpassed; and its dependability beyond expectations. Altec equipment is designed to work together, without extra matching transformers or other expensive adaptations. Whether it is the new 601A Duplex monitor speaker or a complete speech input installation, you'll find Altec audio equipment will do the job better, longer, more economically.



250A Console. This beautiful master console represents a new quality standard for speech input equipment. Like all Altec consoles and mixers, its frequency response, noise level and low distortion more than meet the most stringent broadcast requirements. It is compact and *completely* self-contained, without external power supplies or junction boxes. All amplifiers and power supplies are precision-engineered miniature plug-in units.

Ask our distributor or write direct for complete information on any item of Altec audio equipment.

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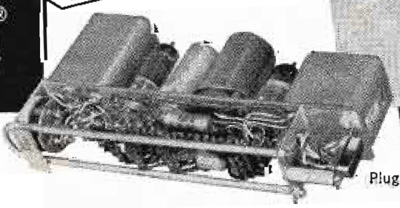
Plug-in Preamplifier . . . A-428A

15—Audio Equipment

Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.—PAA
Acorn Electronics Corp., Box 348, Gibson City, Ill.—PB, PF, PI, PJ, PAA, PAB
Aero Electronics Co., 1512 N. Wells St., Chicago 10, Ill.—PB, PC, PD, PE, PF, PH, PI, PJ, PAA, PAB
Airtronix Development Corp., 20 W. 22 St., New York 10, N. Y.—PAE
Allied Allegri Machine Co., 141 River Rd., Nutley 10, N. J.—PB, PC, PD, PE, PF, PG, PH, PI, PJ
Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill.—PA, PD, PH
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—PB, PC, PD, PE, PF, PG, PH, PI PJ, PL, PN, PT, PV, PW, PX, PZ, PAA, PAB, PAE, PAF
American Electroneering Corp., 5025 W. Jefferson Blvd., Los Angeles 16, Calif.—PC, PK, PL, PAA, PAB
American Microphone Co., 370 S. Fair Oaks Ave., Pasadena 1, Calif.—PU, PV, PW, PX, PZ
American Radio Hardware Co., 152 MacQuesten Pkwy. S., Mt. Vernon, N. Y.—PA, PR
Amperite Co., 56 Broadway, New York 12, N. Y.—PW
Ampex Electric Corp., 934 Charter St., Redwood City, Calif.—PE, PJ, PAB
Amplifier Corp. of America, 398 Broadway, New York 13, N .Y.—PB, PC, PE, PF, PG, PI
Approved Electronic Instrument Corp., 928 Broadway, New York 10, N. Y.—PAB
Art Specialty, 3245 W. Lake, Chicago, Ill.—PA, PZ
Assoc. Eng'g. Corp. of Boston, 38 Euston Rd., Brighton 35, Mass.—PAA
Astatic Corp., 250 Harbor St., Conneaut, Ohio—PS, PU, PV
Atlas Sound Corp., 1449 39 St., B'klyn, N. Y.—PZ
Audio Development Co., 2833 13 Ave. S., Minneapolis 7, Minn.—PR
Audio Equipment Co., 805 Middle Neck Rd., Great Neck, L. I., N. Y.—PAE
Audio Instrument Co., 133 W. 14th St., New York 11, N. Y.—PO, PP, PT, PAB
Audio & Video Products Corp., 730 5 Ave., New York 3, N. Y.—PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PR, PS, PT, PU, PV, PW, PX, PZ, PAA, PAB, PAD, PAE, PAF, PAG
Aurex Corp., 1117 N. Franklin St., Chicago 10, Ill.—PT
Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill.—PQ, PS
Bardwell & McAlister, 2950 N. Ontario St., Burbank, Calif.—PA, PB, PC, PD
Beam Instruments Corp., 350 5 Ave., New York 1, N. Y.—PH, PQ, PS, PT, PU, PV, PW, PX, PAB
Bell Sound Systems, Inc., 555 Marion Rd., Columbus 7, Ohio—PF, PI, PQ
Berkeley Custom Electronics, 2302 Roosevelt, Berkeley 3, Calif.—PO, PP
Berlant Associates, 4917 W. Jefferson Blvd., Los Angeles 16, Calif.—PE, PH, PI
Berndt-Bach, Inc., Auricon Div., 7325 Beverly Blvd., Los Angeles 36, Calif.—PI, PV, PX, PZ
Bestcraft Products Co., Inc., 626 Broadway, New York 12, N. Y.—PA
Best Mfg. Co., 1200 Grove St., Irvington 11, N. J.—PN
Bogen Co., Inc., David, 29 9 Ave., New York, N. Y.—PD, PE, PF, PJ, PQ, PAB
Bogue Railway Equipment Div., 52 Iowa Ave., Paterson 5, N. J.—PAA
Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif.—PL, PM, PO, PQ, PAA, PAB, PAE, PAF
Boom Electric & Amplifier Co., 1227 W. Washington Blvd., Chicago 7, Ill.—PAE

Brook Electronics, Inc., 34 DeHart Pl., Elizabeth 2, N. J.—PI
Browning Laboratories, Inc., 750 Main St., Winchester, Mass.—PH
Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio—PI, PN, PU
Burgess Battery Co., Freeport, Ill.—PAA
Burnell & Co., 45 Warburton Ave., Yonkers 2, N. Y.—PO, PP

Caltron Products Co., 1406 S. Hobart Blvd., Los Angeles 6, Calif.—PU, PV, PAB
Camera Mart, Inc., 1845 B'way, New York 23, N. Y.—PZ
Camfield Mfg. Co., 7 St., Grand Haven, Mich.—PK
Cannon Co., C. F., Springwater, N. Y.—PN
Centralab, Div. Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.—PD, PAB
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.—PAA
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.—PA, PB, PD, PE, PF, PH, PI, PK, PL, PM, PO, PP, PR, PAA, PAB, PAD, PAF
Cinematic Devel. & Cine. Lab., 2125 32 Ave., San Francisco 8, Calif.—PE, PI, PO, PP
Clarke Instruments, 919 Jesup-Blair Dr., Silver Spring, Md.—PR
Collins Audio Prods. Co., P. O. Box 368, Westfield, N. J.—PE, PF, PI, PAA, PAB
Collins Radio Co., 855 35 St. N. E., Cedar Rapids, Iowa—PA, PB, PC, PD, PE, PF, PH, PI, PJ, PK, PL, PR, PAA, PAB, PAF, PAG
Colonial Brass Co., Middleboro, Mass.—PY
Communication Accessories Co., 110 St. & Hillcrest Rd., Hickman Mills, Mo.—PO, PP
Compco Corp., 2251 W. St. Paul, Chicago, Ill.—PA
Condenser Products Co., 7517 N. Clark St., Chicago 26, Ill.—PAA
Conn. Telephone & Electric, 70 Britannia St., Meriden, Conn.—PN, PQ, PR, PS
Cooper Electronic Products Co., 4500 Melrose St., Philadelphia 24, Pa.—PQ
Cornell-Dubilier Elec. Corp., 333 Hamilton Blvd., S. Plainfield, N. J.—PP, PAA

Dalmo Victor, 1414 El Camino, San Carlos, Calif.—PQ
Daven Co., 193 Central Ave., Newark 4, N. J.—PA, PK, PO, PP, PAC, PAG
Dazor Mfg. Co., 4485 Duncan, St. Louis, Mo.—PZ
DeCoursey Eng'g. Lab., P. O. Box 235, W. Los Angeles 25, Calif.—PO, PP
Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wisc.—PAA
Dukane Corp., 110 N. 11 St., St. Charles, Ill.—PE, PH, PL, PQ
Dyna-Labs. Inc., 1075 Stewart Ave., Garden City, N. Y.—PU

Eagle Electric Mfg. Co., 23-10 Bridge Plaza S., Long Island City 1, N. Y.—PQ, PR, PAA
Edu-Craft Sales Corp., 150-45 12 Ave., Whitestone, N. Y.—PH, PQ, PAB
Electronic Communication Equip. Co., 1219 Loyola Ave., Chicago 26, Ill.—PC, PD, PF, PL, PQ, PAB
Electronic Development Lab., 43-07 23 Ave., Long Island City 5, N. Y.—PA, PB, PC, PD, PE, PF, PH, PI, PJ, PL, PM, PO, PQ, PAA, PAB, PAD, PAE, PAF, PAG
Electron-Radar Products, Inc., 1041 N. Pulaski Rd., Chicago 51, Ill.—PK, PS
Electro Products Labs., 4501 N. Ravenswood Ave., Chicago 40, Ill.—PAA
Electro-Voice, Inc., Cecil & Carroll Sts., Buchanan, Mich.—PD, PH, PN, PS, PT, PU, PV, PW, PX, PZ, PAB, PAE
Elex Co., 69-19 215 St., Bayside, L. I., N. Y.—PH, PI, PQ, PAA, PAB
Engineering Research & Devel. Co., P. O. Box 166, Hinsdale, Ill.—PAA
Equipment & Service Co., 6815 Oriole Dr., Dallas 9, Tex.—PA, PK, PL, PO, PP, PR, PAA
Erwood Inc., 1770 W. Berteau Ave., Chicago 13, Ill.—PE, PF, PI, PJ, PAA, PAB, PAE
Espey Mfg. Co., Inc., 528 E. 72 St., New York 21, N. Y.—PH
Executone, Inc., 415 Lexington Ave., New York 17, N. Y.—PQ

Fairchild Recording Equip. Corp., 154 St. & 7th Ave., Whitestone 57, N. Y.—PB, PE, PF, PH, PI, PO, PAA, PAB
Farmers Eng'g & Mfg., Irwin, Pa.—PQ, PAB
Ferrar Radio & Television Corp., 55 W. 26 St., New York 10, N. Y.—PQ, PAB
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.—PAA
Fidelity Amplifier Co., 703 W. Willow St., Chicago, Ill.—PAB
Fisher Radio Corp., 41 E. 47 St., New York 17, N. Y.—PD, PI, PJ, PO, PAB
Fluke Engineering, Box 755, Springdale, Conn.—PAA
Furst Electronics, 3322 W. Lawrence Ave., Chicago 25, Ill.—PAA

Gates Radio Co., 123 Hampshire St., Quincy 1, Ill.—PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PAA, PAB, PAD, PAF, PAG
General Control Co., 1200 Soldiers Field Rd., Boston 34, Mass.—PAG
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.—PA, PB, PC, PD, PE, PF, PH, PI, PJ, PL, PO, PP, PR, PAA, PAB, PAF, PAG
General Electrosonics, Inc., 32 W. 22 St., New York 10, N. Y.—PAA
Georator Corp., 1820 N. Nash, Arlington, Va.—PAA
Geraton Products, 2115 N. Charles St., Baltimore 18, Md., PAE, PAF
Godfrey Mfg. Co., 2642 S. Michigan Ave., Chicago 16, Ill.—PQ
Gray Research & Development Co., 658 Hilliard St., Manchester, Conn.—PA, PO, PAD
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.—PT, PU, PW, PAB

Hall, Inc., F. Sumner, 153 W. 33 St., New York 1, N. Y.—PO, PP, PR, PY, PAA
Hallen Corp., 3503 W. Olive Ave., Burbank, Calif.—PM, PO, PP, PW, PAA
Hart, Arthur H., 2125 32 Ave., San Francisco 16, Calif.—PO, PP
Hartman Engineering Co., 117 Oakland St., Springfield, Mass.—PAA
Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.—PK, PAA

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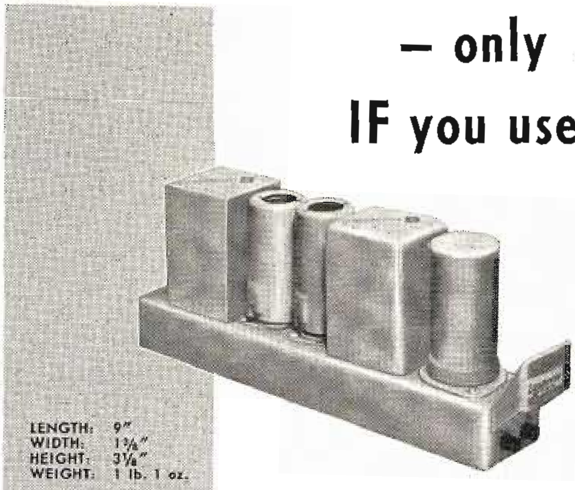
– only 3½" of standard panel space

IF you use the NEW Langevin 5000 Series



TYPE 5116 AMPLIFIER
• 11 will fit in the standard rack •

TYPE 5116 AMPLIFIER

A plug-in, low-noise pre-amplifier for use in broadcast audio facilities, recording, or sound systems. Can be used as a booster amplifier with 18 dbm output.

Gain: 45 db into unloaded input transformer, with provision for adjusting to 40 db.

Input source impedance: 30/150/600 ohms. Center tap available when strapped for 150 or 600 ohms.

Output load impedance: 150/600 ohms, with center tap on 600 ohm position.

Output noise: equivalent to input signal of −120 dbm or less.

Output power: −18 dbm (0.163 watt) with less than 0.5% RMS total distortion from 50 to 15,000 cps, only 1% at 30 cps.

Frequency characteristic: ±0.5 db from 30 to 15,000 cps.

Power requirements: 6 ma DC at 275 v., 0.3 amp AC at 6.3 v.

Tube complement: two Type 5879.

TYPE 5117 AMPLIFIER

A plug-in, low-noise, low-distortion, fixed-gain unit for use as a program monitor or booster amplifier in broadcast audio facilities, recording, or sound systems.

Gain: 55 db, fixed.

Input source impedance: 150/600 ohms, center tapped.

Output load impedance: 150/600 ohms, with center tap on 600 ohm position.

Output noise: equivalent to input signal of −110 dbm or less.

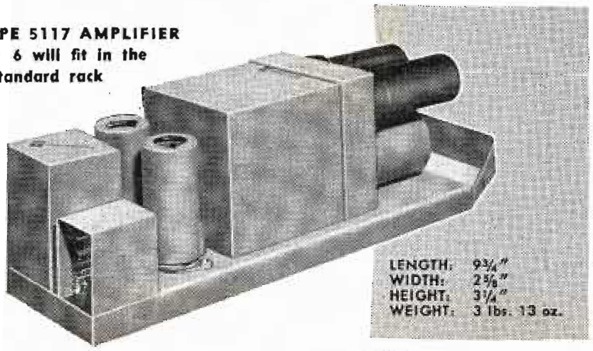
Output power: 30 dbm (1 watt) with less than 0.5% RMS total distortion from 30 to 15,000 cps; 39 dbm (8 watts) with less than 1% RMS total distortion from 50 to 15,000 cps.

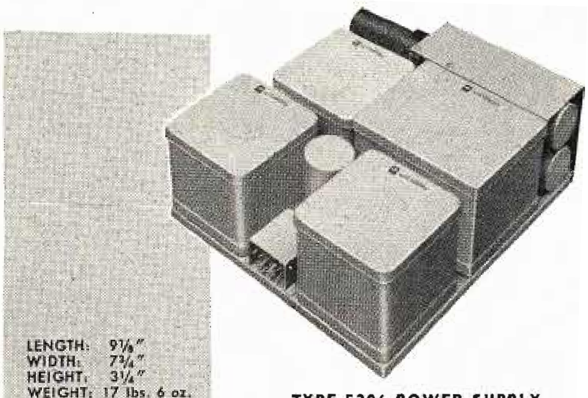
Frequency characteristic: 0.5 db from 30 to 15,000 cps.

Power requirements: 70 ma DC at 300 v, 1.2 amps AC at 6.3 v.

Tube complement: two Type 6V6, two Type 5879.

TYPE 5117 AMPLIFIER
• 6 will fit in the standard rack





TYPE 5206 POWER SUPPLY
• 2 will fit in the standard rack •

TYPE 5206 POWER SUPPLY

A plug-in unit capable of powering as many as 22 Type 5116 pre-amplifiers, or 10 Type 5116 pre-amplifiers plus two Type 5117 monitor amplifiers.

Load current: 210 ma DC at 300 volts.

Filament current: 6.5 amps AC at 6.3 volts.

Ripple: less than 2 millivolts pre-amplifier supply, less than 10 millivolts monitor amplifier supply.

Power requirements: 105-125/210-250 volts, at 50 to 60 cps.

Rectifier: selenium cell.

TOGETHER FOR THE FIRST TIME! Compactness beyond belief • Top broadcast quality • Balanced output • Low-impedance input • Plug-in construction • Gold-plated plugs • Only two tube types • Tube-pull without plug-out • Plate-current-check switches.

Why not try Langevin for your transformers — custom-built to commercial or MIL-T-27 specs. Fastest delivery in the country on test samples!

SEE US IN ROOM 531 AT THE 1952 AUDIO FAIR

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Highland Engineering Co., Main & Urban, Westbury, L. I., N. Y.—PAA
Holl Audio Industries, 5014 N. Encinita Ave., Temple City, Calif.—PA
Holub Industries, Inc., 413 DeKalb Ave., Sycamore, Ill.—PA
Houston-Fearless Corp., 11801 W. Olympic Blvd., West Los Angeles 64, Calif.—PL, PZ, PAF
Hunt & Piper Mfg. Co., 7045 Romaine St., Hollywood 38, Calif.—PZ
Hycor Co., 11423 Vanowen St., North Hollywood, Calif.—PK, PO, PP
INET, Inc., 8655 S. Main St., Los Angeles 3, Calif., PAA, PAB
Insuline Corp. of America, 36-02 35 Ave., Long Island City 1, N. Y.—PR
Intercall Systems, Inc., 999 E. First St., Dayton 1, Ohio—PQ
International Projector Corp., 55 LaFrance Ave., Bloomfield, N. J.—PAE
International Research Associates, A Div. of Iresco Inc., 2221 Warwick Ave., Santa Monica, Calif.—PB, PC, PD, PE, PF, PH, PI, PJ, PK, PO, PQ, PT, PAA, PAB
Jensen Mfg. Co., 6601 S. Laramie Ave., Chicago 38, Ill.—PAE
Kalbfell Laboratories, Inc., 1090 Morena Blvd., San Diego 10, Calif.—PK
Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago 38, Ill.—PQ, PS, PT
Kepco Laboratories, Inc., 131-38 Sanford Ave., Flushing 55, N. Y.—PAA
Key Electronics Corp., 20 W. 22 St., New York 10, N. Y.—PE, PQ, PR, PAB
Keystone Electronics Corp., 423 Broome St., New York 13, N. Y.—PA
Kinevox Inc., 116 S. Hollywood Way, Burbank; Calif.—PE, PV, PW, PZ
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—PI, PAC
K. V. Transformer Corp., 4412 Park Ave., New York 57, N. Y.—PP
Lambda Electronics Corp., 103-02 Northern Blvd., Corona 68, N. Y.—PAA
Langevin Mfg. Corp., 37 W. 65 St., New York 23, N. Y.—PB, PC, PD, PE, PF, PG, PH, PI, PJ, PL, PM, PP, PQ, PAA, PAB, PAE, PAF, PAG
Leland, Inc., 123 Webster, Dayton 2, Ohio—PAG
Lenkurt Electric Co., 1105 County Road, San Carlos, Calif.—PP
Libra Film & Equipment, 6525 Sunset Blvd., Hollywood 28, Calif.—PZ
Loge Sound Engineers, J. M., 2171 W. Wash. Blvd., Los Angeles 18, Calif.—PA
McClure Talking Pictures, O. J., 1115 W. Washington Blvd., Chicago 7, Ill.—PAE
McIntsoh Lab., Inc., 320 Water St., Binghamton, N. Y.—PD, PF, PH, PI, PAB
Magna Electronics Co., Box 338, Inglewood, Calif.—PA, PE, PG, PH, PI, PJ, PAA, PAB, PAG
Magnecord, Inc., 225 W. Ohio, Chicago, Ill.—PI, PAB
Mallory & Co., P. R., 3029 E. Washington St., Indianapolis 6, Ind.—PP, PAA
Maurer, Inc., J. A., 37-01 31 St., Long Island City 1, N. Y.—PI
Meletron Corp., 950 N. Highland Ave., Los Angeles 38, Calif.—PZ
Melody Master Mfg. Co., 2106 Berwyn Ave., Chicago 25, Ill.—PC, PE, PG, PJ, PN
Merix Chemical Co., 1021 E. 55th St., Chicago 15, Ill.—PA
Millen Mfg. Co., James, 150 Exchange St., Malden 48, Mass.—PAA
Model Rectifier Corp., 557 Rogers Ave., Brooklyn 25, N. Y.—PAA
Mole-Richardson Co., 937 N. Sycamore Ave., Hollywood 38, Calif.—PZ
MP Concert Installations, Fairfield, Conn—PD, PE, PF, PI, PAA, PAB
National Inter-Communicating Systems, 1531 Devon Ave., Chicago 26, Ill.—PQ
Neptune Electronics Co., 433 Broadway, New York 13, N. Y.—PA, PF, PJ, PL, PP, PQ, PR, PAA, PAB
Neutronic Assoc., 83-56 Victor Ave., Elmhurst 73, N. Y.—PAA
Newcomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif.—PH
North Electric Mfg. Co., 501 S. Market St., Galion, Ohio—PAG
O'Brien Electric Co., 6514 Santa Monica Blvd., Hollywood 38, Calif.—PL, PM, PQ, PAC, PAD, PAE, PAF, PAG
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.—PK
Olesen Co., Otto K., 1534 Cahuenga Blvd., Hollywood 28, Calif.—PB, PD, PE, PF, PH, PJ, PL, PQ, PAB, PAD, PAE, PAF
Opad-Green Co., 71 Warren, New York, N. Y.—PAA
Pacific Mercury Television Mfg. Corp., 5955 Van Nuys Blvd., Van Nuys, Calif.—PC, PI, PJ, PAA, PAB
Pacific Transducer Corp., 11921 S. West Pico Blvd., Los Angeles 64, Calif.—PO, PP
Pan-Electronics Co., 276 E. 150th St., New York, N. Y.—PC, PD, PE, PF, PG, PH, PI, PJ, PO, PAB, PAE
PCA Inc., 6368 DeLongpre Ave., Hollywood 28, Calif.—PD, PE, PF, PJ, PAA, PAB, PAE
Pedersen Electronics, Mt. Diablo Blvd., Box 572, Lafayette, Calif.—PO, PAA, PAB
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.—PN, PV, PW, PAE
Philmore Mfg. Co., 113 University Place, New York 3, N. Y.—PN, PS
Pickering & Co., 309 Woods Ave., Oceanside, N. Y.—PO, PAB
Precision Electronics, 641 Milwaukee Ave., Chicago 22, Ill.—PA
Racon Electric Co., Inc., 52 E. 19th St., New York, N. Y.—PZ
Premier Electronic Labs., 382 Lafayette St., New York 3, N. Y.—PI
Radio Corp. of America, RCA-Victor Div., Camden, N. J.—PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PO, PP, PQ, PR, PS, PT, PU, PV, PW, PX, PY, PZ, PAA, PAB, PAC, PAD, PAE, PAF, PAG
Radio Craftsmen Inc., The, 4401 N. Ravenswood Ave., Chicago 40, Ill.—PH, PI
Radio Essentials Inc., 152 Mac Questen Pkwy. S., Mount Vernon, N. Y.—PA, PR
Radio Labs., 1846 Westlake N., Seattle 9, Wash.—PC, PD, PJ, PQ
Radio-Music Corp., 84 S. Water St., Port Chester, N. Y.—PB, PF, PO, PP, PAB, PAD

Radio Sonic Corp., 186 Union Ave., New Rochelle, N. Y. —PAA
Rauland-Borg Corp., 3515 W. Addison St., Chicago 18, Ill.—PQ, PAE, PAQ
Remler Co., 2101 Bryant St., San Francisco 10, Calif.—PA, PI, PJ, PQ, PW
Roanwell Corp., 662 Pacific St., Brooklyn 17, N. Y.—PN, PS, PV, PW
Rosen Engineering, Raymond, 32 & Walnut Sts., Philadelphia 4, Pa.—PAG
Rowe Industries, 1702 Wayne St., Toledo 9, Ohio—PB, PC, PD, PE, PF, PG, PH, PI, PJ, PAE
St. Louis Microphone Co., 2726 Brentwood Blvd., St. Louis 17, Mo.—PW
Sargent-Rayment Co., 212 9th, Oakland, Calif.—PH
Scott, Inc., Hermon Hosmer, 385 Putnam Ave., Cambridge 39, Mass.—PB, PF, PG, PI, PO, PAA, PAB
Sealtron Co., The, 9701 Reading Rd., Cincinnati 15, Ohio—PB, PP, PAA, PAB
Shallcross Mfg. Co., Pusey & Jackson Aves., Collingdale, Pa.—PA
Shevers, Inc., Harold, 123 W. 64 St., New York 23, N. Y.—PB, PC, PD, PE, PF, PG, PH, PI, PJ,
Shrader Mfg. Co., 2803 M. St., N. W., Washington, D. C.—PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PO, PQ, PR, PT, PU, PV, PW, PX, PAA, PAB, PAF, PAG
Shura-tone Products Inc., 440 Adelphi St., Brooklyn 17, N. Y.—PB, PI, PQ, PAA, PAB
Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill.—PS, PU, PV, PW, PX
Simpson Mfg. Co., Mark, 32-28 49 St., Long Island City 3, N. Y.—PD, PE, PH, PAE
Sorensen & Co., 375 Fairfield Ave., Stamford, Conn.—PAA
S. O. S. Cinema Supply Corp., 602 W. 52 St., New York 19, N. Y.—PI, PU, PV, PX, PZ, PAE
Sound Labs., 323 E. 48 St., New York 17, N. Y.—PH, PI, PJ, PL, PO, PQ, PAA, PAB, PAE
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, PK, PL, PM, PN, PP, PQ, PR, PT, PU, PV, PW, PX, PZ, PAA, PAB, PAC, PAD, PAE, PAF, PAG
Special Products Co., 9115 Brookville Rd., Silver Spring, Md.—PZ
Spencer-Kennedy Labs., Inc., 186 Massachusetts Ave., Cambridge 39, Mass.—PP
Square Root Mfg. Co., 391 Saw Mill River Rd., Yonkers 2, N. Y.—PC, PP
Srepco, Inc., 135 E. 2nd St., Dayton, Ohio—PA, PY
Stancil-Hoffman Corp., The, 1016 N. Highland Ave., Hollywood 38, Calif.—PC, PE, PI, PAB
Standard Electronics Corp., 285 Emmet St., Newark 5, N. J.—PB, PC, PE, PF, PH, PI, PJ, PL, PR, PAA, PAB
Stelma, Inc., 389 Ludlow St., Stamford, Conn.—PD, PE, PF, PJ, PQ, PAA, PAB
Stephens Mfg. Corp., 8538 Warner Dr., Culver City, Calif.—PD, PF, PT, PAE
Stromberg-Carlson Co., 1225 Clifford Ave., Rochester, N. Y.—PA, PB, PD, PE, PF, PH, PI, PJ, PQ, PU, PV, PAA, PAB, PAE
Synchromatic Prods., 766 Broadway, Bayonne, N. J.—PB, PJ, PAC

Taffet Radio & TV Co., 2530 Belmont Ave., New York 58, N. Y.—PAA
Talk-A-Phone Co., 1512 S. Pulaski Rd., Chicago 23, Ill.—PQ
Tape Recording Industries, 3335 E. Michigan Ave., Lansing, Mich.—PD, PE, PF, PH, PJ, PU, PV, PW, PX, PZ, PAB
Tartak-Stolle Electronics, 3970 S. Grand Ave., Los Angeles 37, Calif.—PO, PP, PQ
Tech Labs., Inc., Bergen & Edsall Blvd., Palisades Park, N. J.—PK, PAG
Tech-Master Products Co., 443 Broadway, New York 13, N. Y.—PH, PAB
TelAutograph Corp., 16 W. 61 St., New York 23, N. Y. —PB, PC, PD, PE, PF, PG, PH, PI, PJ, PAA, PAB, PAG
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—PA, PI, PJ, PQ, PR, PAA, PAB, PAE, PAG
Teletronic Labs., Inc., 1835 W. Rosecrans Ave., Gardena, Calif.—PR, PAA
Telex, Inc., Telex Park, St. Paul 1, Minn.—PN
Tel-Instrument Co., 50 Paterson Ave., E. Rutherford, N. J.—PK
Tetrad Co., 4054 Ocean Park Ave., Venice, Calif.—PP
Thordarson-Meissner Mfg. Div., Maguire Industries, Inc., 7 & Belmont, Mt. Carmel, Ill.—PH, PAB
Tibbetts Industries, Inc., Camden, Me.—PU
Transformer Technicians, Inc., 2608 N. Cicero Ave., Chicago 39, Ill.—PAA
Transmitter Equipment Mfg. Co., 345 Hudson St., New York 14, N. Y.—PB, PC, PD, PE, PF, PH, PI, PJ, PL, PAA, PAB
Trimm, Inc., 400 W. Lake St., Libertyville, Ill.—PN, PR
Tru-Vue Television Co., 99 Featherbed Lane, Bronx 52, N. Y.—PI, PJ, PQ, PAA
Turner Co., The, 909 17 St., N. E., Cedar Rapids, Iowa —PS, PU, PV, PW, PX
U. S. Recording Co., 1121 Vermont Ave., N. W., Washington 5, D. C.—PA, PB, PC, PD, PE, PF, PG, PH, PI, PJ, JL, PM, PS, PT, PU, PV, PW, PX, PY, PZ, PAA, PAB, PAD, PAF
United Transformer Co., 150 Varick St., New York 13, N. Y.—PK, PO
Universal Aviation Corp., 239 Park Ave., New York 17, N. Y.—PL, PM
Universal Microphone Co., 424 Warren Lane, Inglewood 3, Calif.—PS, PU, PV, PW, PX, PZ
Valco Mfg. Co., 4700 W. Walton, Chicago, Ill.—PW
Varo Mfg. Co., 1801 Walnut, Garland, Tex.—PAA
Vincent Co., A. W., 163 St. Paul St., Rochester 4, N. Y.—PQ, PAG
Vocaline Co. of America, Inc., Coulter St., Old Saybrook, Conn.—PQ
Vokar Corp., 7300 Huron River Dr., Dexter, Mich.—PP, PR
Wadsworth Mfg. Associates, 509 Balsam St., Liverpool, N. Y.—PR
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.—PF, PAB
Webster Electric Co., 1900 Clark St., Racine, Wisc.—PH, PQ
Welch Electric Co., 1221 Wade St., Cincinnati 14, Ohio —PB, PC, PD, PE, PF, PG, PH, PI, PJ, PAA, PAB
Western Sound & Electric Labs., 805 S. 5th St., Milwaukee, Wis.—PB, PC, PD, PE, PF, PG, PH, PI, PJ, PL, PQ, PAA, PAB, PAE, PAF
Wheeler Insulated Wire Co., 1107 E. Aurora St., Waterbury 20, Conn.—PQ
White Rock Mfg. Corp., White Rock, S. C.—PH, PI

FIELD EQUIPMENT

16—Remote Pickup-Video

Accessories	QA
Antennas	QB
Camera controls	QC
Camera switching systems	QD
Dollies	QE
Field cameras	QF
Lenses	QG
Microwave receivers	QH
Microwave transmitters	QI
Power supplies	QJ
Sync. generators	QK
Tripods	QL
Wave guides	QM

Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.—QJ
Acorn Electronics, Box 348, Gibson City, Ill.—QJ
Ainslie Electronic Products, Inc., 312 Quincy Ave., Quincy 69, Mass—QB
Akeley Camera & Instrument Corp., 345 Hudson St., New York, N. Y.—QC, QD, QE, QG, QL
All Channel Antenna Corp., 70-07 Queens Blvd., Woodside 77, N. Y.—QB
Allied Research & Engineering, Inc., 1941 N. Las Palmas Ave., Hollywood 38, Calif.—QM
Alpar Mfg. Co., 466 St. Francis St., Redwood City, Calif.—QR
American Electroneering Corp., 5025 W. Jefferson Blvd., Los Angeles 16, Calif.—QB, QJ
American Television, Inc., 5050 Broadway, Chicago, Ill. —QD, QJ, QK
American Television & Radio Co., 300 E. 4th St., St. Paul 1, Minn.—QJ
Andrew Corp., 363 E. 75th St., Chicago, Ill.—QB
Ansley Electronics, Inc., 85 Tremont St., Meriden, Conn. —QH, QI
Antenna Research Lab., Inc., 797 Thomas Lane, Columbus 14, Ohio—QB
Bausch & Lomb Optical Co., 628 St. Paul St., Rochester, N. Y.—QG
Berndt-Bach, Inc., Auricon Div., 7325 Beverly Blvd., Los Angeles 36, Calif.—QE, QL
Bogue Railway Equipment Div., 52 Iowa Ave., Paterson 5, N. J.—QJ
Bono Engineering Corp., 701 W. Broadway, Glendale 4, Calif.—QM
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa. —QG
Burgess Battery Co., Freeport, Ill.—QJ
Burke & James, Inc., 321 So. Wabash Ave., Chicago 4, Ill.—QG
Camburn, Inc., 32-40 57 St., Woodside, N. Y.—QB
Camera Equipment Co., 1600 Broadway, New York 19, N. Y.—QE, QG, QL
Camera Mart Inc., The, 1845 Broadway, New York 23, N. Y.—QE, QF, QJ, QL
Communication Products Co., Marlboro, N. J.—QB
Co-Operative Industries, Inc., 100 Oakdale Rd., Chester, N. J.—QM
Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., S. Plainfield, N. J.—QB, QJ
Cubic Corp., 2841 Canon St., San Diego 6, Calif.— —QB, QH, QI, QJ, QM
Dage Electronics Corp., 69 N. Second St., Beech Grove, Ind.—QC, QF, QK
Da-Lite Screen Co., 2711 N. Pulaski Rd., Chicago 39, Ill.—QA, QL
Daven Co., 193 Central Ave., Newark 4, N. J.—QD
De Mornay-Bonardi, Inc., 3223 Burton Ave., Burbank, Calif.—QM
Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wisc.—QB, QJ
Du Mont Labs., Inc., Allen B., 1500 Main Ave., Clifton, N. J.—QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM
Eastman Kodak Co., 343 State, Rochester, N. Y.—QG
Electron-Radar Products Inc., 1041 N. Pulaski Rd., Chicago 51, Ill.—QB
Electro Precision Products, Inc., 119-01 22nd Ave., College Point, N. Y.—QM
Erco Radio Laboratories, Inc., Stewart Ave., Garden City, N. Y.—QB
Federal Telecommunication Labs., 500 Washington Ave., Nutley 10, N. J.—QB, QC, QD, QF, QH, QI, QJ, QK
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York, 20, N. Y.—QJ
Fluke Engineering Co., John, Box 755, Springdale, Conn. —QJ
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.—QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL, QM
General Precision Lab., Inc., 63 Bedford Rd., Pleasantville, N. Y.—QC, QD, QE, QF, QG, QJ, QK, QL
Gundlach Mfg. Corp., Fairport, N. Y.—QG
G. W. Associates, P. O. Box 2263, El Segundo, Calif.— QH, QI
Hart, Arthur H., 2125 32 Ave., San Francisco 16, Calif.—QG, QL
Holub Industries, Inc., 413 DeKalb Ave., Sycamore, Ill. —QA
Houston-Fearless Corp., 11801 W. Olympic Blvd., West Los Angeles 64, Calif.—QE, QL
INET, Inc., 8655 S. Main, Los Angeles, Calif.—QJ

Insuline Corp. of America, 36-02 35 Ave., Long Island City 1, N. Y.—QA
International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.—QJ
International Research Associates, A Div. of Iresco Inc., 2221 Warwick Ave., Santa Monica, Calif.—QH, QI, QJ, QK
Kepco Laboratories, Inc., 131-38 Sanford Ave., Flushing 55, N. Y.—QJ
Kings Microwave Co., 50 Marbledale Ave., Tuckahoe, N. Y.—QB, QH, QI, QM
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—QM
Libra Film & Equipment Distributors & Producers, 6525 Sunset Blvd., Hollywood 28, Calif.—QE, QF, QG, QL
Mark Products Co., 3547-49 Montrose Ave., Chicago 18, Ill.—QB, QM
Mitchell Camera Corp., 666 W. Harvard St., Glendale 4, Calif.—QL
Neutronic Assoc., 83-56 Victor Ave., Elmhurst 73, N. Y.—QJ
Opad-Green Co., 71 Warren, New York, N. Y.—QJ
Petrick Bros., Inc., 1938 N. Springfield Ave., Chicago 47, Ill.—QL
Philco Corp., Government & Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa.—QH, QI
Pickard & Burns, 240 Highland Ave., Needham 94, Mass.—QB
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.—QH, QK
Ponder & Best, Tele-Lens Div., 814 N. Cole Ave., Hollywood 38, Calif.—QG
Precision Products, Inc., 719 17th St., N. W., Washington, D. C.—QF, QG
Premax Products Div., Chisholm-Ryder Co., Highland & College Aves., Niagara Falls, N. Y.—QB
Product Development Co., 307 Bergen Ave., Kearny, N. J.—QB
Radiant Mfg. Corp., 2627 W. Roosevelt Rd., Chicago 8, Ill.—QL
Radio Corp. of America, RCA-Victor Div., Camden, N. J. —QA, QB, QC, QD, QE, QF, QG, QH, QI, QJ, QK, QL
Radio Essentials, Inc., 152 Mac Questen Pkwy. S. Mt. Vernon, N. Y.—QA
Ready-Power Co., The, 11231 Freud Ave., Detroit 14, Mich.—QJ
Republic Lens Co., 916 9th Ave., New York, N. Y. —QG
Saftee Glass Co., 4717 Stenton, Philadelphia, Pa.—QG
Sealtron Co., 9701 Reading, Cincinnati, Ohio—QJ
Semon Bache & Co., 636 Greenwich St., New York 14, N. Y.—QG
Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif.—QI, QJ
Sorensen & Co., 375 Fairfield Ave., Stamford, Conn.—QJ
S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19, N. Y.—QE, QK, QL
Square Root Mfg. Co., 391 Saw Mill River Rd., Yonkers 2, N. Y.—QM
Star Expansion Products Co., 147 Cedar St., New York 6, N. Y.—QA
Technical Appliance Corp., 1 Taco St., Sherburne, N. Y.—QB
Technicraft Labs., Inc., Thomaston-Waterbury Rd., Thomaston, Conn.—QA, QM
Telechrome, Inc., 88 Merrick Rd., Amityville, L. I., N. Y.—QG, QH, QI, QJ, QK, QM
Television Zoomar Corp., 500 Fifth Ave., Room 2223, New York 36, N. Y.—QG
Tel-Instrument Co., 50 Paterson Ave., E. Rutherford, N. J.—QK
Terpening Co., L. H., 16 W. 61st St., New York 23, N. Y.—QM
Torngren Co., C. W., 236 Pearl St., Somerville 45, Mass.—QB, QM
T-V Products Co., 152 Sandford, Bklyn, N. Y.—QA, QB
Universal Electronics Co., 2012 S. Sepulveda Blvd., Los Angeles 25, Calif.—QJ
Ward Products Corp., Div. of The Gabriel Co., 1523 E. 45 St., Cleveland 3, Ohio—QB
Waveline Inc., P. O. Box 470, Caldwell, N. J.—QI, QM
Weymouth Instrument Co., 1440 Commercial St., E. Weymouth 89, Mass.—QH, QI, QM
Wincharger Corp., E. 7 at Division, Sioux City 2, Iowa —QJ
Workshop Associates, The Div. of The Gabriel Co., Endicott St., Norwood, Mass.—QB

17—Remote Pickup-Audio

Amplifiers	RA
Auxiliary power supplies	RB
Cue receivers	RC
DC to AC converters	RD
Remote mixing equipment	RE
Transmitters	RF

Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.—RB
Acorn Electronics Corp., Box 348, Gibson City, Ill. —RA, RB
Air Associates Inc., 511 Joyce St., Orange, N. J.—RA, RB, RF
Airpax Products Co., Middle River, Baltimore 20, Md.—RB, RD
Allied Allegri Machine Co., 141 River Road, Nutley 10, N. J.—RA, RE
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—RA, RE
American Machine & Foundry Co., 625 Eighth Ave., New York 18, N. Y.—RA
Ampex Electric Corp., 934 Charter St., Redwood City, Calif.—RE
Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.—RA
Ansley Electronics, Inc., 85 Tremont St., Meriden, Conn. —RF
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—RA, RB, RE
Beam Instruments Corp., 350 Fifth Ave., New York 1, N. Y.—RA
Bogen Co., D., 29 9 Ave., New York, N. Y.—RE
Bogue Railway Equipment Div., 52 Iowa Ave., Paterson 5, N. J.—RB
Budelman Radio Corp., 375 Fairfield Ave., Stamford, Conn.—RC, RF

Radio-Frequency Nomenclature

Very Low (VLF)	30 KC
Low (LF)	30-300 KC
Medium (MF)	30-3000 KC
High (HF	3-30 MC
Very High (VHF)	30-300 MC
Ultra High (UHF)	300-3000 MC
Super High (SHF)	3000-30,000 MC
Extremely High (EHF)	30,000-300,000 MC

Bunnell & Co., J. H., 81 Prospect St., Brooklyn 1, N. Y.—RA, RE, RF
Burgess Battery Co., Freeport, Ill.—RB
Carter Motor Co., 2654 N. Maplewood Ave., Chicago 47, Ill.—RD
Collins Radio Co., 855 35 St., N. E., Cedar Rapids, Iowa—RA, RB
Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., S. Plainfield, N. J.—RB, RD
Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wisc.—RB
Electrodyne Co., 32 Oliver St., Boston, Mass.—RD
Electronic Development Laboratory, 43-07 23 Ave., Long Island City 5, N. Y.—RA, RB, RE
Equipment & Service Co., 6815 Oriole Dr., Dallas 9, Tex.—RA, RB, RE
Erwood Inc., 1770 W. Berteau Ave., Chicago 13, Ill. —RA, RB
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone 57, N. Y.—RE
Fisher Radio Corp., 41 E. 47 St., New York 17, N. Y.—RA
Frutchey, M., Box 28, Haekettstown, N. J.—RA, RB
Gates Radio Co., 123 Hampshire St., Quincy 1, Ill. —RA, RB, RE, RF
Gaydon Co., 561 Hillgrove Ave., La Grange, Ill.—RA
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.—RA, RE, RF
Gullon Mfg. Corp., 212 Durham, Metuchen, N. J.—RA
Hallen Corp., 3503 W. Olive, Burbank, Calif.—RD
Hertner Electric Co., The, 12690 Elmwood Ave., Cleveland 11, Ohio—RD
Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif.—RA
International Research Associates, A Div. of Iresco Inc., 2221 Warwick Ave., Santa Monica, Calif.—RA, RF
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich—RC
Langevin Mfg. Corp., 37 W. 65 St., New York 23, N. Y.—RA, RB, RE
Marconi's Wireless Telegraph, 23 Beaver St., New York 4, N. Y.—RA, RB, RC, RD, RE, RF
Model Rectifier Corp., 557 Rogers Ave., B'klyn, N. Y. —RB
National Inter-Communicating Systems, 1531 Devon Ave., Chicago 26, Ill.—RA, RC, RE
Northern Radio Co., 314 Bell, Seattle, Wash.—RA
O'Brien Electric Co., 6514 Santa Monica Blvd., Hollywood 38, Calif.—RE
Opad-Green Co., 71 Warren, New York, N. Y.—RB
QRK Electronic Products, 445 N. Circle Dr., Fresno 4, Calif.—RA
Pacific Mercury Television Mfg. Corp., 5955 Van Nuys Blvd., Van Nuys, Calif.—RA, RE, RF
PCA Inc., 6368 DeLongpre Ave., Hollywood 28, Calif. —RA, RB
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.—RB, RC
Precision Electronics Corp., 641 Milwaukee Ave., Chicago 22, Ill.—RA
Preston Recording Corp., P. O. Box 500, Paramns, N. J.—RA, RC
Radio Corporation of America, RCA-Victor Div., Camden, N. J.—RA, RE, RF
Radio Laboratories, Inc., 1846 Westlake North, Seattle 9, Wash.—RC, RE, RF
Rowe Industries, 1702 Wayne, Toledo, Ohio—RA
Sealtron Co., 9701 Reading Rd., Cincinnati 15, Ohio —RC
Shevers, Inc., Harold, 123 W. 64 St., New York 23, N. Y.—RA, RB, RC
Shrader Mfg. Co., 2803 M Street, N. W., Washington, D. C.—RA, RB, RE
Shura-Tone Products, Inc., 440 Adelphi St., Brooklyn 17, N. Y.—RA
Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif.—RF
Simpson Mfg. Co., Mark, 32-28 49 St., Long Island City 3, N. Y.—RA
Sound Laboratories, 323 E. 48 St., New York 17, N. Y. —RA
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—RA, RB, RE
Stelma, Inc., 389 Ludlow St., Stamford, Conn.—RA, RE
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.—RF
Stromberg-Carlson Co., 1225 Clifford Ave., Rochester 3, N. Y.—RA
Synchrotone Film Sound, Inc., 1776 Broadway, New York 19, N. Y.—RC
TelAutograph Corp., 16 W. 61 St., New York 23, N. Y. —RA, RB, RD, RF
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—RA, RE
Transmitter Equipment Mfg. Co., 345 Hudson St., New York 14, N. Y.—RA, RE, RF
U. S. Recording Co., 1121 Vermont Ave. N. W., Washington 5, D. C.—RA
Universal Electronics Co., 2012 S. Sepulveda Blvd., Los Angeles 25, Calif.—RB
Varo Mfg. Co., 1801 Walnut St., Garland, Tex.—RD
Vokar Corp., 7300 Huron R. Dr., Dexter, Mich.—RD
Waveforms, Inc., 333 6th Ave., New York, N. Y.—RA
Welch Electric Co., 1221 Wade, Cincinnati, Ohio—RD
Weston Laboratories, 410 Glen Rd., Weston, Mass.—RE
Wincharger Corp., E. 7 at Division, Sioux City 2, Iowa—RB

REPRODUCING & RECORDING EQUIPMENT

18—Disc

Complete recorders, portable ..... SA
Complete recorders, studio .... SB
Cutting mechanisms .... SC
Lathes .... SD
Microscopes .... SE
Motors .... SF
Multispeed turntables .... SG
Pickup arms .... SH
Playback units .... SI
Record changers .... SJ
Record mfg. equipment .... SK
Recording amplifiers .... SL
Recording heads .... SM
Recording turntables .... SN
Reproducing heads .... SO
Synchronized equipment .... SP
Transcription players .... SQ
Turntable bases .... SR

Allianee Mfg. Co., Alliance, Ohio—SF, SG
Allied Recording Produets Co., 21-09 43rd Ave., Long Island City 1, N. Y.—SC, SD, SE, SN, SQ
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—SL
American Microphone Co., 370 S. Fair Oaks Ave., Pasadeoa 1, Calif.—SH
Astatle Corp., 250 Harbor, Conneaut, Ohio—SH, SM
Atlantic Video Corp., 18 Clinton St., Brooklyn 2, N. Y.—SI
Audak Co., 500 Fifth Ave., New York, N. Y.—SM
Audio Industries, Michigan City, Ind.—SA
Audio-Master Corp., 341 Madison Ave., New York 17, N. Y.—SG, SI, SJ, SQ
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SP, SQ, SR
Autocraft Radio, Skokie, Ill.—SI
Baldor Electric Co., 4351 Duncan Ave., St. Louis, Mo.—SF
Barber & Howard, East Ave., Westerly, R. I.—SO

TV Broadcast Industry Profits Climbing*

1952	$90,000,000 profit est.
1951	$41,600,000 profit
1950	$ 9,200,000 loss
1949	$25,300,000 loss

* Income before Federal income tax

Bausch & Lomb Optical Co., 628 St. Paul St., Rochester, N. Y.—SE
Beam Radlonics Corp., 224 N. Desplaines St., Chicago 6, Ill.—SG
Bell Sound Systems, Inc., 555 Marion Road, Colnmbus 7, Ohio—SA, SL
Berger Communieatlons, 109-01 72nd Rd., Forest Hills, L. I., N. Y.—SA, SB
Bodine Electric Co., 2254 W. Ohio St., Chicago 12, Ill.—SF
Bogen Co., 663 Broadway, New York, N. Y.—SQ
Bogue Railway Equipment Div., 52 Iowa Ave., Paterson 5, N. J.—SF
Brush Development Co., The, 3405 Perkins Ave., Cleveland 14, Ohio—SH, SM
Buhl Optical Co., 1009 Beech Ave., Pittsburgh 12, Pa.—SE
Califone Corp., 1041 N. Sycamore Ave., Hollywood 38, Calif.—SI, SQ
Caltron Products Co., 1400 S. Hobart Blvd., Los Angeles 6, Calif.—SH
Camera Equipment Co., 1600 Broadway, New York 19, N. Y.—SA, SB
Camera Mart, Inc., The, 1845 Broadway, New York 23, N. Y.—SA, SB
Carron Mfg. Co., 741 W. Harrison St., Chicago 7, Ill.—SF, SM
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.—SL
Colllns Audio Products Co., P. O. Box 368, Westfield, N. J.—SQ
Collins Radio Co., 855 35 St., N. E., Cedar Rapids, Iowa.—SL
Conn. Telephone & Electric, 70 Britannia St., Meriden, Conn.—SA
Crescent Industries, Ine., 5900 W. Touhy Ave., Chieago 31, Ill.—SJ
Crestwood Reeorder Corp., 5940 N. Northwest Highway, Chicago 31, Ill.—SA
Cyclohm Motor Corp., Div. Howard Industries, Racine, Wisc.—SF
Daystrom Electric Corp., 837 Main St., Poughkeepsie, L. I., N. Y.—SQ
Dorothea Mechanisms, Gale, 81-01 Broadway, Elmhurst, L. I. N. Y.—SQ
Duotone Co., Locust St., Keyport, N. J.—SC, SE
Eastern Air Devlces, Inc., 585 Dean, Bklyn, N. Y.—SF
Eicor, Ine., 1501 W. Congress St., Chicago 7, Ill.—SA, SM
Electrie Specialty Co., 211 South St., Stamford, Conn.—SF
Electron Enterprises 6917 W. Stanley Ave., Berwyn, Ill.—SI, SL, SQ
Electronic Creations Co., 363 Greenwieh St., New York, N. Y.—SI
Electronic Development Laboratory, 43-07 23 Ave., Long Island City 5, N. Y.—SA, SB, SQ
Eleetronles Contracting Co., 122 Chambers St., New York 7, N. Y.—SA, SL
Elex Co., The, 69-19 215 St., Bayside, L. I., N. Y.—SI, SJ, SL, SQ
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone 57, N, Y,—SA, SB, SE, SF, SG, SH, SI, SL, SM, SN, SO
Ferrar Radio & Television Corp., 55 W. 26 St., New York, 10, N. Y.—SI
Fisher Radio Corp., 41 E. 47th St., New York 17, N. Y.—SL
Garod Radio Corp., 70 Washington St., Bklyn, N. Y.—SA
Garrard Sales Corp., 164 Duane, New York N. Y.—SJ
Gates Radio Co., 123 Hampshire St., Quincy 1, Ill.—SC, SD, SE, SF, SG, SH, SI, SL, SM, SN, SO, SQ, SR
General Eleetrle Co., Eleetronlcs Dlv., Electronics Park, Syracuse, N. Y.—SH, SL
General Industries Co., Elyria, Ohio—SF, SN
Globe Industries, 125 Sunrise Place, Dayton, Ohio—SF
Gray Research & Development Co., 658 Hilliard St., Manchester, Conn.—SH
Grem Engineering Co., 206 8th Ave., Brooklyn 15, N. Y.—SA, SB, SL
Hart, Arthur H., 2125 32 Ave., San Francisco 16, Calif.—SA, SF
Heller & Associates, Herman S., 8414 W. 3 St., Los Angeles 48, Calif.—SA, SB, SI, SK, SM, SO, SP, SQ
Hertner Electric Co., The, 12690 Elmwood Ave., Cleveland 11, Ohio—SF
Holtzer-Cabot, 125 Amory, Boston 19, Mass.—SF
International Research Associates, A Div. of Iresco Inc., 2221 Warwick Ave., Santa Monica, Calif.—SL
Key Eleetronics Corp., 20 W. 22 St., New York 10, N. Y.—SI, SQ
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—SL
Lincoln Engineerlng Co., 5701 Natural Bridge Ave., St. Louis 20, Mo.—SJ
Lindberg Instrument Co., 1800 Harmon St., Berkeley, Calif.—SO
Lipps, Edwin A., 5485 W. Washington Blvd., Los Angeles 16, Calif.—SE, SM, SO
McIntosh Lab., 320 Water St., Binghamton, N. Y.—SL
Magnetic Motors Corp., Fox Island Rd., Port Chester, N. Y.—SF, SQ
Mannon Sound Stages Inc., 112 W. 89th St., New York 24, N. Y.—SE, SL

Latest UHF Receiving Tubes

6AF4	Triode oscillator
6AJ4	Triode amplifier
6AM4	Triode mixer
6AN4	Triode amplifier, mixer
6AN4	Triode amplifier, mixer
6BZ7	Twin triode amplifier
6T4	Triode oscillator
5768	Planar triode amplifier, frequency multiplier

Manufacturer's Laboratory, 10610 Keswick, Sun Valley, Calif.—SH
Marble Card Electric Co., Gladstone, Mich.—SF
Milwaukee Stamping Co., 800 S. 72 St., Milwaukee 14, Wisc.—SJ
MP Concert Installatlons, Fairfield, Conn.—SL
Neweomb Audio Products Co., 6824 Lexington Ave., Hollywood 38, Calif.—SQ
Pacific Transducer Corp., 11921 S. West Pico Blvd., Los Angeles 64, Calif.—SE, SH, SO
Pan-Electronics Co., 276 E. 150 St., New York, N. Y.—SB, SI, SL, SQ
Peirce Wire Recorder Corp., 1328 Sherman, Evanston, Ill.—SM, SO
Pfanstiehl Chemical Co., 104 Lake View Ave., Waukegan, Ill.—SH, SO
Plekering & Co., 309 Woods Ave., Oceanside, N. Y.—SH, SO
Poinsettia, Inc., 112 Cedar, Pitman, N. J.—SK
Precislon Electronics Ine., 641 Milwaukee Ave., Chicago 22, Ill.—SL
Premler Eleetronic Labs., 382 Lafayette St., New York 3, N.Y.—SA, SL
Presto Recording Corp., Box 500, Paramus, N. J.—SB, SO, SH, SM
Proetor Soundex Corp., 133 N. 6th Ave., Mount Vernon, N. Y.—SI
QRK Electronle Produets, 445 N. Cirele Dr., Fresno 4, Calif.—SI, SN
Radio Corporation of America, RCA-Victor Div., Camden, N. J.—SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SL, SM, SN, SO, SP, SQ, SR
Radio-Music Corp., 84 S. Water St., Port Chester N. Y.—SG, SH, SN, SO, SP, SQ, SB
Recoton Corp., 147 W. 22, New York, N. Y.—SJ, SO
Redmond Co., Owosso, Mich.—SF
Rek-O-Kut Co., 38-01 Queens Blvd., Long Island City 1, N. Y.—SA, SB, SC, SD, SG, SI, SL, SM, SN, SQ, SR
Remler Co., 2101 Bryant St., San Francisco 10, Calif.—SL
Robinson Recording Labs., 35 S. 9th St., Philadelphia 7, Pa.—SB, SC, SD, SH, SQ
Rowe Industrles, 1702 Wayne, Toledo, Ohio—SL
Scott, Inc., Herman Hosmer, 385 Putnam Ave., Cambridge 39, Mass.—SL
Shura-Tone Produets, Inc., 440 Adelphi St., Brooklyn 17, N. Y.—SL, SR
Simpson Mfg. Co., Mark, 32-28 49 St., Long Island City 3, N. Y.—SA
Sonotone Corp., Elmsford, N. Y.—SO
Sound Laboratories, 323 E. 48th St., New York 17, N. Y.—SI, SL
Sound Projeets Co., 2810 W. Harrison St., Chicago 12, Ill.—SO
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—SA, SB, SH, SI, SJ, SL, SN, SO, SQ, SR
SoundSeriber Corp., The, 146 Munson St., New Haven 4, Conn.—SA, SB
Speak-O-Phone Reeording & Equipment Co., 23 W. 60 St., New York 23, N. Y.—SA
Stancil-Hoffman Corp., The, 1016 N. Highland Ave., Hollywood 38, Calif.—SA, SB, SP
Steelman Phonograph & Radio Co., 12-30 Anderson Ave., Mt. Vernon, N. Y.—SJ, SQ
Stelma, Ine., 389 Ludlow St., Stamford, Conn.—SL
Stromberg-Carlson Co., 1225 Clifford Ave., Rochester, N. Y.—SJ, SL, SQ
Tape Recordlng Industries, 3335 E. Michigan Ave., Lansing, Mich.—SA, SG, SH, SI, SJ, SM, SN, SQ, SR
Telectro Industrles Corp., 35-16 37 St., Long Island City 1, N. Y.—SL
Televex, 474 W. 238 St., New York 63, N. Y.—SE
Tetrad Corp., 62 St. Mary St., Yonkers, N. Y.—SH
U. S. Motor Co., 200 E. Slauson Ave., Los Angeles 11, Calif.—SF
U. S. Reeording Co., 1121 Vermont Ave., N. W., Washington 5, D. C.—SA, SB, SC, SD, SE, SF, SG, SH, SI, SJ, SK, SL, SM, SN, SO, SQ, SR
Unlversal Broadeast Equipment Co., 6035 Northwest Highway, Chicago 31, Ill.—SO
Valentino, Ine., Thomas J., 150 W. 46 St., New York 36, N. Y.—SA, SB, SK
Van Eps Lab., R. D. 2, Plainfield, N. J.—SB, SD, SE, SM
V-M Corp., 280 Park, Benton Harbor, Mich.— SG, SI
Weathers Industries, 66 E. Gloucester Pike, Barrington, N. J.—SH, SO
Webster-Chleago Corp., 5610 W. Bloomingdale Ave., Chicago 34, Ill.—SA, SI, SJ
Wenzel Projeetor Co., 2511 S. State St., Chicago 16, Ill.—SP
Western Sound & Electric Labs., 805 S. 5th St., Milwaukee, Wisc.—SA
White Roek Mfg. Corp., White Rock, S. C.—SA
Wilcox Gay Corp., Charlotte, Mich.—SA
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia 7, Pa., SE, SJ

19—Film

Recorders, magnetic stripe
- 8 mm portable ....TA
- 8 mm studio ....TB
- 16 mm portable ....TC
- 16 mm studio ....TD
- 35 mm portable ....TE
- 35 mm studio ....TF
- 17.5 mm portable ....TG
- 17.5 mm studio ....TH

Recorders, photographic
- 8 mm portable ....TI
- 8 mm studio ....TJ
- 16 mm portable ....TK
- 16 mm studio ....TL
- 35 mm portable ....TM
- 35 mm studio ....TN

Synchronized tape equipment ....TO

Ampex Electric Corp., 934 Charter St., Redwood City, Calif.—TO
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—TO
Bell & Howell Co., 7100 McCormick Road, Chicago 45, Ill.—TC
Berndt-Bach, Inc., Auricon Div., 7325 Beverly Blvd., Los Angeles 36, Calif.—TK, TL
Camera Equipment Co., 1600 Broadway, New York 19, N. Y.—TC, TD, TE, TF, TG, TH, TK, TL, TM, TN, TO
Camera Mart, Inc., The, 1845 Broadway, New York 23, N. Y.—TC, TD, TE, TF, TG, TH, TK, TL, TM, TN, TO
Cinematic Devel. & Cine. Lab., 2125 32nd Ave., San Francisco, Calif.—TD, TK, TL, TM, TN, TO
Cinetech Co., 106 West End Ave., New York 23, N. Y., TK, TL, TM, TN
Collins Audio Products Co., Box 368, Westfield, N. J.—JE
Daystrom Electric Corp., 837 Main St., Poughkeepsie, N. Y.—TE, TF
Electro Vision Laboratory, 30-06 Crescent St., Long Island City 2, N. Y.—TO
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone 57, N. Y.—TO
Feiler Engineering Co., 8026 Monticello Ave., Skokie, Ill.—TK
Hallen Corp., 3503 W. Olive Ave., Burbank, Calif.—TC, TD, TE, TF, TG, TH
Hart, Arthur H., 2125 32 Ave., San Francisco 16, Calif.—TC, TG, TL
Heller & Associates, Herman S., 8414 W. 3 St., Los Angeles 48, Calif.—TA, TB, TC, TD, TE, TF, TG, TH
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—TO
Libra Film & Equipment, 6525 Sunset Blvd., Hollywood 28, Calif.—TK, TL
Mannon Sound Stages, Inc., 112 W. 89th St., New York 24, N. Y.—TK, TL
Maurer, Inc., J. A., 37-01 31 St., Long Island City 1, N. Y.—TK, TL
Micro Eng'g Corp., 6233 Hollywood Blvd., Hollywood 28, Calif.—TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN, TO
Miles Reproducer Co., 812 Broadway, New York 3, N. Y.—TA, TC, TI, TJ, TK, TO
Motiograph Inc., 4431 W. Lake, Chicago, Ill.—TC
Movie-Mite Corp., 1105 Truman Rd., Kansas City 6, Mo.—TC, TO
Radio Corporation of America, RCA-Victor Div., Camden, N. J.—TA, TB, TC, TD, TE, TF, TG, TH, TI, TJ, TK, TL, TM, TN
S. O. S. Cinema Supply Corp., 602 W. 52 St., New York 19, N. Y.—TC, TD, TG, TH, TK, TL, TM, TN, TO
Stancil-Hoffman Corp., The, 1016 N. Highland Ave., Hollywood 38, Calif.—TC, TD, TE, TF, TG, TH
Synchrotone Film Sound, Inc., 1776 Broadway, New York 19, N. Y.—TE, TF, TG, TH
Tape Recording Industries, 3335 E. Michigan Ave., Lansing, Mich.—TO
Victor Animatograph Corp., Davenport Bank Bldg., Davenport, Iowa—TC
Walkirt Co., The, 145 W. Hazel St., Inglewood 3, Calif.—TE, TF

20—Tape

- Mechanisms ....UA
- Power supplies ....UB
- Recorders, miniature portable ....UC
- Recorders, portable ....UD
- Recorders, studio ....UE
- Recording amplifiers ....UF
- Recording heads ....UG
- Special equipment ....UH
- Synchronized equipment ....UI
- Tape indexer ....UJ

Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.—UB
Acorn Electronics Corp., Box 348, Gibson City, Ill.—UB
Alfax Paper & Engineering Co., Box 125, Westboro, Mass.—UC, UD
American Hydromath Corp., 145 57th St., New York 19, N. Y.—UH
American Television & Radio Co., 300 E. 4th St., St. Paul 1, Minn.—UB
Ampex Electric Corp., 934 Charter St., Redwood City, Calif.—UA, UB, UC, UD, UE, UF, UG, UH, UI
Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.—UA, UC, UD, UE, UF, UG, UH, UJ
Ampro Corp., 2835 N. Western Ave., Chicago 18, Ill.—UD, UF

Audio Instrument Co., 133 W. 14 St., New York 11, N. Y.—UH
Audio-Master Corp., 341 Madison Ave., New York 17, N. Y.—UD
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—UA, UB, UC, UD, UE, UF, UG, UH, UI
Aurex Corp., 1117 N. Franklin St., Chicago 10, Ill.—UA, UC
Beam Instruments Corp., 350 Fifth Ave., New York 1, N. Y.—UC
Bell Sound Systems, Inc., 555 Marion Road, Columbus 7, Ohio—UD, UF
Berlant Associates, 4917 W. Jefferson Blvd., Los Angeles 16, Calif.—UA, UD, UE, UF, UG, UH
Bogue Railway Equipment Div., 52 Iowa Ave., Paterson 5, N. J.—UD
Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif.—UB, UF
Broadcast Equipment Specialties Corp., 135-01 Liberty Ave., Richmond Hill 19, N. Y.—UC, UD
Brush Development Co., The, 3405 Perkins Ave., Cleveland 14, Ohio—UA, UB, UD, UF, UG
Burgess Battery Co., Freeport, Ill.—UB
Califone Corp., 1041 N. Sycamore Ave., Hollywood 38, Calif., UD, UE
Camera Equipment Co., 1600 Broadway, New York 19, N. Y.—UC, UD, UE
Carron Mfg. Co., 741 W. Harrison St., Chicago 7, Ill.—UA, UC, UD, UG
Carter Motor Co., 2654 N. Maplewood Ave., Chicago 47, Ill.—UB
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.,—UE, UF, UG
Cinetech Co., 106 West End Ave., New York 23, N. Y.—UB, UD, UE, UF
Conn. Telephone & Electric Corp., 70 Britannia St., Meriden, Conn.—UA, UB, UC, UD, UF, UH
Cook Electric Co., 2700 N. Southport Ave., Chicago 14, Ill.—UD, UE
Daco Machine & Tool, 202 Tillary St., Brooklyn 1, N. Y.—UA
Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wisc.—UB
Dukane Corp., 110 N. 11, St. Charles, Ill.—UD
Ectro Inc., Delaware, Ohio—UD
Edix Eng'g Co., 10495 Scenario Lane, Los Angeles 24, Calif.—UH
EDL Co., 5929 East Dunes Hiway, Miller Station, Gary, Ind.—UH
Eicor, Inc., 1501 W. Congress St., Chicago 7, Ill.—UD, UG
Electronic Creations Co., 376 Greenwich St., New York, N. Y.—UC
Electronic Development Laboratory, 43-07 23 Ave., Long Island City 5, N. Y.—UB, UF
Electro Vision Laboratory, 30-06 Crescent St., Long Island City 2, N. Y.—UA, UH, UI
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone 57, N. Y.—UB, UD, UE, UF, UH, UI
Feller Engineering Co., 8026 Monticello Ave., Skokie, Ill.—UD, UF
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.—UB
General Industries Co., Olive & Taylor St., Elyria, Ohio—UA, UD, UH
Grem Engineering Co., 206 8th Ave., Brooklyn 15, N. Y.—UD, UE
Heller & Associates, Herman S., 8414 W. 3 St., Los Angeles 48, Calif.—UC, UD, UE, UG, UH, UI
Indiana Steel Products, Valparaiso, Ind.—UG
INET, Inc., 8655 S. Main, Los Angeles, Calif.—UB
Int'l Movie Producers' Service, 515 Madison Ave., New York 22, N. Y.—UD
Kepco Laboratories, Inc., 131-38 Sanford Ave., Flushing 55, N. Y.—UB
Kinevox Inc., 116 S. Hollywood Way, Burbank, Calif. UB, UD, UE, UG, UI
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—UF, UH, UI
Lekas Mfg. Co., 111 S. 4th Ave., Ann Arbor, Mich.—UD, UE
Lipps, Edwin A., 5485 W. Washington Blvd., Los Angeles 16, Calif.—UG
McIntosh Lab., Inc., 320 Water St., Binghamton, N. Y.—UF
Magnecord, Inc., 225 W. Ohio St., Chicago 10, Ill. UA, UD, UE, UF, UG, UH
Magnetic Recorders Co., 7124 Melrose Ave., Los Angeles 46, Calif.—UD
Magnetic Recording Industries, 30 Broad St., New York 4, N. Y.—UB, UD, UF, UH
Mannon Sound Stages, Inc., 112 W. 89th St., New York 24, N. Y.—UE
Marconi's Wireless Telegraph, 23 Beaver St., New York 4, N. Y.—UA, UB, UE, UF, UG, UH, UI
Melpar, Inc., 452 Swann Ave., Alexandria, Va.—UG, UH
Micro Eng'g Corp., 6233 Hollywood Blvd., Hollywood 28, Calif.—UA, UB, UC, UD, UE, UF, UG, UH, UI, UJ
Miles Reproducer Co., 812 Broadway, New York 3, N. Y.—UC, UD, UG, UH, UJ
Neutronic Assoc., 83-56 Victor Ave., Elmhurst 73, N. Y.—UB
Opad-Green Co., 71 Warren, New York, N. Y.—UB
Pan-Electronics, 276 E. 150, New York, N. Y.—UE
Pedersen Electronics, Box 572, Lafayette, Calif.—UB
Pentron Corp., The, 221 E. Cullerton Ave., Chicago 16, Ill.—UA, UD, UG
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.—UD, UH
Premier Electronic Labs., 382 Lafayette St., New York 3, N. Y.—UD, UF
Presto Recording, P. O. Box 500, Paramus, N. J.—UE
Product Associates, Inc., 318 W. Olympic Blvd., Los Angeles 15, Calif.—UD
Radio Corporation of America, RCA-Victor Div., Camden, N. J.—UA, UE, UF, UG, UH, UI, UJ
Radio Laboratories, Inc., 1846 Westlake North, Seattle 9, Wash.—UF
Rangertone, 73 Winthrop St., Newark, N. J.—UE
Revere Camera Co., 320 E. 21st St., Chicago 16, Ill.—UD
Rixon Electronics, 3303 Ferndale St., Kensington, Md.—UB
Rowe Industries, 1702 Wayne St., Toledo 9, Ohio—UA, UH
Salesmaster Corp., 3717 W. 54 St., Los Angeles, Calif.—UH

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"FULL DIMENSIONAL SOUND" is an apt description of the tonal perspective that gives these fine records the true balance, depth and full tonal range of the original live performance.

To achieve these outstanding results, Capitol's sound recording methods and equipment include all of the latest technical advances in the audio field. Recording materials—both discs and tape—must measure up to the highest professional standards in every respect. And Capitol—like leading phonograph record manufacturers the country over—has found that Audiodiscs and Audiotape are the ideal combination for meeting these exacting requirements.

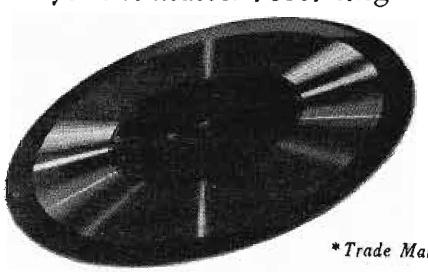
Remember—Audiodiscs and Audiotape are made *by* audio engineers, *for* audio engineers. Their consistent uniform quality is the result of more than a decade of experience by the only company in America devoted solely to the manufacture of fine sound recording media—both discs and tape.

...including **audiotape***

for the original sound

...and **audiodiscs***

for the master recording



Trade Mark

AUDIO DEVICES, Inc.

444 MADISON AVE., NEW YORK 22, N. Y.
Export Dept.: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

Sealtron Co., The, 9701 Reading Road, Cincinnati 15, Ohio—UB
Shoup Engineering Co., 221 E. Cullerton, Chicago 16, Ill.—UD, UE, UF, UG, UH
Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill.—UG
Simpson Mfg. Co., 32-28 49 St., Long Island City 3, N. Y.—UD
Skiatron Electronics & TV, 30 E. 10th St., New York 3, N. Y.—UH
Smith Assoc., Rawdon, 2217 M St., N. W., Washington 7, D. C.—UE, UF
Sonar Radio Corp., 59 Myrtle Ave., Bklyn 1, N. Y. —UA, UD, UF
S. O. S. Cinema Supply Corp., 602 W. 52 St., New York 19, N. Y.—UD, UE, UF, UI
Sound Devices, Inc., 129 E. 124, New York, N. Y.—UG
Sound, Inc., 221 E. Cullerton, Chicago, Ill.—UD, UF
Sound Laboratories, 323 E. 48th St., New York 17, N. Y. —UF
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—UA, UC, UD, UF
SoundScriber Corp., The, 146 Munson St., New Haven 4, Conn.—UD, UE
Speak-O-Phone Recording & Equipment Co., 23 W. 60 St., New York 23, N. Y.—UD
Stancil-Hoffman Corp., The, 1016 N. Highland Ave., Hollywood 38, Calif.— UA, UC, UD, UE, UF, UG, UH
Synchromatic Prods., 766 Broadway, Bayonne, N. J.— UI
Synchrotone Film Sound, Inc., 1776 Broadway, New York 19, N. Y.—UD
Tape Recording Industries, 3335 E. Michigan Ave., Lansing, Mich.—UA, UD, UE, UG
Tapetone Mfg. Corp., 202 Tillary St., Brooklyn, N. Y. —UD
Tech Labs, Inc., Bergen & Edsall Blvd., Palisades Park, N. J.—UH
TelAutograph Corp., 16 W. 61 St., New York 23, N. Y.—UB, UF
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—UA, UB, UC, UD, UF, UH, UJ
U. S. Recording Co., 1121 Vermont Ave., N. W., Washington 5, D. C.—UA, UB, UC, UD, UE, UF, UG, UH
Universal Electronics Co., 2012 S. Sepulveda Blvd., Los Angeles 25, Calif.—UB
Universal Molded Products Corp., Bristol, Va.—UD
Varo Mfg. Co., 1801 Walnut, Garland, Tex.—UB
Walkrit Co., The, 145 W. Hazel St., Inglewood 3, Calif. —UA
Webster-Chicago Corp., 5610 W. Bloomingdale Ave., Chicago 34, Ill.—UD
Webster Electric Co., 1900 Clark, Racine, Wis.—UD
Wenzel Projector Co., 2511 S. State St., Chicago 16, Ill. —UH
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia 7, Pa.—UD
Wilcox-Gay Corp., Charlotte, Mich.—UD

21—Wire

Recorders, miniature portable . . . . VA
Recorders, portable . . . . VB
Recorders, studio VC
Recording heads . . . . VD
Synchronized equipment . . . . VE

Aurex Corp., 1117 N. Franklin, Chicago, Ill.—VA
Brush Development Co., The, 3405 Perkins Ave., Cleveland 14, Ohio—VB, VD
Crescent Industries, Inc., 5900 W. Touhy Ave., Chicago 31, Ill.—VB, VD
Electron Enterprises, 6917 W. Stanley Ave., Berwyn, Ill. —VB
Geratron Products, 2115 N. Charles St., Baltimore 18, Md.—VB
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—VB
Lear, Inc., 110 Ionia Ave., N. W., Grand Rapids 2, Mich.—VB, VC
Mannon Sound Stages, Inc., 112 W. 89th St., New York 24, N. Y.—VC
Marconi's Wireless Telegraph, 23 Beaver St., New York 4, N. Y.—VB
Miles Reproducer Co., 812 B'way, New York, N. Y.—VA
Molded Insulation Co., 335 E. Price St., Philadelphia, Pa.—VC
Peirce Wire Recorder Corp., 1328 Sherman, Evanston, Ill.—VA, VB
Rowe Industries, 1702 Wayne, Toledo, Ohio—VC
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—VB
Synchromatic Prods., 766 Broadway, Bayonne, N. J.—VE
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—VA, VB
Tensolite Insulated Wire Co., Tarrytown, N. Y.—VA, VB, VC, VD
Webster-Chicago Corp., 5610 W. Bloomingdale Ave., Chicago 34, Ill.—VB

22—Graphic

Drives, electric . . . . WA
Drives, flexible auto . . . . WB
Drives, spring . . . . WC
Facsimile equipment . . . . WD
Recorders, fixed . . . . WE
Recorders, portable . . . . WF
Teletype equipment . . . . WG

Alfax Paper & Engineering Co., Box 125, Westboro, Mass.—WD
Audak Co., 500 5th Ave., New York 18, N. Y.—WE
Audio-Tone Oscillator Co., 237 John St., Bridgeport 3, Conn.—WE, WF
Boehme Inc., H. O., 915 Broadway, New York, N. Y. —WA, WB, WE, WF
Clarke Instruments, 919 Jesup-Blair Drive, Silver Spring, Md.—WB
Collins Radio Co., 855 35 St., N. E., Cedar Rapids, Iowa—WG
Douglas Aircraft Co., Santa Monica, Calif.—WE
Edin Co., 207 Main St., Worcester 8, Mass.—WA, WE, WF
Electric Tachometer Corp., 2218 Vine St., Philadelphia 3, Pa.—WE
Electro-Tech Equipment Co., 308 Canal St., New York 13, N. Y.—WE, WF
Esterline-Angus Co., Box 596, Indianapolis 6, Ind.—WA, WC, WE, WF
Fairchild Recording Equipment Corp 154th St. & 7th Ave., Whitestone 57, N. Y.—WD
Fielden Instrument Corp., 2920 N. Fourth St., Philadelphia 33, Pa.—WE
Gorrell & Gorrell, 336 Old Hook Rd., Westwood, N. J.— WA
Hathaway Instrument Co., 1315 Clarkson St., Denver Colo.—WE, WF
Haydon Mfg. Co., 245 E. Elm St., Torrington, Conn. —WA
Heiland Research Corp., 130 E. 5th Ave., Denver 9, Colo.—WE, WF
Hellur & Associates, Herman S., 8414 W. 3 St. Los Angeles 48, Calif.—WE, WF
Las-Lab, 316 W. Saratoga St., Baltimore 1, Md.— WE, WF
Leupold & Stevens Instruments, 4445 N. E. Glisan St., Portland 13, Ore.—WE
North American Philips Co., 100 E. 42nd St., New York 17, N. Y.—WE
Photron Instrument Co., 6516 Detroit Ave., Cleveland 2, Ohio—WE
Remler Co., 2101 Bryant St., San Francisco 10, Calif. —WG
Servo-Tek Products Co., 4 Godwin Ave., Paterson 1, N. J.—WA
Sound Apparatus Co., Stirling, N. J.—WE, WF
Stewart Mfg. Corp., F. W., 4311-13 Ravenswood Ave., Chicago 18, Ill.—WB
Techno Instrument Co., 6666 Lexington Ave., Los Angeles 38, Calif.—WE
TelAutograph Corp., 16 W. 61 St., New York 23, N. Y.—WD
Telechron Dept., General Electric Co., Ashland, Mass. —WA
Telecomputing Corp., Burbank, Calif.—WE
Times Facsimile Corp., 540 W. 58 St., New York 19, N. Y.—WD
U. S. Gauge Div., American Machine & Metals Inc., Sellersville, Pa.—WE, WF
Zernickow Co. 15 Park Row, New York, N. Y.—WF

23—Supplies

Anti-static devices . . . . XA
Cutting needles . . . . XB
Discs XC
Film . . . . XD
Film, magnetic stripe . . . . XE
Miscellaneous . . . . XF
Motion picture film reels & cans . . XG
Paper rolls . . . . XH
Playback needles XI
Reproducing needles . . . . XJ
Tape . . . . XK
Tape erasers XL
Tape reels and flanges . . . . XM
Tape splicers . . . . XN
Wire . . . . XO

Ace Electric Mfg. Co., 1458 Shakespeare Ave., Bronx 52, N. Y.—XN
Acton Co., H. W., Nashua, N. H.—XB, XJ
Advance Recording Products Co., 36-12 34 St., Long Island City 1, N. Y.—XC
Aeronautical Radio Mfg. Co., 155 First St., Mineola, N. Y.—XA, XO
Allied Recording Products Co., 21-09 43rd Ave., Long Island City 1, N. Y.—XC
American Laubscher Corp., 333 W. 52nd St., New York 19, N. Y.—XB, XI
Ampex Electric Corp., 934 Charter St., Redwood City, Calif.—XK, XM
Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.—XK, XL, XN
Ansco Div., General Aniline & Film Corp., Binghamton, N. Y.—XD
Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.—XB, XC, XD, XE, XI, XJ, XK
Audio-Master Corp., 341 Madison Ave., New York 17, N. Y.—XK
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—XB, XC, XF, XI, XJ, XK, XL, XM, XN
Avery Adhesive Label Corp., 1616 S. Calif. Ave., Monrovia, Calif.—XF
Bell & Howell Co., 7100 McCormick Rd., Chicago 45, Ill.—XE
Berndt-Bach, Inc., Auricon Div., 7325 Beverly Blvd., Los Angeles 36, Calif.—XD
Brush Development Co., The, 3405 Perkins Ave., Cleveland 14, Ohio—XK, XO
Camera Equipment Co., 1600 Broadway, New York 19, N. Y.—XK, XL, XM, XN
Camera Mart, Inc., The, 1845 Broadway, New York 23, N. Y.—XD, XE, XG, XK, XL, XM, XN
Chase Brass & Copper Co., 236 Grand St., Waterbury 20, Conn.—XO
Chester Cable Corp., Chester, N. Y.—XO
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.—XL
Cinematic Devel. & Cine. Lab., 2125 32nd Ave., San Francisco 16, Calif.—XD, XG
Colonial Films, 2118 Mass. Ave., N. W., Washington 8, D. C.—XD
Compco Corp., 2251 W. St. Paul Ave., Chicago 47, Ill. XG, XM
Cornish Wire Co., 50 Church, New York, N. Y.—XO
Cummins Business Machines Corp., 4740 Ravenswood Ave., Chicago 40, Ill.—XF

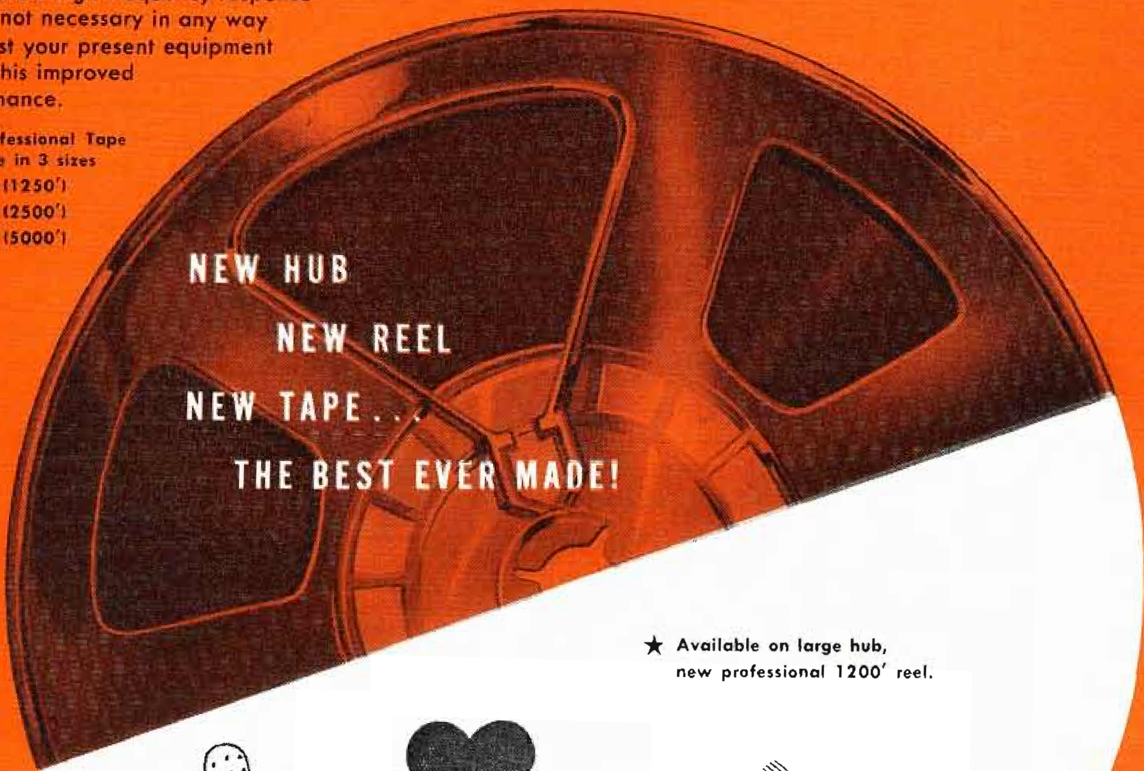
NEW! SOUNDCRAFT professional magnetic recording tape

Professional Quality . . . for Professional Performance

New Soundcraft Professional Tape was created especially for professional use. It is tape of professional quality, for professional performance. It is produced by an entirely new formula that results in:

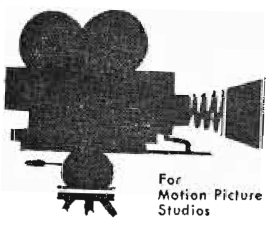
- Greatly reduced distortion at the same output, or . . . higher output at conventional accepted distortion
- Improved high frequency response
- It is not necessary in any way to adjust your present equipment to get this improved performance.

New Professional Tape Available in 3 sizes
SPN-12P (1250')
SPN-25P (2500')
SPN-50P (5000')

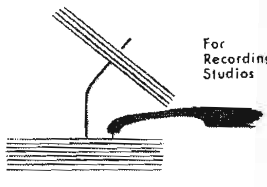


★ Available on large hub, new professional 1200' reel.

For Broadcast Stations



For Motion Picture Studios



For Recording Studios

Exclusive! New Soundcraft Professional Tape is *Micro-Polished!***

In addition to our own special buffing process, Soundcraft Professional Tape is *Micro-Polished*. This exclusive Soundcraft feature produces a new high in performance perfection:

1. Practical elimination of drop-outs
2. Superior high frequency response
3. Improved uniformity
4. Better head contact

*PATENT APPLIED FOR.

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10 East 52nd Street, N. Y. 22, N. Y.

Makers of Magnetic Recording Tape, Magna-Stripe

THE ONLY RECORDING MATERIALS PERFECTED AND MANUFACTURED BY RECORDING SPECIALISTS

Please write for complete information.

Daystrom Electric Corp., 837 Main St., Poughkeepsie, N. Y.—XD
Diamond Phonograph Needle Div., 172 Green St., Boston 30, Mass.—XB, XJ
Diamond Wire & Cable Co., 380 Harvester St., Syracuse, Ill.—XO
Driver-Harris Co., 201 Middlesex St., Harrison, N. J.—XO
DuPont de Nemours & Co., E. I., 10th & Market Sts., Wilmington 98, Del.—XD
Duotone Co., Locust St., Keyport, N. J.—XB, XC, XI, XJ, XK, XM
Eastman Kodak, 343 State, Rochester 4, N. Y.—XD
Edin Co., 207 Main St., Worcester 8, Mass.—XH
Electronic Development Lab., 43-07 23 Ave., Long Island City 5, N. Y.—XB, XC, XK, XL, XM
Electrovox Co., 60 Franklin St., E. Orange, N. J.—XA, XB, XJ
Essex Wire, 1601 Wall St., Ft. Wayne, Ind.—XO
Federal Sapphire Products Co., P. O. Box 245, Fairlawn, N. J.—XB, XI, XJ
Fideltone, Inc., 1616 Devon Ave., Chicago 26, Ill.—XK, XO
Film Research Associates, 150 E. 52nd St., New York 22, N. Y.—XG
Gatti, Inc., Aurele M., 524 E. Washington St., Trenton 9, N. J.—XJ
General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.—XK, XM, XO
General Insulated Wire Works, Inc., 69 Gordon Ave., Providence 5, R. I.—XO
Hart, Arthur H., 2125 32 Ave., San Francisco 16, Calif.—XD, XG
Heller & Associates, Herman S., 8414 W. 3 St., Los Angeles 48, Calif.—XE, XI, XJ, XK, XL, XN
Holub Industries, Inc., 413 DeKalb Ave., Sycamore, Ill.—XF
Imperial Radar & Wire Corp., 4342 Bronx Blvd., Bronx 66, N. Y.—XO
Industrial Cinema Service, 4119 W. North Ave., Chicago 39, Ill.—XC, XK, XO
Ind. Steel Products Co., Valparaiso, Ind.—XK
Int'l. Movie Producers', 515 Madison Ave., New York 22, N. Y.—XD, XK
Jensen Industries, Inc., 329 S. Wood St., Chicago 12, Ill.—XB, XI, XJ, XK, XM, XN
Kinevox Inc., 116 S. Hollywood Way, Burbank, Calif.—XL, XN
Kin-O-Lux, 105 W. 40th, New York 18, N. Y.—XD
Knickerbocker Annunciator Co., 75 Murray St., New York 7, N. Y.—XO
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—XO
Lenz Electric Mfg. Co., 1751 Western Ave., Chicago 47, Ill.—XO
Libra Film & Equipment, 6525 Sunset Blvd., Hollywood 28, Calif.—XD, XG
Lipps, Edwin A., 5485 W. Washington Blvd., Los Angeles 16, Calif.—XB, XI, XJ
Magnasync Mfg., 5717 Cartwright Ave., N. Hollywood, Calif.—XN
Magnecessories, Box 6960, Washington, D. C.—XN
Mallory & Co., P. R., 3029 E. Washington St., Indianapolis 6, Ind.—XA
Merix Chemical Co., 1021 E. 55th St., Chicago 15, Ill. XA
Micro Circuits Co., New Buffalo, Mich.—XA
Miller Mfg. Co., M. A., 1169 E. 43 St., Chicago 15, Ill.—XB, XI, XJ
Minn. Electronics Corp., 47 W. Water St., St. Paul, Minn.—XL
Minn. Mining & Mfg. Co., 900 Fauquier Ave., St. Paul 6, Minn.—XD, XK, XM
Modern Wire Co., 39-30 Review Ave., Long Island City 32, N. Y.—XO
Mystik Adhesive Products, 2635 N. Kildare Ave., Chicago 39, Ill.—XF
National Electric Products Corp., Chamber of Commerce Bldg., Pittsburgh, Pa.—XO
Neumade Products Corp., 330 W. 42nd St., New York 36, N. Y.—XG
North American Philips Co., 100 E. 42nd St., New York 17, N. Y.—XB, XK
ORRadio Industries, Inc., T-120 Marvyn Rd., Opelika, Ala.—XC, XK, XN
Pacific Transducer Corp., 11921 S. West Pico Blvd., Los Angeles 64, Calif.—XI, XJ
Peerless Film Processing, 165 W. 46 St., New York 36, N. Y.—XG
Permo, Inc., 6415 Ravenswood Ave., Chicago 26, Ill.—XA, XB, XI, XJ, XK, XM, XO
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.—XK
Pfanstiehl Chemical Co., 104 Lake View Ave., Waukegan, Ill.—XI, XJ
Phalo Plastics Corp., 25 Foster St., Worcester 4, Mass.—XO
Phonograph Needle Mfg. Co., 42 Dudley St., Providence 5, R. I.—XJ
Plastoid Corp., Hamburg, N. J.—XO
Presto Recording Corp., Box 500, Paramus, N. J.—XB, XC, XJ
Presteseal Mfg. Corp., 3801 Queens Blvd., Long Island City 1, N. Y.—XN
Radio-Music Corp., 84 S. Water St., Port Chester, N. Y.—XJ
Rainbo Record Mfg. Corp., 4335 W. 147 St., Lawndale, Calif.—XC
RecorDisc Corp., 395 Broadway, New York 13, N. Y.—XB, XC, XJ, XK, XO
Recoton Corp., 147 W. 22 St., New York 11, N. Y.—XB, XC, XI, XJ, XK
Reeves Soundcraft Corp., 10 E. 52 St., New York 22, N. Y.—XB, XC, XE, XI, XJ, XK, XM, XN
Rex Corp., 51 Lansdowne St., Cambridge, Mass.—XO
Sequoia Process Corp., 894 Douglas Ave., Redwood City, Calif.—XO
Shura-tone Products, Inc., 440 Adelphi St., Brooklyn 17, N. Y.—XI, XJ
Sonic Recording Products, Inc., 58 Mill Rd., Freeport, L. I., N. Y.—XC
S.O.S. Cinema Supply, 602 W. 52 St., New York 19, N. Y.—XG, XK, XL, XM, XN
Sound Devices, Inc., 129 E. 124 St., New York 35, N. Y.—XC, XK
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—XF, XO
SoundScriber Corp., The, 146 Munson St., New Haven 4, Conn.—XC, XK, XL
Sprague Electric Co., 233 Marshall St., North Adams, Mass.—XO
Srepco Inc., 135 E. 2nd St., Dayton 2, Ohio—XF
Strandberg Recording Co., 705 Woodland Dr., Greensboro, N. Car.—XF
Taffet Radio & TV Co., 2530 Belmont Ave., New York 58, N. Y.—XA
Tape Recording Apparatus Co., Box 221, Caldwell, N. J.—XJ
Tape Recording Industries, 3335 E. Michigan Ave., Lansing, Mich.—XK, XM, XN
Tayloreel Corp., 2 Commercial St., Rochester 14, N. Y.—XG
Tensolite Insulated Wire, Tarrytown, N. Y.—XO
Tetrad Corp., The, 62 St. Mary St., Yonkers 2, N. Y.—XI, XJ
Thor Ceramics, Inc., 225 Belleville Ave., Bloomfield, N. J.—XF
U. S. Recording Co., 1121 Vermont Ave., N. W., Washington 5, D. C.—XB, XC, XI, XJ, XK, XM, XN
U. S. Rubber Co., 1230 Ave. of the Americas, New York, N. Y.—XO
Universal Reels, 9-16 37th Ave., Long Island City, N. Y.—XG
Vallorbs Jewel Co., Box 958, Lancaster, Pa.—XJ
Webster-Chicago Corp., 5610 W. Bloomingdale Ave., Chicago 34, Ill.—XK, XO
Wenzel Projector Co., 2511 S. State St., Chicago 16, Ill.—XC, XF, XG
Western Insulated Wire Co., 2425 E. 30th St., Los Angeles 35, Calif.—XO
Westline Products, 600 E. 2nd St., Los Angeles 54, Calif.—XK
Wildberg Bros., 724 Market St., San Francisco 2, Calif.—XC, XO
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia 7, Pa.—XD, XE, XG, XK, XM, XN
Zephyr Products Co., 129 E. 124 St., New York 35, N. Y.—XC, XI, XJ, XK

24—Servo & Telemetering

Servo devices . . . . YA
Telemetering equipment . . . . YB

Aero Electronics Co., 1512 N. Wells St., Chicago 10, Ill.—YA, YB
Airplane & Marine Instruments, Clearfield, Pa.—YA
Akeley Camera & Instrument Corp., 175 Varick St., New York 14, N. Y.—YA, XB
American Machine & Foundry Co., 625 Eighth Ave., New York 18, N. Y.—YA, YB
Ampex Electric Corp., 934 Charter St., Redwood City, Calif.—YB
Ansley Electronics, Inc., 85 Tremont St., Meriden, Conn.—YA, YB
Antenna Research Laboratory, Inc., 797 Thomas Lane, Columbus 14, Ohio—YB
Applied Science Corp. of Princeton, Box 44, Princeton, N. J.—YB
Atlantic Electronics Corp., 4 Manhasset Ave., Port Washington, N. Y.—YA
Audio Instrument Co., 133 W. 14 St., New York 11, N. Y.—YA, YB
Audio Products Corp., 2265 Westwood Blvd., Los Angeles 64, Calif.—YB
Audio-Tone Oscillator Co., 237 John St., Bridgeport 3, Conn.—YA, YB
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—YB
Automatic Temperature Control Co., Inc., 5212 Pulaski Ave., Philadelphia 44, Pa.—YA, YB
Bardwell & McAlister, 2950 N. Ontario St., Burbank, Calif.—YA, YB
Beckman Instruments, Inc., 820 Mission St., S. Pasadena, Calif.—YA
Bendix Aviation Corp., Pac. Div., 11600 Sherman Way, N. Hollywood, Calif.—YB
Berkeley Scientific Corp., Div. of Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.—YB
Bogue Railway Equipment Div., Bogue Electric Mfg. Co., 52 Iowa Ave., Paterson 5, N. J.—YA
Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif.—YB
Bowmar Instrument Corp., Smith Municipal Airport, Fort Wayne, Ind.—YA
Brush Development Co., The, 3405 Perkins Ave., Cleveland 14, Ohio—YB
Bunnel & Co., 81 Prospect St., Bklyn, N. Y.—YA, YB
Burnell & Co., 45 Warburton, Yonkers 2, N. Y.—YB
Cardwell Mfg. Co., Allen D., Plainville, Conn.—YA
Clarke Instruments, 919 Jesup-Blair Dr., Silver Spring, Md.—YB
Cook Electric, 2700 Southport, Chicago, Ill.—YA
Daco Machine, 202 Tillary, Bklyn 1, N. Y.—YA
Taffet Radio & TV Co., 2530 Belmont Ave., New York 58, N. Y.—YA
Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.—YA
Electrodyne Co., 32 Oliver St., Boston 10, Mass.—YA, YB
Electro Mechanical Research, Inc., 64 Main St., Ridgefield, Conn.—YB
Engineering Research Associates, Inc., 1902 W. Minnehaha Ave., St. Paul W4, Minn.—YA
Engineering Research & Development Co., Box 166, Hinsdale, Ill.—YA, YB
Esterline-Angus Co., Box 596, Indianapolis, Ind.—YB
Fairchild Recording Equipment Corp., 154th St. & 7th Ave., Whitestone 57, N. Y.—YB
Flader, Inc., Frederic, 583 Division St., N. Tonawanda, N. Y.—YA, YB
Ford Instrument Co., 31-10 Thomson St., Long Island City 1, N. Y.—YA, YB
Gamewell Co., The, 1238 Chestnut St., Newton Upper Falls 64, Mass.—YA
General Precision Lab., Inc., 63 Bedford Rd., Pleasantville, N. Y.—YA
Giannini & Co., Inc., G. M., 332 Springfield Ave., Summit, N. J.—YA, YB
Haledy Electronics Co., 57 William St., New York 5, N. Y.—YB
Hammarlund Mfg. Co., 460 W. 34, New York, N. Y.—YB
Hartman Engineering Co., 117 Oakland St., Springfield, Mass.—YB
Harvey-Wells Electronics, Inc., North St., Southbridge, Mass.—YB
Hillyer Instrument Co., 54 Lafayette St., New York 13, N. Y.—YA
Hycor Co., 11423 Vanowen, N. Hollywood, Calif.—YB
Industrial Control Co., Straight Path & Arlington Ave., Wyandanch, L. I., N. Y.—YA
Industrial Elect. Engrs., 3973 Lankershim, N. Hollywood, Calif.—YA, YB
International Research Associates, Div. of Iresco Inc., 2221 Warwick Ave., Santa Monica, Calif.—YB
International Telemeter Corp., 200 Stoner Ave., Los Angeles 25, Calif.—YB
Ionic Electronic Equipment Co., 1705 N. Kenmore, Los Angeles 27, Calif.—YB
Kalbfell Laboratories, Inc., P. O. Box 1578, San Diego 10, Calif.—YA
Ketay Mfg. Corp., 555 B'way, New York, N. Y.—YA
Kinetix Instrument Co., 902 Broadway, New York 10, N. Y.—YA, YB
Leupold & Stevens Instruments, 4445 N. E. Gilsan St., Portland 13, Ore.—YA, YB
Librascope, Inc., 1607 Flower, Glendale, Calif.—YA
Loral Electronics Corp., 794 E. 140 St., New York 54, N. Y.—YA
Low-Bar Products, 938 Pico, Santa Monica, Calif.—YA
Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.—YA
Magnetic Devices Corp., 103 S. Van Brunt St., Englewood, N. J.—YA
Mark Products Co., 3547-49 Montrose Ave., Chicago 18, Ill.—YA
Melpar, Inc., 452 Swann, Alexandria, Va.—YA, YB
Midwestern Geophysical Lab., 3401 S. Harvard Ave., Tulsa, Okla.—YA
Moseley, Francis L., 1136 N. Las Palmas, Los Angeles 38, Calif.—YA
Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.—YB
Pacific Mercury Television Mfg. Corp., 5955 Van Nuys Blvd., Van Nuys, Calif.—YB
Parsons Co., The Ralph M., 689 S. Fair Oaks Ave., Pasadena 2, Calif.—YB
Pedersen Electronics, Box 572, Lafayette, Calif.—YA
Radio Corp. of America, RCA-Victor Div., Camden, N. J.—YB
Radio Laboratories, Inc., 1846 Westlake North, Seattle 9, Wash.—YB
Rahm Instruments, Inc., 12 W. Broadway, New York 7, N. Y.—YB
Reeves Instrument, 215 E. 91 St., New York 28, N. Y.—YA
Resdel Engineering Corp., 2351 Riverside Dr., Los Angeles 39, Calif.—YA, YB
Robinette Co., W. C., 802 Fair Oaks Ave., S. Pasadena, Calif.—YA
Rosen Engineering Products, Inc., Raymond, 32 & Walnut Sts., Philadelphia 4, Pa.—YB
Rowe Industries, 1702 Wayne, Toledo 9, Ohio—YA, YB
Seaboard Electric Co., 417 Canal St., New York 13, N. Y.—YA
Servo Corp. of America, 2020 Jericho Turnpike, New Hyde Park, N. Y.—YA, YB
Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y.—YA, YB
Servo-Tek Products Co., 4 Godwin Ave., Paterson 1, N. J.—YA, YB
Skiatron Electronics & Television Corp., 30 E. 10th St., New York 3, N. Y.—YA, YB
Slate & Associates, Claude C., 11370 W. Olympic Blvd., Los Angeles 64, Calif.—TA
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.—YA
Square Root Mfg. Co., 391 Saw Mill River Rd., Yonkers 2, N. Y.—YA, YB
Standard Electronic Research Corp., 2 East End Ave., New York 21, N. Y.—YA
Streeter-Amet Co., 4101 Ravenswood Ave., Chicago 13, Ill.—YB
Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.—YB
Telemetering Associates, Box 6, Silver Spring, Md.—YB
Transicoil Corp., 107 Grand St., New York N. Y.—YA
Transmitter Equipment Mfg. Co., 345 Hudson St., New York 14, N. Y.—YA, YB
Trans-Sonics, Inc., Bedford, Mass.—YA, YB
Vectron, Inc., 235 High St., Waltham, Mass.—YA
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.—YB

TEST EQUIPMENT SALES*

Jan.—Sept. 1952

	Units	Mfr. Billing
Signal generators and test oscillators	8,684	$1,952,888.79
VTVM and combination meters	36,929	$1,480,019.61
Cathode-ray oscillographs	9,414	$2,791,682.18
Tube testers	9,408	$ 813,912.39
Impedance measuring equipment	1,111	$ 523,400.00
Electronic power supplies	901	$ 91,476.00
Miscellaneous	11,390	$3,311,016.61
TOTAL	77,837	$10,964,395.58

* Information supplied

25—Connectors & Cable

Cable accessories .... **ZA**
Cable connectors .... **ZB**
Cable markers .... **ZC**
Coaxial cable .... **ZD**
Coaxial switches .... **ZE**
Jack panels .... **ZF**
Jacks, telephone & microphone ... **ZG**
Junction boxes .... **ZH**
Microphone connectors .... **ZI**
Patch cords .... **ZJ**
Plugs .... **ZK**
Power connectors .... **ZL**
Reels, cable .... **ZM**
Shielded cable .... **ZN**
Terminals .... **ZO**

Advance Insulated Wire & Cable Co., 72 Woolsey St., Irvington 11, N. J.—ZD, ZN
Aeronautical Radio Mfg. Co., 155 First St., Mineola, N. Y.—ZK
Aircraft-Marine Products Inc., 2100 Paxton St., Harrisburg, Pa.—ZA, ZJ
Airplane & Marine Instruments, Clearfield, Pa.—ZI
Alden Products Co., 123 N. Main St., Brockton 64, Mass.—ZB
Alpha Wire Corp., 430 Broadway, New York 13, N. Y.—ZD, ZM, ZN
American Electric Cable Co., 181 Appleton St., Holyoke, Mass.—ZN
American Phenolic Corp., 1830 S. 54 Ave., Chicago 50, Ill.—ZA, ZB, ZD, ZI, ZK, ZL, ZN
American Radio Hardware Co., 152 Mac Questen Pky. So., Mt. Vernon, N. Y.—ZA, ZB, ZC, ZG, ZJ, ZK
Anaconda Wire & Cable Co., 25 Broadway, New York 4, N. Y.—ZA, ZB, ZD, ZN
Andrew Corp., 363 E. 75 St., Chicago 20, Ill.—ZD, ZF, ZJ
Ansonia Electrical Co., The, 63 Main St., Ansonia, Conn.—ZD, ZN
Assoc. Eng'g. Corp. of Boston, 38 Euston Rd., Brighton 35, Mass.—ZJ, ZK
Audio Development Co., 2833 13 Ave. S., Minneapolis 7, Minn.—ZF, ZG, ZJ, ZK
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—ZF, ZG, ZI, ZJ, ZK, ZL
Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill.—ZG, ZK
Bardwell & McAllister, 2950 N. Ontario St., Burbank, Calif.—ZA
Beam Instruments Corp., 350 Fifth Ave., New York 1, N. Y.—ZD, ZM, ZN
Belden Mfg. Co., 4647 W. VanBuren St., Chicago 44, Ill.—ZD, ZN
Bendix Aviation Corp., Scintilla Magneto Div., Sidney, N. Y.—ZB
Bird Electronic Corp., 1800 E. 38th St., Cleveland 14, Ohio—ZD
Birnbach Radio Co., 145 Hudson, New York, N. Y.—ZN
Brady Co., W. H., 1678 E. Spring St., Milwaukee 3, Wisc.—ZC
Brand & Co., William, The, North & Valley Sts., Willimantic, Conn.—ZC, ZD, ZN
Breeze Corporations, Inc., 41 S. Sixth St., Newark 7, N. J.—ZB
Brookhaven Electronics, Box 931, Sanford, N. C.—ZB
Bud Radio, Inc., 2118 E. 55th, Cleveland, Ohio—ZH
Buggie & Co., H. H., 726 Stanton St., Toledo 1, Ohio—ZA, ZB, ZF, ZJ, ZK
Camburn, Inc., 32-40 57 St., Woodside, N. Y.—ZA, ZB
Camera Equipment Co., 1600 Broadway, New York 19, N. Y.—ZA, ZB, ZK, ZL
Camfield Mfg. Co., Seventh St., Grand Haven, Mich.—ZB, ZE, ZH, ZL
Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.—ZB, ZG, ZI, ZK, ZL
Capitol Stage Lighting Co., 527-529 W. 45 St., New York 36, N. Y.—ZA, ZB, ZK
Carter Parts Co., 213 Institute Place, Chicago 10, Ill.—ZG, ZK
Chase Brass & Copper, 236 Grand St., Waterbury 20, Conn.—ZD, ZN
Chester Cable Corp., Chester, N. Y.—ZD, ZM, ZN
Cinch Mfg. Corp., 1026 S. Homan Ave., Chicago 24, Ill.—ZB
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.—ZF, ZG, ZJ
Circle Mfg. Co., Box 152, Little Falls, N. J.—ZB
Coleman Cable & Wire Corp., 4515 W. Addison St., Chicago 41, Ill.—ZD, ZH
Columbia Technical Corp., 5 E. 57 St., New York 22, N. Y.—ZD
Columbia Wire & Supply Co., 2850 Irving Park Rd., Chicago 18, Ill.—ZD, ZL, ZM, ZN
Communication Products Co., Marlboro, N. J.—ZD
Conn. Telephone & Electric, 70 Britannia St., Meriden, Conn.—ZC, ZF, ZG, ZH, ZJ, ZK
Co-Operative Industries, Inc., 100 Oakdale Rd., Chester, N. J.—ZJ, ZN
Commercial Plastics Co., Merchandise Mart, Chicago 54, Ill.—ZA
Crouse-Hinds Co., Wolf & 7 North Sts., Syracuse 1, N. Y.—ZH, ZK, ZL
Curtis Development & Mfg. Co., 3266 N. 33 St., Milwaukee 16, Wisc.—ZO
Dage Electronics Corp., 69 N. Second St., Beech Grove, Ind.—ZB
DeJur-Amsco Corp., 45-01 Northern Blvd., at 45th St., Long Island City 1, N. Y.—ZB, ZK, ZL
Dial Light Co. of America Inc., 900 Broadway, New York 3, N. Y.—ZI, ZN
Diamond Mfg., 7 North Ave., Wakefield, Mass.—ZB
Diamond Wire & Cable Co., 380 Harvester St., Sycamore, Ill.—ZN
Dielectric Materials Co., 5315-17 N. Ravenswood Ave., Chicago 40, Ill.—ZD, ZN
Dittmore & Freimuth Co., 251 7E. Norwich St., Cudahy, Wisc.—ZA, ZB, ZC, ZE, ZF, ZG, ZH, ZI, ZK, ZL
Eagle Electric Mfg. Co., 23-10 Bridge Plaza S., Long Island City 1, N. Y.—ZA, ZB, ZC, ZH, ZJ, ZK, ZL, ZM, ZN
Eby, Inc., Hugh H., 4700 Stenton Ave., Philadelphia 44, Pa.—ZK
Elco Corp., 190 W. Glenwood Ave., Philadelphia 40, Pa.—ZB, ZK, ZL
Electrical Industries, Inc., 44 Summer Ave., Newark 4, N. J.—ZO
Electronic Development Lab., 43-07 23 Ave., Long Island City 5, N. Y.—ZF, ZJ, ZK
Electro Precision Products, Inc., 119-01 22 Ave., College Point, N. Y.—ZA, ZB, ZG, ZH, ZJ, ZK, ZL
Equipment & Service Co., 6815 Oriole Dr., Dallas 9, Tex.—ZA, ZB, ZF, ZG, ZH, ZI, ZJ, ZK, ZL
Everlast Wire & Cable Co., 12 Maple Ave., Haverstraw, N. Y.—ZD, ZN
Gates Radio Co., 123 Hampshire St., Quincy 1, Ill.—ZA, ZD, ZE, ZF, ZG, ZJ, ZK, ZN
General Cable Corp., 420 Lexington Ave., New York 17, N. Y.—ZD
General Ceramics & Steatite, Keasby, N. J.—ZO
General Communication Co., 681 Beacon St., Boston 15, Mass.—ZE
General Insulated Wire Works, Inc., 69 Gordon Ave., Providence 5, R. I.—ZD, ZN
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.—ZB, ZD, ZJ, ZK
General RF Fittings Co., 702 Beacon St., Boston 15, Mass.—ZB, ZF, ZK
Globe Electrical & Mfg., 11019 Buford Ave., Inglewood, Calif.—ZO
Hallett Mfg. Co., 1601 W. Florence Ave., Inglewood, Calif.—ZA, ZB, ZK, ZN
Hall Inc., F. Sumner, 153 W. 33 St., New York 1, N. Y.—ZF, ZG, ZJ, ZK
Hermetic Seal Products, 33 S. 6 St., Newark 7, N. J.—ZO
Holub Industries, 413 DeKalb Ave., Sycamore, Ill.—ZA, ZB
Industrial Electrical Works, 1509 Chicago St., Omaha 2, Nebr.—ZM
Industrial Power & Equipment Co., 225 Broadmoor Ave., Pittsburgh 34, Pa.—ZL
Industrial Products Co., Danbury, Conn.—ZA, ZB, ZD, ZE
Javex, Garland, Tex.—ZK
Johnson Co., E. F., Waseca, Minn.—ZG
Jones Div., Howard B., Cinch Mfg. Corp., 1026 S. Homan Ave., Chicago 24, Ill.—ZB, ZG, ZK, ZL, ZO
Joy Mfg. Co., Electrical Connector Div., 4235 Clayton Ave., St. Louis 10, Mo.—ZB
Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago 38, Ill—ZF, ZG, ZH, ZJ, ZK
Key Electronics Corp., 20 W. 22 St., New York 10, N. Y.—ZF, ZH
Keystone Electronics Corp., 423 Broome St., New York 13, N. Y.—ZF
Kinevox Inc., 116 S. Hollywood Way, Burbank, Calif.—ZB, ZI, ZJ, ZK, ZL
Kings Electronics Inc., 50 Marbledale Ave., Tuckahoe, N. Y.—ZB
Knickerbocker Annunciator Co., 75 Murray St., New York 7, N. Y.—ZH
Kolton Electric Mfg. Co., 123 N. J. Railroad Ave., Newark 5, N. J.—ZB, ZH
Kulka Electric Mfg. Co., Inc., 633 S. Fulton Ave., Mount Vernon, N. Y.—ZH
Lenz Electric Mfg. Co., 1751 Western Ave., Chicago 47, Ill.—ZN
Leonard Electric Products Co., 67 34 St., B'klyn, N. Y.—ZH
Magna Electronics Co., Inglewood, Calif.—ZA, ZB
Mallory & Co., P. R., 3029 E. Washington St., Indianapolis 6, Ind.—ZG, ZK
Mark Products Co., 3547-49 Montrose Ave., Chicago 18, Ill.—ZD, ZE
Mendelsohn Speedgun, 457 Bloomfield Ave., Bloomfield, N. J.—ZB
Millen Mfg. Co., James, 150 Exchange St., Malden 48, Mass.—ZK, ZL
Neptune Electronics Co., 433 Broadway, New York 13, N. Y.—ZA, ZB, ZF, ZH, ZI, ZK, ZL
New London Instrument Co., P. O. Box 189, New London, Conn.—ZA
North Electric Mfg. Co., 501 S. Market St., Galion, Ohio—ZF, ZG
O'Brien Electric Co., 6514 Santa Monica Blvd., Hollywood 38, Calif.—ZF, ZJ, ZK
Okonite Co., The, Passaic, N. J.—ZD, ZN
Orthon Corp., 196 Albion Ave., Paterson, N. J.—ZH
Pacific Electricord Co., 3217 Exposition Pl., Los Angeles 18, Calif.—ZA, ZB, ZG, ZK
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.—ZI, ZK
Pfleger Products, 3901 W. 54, Los Angeles, Calif.—ZO
Phalo Plastics Corp., 25 Foster St., Worcester 4, Mass.—ZD, ZN
Phelps Dodge Copper Products, 40 Wall St., New York 5, N. Y.—ZD
Philmore Mfg. Co., 113 University Pl., New York 3, N. Y.—ZG, ZI, ZN
Plastic Wire & Cable Corp., E. Main St., Jewett City, Conn.—ZD, ZN
Plasloid Corp., Hamburg, N. J.—ZD, ZN
Precision Tube Co., Church Rd. & Wissahickon, N. Wales, Pa.—ZD
Product Development Co., 307 Bergen Ave., Kearny, N. J.—ZD
Radio Corp. of America, RCA-Victor Div., Camden, N. J.—ZA, ZB, ZD, ZE, ZF, ZG, ZH, ZI, ZJ, ZK, ZL, ZM, ZN
Radio Essentials, Inc., 152 Mac Questen Pkwy. S., Mount Vernon, N.Y.—ZA, ZB, ZC, ZF, ZG, ZI, ZJ, ZK
Red Arrow Electronics, Inc., 420 Alden St., Orange, N. J.—ZA, ZB, ZG, ZH
Remler Co., 2102 Bryant St., San Francisco 10, Calif.—ZB, ZG, ZI, ZK, ZL
Roanwell Corp., 662 Pacific St., Brooklyn 17, N. Y.—ZK
Rockbestos Products Corp., 285 Nicoll St., New Haven 4, Conn.—ZD, ZN
Rome Cable Corp., Ridge St., Rome, N. Y.—ZD, ZN
Rowe Industries, 1702 Wayne St., Toledo 9, Ohio—ZA, ZD
Runzel Cord & Wire Co., 4723-31 W. Montrose Ave., Chicago 41, Ill.—ZJ, ZK, ZN
Schatter Mfg. Co., Carl W., 80 E. Montauk Highway, Lindenhurst, L. I., N. Y.—ZB, ZD, ZE
Shaw Insulator, 160 Coit St., Irvington, N. J.—ZO
Sherman Mfg. Co., 22 Barney St., Battle Creek, Mich.—ZB
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—ZA, ZB, ZD, ZF, ZG, ZH, ZI, ZJ, ZK, ZN
Star Expansion Products Co., 147 Cedar St., New York 6, N. Y.—ZK
Stromberg-Carlson Co., 1225 Clifford Ave., Rochester, N. Y.—ZG, ZH, ZI
Switchcraft, Inc., 1328-30 N. Halsted St., Chicago 22, Ill.—ZG, ZI, ZK
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—ZA, ZF, ZG, ZH, ZI, ZJ, ZM
Teletronic Laboratories, Inc., 1835 W. Rosecrans Ave., Gardena, Calif.—ZC
Tensolite Insulated Wire Co., Tarrytown, N. Y.—ZD, ZN
Thompson Products, Inc., 2196 Clarkwood Rd., Cleveland 3, Ohio—ZE
Topflight Tape Co., 52 S. Duke St., York, Pa.—ZC
Transco Products, 12210 Nebr. Ave., Los Angeles 25, Calif.—ZE
Trimm, Inc., 400 W. Lake St., Libertyville, Ill.—ZF, ZG, ZJ, ZK
T-V Products Co., 152 Sanford St., Brooklyn 5, N. Y.—ZA, ZE, ZG, ZH, ZJ
U. S. Rubber Co., 1230 Ave. of the Americas, New York 20, N. Y.—ZD, ZK, ZN
U. S. Wire & Cable Co., 27 Haynes Ave., Newark, N. J.—ZD
Universal Microphone Co., 424 Warren Lane, Inglewood 3, Calif.—ZK
Univox Corp., 83 Murray St., New York 7, N. Y.—ZD, ZH
Vector Electronic Co., 3352 San Fernando Rd., Los Angeles 65, Calif.—ZK
Wadsworth Mfg. Associates, 509 Balsam St., Liverpool, N. Y.—ZF
Ward Products Corp., Div. of The Gabriel Co., 1523 E. 45 St., Cleveland 3, Ohio—ZB
Weckesser Co., 5261 N. Avondale Ave., Chicago 30, Ill.—ZA
Western Insulated Wire Co., 2425 E. 39 St., Los Angeles, Calif.—ZH
Whitney Blake Co., 1565 Dixwell Ave., Hamden 14, Conn.—ZD, ZJ, ZN

26—Audio Equip.-General

Bass units .... **AAA**
Earphones .... **AAB**
HiFi loudspeaker .... **AAC**
Loudspeakers .... **AAD**
Shielding .... **AAE**
Sound treatment .... **AAF**
Special baffles & forms .... **AAG**
Tweeters .... **AAH**

Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—AAA, AAB, AAC, AAD, AAG, AAH
Atlas Sound Corp., 1449 39 St., Brooklyn 18, N. Y.—AAC, AAD, AAG, AAH
Aud'craft Inc., 77 S. 5th St., B'klyn., N. Y.—AAD
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—AAA, AAB, AAC, AAD, AAH
Beam Instruments Corp., 350 Fifth Ave., New York 1, N. Y.—AAA, AAC, AAD
Bendix Radio Div., Bendix Aviation Corp., Baltimore 4, Md.—AAB
Best Mfg. Co., 1200 Grove St., Irvington 11, N. J.—AAB, AAD
Bogen Co., D., 29 9th Ave., New York 14, N.Y.—AAG
Bozak Co., R. T., 90 Montrose Ave., Buffalo 14, N. Y.—AAC, AAH
Brociner Electronics Laboratory, 1546 Second Ave., New York 28, N. Y.—AAA, AAC, AAD, AAG
Brush Development Co., The, 3405 Perkins Ave., Cleveland 14, Ohio—AAB
Cannon Co., C. F., Springwater, N. Y.—AAB
Carbonneau Industries, 21 Ionia N. W., Grand Rapids 2, Mich.—AAC, AAD
Celotex Co., 120 S. LaSalle St., Chicago, Ill.—AAF
Cleveland Electronics, Inc., 6611 Euclid Ave., Cleveland 3, Ohio—AAC, AAD, AAH
Conn. Telephone & Electric, 70 Britannia St., Meriden, Conn.—AAB
Co-Operative Industries, Inc., 100 Oakdale Road, Chester, N. J.—AAE
C-S Mfg. Co., 4089 Lincoln Blvd., Venice, Calif.—AAD
Delco Radio Div., General Motors Corp., Kokomo, Ind.—AAD
Dukane Corp., 110 N. 11, St. Charles, Ill.—AAD
D X Radio Products Co., 2300 W. Armitage Ave., Chicago 47, Ill.—AAD
Dyna-Labs Inc., 1075 Stewart Ave., Garden City, L.I., N. Y.—AAB
Electronic Development Laboratory, 43-07 23 Ave., Long Island City 5, N. Y.—AAA, AAC, AAD, AAG, AAH
Electro-Voice, Inc., Cecil & Carroll Sts., Buchanan, Mich.—AAA, AAB, AAC, AAD, AAG, AAH
General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.—AAC, AAD
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J.—AAB, AAH
Hallett Mfg. Co., 1601 W. Florence Ave., Inglewood, Calif.—AAE
Heppner Mfg. Co., Round Lake, Ill.—AAD
Holl Audio Industries, 5014 N. Encinita Ave., Temple City, Calif.—AAD
Jensen Mfg. Co., 6601 S. Laramie Ave., Chicago 38, Ill.—AAC, AAD, AAH
Johns-Manville Corp., Acoustical Dept., 20 E. 40 St., New York, N. Y.—AAF
Kimberley-Clark Corp., Insulation Div., Neenan, Wisc.—AAF
Klipsch & Associates, Hope, Ark.—AAC
Kupfrain Mfg. Co., Box 714, Binghamton, N. Y.
Lansing Sound, Inc., James B., 2439 Fletcher Dr., Los Angeles 39, Calif.—AAA, AAC, AAD, AAG, AAH
Lowell Mfg. Co., 1531 Branch St., St. Louis 7, Mo.—AAD, AAG
Magna Electronics Co., Inglewood, Calif.—AAG
Magnavox Co., Bueter Rd., Ft. Wayne 4, Ind.—AAD
Millen Mfg. Co., James, 150 Exchange St., Maiden 48, Mass.—AAE
Multi-Metal Co., 1352 Garrison Ave., New York 59, N. Y.—AAE
Murdock Co., 158 Carter St., Chelsea, Mass.—AAB
Muter Co., The, 1255 S. Michigan Ave., Chicago 5, Ill.—AAC, AAD, AAH
National Gypsum Co., 325 Delaware Ave., Buffalo, N. Y.—AAF

Olesen Co., Otto K., 1534 Cahuenga Blvd., Hollywood 28, Calif.—AAD
Oregon Corvek Co., 1005 N. W. 16 Ave., Portland 9, Ore.—AAG
Oxford Electric Corp., 3911 S. Michigan Ave., Chicago 15, Ill.—AAD
Perfection Electric Co., 2635 S. Wabash, Chicago, Ill.—AAD
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.—AAB, AAC, AAD, AAG
Philmore Mfg. Co., 113 University Pl., New York 3, N. Y.—AAB, AAD
Quam-Nichols Co., 526 E. 33 Place, Chicago 16, Ill.—AAA, AAC, AAD, AAH
Racon Electric Co., Inc., 52 E. 19 St., New York 3, N. Y.—AAD
Radio Corporation of America, RCA-Victor Div., Camden, N. J.—AAG
Radio Corporation of America, RCA Tube Dept., Harrison, N. J.—AAC, AAD
Radio-Music Corp., 84 South Water St., Port Chester, N. Y.—AAC, AAD
Roanwell Corp., 662 Pacific St., Brooklyn 17, N. Y.—AAB
Rowe Industries, 1702 Wayne St., Toledo 9, Ohio—AAA, AAC
Shrader Mfg. Co., 2803 M St., N. W., Washington, D. C.—AAG
Shura-tone Products, Inc., 440 Adelphi St., Brooklyn 17, N. Y.—AAG
Sisalkraft Co., 205 W. Wacker Dr., Chicago 6, Ill.—AAE
Sonotone Corp., Box 200, Elmsford, N. Y.—AAB
S.O.S. Cinema Supply 602 W. 52 St., New York 19, N. Y.—AAC, AAD, AAG, AAH
Sound Laboratories, 323 E. 48 St., New York 17, N. Y.—AAG
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—AAA, AAB, AAC, AAD, AAE, AAF, AAG, AAH
Stephens Mfg. Corp., 8538 Warner Drive, Culver City, Calif.—AAC, AAD, AAG, AAH
Stromberg-Carlson Co., 1225 Clifford Ave., Rochester, N. Y.—AAC, AAD, AAH
Tape Recording Industries, 3335 E. Michigan Ave., Lansing, Mich.—AAA, AAB, AAC, AAD, AAH
Telemarine Communications Co., 536 W. 27 St., New York 1, N. Y.—AAD
Telex, Inc., Telex Park, St. Paul, Minn.—AAB
Trimm, Inc., 400 W. Lake, Libertyville, Ill.—AAB
U. S. Gypsam Co., 300 W. Adams St., Chicago 6, Ill.—AAB
U. S. Recording Co., 1121 Vermont Ave., N. W., Washington 5, D. C.—AAC, AAD
University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.—AAA, AAC, AAD, AAH
Utah Radio Products Co., 1123 E. Franklin St., Huntington, Ind.—AAA, AAC, AAD, AAF, AAG, AAH
Wright Zimmerman, Inc., 330 5th Ave., New Brighton 8, Minn.—AAB, AAC, AAD

27—Test Equipment

Amplifiers, special ..... BBA
Analyzers, spectrum ..... BBB
Attenuators, AF ..... BBC
Attenuators, RF ..... BBD
Attenuators, logarithmic ..... BBE
Boxes, decade resistance ..... BBF
Bridges, capacity ..... BBG
Bridges, impedance ..... BBH
Bridges, resistance ..... BBI
Cameras, osciloscope recording ..... BBJ
Design, custom ..... BBK
Detector, vacuum leak ..... BBL
Generators, AM ..... BBM
  FM ..... BBN
  TV ..... BBO
  composite TV signal ..... BBP
  grating ..... BBQ
  microwave signal ..... BBR
  noise ..... BBS
  pulse ..... BBT
  signal ..... BBU
  square wave ..... BBV
  sweep ..... BBW
  timing marker ..... BBX
Graphic recorders ..... BBY
Indicators, resonance ..... BBZ
Instruments, special laboratory ..... BCA
Q-Meters ..... BCB
Meters, crystal impedance ..... BCC
Meters, distortion and noise ..... BCD
  frequency ..... BCE
  grid dip ..... BCF
  output power ..... BCG
  phase ..... BDA
  power level ..... BDC
  sound level ..... BCH
  vibration ..... BCI
  wow and flutter ..... BCJ
Microvolter, audio frequency ..... BCK
Noise diodes ..... BCL
Oscillators, audio ..... BCM
Oscillators, UHF ..... BCN
Oscilloscopes ..... BCO
Records, frequency test ..... BCP
Sets, field strength measuring ..... BCQ
  insulation test ..... BCR
  sound level measuring ..... BCS
  transmission measuring ..... BCT
Standards, frequency ..... BCU
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Testers, tube ..... BCW
Voltmeters, vacuum tube ..... BCX
Volt-ohm-milliammeters ..... BCY
Units, decade inductor ..... BCZ

Acorn Electronics Corp., Box 348, Gibson City, Ill.—BBA
Advance Electronics Co., Box 394, Passaic, N. J.—BBA, BBT, BBV
Aerocoil, Inc., 507 26 St., Union City, N. J.— BBD, BBZ, BCE, BCF, BCG, BCN
Aero Electronics Co., 1512 N. Wells St., Chicago 10, Ill.—BBA, BBK, BBY, BCA
Aero-Sonic Mfg., 2015 Pontius Ave., Ios Angeles 25, Calif.—BBK
Aircraft Electronics Assoc., 94 Silas Dean Highway, Rocky Hill, Conn., BBK, BCA
Aircraft Radio Corp., Boonton, N. J.—BBU
Airlectron, Inc., Caldwell, N. J.—BCO, BCX
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—BBA
American Chronoscope Corp., 316 W. First St., Mount Vernon, N. Y.—BCX, BCY
American Electroneering Corp., 5025 W. Jefferson Blvd., Los Angeles 16, Calif.—BBA, BBD, BBM, BBR, BBU, BCN, BCQ
American Television, Inc., 5050 Broadway, Chicago, Ill.—BBO, BBP, BBV, BBW, BCO
American Time Products, Inc., 580 Fifth Ave., New York 19, N. Y.—BCU
Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.—BBA
Ansley Electronics, Inc., 85 Tremont St., Meriden, Conn.—BBA, BBB
Antenna Research Laboratory, 797 Thomas Lane, Columbus 14, Ohio—BBA
Applied Science Corp. of Princeton, Box 44, Princeton, N. J.—BBT, BCA
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ARF Prods., Inc., 7627 W. Lake St., River Forest, Ill.—BBN, BBW
Associated Research, Inc., 3758 W. Belmont Ave., Chicago 18, Ill.—BCA, BCR
Atlantic Electronics Corp., 4 Manhasset Ave., Port Washington, N. Y.—BBA, BBK, BBS, BBT, BBV, BBX, BCX
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75 OHMS-BNC CONNECTOR

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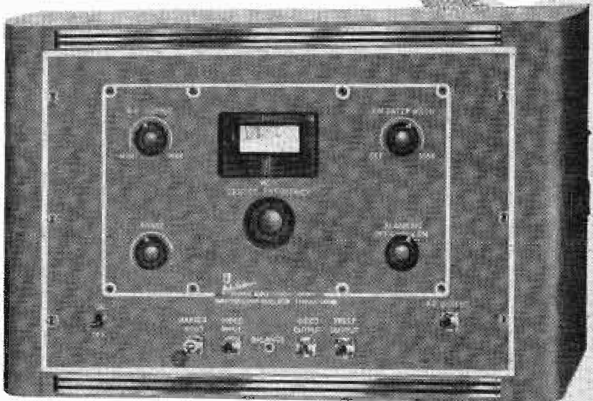

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Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.—BBG, BBI, BCA

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Berkeley Scientific Corp., Div. of Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.—BBT, BCA, BCE, BCU

Berkshire Laboratories, 586 Beaver Pond Road, Lincoln, Mass.—BBT, BCA, BCV

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Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif.—BBA, BCI

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Booth Co., Arthur E., 4124 Beverly Blvd., Los Angeles 4, Calif.—BCR

Brown Electro-Measurement Corp., 4635 S. E. Hawthorne Blvd., Portland 15, Ore.—BBA, BBF, BBG, BBH, BBI

Browning Laboratories, Winchester, Mass.—BCO

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Carbonneau Industries, 2[illegible] Ionia N. W., Grand Rapids 2, Mich.—BBK

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Central Research Labs., Red Wing, Minn.—BCA

Central Scientific Co., 1700 Irving Park Road, Chicago 13, Ill.—BCO

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Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.—BBT

Chicago Industrial Instrument Co., 536 W. Elm St., Chicago 10, Ill.—BCX

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Clarke Instruments, 919 Jesup-Blair Drive, Silver Spring, Md., BBD, BCQ

Clippard Instrument Laboartory, Inc., 7350-90 Colerain Road, Cincinnati 24, Ohio—BBG, BBI, BCY

Clough-Brengle Co., The, 6014 Broadway, Chicago 40, Ill.—BBG, BBI, BBM, BBU, BCM, BCT

Coastwise Electronics Co., 322 N. Foothill Rd., Beverly Hills, Calif.—BBU

Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.—BCX

Coleman Instruments, Inc., 318 Madison St., Maywood, Ill.—BCA

Columbus Electronics Corp., 229 S. Waverly St., Yonkers, N. Y.—BCA

Communication Measurements Lab., 120 Greenwich St., New York 6, N. Y.—BBK, BBM, BCV

Communications Co., 300 Greco Ave., Coral Gables 34, Fla.—BCG, BCQ

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Consolidated Engineering Corp., 300 N Sierra Madre Villa, Pasadena 15, Calif.—BBL, BBY, BCI

Constable Eng'g Co., J. M., 101-05 77 St., Ozone Park 17, N. Y.—BBK

Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., S. Plainfield, N. J.—BBG

Crest Laboratories, Inc., Whitehall Bldg., Far Rockaway 91, N. Y.—BBU

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Dayco Radio Corp., 915 Valley St., Dayton 4, Ohio—BCW

Decade Instrument Co., Caldwell, N. J.—BBU

Decimeter, Inc., 1430 Market St., Denver 2, Colo BBA, BCN

DeMornay-Bonardi, Inc., 3223 Burton Ave., Burbank, Calif.—BBA, BBD, BBK, BBV, BCA, BCC, BCE, BCU

De-Tec Tronic Laboratories, 1711 Terra Cotta Pl., Chicago 14, Ill.—BCN

Development Eng'g, 1723 Waugh Dr., Houston 6, Tex.—BCA

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Eclipse-Pioneer Div., Bendix Aviation Corp., Teterboro, N. J.—BBA
Edin Co., 207 Main St., Worcester 8, Mass.—BBA, BBC, BBD
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Electrodyne Co., 32 Oliver St., Boston 10, Mass.—BBF, BBG, BBH, BBI, BBJ, BBK, BBY, BCA, BCX
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Electron-Radar Products, Inc., 1041 N. Pulaski Road, Chicago 51, Ill.—BBC, BBD, BBE, BCA, BCE, BCG, BCH
Electronic Workshop, The, 351 Bleecker St., New York 14, N. Y.—BCM
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Freed Transformer Co., 1718 Weirfield St., Brooklyn 27, N. Y.—BBH, BCB, BUU
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General Instrument Corp., 829 Newark Ave., Elizabeth 3, N. J.—BBW, BCN
General Precision Lab., Inc., 63 Bedford Rd., Pleasantville, N. Y.—BCA
General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.—BBC, BBD, BBF, BBG, BBH, BBI, BBJ, BBM, BBN, BBS, BBT, BBU, BBV, BCD, BCE, BCG, BCH, BCI, BCK, BCM, BCN, BCR, BCS, BCU, BCV, BCX, BCZ
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Harvey Radio Laboratories, 447 Concord Ave., Cambridge 38, Mass.—BBU
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Highland Engineering Co., Main & Urban, Westbury, L. I., N. Y.—BBA
Hillyer Instrument Co., 54 Lafayette St., New York 13, N. Y.—BBK, BBT, BBU
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INET, Inc., 8655 S. Main St., Los Angeles 3, Calif. —BBA
Instrument Electronics Corp., 90 Main St., Port Washington, N. Y.—BCX
Instrument Laboratories, 315 W. Walton Place, Chicago 10, Ill.—BCA, BCY
International Instruments Inc., 331 East St., New Haven 11, Conn.—BCX
International Mutoscope Co., 4401-09 Eleventh St., Long Island City 1, N. Y.—BCA
International Research Associates, A Div. of Iresco Inc., 2221 Warwick Ave., Santa Monica, Calif.—BBA, BBC, BBD, BBF, BBI, BBO, BBT, BCE, BCF, BCM, BCN, BCO, BCQ, BCX
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Jackson Electrical Instrument Co., The, 18 S. Patterson Blvd., Dayton 2, Ohio—BBM, BBN, BBO, BBU, BBW, BCM, BCO, BCW, BCX
J-B-T- Instruments, 441 Chapel St., New Haven 8, Conn.—BCE
Jerrold Electronics Corp., 26 & Dickinson Sts., Philadelphia 46, Pa.—BBD, BCE, BCQ
Jones Electronics Co., M. C., 96 No. Main St., Bristol, Conn.—BCG
Kalbfell Laboratories, Inc., P. O. Box 1578, San Diego 10, Calif.—BBA, BBC, BBE
Kay Electric Co., Maple Ave., Pine Brook, N. J., BBB, BBC, BBD, BBK, BBM, BBN, BBO, BBR, BBS, BBT, BBV, BBW, BCA, BCE, BCI, BCL, BCN
Keithley Instruments, 3868 Carnegie Ave., Cleveland 15, Ohio—BBA, BCA, BCX
Kelly-Koett Mfg. Co., 12-T E. 6th St., Covington, Ky. —BCW
Keystone Electric Co., 2002 N. 51st St., Omaha 4, 4, Nebr.—BBK
Kings Electronics, Inc., 50 Marbledale Ave., Tuckahoe, N. Y.—BBD, BCA
Kings Microwave Co., 50 Marbledale Ave., Tuckahoe, N. Y.—BBD, BBR
Krohn-Hite Instrument Co., 580 Masaschusetts Ave., Cambridge 39, Mass.—BBV, BCM

Laboratory for Electronics, 75 Pitts St., Boston 14, Mass.—BCA, BCM, BCN, BCO
Lampkin Laboratories, Bradenton, Fla.—BCE
Langevin Mfg., 37 W. 65, New York 23, N. Y.—BBA
Las-Lab, 316 W. Saratoga, Baltimore 1, Md.—BBJ
Lavoie Laboratories, Morganville, N. J.—BBT, BBU, BBV, BCF, BCO
Lawton Prods. Co., 624 Madison Ave., New York, N. Y. —BBK, BCA
Lenkurt Electric Co., 1105 County Rd., San Carlos, Calif.—BCM, BCT, BCZ
Leonard Electric Products Co., 67 34 St., Brooklyn 32, N. Y.—BBA, BBK
Link Radio Corp., 125 W. 17 St., New York 11, N. Y.—BCE, BCG
Liston-Becker Instrument Co., 20 Beckley Ave., Stamford, Conn.—BBA, BCA
Lloyd's Enterprises, Altadena, Calif.—BCW
Lyman Electronic Corp., 12 Cass St., Springfield, Mass. —BCY
Lysco Mfg. Co., 1401 Clinton St., Hoboken, N. J. —BCF, BCY
Magna Electronics Co., 9810 Anza Ave., Box 338, Inglewood, Calif.—BBA
Magnetic Amplifiers Inc., 632 Tinton Ave., New York 55, N. Y.—BBA
Marma Electronic Co., 703 Willow St., Chicago 14, Ill.—BBC, BBD
Maryland Electronic Mfg. Corp., 5009 Calhert Rd., College Park, Md.—BCO
Massa Laboratories, 3868 Carnegie Ave., Cleveland 15, Ohio—BCS
Master Appliances, Inc., 1600 Factory Ave., Marion, Ind.—BCA
M. B. Mfg. Co., The, 1060 State St., New Haven 11, Conn.—BCI
Measurements Corp., Box 180, Boonton, N. J.—BBD, BBM, BBN, BBO, BBT, BBU, BBV, BCA, BCD, BCF, BCN, BCQ, BCX
Melpar, 452 Swann Ave., Alexandria, Va.—BBA, BBK
Menlo Research Laboratory, Box 522, Menlo Park, Calif.—BCA
Mercury Electronic Co., Box 450, Red Bank, N. J. —BBA, BBK, BCC, BCV, BCW, BCX
Meters, Inc., 915 Westfield Blvd., Indianapolis 20, Ind.—BBK
Metropolitan Electronics & Instruments Co., 106 Fifth Ave., New York 11, N. Y.—BBM, BBN, BBO, BBP, BBR, BBU, BBV, BBW, BCA, BCM, BCN, BCO, BCW, BCX, BCY
Microlab, 301 S. Ridgewood Road, South Orange, N. J. —BBD, BBR
Microwave Assoc., Inc., 22 Cummington St., Boston 15, Mass.—BBB
Midwestern Geophysical Laboratory, 3401 S. Harvard Ave., Tulsa, Okla.—BBY
James Millen Mfg. Co., 150 Exchange St., Malden 48, Mass.—BCF
Miller Corp., Wm., 325 N. Halstead Ave., Pasadena 8, Calif.—BCI
Millivac Instrument Corp., 444 Second St., Schenectady 6, N. Y.—BCX

Minnesota Electronics Corp., 47 W. Water St., St. Paul, Minn.—BCE, BCJ
Monarch Mfg. Co., 2014 N. Major Ave., Chicago 39, Ill.—BCA
Moulic Specialties Co., 1005-7 W. Washington St., Bloomington, Ill.—BBA, BBK
MP Concert Installations, Fairfield 10, Conn.—BBA, BBI, BBK
Munston Mfg. & Service, Inc., Beech St., Islip, L. I., N. Y.—BBU
National Research Corp., 70 Memorial Dr., Cambridge 42, Mass.—BBK, BBL, BCA
National Technical Labs., 820 Mission St., S. Pasadena, Calif.—BCA
Neptune Electronics Co., 433 Broadway, New York 13, N. Y.—BBA, BBK, BBM, BBZ, BCM
Network Mfg. Corp., 213 W. 5tb St., Bayonne, N. J. —BBG
Neutronic Assoc., 33-56 Victor Ave., Elmhurst 73, N. Y.—BBK, BCA
Norrman Labs., Ernst, Williams Bay, Wis.—BCU
Offner Electronics, 5320 N. Kedzie Ave., Chicago 25, Ill.—BBY, BCA
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.—BBC, BBF
Owen Labs., 412 Woodward Blvd., Pasadena 10, Calif. —BBA, BBX
Pacific Mercury Television Mfg. Corp., 5955 Van Nuys, Calif.—BBA, BBK, BBM, BBN, BBO, BCE
Pacific Transducer Corp., 11921 S. West Pico Blvd., Los Angeles 64, Calif.—BCP, BCU
Pan-Electronics Co., 276 E. 150th St., New York, N. Y.—BBA, BCD
Panoramic Radio Products, Inc., 10 S. Second Ave., Mt. Vernon, N. Y.—BBB
Parsons Co., Ralph M., The, 689 S. Fair Oaks Ave., Pasadena 2, Calif.—BBS
PCA, Inc., 6368 DeLongpre Ave., Hollywood 28, Calif. —BBK, BBT
Peirce Wire Recorder Corp., 1328 Sherman St., Evanston, Ill.—BCW
Phaostron Co., 151 Pasadena Ave., S. Pasadena, Calif. —BCA, BCY
Photron Inst. Co., 6515 Detroit Ave., Cleveland 2, Ohio—BBA
Pickard & Burns, 240 Highland Ave., Needham 94, Mass. —BBA
Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.—BBB, BBD, BBP, BBR
Polytechnic Research & Development Co., 55 Johnson St., Brooklyn, N. Y.—BBA, BBB, BBD, BBN, BBO, BBR, BBS, BBT, BCE, BCN, BBW
Potter Instrument Co., 115 Cutter Mill Rd., Great Neck, N. Y.—BCE
Precise Development Corp., 999 Long Beach Rd., Oceanside, N. Y.—BBM, BBT, BBV, BCM, BCX, BCY
Precision Apparatus Co., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.—BBM, BBN, BBU, BBW, BCO, BCW, BCX, BCY
Precision Electronics, Inc., 641 Milwaukee Ave., Chicago 22, Ill.—BBU, BCX
Premier Electronic Labs., 382 Lafayette St., New York 3, N. Y.—BBU
Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.—BBA, BBK, BBL, BCA
Professional Electronics, 180 E. Calif. St., Pasadena, Calif.—BCA
Radex Corp., 2076 Elston Ave., Chicago 14, Ill.—BBH, BCM
Radiation Counter Labs., 51 W. Grove St., Skokie, Ill. —BBA, BBK, BCA
Radioactive Prods., Inc., 443 W. Congress St., Detroit 26, Mich.—BCO
Radio City Products Co., 152 W. 25th St., New York 1, N. Y.—BBI, BBM, BBN, BBO, BBU, BBV, BCO, BCW, BCX, BCY
Radio Corporation of America, RCA Tube Dept., Harrison, N. J.—BBK, BBL, BBO, BBU, BBW, BCN, BCO, BCX, BCY
Radio Frequency Labs., Boonton, N. J.—BBK, BCR
Radio Sonic Corp., 186 Union Ave., New Rochelle, N. Y. —BBA, BBB, BBK
Radio Supply & Eng'g Co., 85 Selden Ave., Detroit 1, Mich.—BCO
Radio Transceiver Labs., 116-23 Jamaica Ave., Richmond Hill 18, N. Y.—BCQ
Rahm Instruments, Inc., 12 W. Broadway, New York 7, N. Y.—BBA, BCM
Rawson Electrical Instrument Co., 117 Potter St., Cambridge 42, Mass.—BCA
Raypar Inc., 7810 W. Addison St., Chicago 13, Ill. —BBU
Reed Research, Inc., 1048 Potomac St., Washington 7, D. C.—BDC
Reiner Electronics Co., 152 W. 25th St., New York 1, N. Y.—BBI, BBK, BBU, BBV, BCX
Resdel Eng'g Corp. 2351 Riverside Dr., Los Angeles 39, Calif.—BBA, BBD, BBH, BBR, BBS, BBT, BBU, BBV, BCB, BCF, BCN, BCO, BCQ
Riverbank Labs., Dept. of Eng'g, Geneva, Ill.—BCU
Rixon Electronics, 3303 Ferndale St., Kensington, Md. —BBA, BBK, BCA
Rochester Electronics Co., Box 227, Penfield, N. Y.—BBF
Rollin Co., 2010 Lincoln Ave., Pasadena, Calif.—BBU
Rowe Industries, 1702 Wayne, Toledo, Ohio—BBA
Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif.—BBK, BBT, BBV, BBX, BCA
Rutishauser Corp., 490 S. Fair Oaks Ave., Pasadena, Calif.—BCA
Scott, Inc., Herman Hosmer, 385, Putnam Ave., Cambridge 39, Mass.—BBA, BBB, BBS, BCD, BCH, BCI, BCS
Sealtron Co., The, 9701 Reading Rd., Cincinnati 15, Ohio—BBA, BBF, BBK
Shallcross Mfg. Co., Pusey & Jackson Aves., Collingdale, Pa.—BBC, BBE, BBF, BBG, BBI, BCA
Shevers, Inc., Harold, 123 W. 64th St., New York 23, N. Y.—BBA, BBM, BBN, BBO, BBP, BBU, BBV, BBW, BCM, BCN, BCO, BCW, BCX, BCY
Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif.—BBA, BBB, BBD, BBK, BBT, BCA, BCQ, BCT, BCX
Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.—BBG, BBM, BBN, BBO, BBU, BBW, BCB, BCE, BCG, BCH, BCO, BCQ, BCS, BCT, BCW, BCX, BCY

Skiatron Electronics & Television Corp., 30 E. 10th St., New York 3, N. Y.—BBK
Sound Sales & Eng'g Co., 2005 La Branch, Houston 3, Tex.—BBK, BCS
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., Houston 19, Tex.—BBH, BBK, BCA, BCK, BCM, BCR, BCX
Special Instruments Lab., Inc., 1003 Highland Ave., Knoxville, Tenn.—BBA, BBI, BBK, BCA
Spectrum Engineers, 540 N. 63rd St., Philadelphia 31, Pa.—BBK
Spellman Television Co., 3029 Webster Ave., New York 67, N. Y.—BBK
Spencer-Kennedy Labs., Inc., 186 Massachusetts Ave., Cambridge 39, Mass.—BBA, BBD, BBT, BBW, BCA, BCO
Sperry Gyroscope Co., Great Neck, L. I., N. Y.—BBD, BBH, BBN, BBR, BBT, BBU, BBW, BBX, BCC, BCE, BCG, BCN, BCT, BCU
Sprague Electric Co., Beaver St., N. Adams, Mass.—BBG
Square Root Mfg. Co., 391 Saw Mill River Rd., Yonkers 2, N. Y.—BBK, BCA
Standard Electronic Research Corp., 2 East End Ave., New York 21, N. Y.—BBA, BBK
Sterling Instruments Co., 13331 Linwood Ave., Detroit 6, Mich.—BBK
Sticht Co., Herman H. 27 Park Place, New York 7, N. Y.—BBF, BBI, BCR, BCY
Stoddard Aircraft Radio Co., 6644 Santa Monica Blvd., Hollywood 38, Calif.—BBD, BCQ
Stromberg-Carlson Co., 1225 Clifford Ave., Rochester, N. Y.—BBA
Sunrise Products, Box 173, Hawthorne, N. J.—BCV
Superior Instruments Co., 227 Fulton St., New York 7, N. Y.—BBO
Supreme, Inc., 1716 Carolton Dr., Greenwood, Miss. —BBM, BBN, BBO, BBP, BBU, BBW, BCM, BCO, BCW, BCX, BCY
Sylvan Electronic Labs., Broadalbin, N. Y.—BCF
Sylvania Electric Prods. Co., 1740 Broadway New York 19, N. Y.—BBL, BBM, BBN, BBU, BBW, BCO, BCW, BCY
Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill.—BBT, BBW, BBX, BCO

Taffet Radio & TV Co., 2530 Belmont Ave., New York 58, N. Y.—BBA, BCA
Tech Labs., Inc., Bergen & Edsall Blvd., Palisades Park, N. J.—BBC, BBE, BBF, BCA
Technicraft Labs., Inc., Thomaston-Waterbury Rd., Thomaston, Conn.—BBD, BBK, BCA, BCU
Techno Instrument Co., 6666 Lexington Ave., Los Angeles 38, Calif.—BCH
Technology Instrument Corp., 531 Main St., Acton, Mass.—BBA, BBF, BBG, BBH, BBI, BBU, BCA
Tektronix, Inc., P. O. Box 831, Portland 7, Ore. —BBA, BBT, BBV, BBX, BCO
TelAutograph Corp., 16 W. 61st St., New York 23, N. Y.—BBA
Telechrome, Inc., 88 Merrick Rd., Amityville, L. I., N. Y.—BBA, BBB, BBK, BBO, BBP, BBQ, BBS, BBU, BBX, BCO
Telectro Industries Corp., 35-16 37th St., Long Island City 1, N. Y.—BBA, BBG, BBH, BBI, BBU, BCA, BCY
Telequip Radio Co., 2559 W. 21 St., Chicago 8, Ill. —BBP
Teletronic Labs., Inc., 1835 W. Rosecrans Ave., Gardena, Calif.—BBK, BCA, BCO
Teletronics Lab., Inc., Kinkel St., Westbury, L. I., N. Y.—BBK, BBT, BBX
Television Equip. Corp., 238 William St., New York 38, N. Y.—BBT, BBV, BCM, BCO
Television Projects, 3660 Coral Way, Miami 35, Fla. —BBU, BBW
Tel-Instrument Co., 50 Paterson Ave., E. Rutherford, N. J.—BBA, BBD, BBO, BBW
Testing Instruments, Inc., 120 W. 2nd St., Dayton 2, Ohio—BCA
Tetrad Co., 4054 Ocean Park, Venice, Calif.—BCZ
Torocoil, 1374 Mobile Ct., St. Louis, Mo.—BBF
Trac-Tape Recording Apparatus Co., Box 221, Caldwell, N. J.—BCA
Transitron, Inc., 154 Spring St., New York 12, N. Y. —BBD, BBK, BBS, BBT, BBV
Transmitter Equip. Mfg. Co., 345 Hudson St., New York 14, N. Y.—BBA, BBK
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass. —BCA
Transvision, Inc., New Rochelle, N. Y.—BBW, BCQ
Tri-Dex Co., Box 1207, Lindsay, Calif.—BBA, BCM
Triplett Electrical Instrument Co., Harmon Rd., Bluffton, Ohio—BBM, BBN, BBO, BBU, BBW, BCO, BCW, BCX, BCY
Triumph Mfg. Co., 913 W. Van Buren St., Chicago 7, Ill.—BBV, BCM, BCO, BCY
Trojan Electronics, 3706 N. Halsted St., Chicago 13, Ill.—BCW

Univox Corp., 83 Murray, New York 7, N. Y.—BBA
Utility Electronics Corp., 231 Grant Ave., E. Newark, N. J.—BBA, BBM, BBN, BBU, BCM, BCX, BCY

Vacuum-Electronic Eng'g Co., 756 Third Ave., Brooklyn 32, N. Y.—BBL
Vacuum Tube Products, 506 S. Cleveland St., Oceanside, Calif.—BBL, BCL
Varo Mfg., 1801 Walnut, Garland, Tex.—BBA, BCM
Vectron Mfg., 235 High, Waltham, Mass.—BBX

Wadsworth Mfg. Assoc., 509 Balsam St., Liverpool, N. Y.—BBK
Walkirt Co., 145 W. Hazel St., Inglewood 3, Calif. —BBA, BBT, BBU, BBV, BCE, BCI, BCU
Wang Labs., 296 Columbus, Boston, Mass.—BCE
Waterman Products Co., 2445 Emerald St., Philadelphia 25, Pa.—BCO
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y. —BBA, BBK, BBM, BBN, BCM, BCX
Waveline, Inc., P. O., Box 470, Caldwell, N. J. —BBD, BBR
Weinschel Eng'g Co., 919 Jesup-Blair Dr., Silver Spring, Md.—BBD, BBM, BCM
Welch Electric Co., 1221 Wade St., Cincinnati 14, Ohio—BCA, BCR
Western Sound & Electric Labs., Inc., 805 S. 5th St., Milwaukee 4, Wis.—BBA, BBC, BBG, BBH, BBI, BBU, BBV, BCM, BCX
Weston Labs., 410 Glen Rd., Weston 93, Mass.—BCM, BCX
Wheeler Labs., Inc., 122 Cutter Mill Rd., Great Neck, N. Y.—BBK, BBR

28—*Indicating Devices*

Antenna ammeters . . . . **CCA**
Galvanometers . . . . **CCB**
Meters, ampere . . . . **CCC**
Meters, frequency . . . . **CCD**
Meters, RF power . . . . **CCE**
Meters, volt . . . . **CCF**
Meter repair service . . . . **CCG**
Miscellaneous . . . . **CCH**
Thermocouple instruments . . . . **CCI**
Volume indicators . . . . **CCJ**

Aero Instrument Co., 11423 Vanown St., N. Hollywood, Calif.—CCD
American Hydromath Corp., 145 W. 57th St., New York 19, N. Y.—CCH
Andrew Corp., 363 E. 75, Chicago, Ill.—CCA
Assembly Products, Chagrin Falls, Ohio—CCC
Associated Projects Co., 157 Marconi Blvd., Columbus, Ohio—CCH
Associated Research, Inc., 3758 W. Belmont Ave., Chicago 18, Ill.—CCG
Ballantine Laboratories, Inc., Boonton, N. J.—CCF
Barber-Colman Co., 1300 Rock St., Rockford, Ill.—CCC, CCF, CCI
Barker & Williamson Co., 237 Fairfield Ave., Upper Darby, Pa.—CCD
Barnes Development Co., 213 W. Baltimore Pike, Lansdowne, Pa.—CCI
Bassett, Inc., Rex., 1314 N. E. 17 Court, Ft. Lauderdale, Fla.—CCD
Beede Electrical Instrument Co., Penacook, N. H.—CCB, CCC, CCF, CCG
Berkeley Scientific Corp., Div. Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif.—CCD
Berndt-Bach, Inc., Auricon Div., 7325 Beverly Blvd., Los Angeles 36, Calif.—CCB
Beta Electric Corp., 333 E. 103 St., New York 29, N. Y.—CCF
Biddle Co., James G., 1316 Arch St., Philadelphia 7, Pa.—CCB, CCD
Bird Electronic Corp., 1800 E. 38 St., Cleveland 14, Ohio—CCE, CCI
Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio—CCB
Burlington Instrument Co., 203 N. 3 St., Burlington, Iowa—CCC, CCF, CCJ
Burnett Radio Lab., Wm. W. L., 4814 Idaho St., San Diego 16, Calif.—CCD
Burton-Rogers Co., 292 Main St., Cambridge 42, Mass. —CCC, CCF
Chicago Industrial Instrument Co., 536 W. Elm St., Chicago 10, Ill.—CCC, CCF
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.—CCJ
Cole Instrument Co., 1320 S. Grand Ave., Los Angeles 15, Calif.—CCA, CCG, CCJ
Conn Ltd., C. G., Electronics Div., Jackson Blvd., Elkhart, Ind.—CCD
Continental Electronics Mfg. Co., 4212 S. Buckner Blvd., Dallas 10, Tex.—CCA
Cubic Corp., 2841 Canon, San Diego, Calif.—CCE
Daven Co., 193 Central Ave., Newark 4, N. J.—CCD, CCF, CCH, CCJ
Delta Electrical Instrument Co., 2700 S. Hill St., Los Angeles 7, Calif.—CCC
Diamond Mfg., 7 North Ave., Wakefield, Mass.—CCD
Electric Design & Mfg. Co., Burlington, Iowa—CCC, CCF
Electrix Corp., 150 Middle, Pawtucket, R. I.—CCD
Electrodyne Co., 32 Oliver, Boston 10, Mass.—CCI
Electronic Development Laboratory, 43-07 23 Ave., Long Island City 5, N. Y.—CCJ
Electronic Signal Co., 541 Willis Ave., Williston Park, N. Y.—CCI
Electron-Radar Products, Inc., 1041 N. Pulaski Rd., Chicago 51, Ill.—CCD
Electro-Tech Equipment Co., 308 Canal St., New York 13, N. Y.—CCA, CCB, CCC, CCD, CCE, CCF, CCG, CCH, CCI, CCJ
Equipment & Service Co., 6815 Oriole Dr., Dallas 7, Tex.—CCC, CCD, CCE, CCF, CCJ
Federal Mfg. & Engineering Corp., 211 Steuben St., Brooklyn 5, N. Y.—CCD
Feiler Engineering Co., 8026 Monticello Ave., Skokie, Ill.—CCH
Field Electrical Instrument Co., 8 N. Manheim Blvd., New Paltz, N. Y.—CCI
Fielden Instrument Corp., 2920 N. Fourth St., Philadelphia 33, Pa.—CCI
Fluke Engineering Co., John, Box 755, Springdale, Conn.—CCC, CCE, CCF
Gates Radio Co., 123 Hampshire, Quincy 1, Ill.—CCJ
Gaydon Co., 561 Hillgrove, La Grange, Ill.—CCG
G & M Equipment Co., 7315 Varna Ave., N. Hollywood, Calif.—CCD
Hastings Instrument Co., Super H'way. & Pine Ave., Hampton, Va.—CCI
Heath Co., Benton Harbor, Mich.—CCF
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.—CCD, CCF
Illinois Testing Labs., Inc., 420 N. LaSalle St., Chicago 10, Ill.—CCG, CCI
Industrial Devices, Inc., 22 State Rd., Edgewater 24, N. J.—CCC, CCF
Instrument Laboratories, 315 W. Walton Pl., Chicago 10, Ill.—CCC, CCF, CCG
International Instruments Inc., 331 East St., New Haven 11, Conn.—CCC
Ionic Equipment Co., 1705 N. Kenmore, Los Angeles 27, Calif.—CCH
J-B-T Instruments, Inc., 441 Chapel St., New Haven 8, Conn.—CCD, CCI
Jerrold Electronics Corp., 26 & Dickinson Sts., Philadelphia 46, Pa.—CCD
Jones Electronics Co., M. C., 96 N. Main St., Bristol, Conn.—CCE
Link Radio Corp., 125 W. 17 St., New York 11, N. Y. —CCD, CCE
Liston-Becker Instrument Co., 20 Beckley Ave., Stamford, Conn.—CCB, CCI

Marion Electrical Instrument Co., 400 Canal St., Manchester, N. H.—CCC, CCF, CCJ
Menlo Research Laboratory, Box 522, Menlo Park, Calif.—CCH
Meters, Inc., 915 Westfield Blvd., Indianapolis 20, Ind.—CCH, CCJ
Metropolitan Electronics, 106 5 Ave., New York 11, N. Y.—CCB
Midwestorn Geophysical Lab., 3401 S. Harvard Ave., Tulsa, Okla.—CCB
Modulation Products Co., 56 Lispenard St., New York 13, N. Y.—CCC, CCF, CCG, CCH, CCJ
National Research Corp., 70 Memorial Dr., Cambridge, 42, Mass.—CCH, CCI
Phaostron Co., 151 Pasadena Ave., S. Pasadena, Calif.—CCA, CCC, CCE, CCF
Precision Apparatus Co., 92-27 Horace Harding Blvd., Elmhurst, L. I., N. Y.—CCC, CCF
Pyramid Instrument Corp., 630 Merrick Rd., Lynbrook, N. Y.—CCC, CCF
Pyrometer Instrument Co., Bergenfield, N. J.—CCI
Radio Frequency Labs., Boonton, N. J.—CCH, CCE
Rawson Electrical Instrument Co., 117 Potter St., Cambridge 42, Mass.—CCF, CCI
Reeder & Co., Charles M., 171 Victor Ave., Detroit 3, Mich.—CCI
Shallcross Mfg. Co., Pusex & Jackson Aves., Collingdale, Pa.—CCB
Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif.—CCE
Simpson Electric Co., 5200 W. Kinzie St., Chicago 44, Ill.—CCB, CCC, CCD, CCE, CCF, CCG, CCH, CCI, CCJ
Sound Sales & Engineering Co., 2005 La Branch, Houston 3, Tex.—CCJ
Spellman Television Co., 3029 Webster Ave., New York 67, N. Y.—CCF
Sperry Gryoscope Co., Div. Sperry Corp., Great Neck, L. I., N. Y.—CCD, CCE
Sterling Mfg. Co., 7201 Wentworth Ave., Cleveland 2, Ohio—CCC, CCF, CCH
Sunrise Products Co., Box 173, Hawthorne, N. J.—CCH
Supreme, Inc., 1716 Carolton Dr., Greenwood, Miss.—CCC, CCF, CCG
Taco Wost Corp., 525 N. Noble St., Chicago 22, Ill.—CCB, CCC, CCF
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—CCH
Trans-Sonics, Inc., Bedford Airport, Bedford, Mass.—CCI
Triplett Electrical Instrument Co., Harmon Rd., Bluffton, Ohio—CCC, CCF, CCI, CCJ
Walkirt Co., The, 145 W. Hazel St., Inglewood 3, Calif.—CCD
Wang Laboratories, 296 Columbus Ave., Boston 16, Mass.—CCD
Waveforms, Inc., 333 6 Ave., New York, N. Y.—CCF
Welch Mfg. Co., W. M., 1515 Sedgwick St., Chicago 10, Ill.—CCC, CCD, CCF, CCI
Weston Electrical Instr. Corp., 614 Frelinghuysen Ave., Newark 5, N. J.—CCC, CCD, CCE, CCF, CCI, CCJ
Weymouth Instrument Co., 1440 Commercial St., E. Weymouth 89, Mass.—CCD

29—Major Replacement Parts

Cable .... **DDA**
Capacitors, air .... **DDB**
  ceramic .... **DDC**
  electroytic .... **DDD**
  mica .... **DDE**
  oil .... **DDF**
  paper .... **DDG**
  pressurized .... **DDH**
  tantalum .... **DDI**
  vacuum .... **DDJ**

Circuit breakers, magnetic .... **DDK**
Deflection yokes .... **DDL**
Delay lines .... **DEF**
Filters, RF interference .... **DDM**
Inductances, filter .... **DDN**
Inductances, tuning .... **DDO**
Rectifiers, metal .... **DDP**
Relays, antenna .... **DDQ**
Relays, audio control .... **DDR**
Relays, power .... **DDS**
Relays, time delay .... **DEI**
Relays, video control .... **DDT**
Resistors, power type .... **DDU**
Resistors, variable .... **DDV**
Switches, lever .... **DDW**
Switches, mercury .... **DDX**
Switches, power .... **DDY**
Switches, rotary .... **DDZ**
Switches, time delay .... **DEA**
Transformers, audio .... **DEB**
Transformers, Flyback .... **DEG**
Transformers, power .... **DEC**
Transformers, pulse .... **DED**
Switches, vacuum .... **DEH**

Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.—DEC
Acme Electric Corp., Water St., Cuba, N. Y.—DDN, DEB, DEC, DED
Acme Electronics, Inc., 300 N. Lake Ave., Pasadena 4, Calif.—DDM
Acorn Electronics Corp., Box 348, Gibson City, Ill.—DEB, DEC, DED
Acro Products Co., 215 Arch St., Philadelphia 6, Pa.—DEB, DEC

Acro Transformer & Mfg. Corp., 26-02 4th St., Long Island City 2, N. Y.—DDN, DEB, DEC, DED
Adams & Westlake Co., 1025 N. Michigan, Elkhart, Ind. —DDS, DDX, DEA, DEI
Advance Electric & Relay Co., 2435 N. Naomi St., Burbank, Calif.—DDQ, DDR, DDS, DDT
Advance Electronics Co., Box 394, Passaic, N. J.—DEF
Advance Insulated Wire & Cable Co., 72 Woolsey St., Irvington 11, N. J.—DDA
Advance Transformer Co., 1122 W. Catalpa Ave., Chicago 40, Ill.—DEC
Aerocoil, Inc., 507 26 St., Union City, N. J.—DDM, DDO
Aerovox Corp., 740 Belleville Ave., New Bedford, Mass. —DDC, DDD, DDE, DDF, DDG, DDM
Aircraft Transformer, Long Branch, N. J.—DEC
Airpeax Products Co., Middle River, Baltimore 20, Md.—DDM, DDN, DDO, DEB, DEC, DED
Allen-Bradley Co., 138 W. Greenfield Ave., Milwaukee 4, Wisc.—DDR, DDS, DDV
Allied Allegri Machine Co., 141 River Rd., Nutley 10, N. J.—DDM, DDO
Allied Control Co., 2 East End Ave., New York 21, N. Y. —DDQ, DDR, DDS
All Star Products, Box 187, Defiance, Ohio—DDB
Alpha Electronics, Inc., 53 Bergen Turnpike, Little Ferry, N. J.—DDL
Alpha Electronics, Inc., 53 Bergen Turnpike, Little Ferry, N. J.—DDL
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—DEB, DED
Amalgamated E'tronics, Clinton Corners, N. Y.—DDV
American Condenser Co., 4410 N. Ravenswood Ave., Chicago 40, Ill.—DDD, DDG
American Electric Cable Co., 181 Appleton St., Holyoke, Mass.—DDA
American Gas Accumulator Co., 1029 Newark Ave., Elizabeth 2, N. J.—DDS
American Phenolic Corp., 1830 S. 54 Ave., Chicago 50, Ill.—DDA
American Radio Hardware Co., 152 Mac Questen Pkwy. S., Mt. Vernon, N. Y.—DDW
American Radionic Co., 33 Flatbush Ave., Brooklyn 17, N. Y.—DDF, DDG
American Relay & Controls, Inc., 4901 W. Flournoy St., Chicago 44, Ill.—DDS
American Television & Radio Co., 300 E. 4 St., St. Paul 1, Minn.—DDP
American Transformer Co., 178 Emmet St., Newark 5, N. J.—DEC
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y.—DDJ
Amporite, 561 Broadway, New York, N.Y.—DEI
Andersen Laboratories, Inc., 39 Talcott Rd., W. Hartford 10, Conn.—DEF
Andrew Corp., 363 E. 75 St., Chicago 20, Ill.—DDQ
Anthony Mfg. Co., 2322 W. Slauson Ave., Los Angeles 43, Calif.—DEB, DEC
Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.—DDZ
Assembly Products, Inc., Chagrin Falls, Ohio—DDS
Astron Corp., 255 Grant Ave., E. Newark, N. J.—DDD, DDF, DDG
Atlas Resistor Co., 423 Broome St., New York 13, N. Y. —DDU, DDV
Audio Development Co., 2833 13 Ave. S., Minneapolis 7, Minn.—DDN, DEB, DEC, DED
Audio & Video Products Corp., 730 5 Ave., New York 3, N. Y.—DEB
Autocall Co., Shelby, Ohio—DDS
Aurex Corp., 1117 N. Franklin St., Chicago 10, Ill.—DEB
Automatic Electric Mfg. Co., 10 State St., Mankato, Minn.—DDQ, DDR, DDS, DDT, DEA
Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill.—DDG, DDQ, DDR, DDS, DDT, DDW, DDZ
Automatic Mfg. Corp., 65 Gouverneur St., Newark 4, N. J.—DDC, DDO
Bardwell & McAlister, 2950 N. Ontario St., Burbank, Calif.—DDM, DDN, DDO
Beam Instruments Corp., 350 5 Ave., New York 1, N. Y. —DDA
Berkshire Laboratories, 586 Beaver Pond Rd., Lincoln, Mass.—DED
Birdsell Mfg. Co., 750 San Antonio Rd., Palo Alto, Calif.—DEC
Bogen Co., David, 29 9th Ave., New York 14, N. Y.—DEB, DEC
Bond Electronics, 60 Springfield Ave., Springfield, N. J.—DDF
Brand & Co., William, North & Valley St., Willimantic, Conn.—DDA
Broadway Coil Co., 5638 N. Broadway, Chicago 40, Ill. —DDO
Bunnell & Co., J. H., 81 Prospect St., Brooklyn 1, N. Y. —DDO, DDR
Burnell & Co., 45 Warburton Ave., Yonkers 2, N. Y.—DEF
Burton Electronic Mfg. Co., 2353 Cotner Ave., Los Angeles 35, Calif.—DDV
Calif. Electronic Services, 21332 Ventura Blvd., Woodland Hills, Calif.—DDM
Camfield Mfg. Co., 7 St., Grand Haven, Mich.—DDM, DDZ
Carbonneau Industries, Inc., 21 Ionia N. W., Grand Rapids 2, Mich.—DDM
Carborundum Co., Globar Div., Niagara Falls, N. Y.—DDU
Cardwell Mfg. Co., Allen D., Plainville, Conn.—DDB
Carter Parts Co., 213 Institute Pl., Chicago 10, Ill.—DDU, DDV, DDW, DDZ
Centralab, Div., Globe-Union, Inc., 900 E. Keefe Ave., Milwaukee 1, Wisc.—DDC, DDV, DDW, DDY, DDZ
Central Transformer Co., 910 W. Jackson Blvd., Chicago 7, Ill.—DDN, DDO, DEB, DEC, DED
Ceramic Heater Cathode Resistor Co., 20 First St., Keyport, N. J.—DDU
C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.—DDN, DDO
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.—DDX
Chase Brass & Copper Co., 236 Grand St., Waterbury 20, Conn.—DDA
Chemo-Vac Electronic Corp., 760 Reed St., Santa Clara, Calif.—DDJ
Chester Cable Corp., Chester, N. Y.—DDA
Chicago Condenser Corp., 3255 W. Armitage Ave., Chicago 47, Ill.—DDF, DDG
Chicago Telephone Supply Corp., 1142 W. Beardsley Ave., Elkhart, Ind.—DDV

Chicago Transformer Div., Essex Wire Corp., 3501 Addison St., Chicago 18, Ill.—DEB, DEC, DED
Church Co., George H., 5109 Halifax Ave., Minneapolis 10, Minn.—DDF, DDG, DDM
Cima Corp., 119 Braintree St., Allston 34, Mass.—DDU
Cinema Engineering Co., 1510 W. Verdugo Ave., Burbank, Calif.—DDZ
Clare & Co., C. P., 4719 Sunnyside Ave., Chicago 30, Ill.—DDQ, DDR, DDS, DDT, DDW
Clark Electronic Laboratories, Box 165, Palm Springs, Calif.—DDP
Clarostat Mfg. Co., Dover, N. H.—DDV, DDU
Cleveland Container Co., 6201 Barberton Ave., Cleveland 2, Ohio—DDQ, DDR
Coil Winders, Inc., New York Ave., Westbury, L. I., N. Y.—DDL, DDM, DDN, DDO
Columbia Technical Corp., 5 E. 57 St., New York 22, N. Y.—DDA, DEF
Columbia Wire & Supply Co., 2850 Irving Pk. Rd., Chicago 18, Ill.—DDA
Columbus Process Co., State & Maple Sts., Columbus, Ind.—DEC
Communication Accessories Co., 110 St. & Hillcrest Rd., Hickman Mills, Mo.—DDN, DEB, DED
Communication Products Co., Marlboro, N. J.—DDZ
Conant Laboratories, 6500 O St., Lincoln 5, Nebr.—DDP
Condenser Products Co., 7517 N. Clark St., Chicago 26, Ill.—DDF
Conn. Telephone & Electric, 70 Brittannia St., Meriden, Conn.—DDW
Cook Electric Co., 2700 Southport Ave., Chicago 14, Ill. DDR, DDS
Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., S. Plainfield, N. J.—DDC, DDD, DDE, DDF, DDG, DDH, DDI, DDM, DDW
Cosmic Radio Corp., 853 Whittier St., New York 59, N. Y.—DDD, DDG
Cramer Co., R. W., Centerbrook, Conn.—DEA
Crescent Co., Box 260, Pawtucket, R. I.—DDA
Crest Laboratories, Inc., Whitehall Bldg., Far Rockaway 91, N. Y.—DEB, DEC, DED
Crest Transformer Corp., 1834 W. North Ave., Chicago 22, Ill.—DDN, DEB, DEC
Crittenden Transformer Works, 1220 Nadeau St., Los Angeles 1, Calif.—DEB, DEC, DED
Cutler Hammer, Inc., 411 N. 12 St., Milwaukee 1, Wisc.—DDS
Dale Products, Inc., Box 1, Columbus, Nebr.—DDU
Daven Co., 193 Central Ave., Newark 4, N. J.—DDV, DDZ
De Coursey Eng'g. Lab., Box 235, W. Los Angeles 25, Calif.—DDN
Delco Radio, Box 737, Kokomo, Ind.—DEB, DEC
Dietz Design & Mfg. Co., Grandview, Mo.—DDN, DDO, DEB, DEC
Dinion Coil Co., Drawer D, Caledonia, N. Y.—DEB, DEC, DED
Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wisc.—DDB, DEB, DEC
Dolinko & Wilkens, Inc., 89 Adams St., Hoboken, N. J. —DDJ
DIT-MCO, Inc., 505 W. 9 St., Kansas City 5, Mo.—DEC
Drake Co., R. L., 11 Longworth St., Dayton 2, Ohio—DDM
Dumont Electric Corp., 308 Dyckman, New York 34, N. Y.—DDD, DDF, DDG
Dunkle Coil Co., 2508 W. 8 St., Los Angeles 5, Calif.—DEC
Durakool, Inc., 1010 N. Main, Elkhart, Ind.—DDS
DX Radio Products Co., 2300 W. Armitage Ave., Chicago 47, Ill.—DDL, DDN, DDO
Dynamic Resistor Corp., 42-27 Francis Lewis Blvd., Bayside, L. I., N. Y.—DDU
Eagle Electric Mfg. Co., 23-10 Bridge Plaza S., Long Island City 1, N. Y.—DDA, DDU, DDW, DDY, DDZ
Ebert Electronics Co., 185-09 Jamaica Ave., Hollis 7, N. Y.—DDS, DDX
Edison, Inc., Thomas A., Instrument Div., 93 Lakeside Ave., W. Orange, N. J.—DEA
Electricoil Transformer Co., Westerly Rd., Ossining, N. Y. —DDP, DEC
Electrical Windings, Inc., 2015 N. Kolmar Ave., Chicago 39, Ill.—DEB, DEC
Electro-Cap, Inc., 1269 Riverside Dr., Los Angeles 31, Calif.—DDC
Electro Development Corp., 6014 Washington Blvd., Culver City, Calif.—DDZ
Electro Eng'g. Works, 6021 College Ave., Oakland 18, Calif.—DEC
Electro Motive Mfg., Willimantic, Conn.—DDC, DDE
Electronic Apparatus Corp., 116 E. Jackson Blvd., Elkhart, Ind.—DDS, DDX
Electronic Development Laboratory, 43-07 23 Ave., Long Island City 5, N. Y.—DEB, DEC
Electronic Devices, Inc., 429 12 St., Brooklyn 11, N. Y.—DDP
Electronic Indicator Corp., 259 Green St., Brooklyn, N. Y.—DDU
Electronic Rectifiers, Inc., 2102 Spann Ave., Indianapolis 3, Ind.—DDP
Electronic Transformer Co., 207 W. 25 St., New York 1, N. Y.—DDN, DDO, DEB, DEC, DED
Electro Switch Corp., 167 King Ave., Weymouth 88, Mass.—DDZ
Electro-Tech Equipment Co., 308 Canal St., New York 13, N. Y.—DDO, DDP, DDQ, DDR, DDS, DDT, DDU, DDV, DDW, DDX, DDY, DDZ, DEA, DEC
El-Rad Mfg. Co., 4087 N. Broadway, Chicago 13, Ill. —DDN, DDO, DDQ, DDR, DDS
Engineered Instruments, Inc., 815 Soto St., Hayward, Calif.—DDQ
Engineering Research Assoc., Inc., 1902 W. Minnehaha Ave., St. Paul W4, Minn.—DED
Equipment & Service Co., 6815 Oriole Dr., Dallas 7, Tex.—DDD, DDP, DDQ, DDR, DDT, DDU, DDV, DDZ, DEB, DEC, DED
Erie Resistor Co., 644 W. 12 St., Erie 6, Pa.—DDC, DDE
Essex Electronics, Springfield Ave., Berkeley Heights, N. J.—DDO
Eureka Television & Tube Corp., 69 Fifth Ave., Hawthorne, N. J.—DEA
Fansteel Metallurgical Corp., 2200 Sheridan Rd., N. Chicago, Ill.—DDI, DDP
Fast & Co., John E., 3129 N. Crawford Ave., Chicago 41, Ill.—DDF, DDG
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.—DDN, DEB, DEC, DED

Filtron Co., 131-05 Fowler Ave., Flushing 55, N. Y.—DDG, DDM, DDN
Ford Eng'g., 129 E. "A" St., Upland, Calif.—DDV
Forest Electric Co., 7216 Circle Ave., Forest Park, Ill. —DDO, DEB
Foster Transformer Co., 3820 Colerain Ave., Cincinnati 23, Ohio—DEB, DEC, DED
Franklin Television Labs., Inc., 18 Johnson Ave., Brooklyn 6, N. Y.—DEG
Freed Transformer Co., 1718 Weirfield St., Brooklyn 27, N. Y.—DDN, DEB, DEC, DED
Galvanic Products Corp., 110 E. Hawthorne Ave., Valley Stream 10, N. Y.—DDP
Gamewell Co., 1238 Chestnut St., Newton Upper Falls 64, Mass.—DDV, DDW, DDZ
Gardner Electric Mfg. Co., 4227 Hollis St., Emeryville 8, Calif.—DEC
Gates Radio Co., 123 Hampshire St., Quincy 1, Ill.—DDO, DDY
Gee-Lar Mfg. Co., 1330 10 Ave., Rockford, Ill.—DDW, DDX, DDY, DDZ
General Cement Mfg. Co., 919 Taylor Ave., Rockford, Ill.—DDW, DDY, DDZ
General Control Co., 1200 Soldiers Field Rd., Boston 34, Mass.—DDW, DDZ, DEA
General Instrument Corp., 829 Newark Ave., Elizabeth 3, N. J.—DDB, DDH, DDJ, DDL, DDM, DDN, DDO
General Insulated Wire Works, Inc., 69 Gordon Ave., Providence 5, R. I.—DDA
General Transformer Co., 18240 Harwood Ave., Homewood, Ill.—DEB, DEC
Gilandun Electronics, Rt. 1, Box 489, Cupertino, Calif. —DDH

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Goslin Electric & Mfg. Co., 2921 W. Olive Ave., Burbank, Calif.—DEB, DEC
Gramer Transformer Corp., 2734 N. Pulaski Rd., Chicago 39, Ill.—DDN, DEB, DEC, DED
Grayhill, 4524 W. Madison St., Chicago, Ill.—DDZ
Grigsby-Allison Co., 407 N. Salem Ave., Arlington Heights, Ill.—DDW, DDZ
Guardian Electric Mfg. Co., 1621 W. Walnut St., Chicago 7, Ill.—DDK, DDQ, DDR, DDS
Gudeman Co., 340 W. Huron St., Chicago 10, Ill.—DDD, DDF, DDG, DDI
Gulton Mfg. Corp., 212 Durham Ave., Metuchen, N. J. —DEB
Guthman & Co., Edwin I., 15 S. Throop St., Chicago 7, Ill.—DEF
G-V Controls, 28 Hollywood Pl., E. Orange, N. J.—DEA
Hadley, Robert M., 5112 S. Hoover St., Los Angeles, Calif.—DEC
Halldorson Transformer Co., 4500 Ravenswood Ave., Chicago 40, Ill.—DEB, DEC
Hallett Mfg. Co., 1601 W. Florence Ave., Inglewood, Calif.—DDA, DDM
Hamilton-Hall Mfg. Co., 227 N. Water St., Milwaukee 2, Wisc.—DDU
Hammarlund Mfg. Co., 460 W. 34 St., New York 1, N. Y.—DDB
Hansell, Inc., U., 50 Liberty St., Westerly, R. I.—DDC
Hardwick, Hindle, Inc., 40 Hermon St., Newark, N. J. —DDU, DDV
Hart Mfg. Co., 110 Bartholomew Ave., Hartford 1, Conn.—DDS, DDW, DDZ
Haydon Mfg. Co., 245 E. Elm, Torrington, Conn.—DEA
Heinemann Electric Co., Penna. Ave. & Plum St., Trenton 8, N. J.—DDK, DEA, DEI
Helipot Corp., 916 Meridian Ave., S. Pasadena, Calif.—DDV
Herlec Corp., 422 N. 5 St., Milwaukee 3, Wisc.—DDC
Hetherington, Inc., 1200 Elmwood Ave., Sharon Hill, Pa.—DDW
Highland Engineering Co., Main & Urban, Westbury, L. I., N. Y.—DDN, DEB, DEC, DED
Hindle Transformer Co., Woods Church Rd., Flemington, N. J.—DEB, DEC, DED
Hi-Q Division, Aerovox Corp., Olean, N. Y.—DDC, DDU
Hopkins Eng'g. Co., 2082 Lincoln Ave., Altadena, Calif. —DDM
Hufco Industries, Burbank, Calif.—DDQ, DDS
Hycor Co., 11423 Vanowen St., N. Hollywood, Calif.—DDO
Illinois Condenser Co., 1616 N. Throop St., Chicago 22, Ill.—DDD
Imperial Radar & Wire Corp., 4342 Bronx Blvd., Bronx 66, N. Y.—DDA
Industrial Condenser Corp., 3243 N. Calif. Ave., Chicago 18, Ill.—DDA
INET, Inc., 8655 S. Main St., Los Angeles 3, Calif.—DDP, DEC
Instrument Resistors Co., 1036 Commerce Ave., Union, N. J.—DDU
International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.—DDP
International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa.—DDU, DDV
I-T-E Circuit Breaker Co., Resistor Div., 19 & Hamilton Sts., Philadelphia 30, Pa.—DDL, DDU, DDV
Jacobs Instrument Co., 4718 Bethesda Ave., Bethesda 14, Md.—DED
J-B-T Instruments, Inc., 441 Chapel St., New Haven 8, Conn.—DDW, DDZ
Jeffers Electronics Div., Speer Carbon Co., DuBois, Pa. —DDC
Jefferies Transformers Co., 1710 E. 57 St., Los Angeles, Calif.—DEC
Jefferson Electric Co., 900 25 Ave., Belwood, Ill.—DEB
Jennings Radio Mfg. Co., 970 McLaughlin Ave., San Jose 8, Calif.—DDJ, DEH
JFD Electronics, 6127 16th Ave., Brooklyn 4, N. Y.—DDB
Johnson Co., E. F., Waseca, Minn.—DDB, DDH, DDN, DDO, DDQ,

Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago 38, Ill.—DDA, DDR, DDW
Kenyon Transformer Co., 840 Barry St., New York 59, N. Y.—DEC
Keystone Products Co., 904 23 St., Union City 6, N. J.—DEC
K-F Development Co., 867 Woodside Way, San Mateo, Calif.—DDV
Kolton Electric Mfg. Co., 123 N. J. Railroad Ave., Newark 5, N. J.—DDK, DDY
Kulka Electric Mfg. Co., 633 S. Fulton Ave., Mt. Vernon, N. Y.—DDY
Kurman Electric Co, 35-18 37 St., Long Island City, 1, N. Y.—DDS
K. V. Transformer Corp., 4412 Park Ave., New York 57, N Y.—DEB, DEC, DED
Kyle Corp., S. Milwaukee, Wisc.—DEC
Langevin Mfg. Corp., 37 W. 65 St, New York 23, N Y. —DDM, DEB, DEC, DED
Lapp Insulator Co., Gilbert St., Le Roy, N. Y.—DDH
Leach Relay Co., 5915 Avalon Blvd., Los Angeles 3, Calif.—DDQ, DDR, DDS
Lectrohm, Inc., 5560 Northwest Hway., Chicago 30, Ill. —DDU
Lenkurt Electric Co., 1105 County Rd., San Carlos, Calif.—DDN, DEB
Lenz Electric Mfg. Co., 1751 N. Western Ave., Chicago 47, Ill.—DDA
Leonard Electric Products Co., 67 34th St., Brooklyn 32, N. Y.—DDN, DEB, DEC, DED
Legri S Co., 158 W. 99 St., New York 25, N. Y.—DDU, DDV
Leland, Inc., G. H., 123 Webster St., Dayton 2, Ohio—DDP, DDY, DDZ
Linell Engineering Corp., Oak Park, Ill.—DDO
Lionel Corp., Irvington, N. J.—DDK, DDP, DDQ, DDR, DDS, DDY, DEA, DEB, DEC
Lumenite Electronic Co., 407 S. Dearborn St., Chicago 5, Ill.—DDS, DDY, DEA
Luther Electronic Mfg. Co., 5767 W. Adams Blvd., Los Angeles 16, Calif.—DDD
McIntosh Lab., Inc., 320 Water St., Binghamton, N. Y. —DEB
Magnavox Co., Bueter Rd., Ft. Wayne 4, Ind.—DDD, DEB, DEC
Mallory & Co., P. R., 3029 E. Washington St., Indianapolis 6, Ind.—DDC, DDD, DDE, DDF, DDG, DDI, DDM, DDP, DDU, DDV, DDW, DDY, DDZ, DEA
Mark Products Co., 3547 Montrose, Chicago, Ill.—DDQ
Maxson Corp., W. L., 460 W. 34 St., New York 1, N. Y.—DDW
Melco Products, Inc., 22 E. Hennepin Ave., Minneapolis 1, Minn.—DEC
Mepco, Inc., Morristown, N. J.—DDU
Merit Coil & Transformer Corp., 4427 N. Clark St., Chicago 40, Ill.—DDL, DDM, DDN, DDO, DEB, DEC
Micamold Products Corp., 1087 Flushing Ave., Brooklyn, N. Y.—DDD, DDG, DDV
Mico Instrument Co., 80 Trowbridge St., Cambridge 38, Mass.—DDN
Microlab, 301 S. Ridgewood, S. Orange, N. J.—DDM
Midwest Coil & Transformer Co., 1624 N. Halsted St., Chicago 14, Ill.—DEB, DEC, DED
Millen Mfg. Co., James, 150 Exchange St., Malden 48, Mass.—DDO
Miller Co., B. F., Box 568, Trenton, N. J.—DDN
Miller Co., J. W., 5917 S. Main St., Los Angeles 3, Calif.—DDM, DDN, DDO
Minn.-Honeywell Regulator, Micro Div., Freeport, Ill. —DDW, DDX, DDY
Model Engineering & Mfg. Inc., 237 E. Park Dr., Huntington, Ind.—DDU
Modulation Products Co., 56 Lispenard St., New York 13, N. Y.—DDE, DDF
Monarch Mfg. Co., 2014 N. Major Ave., Chicago 39, Ill.—DDN
Mucon Corp., 9 St. Francis St, Newark 5, N. J.—DDC
Mullenbach Electric Mfg., 2300 E. 27 St., Los Angeles, Calif.—DEC
Muter Co., 1255 S. Michigan Ave., Chicago 5, Ill.—DDC, DDU
National Co., Malden, Mass.—DDB
Nazareth Transformer Corp., 12 North St., Danbury, Conn.—DEC
Neomatic Inc., 9010 Bellanca Ave., Los Angeles 45, Calif.—DDQ, DDR, DDS, DDT
Neptune Electronics Co., 433 Broadway, New York 13, N. Y.—DDF, DDG, DDM, DDU, DDV
Network Mfg. Corp. 213 W. 5 St., Bayonne, N. J.—DDW
North Electric Mfg. Co., 501 S. Market St., Galion, Ohio—DDQ, DDR, DDS, DEC
Nothelfer Winding Lab., 118 Albemarle Ave., Trenton, N. J.—DEC
Ogden Coil & Transformer Co., 2130 W. Carroll Ave., Chicago 12, Ill.—DEB, DEC, DED
Ohio Carbon, 12508 Berea Rd., Cleveland, Ohio—DDU
Ohmite Mfg. Co., 4835 W. Flournoy St., Chicago 44, Ill.—DDU, DDV, DDY
Okonite Co., Passaic, N. J.—DDA
Orthon Corp., 196 Albion Ave., Paterson 2, N. J.—DDM, DDN
Osborne Transformer Corp., 948 E. Lafayette Ave., Detroit 7, Mich.—DDN, DEC
Pacific Transducer Corp., 11921 S. W. Pico Blvd., Los Angeles 64, Calif.—DEB
Parts Producing Corp., Manhattan Div., 1861 2 Ave., New York 28, N. Y.—DDB, DDJ, DDR, DDW
PCA Inc., 6368 DeLongpre Ave., Hollywood 28, Calif. —DDN, DDO, DEB, DEC, DED, DEF
Peerless Electrical Products, 6920 McKinley Ave., Los Angeles 1, Calif.—DEB
Penn-Tran Corp., Bellefonte, Pa.—DDN, DEB, DEC
Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill. —DDR, DEB
Phalo Plastics Corp., 25 Foster St., Worcester 4, Mass. —DDA
Phaostron Co., 151 Pasadena Ave., S. Pasadena, Calif. —DDQ, DDS
Phillips Control Corp., 84 W. Jefferson St., Joliet, Ill. —DDQ, DDR, DDS, DDT
Philmore Mfg., 113 University Pl., New York 3, N. Y.—DDD, DDE, DDG, DDZ, DEB, DEC
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Precision Resistor Co., 334 Badger Ave., Newark 8, N. J. —DDO
Priee Electric Corp., Church & 2 Sts., Frederick, Md. —DDQ, DDR, DDS, DDT
Pyramid Electric Co., 1445 Hudson Blvd., N. Bergen, N. J.—DDD, DDF, DDG
Radio Corp. of America, RCA Tube Dept., Harrison, N. J. DDL, DEC, DED
Radio Materials Corp., 3324 N. California Ave., Chicago 18, Ill.—DDC, DDE
Radio-Music Corp., 84 S. Water St., Port Chester, N. Y. —DEB, DEC
Radio Receptor Co., 251 W. 19 St., New York 11, N. Y. —DDP
Ram Eectronics, Inc., S. Buckout St., Irvington-On-Hudson, N. Y.—DDL, DEB, DED
R-B-M Div., Essex Wire Corp., Hanna & Chestnut, Logansport, Ind.—DDQ, DDR, DDS
Recora Co., 7419 S. Western Ave., Chicago 36, Ill.—DDY, DEA
Relay Sales, 4721 W. Madison St., Chicago 44, Ill.—DDQ, DDR, DDS, DDT
Resdel Engineering Corp., 2351 Riverside Dr., Los Angeles 39, Calif.—DDM
Resistance Products, 714 Race, Harrisburg, Pa.—DDU
Rex Rheostat, 3 Foxhurst Rd., Baldwin, N. Y.—DDV
Reynolds Electronics Corp., 507 West St., New York 14, N. Y.—DDC
Rhodes, Inc., M. H., 30 Bartholomew Ave., Hartford 6, Conn.—DEA
Roanwell Corp., 662 Pacific St., B'klyn, N. Y.—DDW
Rockbestos Products Corp., 285 Nicoll St., New Haven 4, Conn.—DDA
Rome Cable Corp., Ridge St., Rome, N. Y.—DDA
Runzel Cord & Wire Co., 4723 W. Montrose Ave., Chicago 41, Ill.—DDA
Sangamo Electric Co., Capacitor Div., Marion, Ill. —DDD, DDE, DDF, DDG
Schuttig & Co., 9 & Kearney Sts. N. E., Washington 17, D. C.—DDQ
Shallcross Mfg. Co., Pusex & Jackson Aves., Collingdale, Pa.—DDV, DDZ
Sickles Co., F W., Div. General Instrument Corp., 165 Front St., Chicopee, Mass.—DDO
Sigma Instruments Inc., 170 Pearl St., S. Braintree, Boston, Mass.—DDR
SNC Mfg. Co., Box 277, Oshkosh, Wisc.—DEB, DEC
Solar Mfg. Corp., 2660 E. 46 St., Los Angeles 58, Calif.—DDC, DDE
Sound Sales & Engineering Co., 2005 LaBranch, Houston 3, Tex.—DDA, DEB
Southwestern Industrial Electronics Co., 2831 Post Oak Rd., Houston 19, Tex.—DDN, DEB, DEC
Specialties, Inc., Skunks Misery Rd., Syosset, L. I., N. Y.—DEB, DEC, DED
Sprague Electric Co., 233 Marshall St., N. Adams, Mass. —DDC, DDD, DDU
Square D Co., 4041 N. Richards St., Milwaukee 12, Wisc.—DDK, DDS, DDU, DDY, DEA
Square Root Mfg. Co., 391 Saw Mill River Rd., Yonkers 2, N. Y.—DDN, DDO, DEB, DEC, DED
Stackpole Carbon Co., St. Marys, Pa.—DDV
Standard Arcturus, 54 Clark, Newark, N. J.—DDP
Standard Coil Products Co., 2329 N. Pulaski Rd., Chicago 39, Ill.—DDM, DDO
Standard Electrical Products Co., 400 E. 1st St., Dayton 2, Ohio—DEB, DEC
Standard Electronics Corp., 285 Emmet St., Newark 5, N. J.—DEB, DEC
Standard Electronics Mfg. Co., 11861 Teale St., Culver City, Calif.—DDV
Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.—DEB, DEC, DED
Standard Winding Co., 44-62 Johnes St., Newburgh, N. Y.—DEB, DEC
Stevens-Arnold, 22 Elkins, S. Boston, Mass.—DDR
Stromberg-Carlson Co., 1225 Clifford Ave., Rochester, N. Y.—DDR
Struthers-Dunn, Inc., 150 N. 13 St., Philadelphia 7, Pa.—DDK, DDQ, DDR, DDS
Super Electric Products Corp., 46 Oliver St., Newark, N. J.—DEB
Switchcraft, 1328 N. Halsted, Chicago, Ill.—DDW
Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill.—DDL, DED
Tartak-Stolle Electronics, 3970 S. Grand Ave., Los Angeles 37, Calif.—DDM, DDN, DDO, DEB, DEC, DED
Tarzian, Inc., Sarkes, Rectifier Div., 415 N. College Ave., Bloomingdale, Ind.—DDP
Tech Labs., Inc., Bergen & Edsall Blvd., Palisades Park, N. J.—DDZ, DEA
Telechrome, Inc., 88 Merrick Rd., Amityville, L. I., N. Y.—DED
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—DDM, DEB, DEC, DED
Telctronic Laboratories, Inc., 1835 W. Rosecrans Ave., Gardena, Calif.—DDA
Telex, Inc., Telex Park, St. Paul, Minn.—DDU
Tel-Rad, Fennimore, Wisc.—DDQ, DDR, DEC
Tetrad Co., 4054 Ocean Park Ave., Venice, Calif. —DDM, DDN, DEB, DEC, DED
Thermador Electrical Mfg. Co., 5119 District Blvd., Los Angeles 22, Calif.—DDN, DEB, DEC
Thor Transformers & Electronics, 750 San Angonio Rd., Palo Alto, Calif.—DEC
Thordarson-Meissner Mfg. Div., Maguire Industries, Ind., 7 & Belmont, Mt. Carmel, Ill.—DDL, DEB, DEC
Todd-Tran Corp., 752 S. 3rd Ave., Mt. Vernon, N. Y. —DDL, DEB, DEC
Transformer Engineers, 161 E. Calif. St., Pasadena 1, Calif.—DEC
Transformer Technicians, Inc., 2608 N. Cicero Ave., Chicago 39, Ill.—DEB, DEC, DED
Trenton Transformer Corp., Box 568, Trenton, N. J. —DDN, DEB, DEC
Triad Transformer Mfg. Co., 4055 Redwood Ave., Venice, Calif.—DDN, DEB, DEC
Tri-Dex Co., Box 1207, Lindsay, Calif.—DDN, DDO
Triumph Mfg. Co., 913 W. Van Buren St., Chicago 7, Ill.—DDL
Tru-ohm Products, Div. Model Eng'g. & Mfg., Inc., 2800 N. Milwaukee Ave., Chicago 18, Ill.—DDU, DDV
T-V Products Co., 152 Sanford St., Brooklyn 5, N. Y. —DDM
Ulanet Co., George., 413 Market St., Newark 5, N. J. —DEA
U. S. Rubber Co., 1230 Avenue of the Americas, New York, N. Y.—DDA
United Transformer Co., 150 Varick St., New York 13, N. Y.—DEB, DEC, DED
Utah Radio Products Co., 1123 E. Franklin St., Huntington, Ind.—DEB, DEC, DED
Variable Condenser Corp., 63 Hope St., Brooklyn 11, N. Y.—DDP
Vacuum Tube Products, 506 S. Cleveland St., Oceanside, Calif.—DDJ
Varo Mfg. Co., 1801 Walnut St., Garland, Tex.—DEC
Vickers Elec., 1815 Locust, St. Louis, Mo.—DDP
Vincent Co., A. W., 163 St. Paul St., Rochester 4, N. Y.—DDR, DDT
Vitramon, Inc., Stepney, Conn.—DDC
Vokar Corp., 7300 Huron R. Dr., Dexter, Mich.—DDM
Wadsworth Mfg. Associates, 509 Balsam St., Liverpool, N. Y.—DDB
Ward Leonard Electric Co., Mt. Vernon, N. Y.—DDQ, DDS, DDU, DDV
Welch Electric Co., 1221 Wade St., Cincinnati 14, Ohio—DDQ, DDR, DDS, DDT, DDZ
Wells Sales, Inc., 833 W. Chicago Ave., Chicago 22, Ill.—DDW
Wilkor Products Inc., 3835 W. 150 St., Cleveland 11, Ohio -DDL
Wirt Co., 5221 Greene St., Germantown, Philadelphia 44, Pa.—DDO, DDU, DDV
Wright Zimmerman, Inc., 330 5 Ave., New Brighton 8, Minn.—DDR
Yonkers Industries, Inc., Subs. Electronic Designs, Inc., 28 School St., Yonkers, N. Y.—DDU

30—Services

Construction . . . . EEA
Design, special audio . . . . EEB
Dubbing, sound . . . . EEC
Effects record, sound . . . . EED
Equipment theater TV . . . . EEE
Kinescoping . . . . EEF
Laboratories, film processing . . . . EEG
Libraries, record . . . . EEH
Libraries, tape music . . . . EEI
Materials, special effects . . . . EEJ
Production, film . . . . EEK
Production, slides . . . . EEL
Production, TV spot film . . . . EEM
Production, transcriptions . . . . EEN
Property & scenery, TV . . . . EEO
Rental, motion picture equipment . EEP
Rental, TV film . . . . EEQ
Services, film editing, titling, etc. EER
Services, frequency measuring . . EES
Services, news . . . . EET
Services, program . . . . EEU
Services & repairs, special optical & motion picture . . . . EEV
Stages, sound . . . . EEW
Studios, film . . . . EEX

Academy Film Production, 123 W. Chestnut St., Chicago, Ill.—EEK
Acme Teleetronix Div., NEA Service, Inc., 1200 W. 3rd St., Cleveland, Ohio.
Aero Electronics Co., 1512 N. Wells St., Chicago 10, Ill.—EEB
Affiliated Film Producers, 164 E. 38th St., New York 16, N. Y.—EEL
Airplane & Marine Instruments, Clearfield, Pa.—EEA
Alexander Film Co., Alexander Film Bldg., Colorado Springs, Colo.—EEG, EEK, EEM, EEQ, EEW, EEX
Allen & Allen Productions, 3947 W. 59th Pl., Los Angeles 43, Calif.—EEK, EEM, EER, EEQ, EEU, EEW, EEX
Allied Record Mfg. Co., 1041 N. Las Palmas Ave., Hollywood 38, Calif.—EEN
Ambassador Films, Inc., 118 W. 57th St., New York 19, N. Y.—EEK
American Electroneering Corp., 5025 W. Jefferson Blvd., Los Angeles 16, Calif.—EES
American Film Producers, 1600 Broadway, New York 19, N. Y.—EEK
Animated Productions, 1600 B'dway, New York, N. Y. —EEK
Apex Film Corp., 971 N. La Cienega Blvd., Los Angeles 46, Calif.—EEK
Archer Productions, Inc., 35 W. 53rd St., New York 19, N. Y.—EEK
Associated Electronics Co., 132 Nassau St., New York 7, N. Y.—EEB, EEK, EEM, EEL, EEN, EER, EET, EEU, EEV
Atlantic Electronics Corp., 4 Manhasset Ave., Port Washington, N. Y.—EEA, EEB
Atlantic Video Corp., 18 Clinton, B'klyn, N. Y.—EEB
Atlas Film Corp., 111 S. Blvd., Oak Park, Ill.—EEK
Audio Equipment Sales, Div. F. Sumner Hall, Inc., 153 W. 33 St., New York 1, N. Y.—EEB
Audio Instrument, 133 W. 14 St., New York, N. Y. —EEB
Audio Productions, Inc., 630 Ninth Ave., New York 19, N. Y.—EEK
Audio & Video Products Corp., 730 Fifth Ave., New York 3, N. Y.—EEA, EEB, EEC, EED, EEI, EEJ, EEK, EEL, EEM, EEN, EEP, EEQ, EEW
Background Engineers, 6611 Santa Monica Blvd., Hollywood 38, Calif.—EEJ
Baldwin, Ted, 270 Park Ave., New York, N. Y.—EEK
Bardwell & McAlister, 2950 N. Ontario St., Burbank, Calif.—EEA, EEB
Baam Instruments Corp., 350 Fifth Ave., New York 1, N. Y.—EEB
Beeland Co., Charles D., 324 Walton Bldg., Atlanta 3, Ga.—EEC, EEH, EEK, EEM, EEN, EER, EEX
Bell Sound Systems, Inc., 55 Marion Road, Columbus 7, Ohio—EEB
Berkeley Custom Electronics, 2571 Shattuck Ave., Berkeley 4, Calif.—EEA, EEB
Berman & Bettenbender, 410 S. Michigan Ave., Chicago, Ill.—EEK
Bogen Co., D., 29 9th Ave., New York, N. Y.—EEB
Bowman Films, Inc., 360 N. Michigan Ave., Chicago 1, Ill.—EEK
Bray Studios, 729 7th Ave., New York 19, N. Y. —EEC, EEM, EER, EEV
Brinkley Recording Co., 232 E. Erie St., Chicago 11, Ill.—EEC, EEK, EEM, EER, EEW, EEX
Broidy Productions, Inc., William F., 5545 Sunset Blvd., Hollywood 28, Calif.—EEK
Byron, Inc., 1226 Wisconsin Ave., N. W., Washington, D. C.—EEC, EEK, EEM, EER, EEV, EEW
Burnett Radio Lab., Wm. W. L., 4814 Idaho St., San Diego 16, Calif.—EES
Calvin Mfg., 15th St. E., Kansas City, Mo.—EEK
Camburn, Inc., 32-40 57 St., Woodside, N. Y.—EEA
Camera Equipment Co., 1600 Broadway, New York 19, N. Y.—EEP, EEV
Camera Mart, Inc., 1845 Broadway, New York 23, N. Y.—EEP, EEV
Camfield Mfg. Co., Seventh St., Grand Haven, Mich. —EES
Campbell-Cahill Studio, 360 N. Michigan Ave., Chicago 1, Ill.—EEK
Capitol Records, Inc., Broadcast Div., Sunset & Vine, Hollywood 28, Calif.—EEN
Caravel Films, 730 5th Ave., New York 19, N. Y.—EEK
Cardinal Co., 6000 Sunset Blvd., Hollywood 28, Calif. —EEK, EEM, EEV, EEX
Cascade Pictures of Calif., 8822 Washington Blvd., Culver City, Calif.—EEK
C & G Film Effects, 1600 Bway, New York 19, N. Y. —EEC, EEK, EEM, EER
Chase Electronics Laboratory, 128 N. Fair Oaks Ave., Pasadena 1, Calif.—EEA, EEB
Chicago Film Laboratory, Inc., 56 E. Superior St., Chicago 11, Ill.—EEK
Church Productions, Arthur B., Pickwick Hotel, Kansas City 6, Mo.—EEK, EEQ, EEV
Cineffects, 115 W. 45th St., New York, N. Y.—EER
Cinema Research Corp., 7000 Romaine St., Hollywood 38, Calif.—EEG, EER
Cinemart, Inc., 322 E. 44th St., New York 17, N. Y. —EEC, EER, EEW, EEX
Cinescope Films, 42-45 160th St., New York 36, N. Y. —EEK
Cine-Tela Productions, 1161 N. Highland Ave., Hollywood 38, Calif.—EEG, EEK, EEM, EER
Colburn Laboratory, Inc., George W., 164 N. Wacker Drive, Chicago 6, Ill.—EEC, EEG, EEK, EEM, EEL, EEN, EER, EEV, EEX
Colonial Films, 1989 S. George Mason Dr., Arlington, Va.—EEC, EEF, EEG, EEK, EEM, EER, EET, EEV, EEW, EEX
Columbia Records, Inc., 700 Seventh Ave., New York 19, N. Y.—EEH, EEN
Columbia Transcriptions, 700 7th Ave., New York 19, N. Y.—EEN
Cousens, Clayton W., 152 W. 42nd St., New York 22, N. Y.—EEK
Commodore Productions & Artists, Inc., 1350 N. Highland Ave., Hollywood 28, Calif.—EEK
Commonwealth Film & Television Inc., 732 Seventh Ave., New York 19, N. Y.—EEQ
Consolidated Film Industries, Div. of Republic Pictures Corp., 1740 Broadway, New York, N. Y.—EEK
Constable Engineering Co., J. M., 101-05 77 St., Ozone Park 17, N. Y.—EEA
Crosby Enterprises, Inc., 9028 Sunset Blvd., Hollywood 46, Calif.—EEK
Culhane Productions, Shamus, 207 E. 37th St., New York N. Y.—EEK, EEM, EEQ, EEV
Custom Craft Mfg. Co., 256 E. 98th St., Brooklyn 12, N. Y.—EEA, EEB
Dage Electronics Corp., 69 N Second St., Beech Grove, Ind.—EEA
Damon Recording Studios, Inc., 117 W. 14 St., Kansas City 6, Mo.—EEC, EED, EEJ, EEN
Daveu Co., 193 Central Ave., Newark 4, N. J.—EEA, EEB
Dawson, Stuart V., 520 N. Michigan Ave., Chicago, Ill. —EEK
Day Productions, Gordon M., 108 E. 30th St., New York 16, N. Y.—EEK, EEM, EEN, EEV
Decca Records, Inc., 50 W. 57th St., New York 19, N. Y.—EED, EEN
DeFrenes Co., 1909 Buttonwood St., Philadelphia 30, Pa.—EEK
De Luxe Labs., 850 10th Ave., New York, N. Y.—EEK
Demby, Brown & Co., 34 E. 51st St., New York 22, N. Y.—EEK
Douglas Productions, 1425 S. Racine Ave., Chicago, Ill. —EEK
DePhoure Studios, 782 Commonwealth Ave., Boston 15, Mass.—EEK
Depicto Films, Inc., 254 W. 54th St., New York 19, N. Y—EEK
Disney Productions, Burbank, Calif.—EEK
Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wisc.—EEB
Du Art Film Labs., 245 W. 55th St., New York, N. Y. —EEK
Dubois Co., Jean, 2214 Dahlia St., Denver 7, Colo. —EEK
Dudley Television Corp., 9908 Santa Monica Blvd., Beverley Hills, Calif.—EEK, EEM
Dynamic Films, Inc., 112 W. 89th St., New York 24, N. Y.—EEC, EEF, EEK, EEM, EER, EET, EEW, EEX
Eastman Kodak Co., 343 State St., Rochester 4, N. Y. —EEC, EEF, EEK, EEM, EER, EET, EEW, EEX
EDL Co., 5929 East Dunes Hiway, Miller Station, Gary, Ind.—EEG, EEV
Education Films Corp. of Amer., 1501 Broadway, New York, 36, N. Y.—EEK
Eidson Electronic Co., 1802 N. Third St., P. O. Box 31, Temple, Tex.—EES
Electrical Tower Service, Peoria, Ill.—EEA
Electron Enterprises, 6917 W. Stanley Ave., Berwyn, Ill.—EEA
Electronic Development Laboratory, 43-07 23 Ave., Long Island City 5, N. Y.—EEA, EEB, EES, EEV
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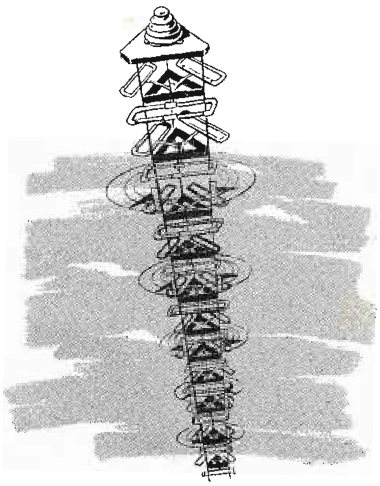

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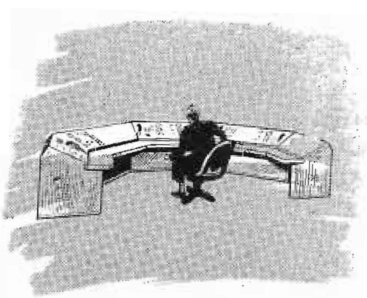

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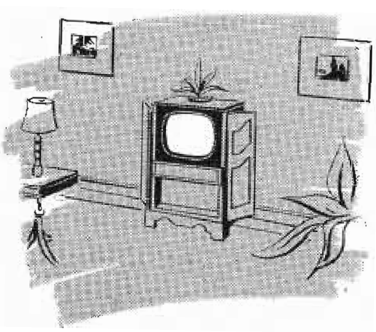

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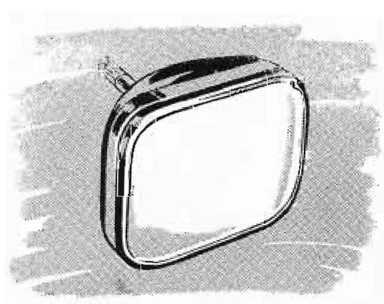

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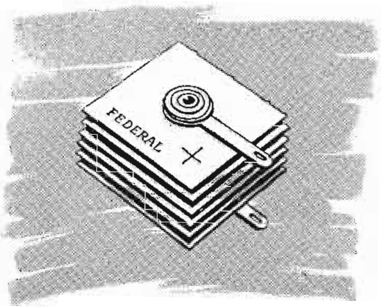

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Engineering Research & Development Co., Box 166, Hinsdale, Ill.—EEB
Equipment & Service Co., 6815 Oriole Dr., Dallas 9, Tex.—EEA, EEB
Explorers Pictures Corp., 1501 Broadway, New York 36, N. Y.—EEK
Fairbanks, Inc., Jerry, 6052 Sunset Blvd., Hollywood 28, Calif.—EEK, EEM
Fairfield Films, Inc., 40 E. 51st St., New York 22, N. Y.—EEK
Famous Artists Corp., 9441 Wilshire Blvd., Beverley Hills, Calif.—EEK
Federated Television Productions, 40 E. 40th St., New York, N. Y.—EEK, EEM, EER, EEW, EEX
Fennell Co., Paul J., 1159 N. Highland Ave., Hollywood 38, Calif.—EEK
Ferrar Radio & Television Corp., 55 W. 26 St., New York 10, N. Y.—EEA, EEB
Flmack Trailer Corp., 1327 S. Wabash Ave., Chicago 5, Ill.—EEC, EEG, EEK, EEL, EEM, EER, EEX
Film Associates, Inc., 440 E. Schantz Ave., Dayton 9, Ohio—EEC, EED, EEF, EEG, EEH, EEK, EEL, EEM, EEN, EEP, EER, EEW, EEX
Filmcraft Productions, 8451 Melrose, Hollywood, Calif. —EEK
Filmeffects of Hollywood, 1153 N. Highland Ave., Hollywood, Calif.—EEJ, EEM
Film Features Associates, 661 West End Ave., New York 25, N. Y.—EEK, EEM, EEN, EEU
Film Graphics, 245 W. 55th, New York, N. Y.—EEK
Filmlab, 126 W. 46th St., New York, N. Y.—EEK
Films for Industry, 135 W. 52nd St., New York 19, N. Y.—EEK
Fine Sound, Inc., Tomkins Cove., N. Y.—EEA, EEB, EEC, EED, EEH, EEI, EEJ, EEK, EEM, EEN, EEU, EEW, EEX
Fish-Schurman Corp., 70 Portmand Rd., New Rochelle, N. Y.—EEE, EEJ
Five Star Productions, 6526 Sunset Blvd., Hollywood 28, Calif.—EEK, EEM, EEV
Flett Laboratory, 3711 Marshall Road, Drexel Hill, Pa.—EEA, EEB
Flexon Products Corp., 249 W. 34th St., New York 1, N. Y.—EEJ, EER
Florez, 815 Bates St., Detroit 26, Mich.—EEK
Fox Movietone News, 460 W. 54th St., New York, N. Y. —EEK, EET
Freed Transformer Co., 1718 Weirfield St., 1718 Weirfield St., Broklyn 27, N. Y.—EEB
Frutchey, M., Box 28, Hackettstown, N. J.—EEA, EEB
Funt Radio Production, Allen A., 100 Central Park S., New York 17, N. Y.—EEK, EEM
Gamble Productions, Inc., 129 E. 58th St., New York, N. Y.—EEK, EET, EEQ
Ganz Co., William J., 40 E. 49th St., New York 17, N. Y.—EEK
General Pictures Productions, 621 Sixth Ave., Des Moines 9, Iowa—EEC, EEG, EEK, EER
General Precision Lab., Inc., 63 Bedford Rd., Pleasantville, N. Y.—EEE, EEF
Harold R. Gingrich, 520 N. Michigan Ave., Chicago, Ill. —EEK
G-L Enterprises, Inc., 270 Park Ave., New York 17, N. Y.—EEK
Goodman Radio & TV Productions, Harry S., 19 E. 53rd St., New York 22, N. Y.—EEK, EEM, EEV, EEX
Gorrell & Gorrell, 336 Old Hook Rd., Westwood, N. J. —EEA
Gotham Recording Corp., 2 W. 46 St., New York 36, N. Y.—EEA, EEN, EEP, EEV, EEW
Gray-O-Reilly Studios, 480 Lexington Ave., New York, N. Y.—EEK, EEM
Guffanti Film Labs., Inc., 630 9th Ave., New York, N. Y.—EEK
Gulton Mfg. Corp., 212 Durham Ave., Metuchen N. J. —EEB
G & W Television Productions, Inc., 307 E. 44th St., New York 17, N. Y.—EEK
Handy, Jam Organization, 2821 E. Grand Blvd., Detroit 11, Mich.—EEB, EEC, EED, EEJ, EEK, EEM, EEL, EEN, EEO, EEP, EEQ, EER, EEV, EEW, EEX
Hankinson Studio, 15 W. 46th St., New York, N. Y. —EEK
Hart, Arthur H., 2125 32 Ave., San Francisco 16, Calif.—EEU
Hartley Productions, 20 W. 47th St., New York 19, N. Y. —EEK, EEV
Hartman Engineering Co., 117 Oakland St., Springfield, Mass.—EEA
Harvey-Wells Electronics, Inc., North St., Southbridge, Mass.—EEA, EEB
Heller & Associates, Herman S., 8414 W. 3 St., Los Angeles 48, Calif.—EEC
Holbert Productions, 1564 Broadway, New York 19, N. Y.—EEK
Houston-Fearless Corp., 11801 W. Olympic Blvd., West Los Angeles 64, Calif.—EEG
Hycon Mfg. Co., 2961 E. Colorado St., Pasadena 8, Calif.—EEA
Hycor Co., 11423 Vanowen, N. Hollywood, Calif.—EEB
Industrial Electronic Engineers, 3973 Lankershim Blvd., N. Hollywood, Calif.—EEA, EEB
Int'l Movie Producer's, 515 Madison Ave., New York 22, N. Y.—EEH, EEM, EEP, EER, EEW, EEX
International News Service, 235 E. 45th St., New York 17, N. Y.—EET
Int'l Research Associates, A Div. of Iresco Inc., 2221 Warwick Ave., Santa Monica, Calif.—EES
International Tele-Film, Inc., 331 Madison Ave., New York 17, N. Y.—EEK
Intervox Corp., 1846 Westlake N., Seattle 9, Wash. —EEA, EEB
Ivanhoe Electronic Laboratories, 14238 S. LaSalle St., Chicago 27, Ill.—EES
Jarvis Electronics, 6058 W. Fullerton Ave., Chicago 39, Ill.—EEA
Jewell Radio & Television Productions, 185 N. Wabash Ave., Chicago, Ill.—EEK
Jones Productions, Dallas, 1725 N. Wells St., Chicago, Ill.—EEK
Kalbfell Laboratories, Inc., P. O. Box 1578, San Diego 10, Calif.—EEA
Kaleb Film Co., 19 W. 45th, New York, N. Y.—EEK
Kenco Productions, 333 W. 52nd, New York, N. Y. —EEK

Kerkow, H., 480 Lexington Ave., New York, N. Y. —EEK
Kling Studio, Inc., 601 N. Fairbanks Ct., Chicago, Ill. —EEC, EEF, EEK, EEM, EEL, EEN, EEO, EEQ, EER, EET, EEU, EEW, EEX
Knickerbocker Productions, 1600 Broadway, New York 19, N. Y.—EEK, EEM, EEL, EER
Kollmorgen Optical Corp., 2 Franklin Ave., Brooklyn 11, N. Y.—EEV
Korb Engineering & Mfg. Co., 30 Ottawa Ave., Grandville, Mich.—EEB
Lailey & Love, Inc., 3 E. 57th St., New York 22, N. Y.—EEK
Langevin Mfg. Corp., 37 W. 65 St., New York 23, N. Y.—EEB
Lang-Worth Feature Programs, 113 W. 57th St., New York 19, N. Y.—EEC, EEH, EEV, EEX
Las-Lab, 316 W. Saratoga St., Baltimore 1, Md.—EEV
Laufman & Co., Herbert S., 624 S. Michigan Ave., Chicago, Ill.—EEK
Laurence Productions, Robt., 418 W. 54th St., New York, N. Y.—EEK
Lehman, Harry, 11-61 N. Highland Ave., Hollywood 38, Calif.—EEK, EEM
Lewis Sound Films, 75 W. 45th, New York, N. Y.—EEK
Libra Film & Equipment, 6525 Sunset Blvd., Hollywood 28, Calif.—EEK, EEL, EEM, EEQ, EER, EET, EEU
Lion Television Pictures, 1501 Broadway, New York 36, N. Y.—EEK
Lloyds Film Storage Corp., 729 Seventh Ave., New York, N. Y.—EEJ, EEP
London Film Productions, 350 5th Ave., 148 W. 57th St., New York, N. Y.—EEK, EEQ, EEU
Loucks & Norling Studios, Inc., 245 W. 55th St., New York 19, N. Y.—EEK, EEM, EEL, EER, EEV

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Mannon Sound Stages, Inc., 112 W. 89th St., New York 24, N. Y.—EEC, EEO, EER, EEW, EEX
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Packaged Programs, Inc., 634 Penn Ave., Pitsburgh 22, Pa.—EEG, EEK, EEM, EEL, EEN, EER, EET, EEU
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Paramount TV Productions, Inc., 1501 Broadway, New York 18, N. Y.—EEE, EEF, EEX

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PCA Inc., 6368 DeLongpre Ave., Hollywood 28, Calif. —EEA, EEB, EES
Philco Corp., Government & Industrial Div., 4700 Wissahickon Ave., Philadelphia 44, Pa.—EEA
Pictorial Films, Inc., 1501 Broadway, New York 18, N. Y.—EEK
Post Pictures Corp., 115 W. 45th St., New York 19, N. Y.—EEK
Precision Film Laboratories, Inc., 21 W. 46 St., New York 36, N. Y.—EEG
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Proekter, Bernard J., 221 W. 57th St., New York 19, N. Y.—EEK
Radio Laboratories, 1846 Westlake N., Seattle 9, Wash.—EEA, EEB
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Radio Sonic Corp., 186 Union Ave., New Rochelle, N. Y.—EEA, EEB
RAM Productions, 661 West End Ave., New York 25, N. Y.—EEN, EEU
Rarig Motion Picture Co., 5514 University Way, Seattle 5, Wash.—EEK
Ray Film Industries, Reid H., 2269 Ford Parkway, St. Paul 1, Minn.—EEK
RCA Communications, Inc., 66 Broad St., New York 4, N. Y.—EES, EEU
RCA Recorded Program Services, 630 5th Ave., New York, N. Y.—EEC, EEH, EEN, EEU
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Reeves Sound Studios, 304 E. 44th St., New York 19, N. Y.—EEB, EEC, EEM, EEN, EER, EEW
Remler Co., Ltd., 2101 Bryant St., San Francisco 10, Calif.—EEB
Republic Television Features, 64 E. Lake St., Chicago, Ill.—EEK
RKO-Pathe, 625 Madison Ave., New York 22, N. Y. —EEK, EEM
Roach Studios, Hal, 8822 Washington Blvd., Culver City, Calif.—EEK, EEM
Rocket Pictures Inc., 6108 Santa Monica Blvd., Hollywood 38, Calif.—EEK
Rockett Co., Frederick K., 6063 Sunset Blvd., Hollywood 28, Calif.—EEK
Sherwin, Robert Rodgers, 720 N. Michigan Ave., Chicago, Ill.—EEK
Rolab Photo-Science Labs., Sandy Hook, Conn.—EEK
Rosen Eng'g Prods, Raymond, 32 & Walnut Sts., Philadelphia 4, Pa.—EEB
Rowe Industries, 1702 Wayne St., Toledo 9, Ohio—EEB
Royal Recording Co., 601 Ashby Ave., Berkley 10, Calif.—EEC, EEW
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Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif.—EEA
Sackett Productions, Bernard L., Bankers Securities Bldg., Philadelphia 7, Pa.—EEU
Sarra, Inc., 16 Ontaria St., Chicago 11, Ill.—EEK, —EEA
Schumaker Construction Co., Michigan City, Ind., —EEA
Science Pictures, Inc., 5 E. 57th St., New York 22, N. Y.—EEK
Screen Gems, Inc., 729 7th Ave., New York 19, N. Y. —EEK
Screen Televideo Products, 328 S. Beverley Drive, Hollywood, Calif.—EEK
Seaboard Studios, Inc., 157 E. 69th St., New York 21, N. Y.—EEB
Sealtron Co., The, 9701 Reading Road, Cincinnati 15, Ohio—EEA, EEB
Sellers Co., 905½ Main St., Dallas, Tex.—EEC, EED, EEI, EEN
Sesac, Inc., 475 Fifth Ave., New York 17, N. Y. —EEH, EEU
Sherwood Pictures Corp., 1569 Broadway, Brooklyn 7, N. Y.—EEQ, EEU
Shevers, Inc., Harold, 123 W. 64 St., New York 23, N. Y.—EEB
Shrader Mfg. Co., 2803 M. St., N. W., Washington, D. C.—EEA, EEB
Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif.—EEA, EEB
Simmel-Meservey, Inc., 321 S. Beverly Dr., Beverly Hills, Calif.—EEH, EEK, EEQ, EEU, EEX
Skiatron Electronics & Television, 30 E. 10th St., New York, N. Y.—EEE
Skyline Productions, 127 E. 61st St., New York 21, N. Y.—EEK
Smith Studios, Fletcher, 321 E. 44th St., New York 17, N. Y. —EEK
Snader Productions, 328 S. Beverly Drive, Beverly Hills, Calif.—EEK
S. O. S. Cinema Supply Corp., 602 W. 52 St., New York 19, N. Y.—EEP, EEV
Sound Laboratories, 323 E. 48 St., New York 17, N. Y.—EEB
Sound Masters, Inc., 165 W. 46th St., New York 19, N. Y.—EEK
Sound Sales & Engineering Co., 2005 LaBranch, Houston 3, Tex.—EEA, EEB, EEC, EEE, EEN
Souvaine Co., 30 Rockefeller Plaza, New York 20, N. Y.—EEU
Special Instruments Laboratory, Inc., 1003 Highland Ave., Knoxville, Tenn.—EEA
Special Purpose Film, Inc., 44 W. 56th St., New York 19, N. Y.—EEK
Square Root Mfg. Co., 391 Saw Mill River Road, Yonkers 2, N. Y.—EEB
Sterling Television Co., Inc., 316 W. 57th St., New York 19, N. Y.—EEK
Sturm, Bill Studios, 734 Broadway, New York, N. Y. —EEK

Streech, Wilbur Productions, 1697 Broadway, New York 19, N. Y.—EEK
Sun Dial Films, Inc., 341 E. 43rd St., New York 17, N. Y.—EEK, EEM, EEL, EER, EEU, EEW, EEX
Sutherland Productions, Inc., John, 201 N. Occidental Blvd., Los Angeles 26, Calif.—EEK
Swank Films, 627 Salem, Dayton 2, Ohio—EEX
Synchromatic Prods., 766 Broadway, Bayonne, N. J. —EEL, EEM
Tape Recording Apparatus Co., Box 221, Caldwell, N. J.—EEB
Tape Recording Industries, 3335 E. Michigan Ave., Lansing, Mich.—EEI
Tech Labs, Inc., Bergen & Edsall Blvd., Palisades Park, N. J.—EEC
Teevee Co., The, 211 S. Beverly Drive, Beverly Hills, Calif.—EEK
Telamerica, Inc., 270 Park Ave., New York 17, N. Y. —EEK
Telecast Films, Inc., 112 W. 48th St., New York 19, N. Y.—EEK
Telechrome, Inc., 88 Merrick Rd., Amityville, L. I., N. Y.—EEE, EEF
Telectro Industries Corp., 35-16 37 St., Long Island City 1, N. Y.—EEA, EEB
Telefex, 5919 Hollywood Blvd., Hollywood 28, Calif. —EEJ, EEL, EEP, EEU, EEV
Telefilm, Inc., 6039 Hollywood Blvd., Hollywood 28, Calif.—EEC, EED, EEF, EEH, EEK, EEM, EEQ, EER, EEW, EEX
Telemated Cartoons, 70 E. 45th St., New York 17, N. Y.—EEC, EEK, EEM, EEQ, EER
Telenews Productions, Inc., 630 Ninth Ave., New York 19, N. Y.—EEK, EEM, EER, EET, EEU
Telepix Corp., 6233 Hollywood Blvd., Hollywood 28, Calif.—EEC, EED, EEK, EEM, EEL, EEN, EER, EEW, EEX
Television Cartoons, Inc., 155 W. 46 St., New York 13, N. Y.—EEC, EEK, EEM, EEQ, EER
Television Graphics, 245 W. 55th St., New York, N. Y. —EEK
Television Screen Productions, 17 E. 45th St., New York 17, N. Y.—EEK, EEM
Tel-Instrument Co., 50 Paterson Ave., E. Rutherford, N. J.—EEA
Tempo Record Co. of America, 8540 Sunset Blvd., Hollywood 28, Calif.—EEH
Tel Ra Productions, 1518 Walnut St., Philadelphia 2, Pa.—EEK
Times Square Prods., 145 W. 45th St., New York 19, N. Y.—EEK
Tonechek Recordings, 11 Pleasant Ct., Maywood, N. J. —EEA, EEC, EED, EEN
Tower Construction Co., 107 4th St., Sioux City, Iowa—EEA
Transfilm, Inc., 35 W. 45th St., New York 19, N. Y. —EEK, EEM
Transitron, Inc., 154 Spring St., New York 12, N. Y.—EEA
TransLux Corp., 1270 6th Ave., New York 20, N. Y. —EEJ
Transmitter Equipment Mfg. Co., 345 Hudson St., New York 14, N. Y.—EEB
Transvideo Corp. of America, 2 W. 46th St., New York 19, N. Y.—EEK
Tressel Television Productions, Inc., 11 S. La Salle, Chicago, Ill.—EEK, EEM, EEL, EEX
Triad Transformer Mfg. Co., 4055 Redwood Ave., Venice, Calif.—EEB
Tri-Dex Co., Box 1207, Lindsay, Calif.—EEA
Tru-Vue Television Co., 99 Featherbed Lane, Bronx 52, N. Y.—EEA, EEB, EEV
TV-Unlimited, Inc., 341 Madison Ave., New York 17, N. Y.—EEK
Twentieth Century Fox Co., 444 W. 56th St., New York, N. Y.—EEK, EEM
United Broadcasting Co., 301 E. Erie St., Chicago, Ill. —EEK
United Productions of America, 40 W. Olive Ave., Hollywood, Calif.—EEK
United World Films, Inc., 445 Park Ave., New York 29, N. Y.—EEK, EEM, EEL, EEQ
Unity Television Corp., 1501 Broadway, New York 18, N. Y.—EEK
U. S. Recording Co., 1121 Vermont Ave., N. W., Washington 5, D. C.—EEB, EEC
Van Praag Productions, 1600 Broadway, New York 19, N. Y.—EEK
Valentino, Inc., Thomas J., 150 46th St., New York 36, N. Y.—EEC, EED, EEH, EEN, EET
Video Films, 1004 E. Jefferson Ave., Detroit 14, Mich. —EEC, EEK, EEM, EEP, EER
Video Varieties Corp., 41 E. 50th St., New York 22, N. Y.—EEK, EEM, EER, EEW, EEX
Vidicam Pictures Corp., 240 E. 39th St., New York 16, N. Y.—EEK
Visual Methods, Inc., 336 Second Nat'l. Bk. Bldg., Akron, Ohio—EEK
Vogue Wright Studios, 237 E. Ontario St., Chicago 11, Ill.—EEK, EEM, EEL, EEN, EER, EEU, EEX
Walkirt Co., The, 145 W. Hazel St., Inglewood 3, Calif.—EEA, EEB
Waveforms, Inc., 333 Sixth Ave., New York 14, N. Y.—EEB
West Coast Sound Studios, 510 W. 57th St., New York 19, N. Y.—EEK, EEM, EEX
Western Instrument Co., 826 N. Victory Blvd., Burbank, Calif.—EEV
Western Sound & Electric Labs., Inc., 805 S. 5th St., Milwaukee 4, Wis.—EEB
Wilding Picture Productions, 1345 Argyle St., Chicago 40, Ill.—EEK, EEM
Willard Pictures, Inc., 45 W. 45th St., New York 19, N. Y.—EEK
Williams, Brown & Earle, Inc., 918 Chestnut St., Philadelphia 7, Pa.—EEP
Wind Turbine Co., E. Market St. & P. R. R., West Chester, Pa.—EEA
Winik Films, Inc., 625 Madison Ave., New York, N. Y. —EEK EEM
Wolff Studios, Raphael G., 5631 Hollywood Blvd., Hollywood 28, Calif.—EEK
Woodruff Associates, 210 E. 41st St., New York 22, N. Y.—EEK, EEM, EEL, EEO, EEP, EER, EEU, EEV, EEW, EEX
WOR Recording Studios, 1440 Broadway, New York 18, N. Y.—EEN, EEW
World Broadcasting System, 488 Madison Ave., New York 22, N. Y.—EEH, EEU
Wyeth Eng'g, 6021 Dempster St., Morton Grove, Ill. —EEA
Ziv Television Programs, Inc., 1529 Madison Rd., Cincinnati 6, Ohio—EEH, EEN, EEU

31—Batteries

Dry . . . . FFA
Dry, portable . . . . FFB
Hearing Aid type . . . . FFC
Nickel-Alkaline . . . . FFD
Storage, fixed . . . . FFE
Storage, portable . . . . FFF

Acme Battery Co. 59 Pearl St., B'klyn, N. Y.—FFA
Bond Electric Corp., Div. of Olin Industries, New Haven 4, Conn.—FFB
Bright Star Battery Co., 600 Getty Ave., Clifton, N. J. —FFA, FFB
Burgess Battery Co., Freeport, Ill.—FFA, FFB, FFC
Camera Mart, 1845 B'dway., New York, N. Y.—FFF
Electric Storage & Battery Co., P. O. Box 8109, Philadelphia 1, Pa.—FFE, FFF
Electronic Batteries, Inc., 34 35th St., Brooklyn 32, N. Y.—FFF
Electronic Development Lab., 43-07 23 Ave., Long Island City 5, N. Y.—FFA, FFB, FFE, FFF
Galvanic Products Corp., 110 E. Hawthorne Ave., Valley Stream 10, N. Y.—FFB, FFC, FFF
Gamewell Co., 1238 Chestnut St., Newton Upper Falls 64, Mass.—FFE
General Dry Batteries, Inc., 13000 Athens Ave., Cleveland 7, Ohio—FFA
Kinevox Inc., 116 S. Hollywood Way, Burbank, Calif. —FFB
Mallory & Co., P. R., 3029 E. Washington St., Indianapolis 6, Ind.—FFA, FFB, FFC
National Carbon Co., 30 E. 42 St., New York 17, N. Y.—FFA, FFB, FFC
Nickel Cadmium Battery Corp., Pleasant St., Easthampton, Mass.—FFD, FFE, FFF
Olin Industries, Inc., Electrical Div., Winchester Ave., New Haven 4, Conn.—FFA, FFB, FFC
Radio Corp. of America, RCA Tube Dept., Harrison, N. Y.—FFA, FFB, FFC
Ray-O-Vac Co., 212 E. Washington Ave., Madison 10, Wisc.—FFA, FFB, FFC
Sonotone Corp., Box 200, Elmsford, N. Y.—FFD
Specialty Battery Co., 212 E. Washington Ave., Madison 3, Wisc.—FFA, FFB
Willard Storage Battery Co., 246 E. 131st St., Cleveland, 1, Ohio—FFB, FFE, FFF

32—Power Supplies

Chargers, battery . . . . GGA
Converters, rotary . . . . GGB
Converters, vibrator . . . . GGC
Regulators, 60 cps. . . . . GGD
Regulators, 400 cps. . . . . GGE
Sets, generator engine driven . . . GGF
Supplies, AC/DC . . . . GGG
Supplies, regulated power . . . . . . GGH
Supplies, special purpose . . . . GGI
Supplies, variable frequency . . . GGJ

Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.—GGA, GGG, GGH, GGI, GGJ
Acme Electric Corp., Water St., Cuba, N. Y.—GGA
Acorn Electronics Corp., Box 348, Gibson City, Ill.—GGG, GGH, GGI, GGJ
Air Associates Inc., 511 Joyce, Orange, N. J.—GGI
Airpax Products Ca., Middle River, Baltimore 20, Md.—GGA, GGC, GGD, GGE, GGG, GGH, GGI
Allied Allegri Machine Co., 141 River Rd., Nutley 10, N. J.—GGH
Allis-Chalmers, 935 S. 70 St., Milwaukee 1, Wisc.—GGD, GGE
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—GGH
American Bosch Corp., Springfield 7, Mass.—GGA
American Electroneering Corp., 5025 W. Jefferson Blvd., Los Angeles 16, Calif.—GGD, GGE, GGG, GGH, GGI, GGJ
Ampex Electric Corp., 934 Charter St., Redwood City, Calif.—GGD, GGH, GGI
Amplifier Corp. of America, 398 Broadway, New York 13, N. Y.—GGH
Ansley Electronics, Inc., 85 Tremont St., Meriden Conn.—GGI
Antenna Research Lab., Inc., 797 Thomas Lane, Columbus 14, Ohio—GGJ
Assoc. Eng'g. Corp. of Boston, 38 Euston Rd., Brighton 35, Mass.—GGH, GGI
Atlantic Electronics Corp., 4 Manhasset Ave., Port Washington, N. Y.—GGD, GGE, GGH
Audio Equipment Sales, Div. F. Sumner Hall, Inc., 153 W. 33 St., New York 1, N. Y.—GGH, GGI
Audio & Video Products Corp., 730 5 Ave., New York 3, N. Y.—GGH
Automatic Electric Co., 1033 W. Van Buren St., Chicago 7, Ill.—GGA
Automatic Switch Co., 391 Lakeside Ave., Orange N. J.—GGA
Babcock Radio Eng. Inc., 7942 Woodley Ave., Van Nuys, Calif.—GGC
Bardwell & McAlister, 2950 N. Ontario St., Burbank, Calif.—GGD, GGE, GGG, GGH, GGI
Bendix Aviation Corp., Red Bank Div., Eatontown, N. J.—GGE, GGF, GGG, GGH, GGI, GGJ
Berkeley Custom Electronics, 2571 Shattuck Ave., Berkeley 4, Calif.—GGI
Beta Electric Corp., 333 E. 103 St., New York 29, N. Y.—GGG, GGH
Bogue Railway Equipment, 52 Iowa Ave., Paterson 5, N. J.—GGA, GGB, GGD, GGE, GGF, GGG, GGH, GGI, GGJ
Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif.—GGA, GGH
Booth Co., Arthur E., 4124 Beverly Blvd., Los Angeles 4, Calif.—GGA, GGG, GGH, GGI
Browning Laboratories, Inc., Winchester, Mass.—GGJ
Buda Co., 154 & Commerical, Harvey, Ill.—GGF
Camera Mart, Inc., 1845 Broadway, New York 23, N. Y.—GGA, GGB
Carter Motor Co., 2654 N. Maplewood Ave., Chicago 47, Ill.—GGB
Caterpillar Tractor Co., Peoria 8, Ill.—GGF
Chase Electronics Laboratory, 128 N. Fair Oaks Ave., Pasadena 1, Calif.—GGH
Chatham Electronics Corp., 475 Washington St., Newark 2, N. J.—GGH, GGI
Columbus Electronics Corp., 229 Waverly St., Yonkers, N. Y.—GGB
Conn. Telephone & Elec. Corp., 70 Brittania St., Meriden, Conn.—GGA
Constable Engineering Co., J. M., 101-05 77 St., Ozone Park 17, N. Y.—GGH, GGI
Cornell-Dubilier Electric Corp., 333 Hamilton Blvd., S. Plainfield, N. J.—GGA, GGC, GGD, GGE, GGG, GGH, GGI, GGJ
Cyclohm Motor Corp., Div. Howard Industries, Racine, Wisc.—GGF
Dalmotor Co., 1375 Clay St., Santa Clara, Calif., —GGI
Douglas Radio Labs., 176 Norfolk Ave., Boston 19, Mass.—GGG, GGH, GGI
De Mornay-Bonardi, Inc., 3223 Burton Ave., Burbank, Calif.—GGH, GGI
DX Radio Products Co., 2300 W. Armitage Ave., Chicago 47, Ill.—GGI
Eagle Electric Mfg. Co., 23-10 Bridge Plaza S., Long Island City 1, N. Y.—GGG
Eastgap Co., 285 Columbus, Boston 16, Mass.—GGH
Eicor Inc., 1501 W. Congress St., Chicago 7, Ill. —GGB, GGE, GGH, GGJ
Electric Specialty Co., 211 South St., Stamford, Conn. —GGB, GGF, GGH, GGI
Electron Enterprises, 6917-21 W. Stanley Ave., Berwyn, Ill.—GGG
Electronic Rectifiers, Inc., 2102 Spann Ave., Indianapolis 3, Ind.—GGA
Electro Products Labs., 4501 N. Ravenswood Ave., Chicago 40, Ill.—GGA, GGC, GGG, GGI
Electronic Development Lab., 43-07 23 Ave., Long Island City 5, N. Y.—GGA, GGH, GGI, GGJ
Electro-Tech Equipment Co., 308 Canal St., New York 13, N. Y.—GGG, GGH, GGI
Engineering Research & Devel. Co., P. O. Box 166, Hinsdale, Ill.—GGD, GGH, GGI
Equipment & Service Co., 6815 Oriole Dr., Dallas 9, Tex.—GGG, GGH, GGI
Fairbanks-Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.—GGF, GGI
Fansteel Metallurgical Corp., 2200 Sheridan Rd., N. Chicago, Ill.—GGA, GGH
Federal Mfg. & Engineering Corp., 211 Steuben St., Brooklyn 5, N. Y.—GGI
Ferranti Electric, Inc., 30 Rockefeller Plaza, New York 20, N. Y.—GGD, GGE, GGH, GGI
Fluke Eng'g Co., John, Box 755, Springdale, Conn.—GGH, GGI, GGJ
Gaertner Radio Co., 3612 Maple Ave., Los Angeles 11, Calif.—GGH
Galvanic Porducts Corp., 110 E. Hawthorne Ave., Valley Stream 10, N. Y.—GGA
Gamewell Co., The, 1238 Chestnut St., Newton Upper Falls 64, Mass.—GGA
Gates Radio Co., 123 Hampshire St., Quincy 1, Ill.—GGD, GGG, GGH, GGI
General Electrosonics, Inc., 32 W. 22nd St., New York 10, N. Y.—GGG, GGH, GGI, GGJ
General Precision Lab., Inc., 63 Bedford Rd., Pleasantville, N. Y.—GGH, GGI
General Transformer Co., 18240 Harwood Ave., Homewood, Ill.—GGA, GGG
Gerator Corp., 1820 N. Nash St., Arlington 9, Va.—GGA, GGF
G. W. Associates, P. O. Box 2263, El Segundo, Calif. —GGI
Hallen Corp., 3503 W. Olive Ave., Burbank, Calif.—GGB
Harvey Radio Labs., 447 Concord Ave., Cambridge 38, Mass.—GGH
Harvey-Wells Electronics, Inc., North St., Southbridge, Mass.—GGC, GGD, GGE, GGG, GGH, GGI, GGJ
Hertner Electric Co., The, 12690 Elmwood Ave., Cleveland 11, Ohio—GGA, GGB, GGF, GGG, GGH, GGI, GGJ
Hewlett-Packard Co., 395 Page Mill Rd., Palo Alto, Calif.—GGH, GGI
Hindle Transformer Co., Woods Church Rd., Flemington, N. J.—GGI
Horlick Co., William I., 206 Summer St., Boston 10, Mass.—GGB, GGD, GGE, GGG, GGH
Howard Co., 934 Argyle Rd., Drexel Hill, Pa.—GGI
Howard Industries, 1760 State, Racine, Wis.—GGF
Hycon Mfg. Co., 2961 E. Colorado St., Pasadena 8, Calif.—GGG, GGH, GGI
Industrial Television, Inc., 369 Lexington Ave., Clifton, N. J.—GGI
INET, Inc., 8655 S. Main St., Los Angeles 3, Calif. —GGA, GGB, GGC, GGD, GGE, GGF, GGG, GGH, GGI, GGJ
International Research Assoc., 2221 Warwick Ave., Santa Monica, Calif.—GGF, GGG, GGH, GGI
Janette Electrical Mfg. Co., 556 W. Monroe St., Chicago 6, Ill.—GGB
Kato Eng'g., 1415 First Ave., Mankato, Minn.—GGF
Kellogg Switchboard & Supply Co., 6650 S. Cicero Ave., Chicago 38, Ill.—GGA
Kepco Labs., Inc., 131-38 Sanford Ave., Flushing 55, N. Y.—GGA, GGD, GGE, GGG, GGH, GGI, GGJ
Kinevox, Inc., 116 S. Hollywood Way, Burbank, Calif.—GGA, GGB, GGG
Kohler Co., Kohler, Wis.—GGF
Langevin Mfg. Corp., 37 W. 65th St., New York 23, N. Y.—GGG, GGH, GGI, GGJ

Lee Electric & Mfg. Co., 2806 Clearwater St., Los Angeles 39, Calif.—GGA, GGH, GGI

Lenkurt Electric Co., 1105 County Rd., San Carlos, Calif.—GGI

McColpin-Christie Corp., 3410 W. 67th St., Los Angeles 43, Calif.—GGA, GGG, GGH

Magnetic Amplifiers, Inc., 632 Tinton Ave., New York 55, N. Y.—GGD, GGE, GGH

Mallory & Co., P. R., 3029 E. Washington St., Indianapolis 6, Ind.—GGA, GGG, GGH, GGI

Mercury Electronic Co., Box 450, Red Bank, N. J.—GGE, GGG, GGH, GGI, GGJ

Millen Mfg. Co., James, 150 Exchange St., Malden 48, Mass.—GGC, GGH, GGI

Model Rectifier Corp., 557 Rogers Ave., Brooklyn 25, N. Y.—GGA, GGG, GGH, GGI

Motorsearch Co., 1600 Junction Ave., Racine, Wis.—GGB, GGC, GGF, GGI, GGJ

Moulic Specialties Co., 1005-07 W. Washington St., Bloomington, Ill.—GGH

Neptune Electronics Co., 433 Broadway, New York 13, N. Y.—GGG, GGH, GGI

Neutronic Assoc., 83-56 Vietor Ave., Elmhurst 73, N. Y.—GGH, GGI, GGJ

North American Phillips Co., 750 S. Fulton Ave., Mt. Vernon, N. Y.—GGH

North Electric Mfg. Co., 501 S. Market St., Galion, Ohio—GGA, GGC

Onan & Sons, Inc., D. W., University Ave., S. E. at 25, Minneapolis 14, Minn.—GGA, GGF, GGI

Opad-Green Co., 71 Warren St, New York 7, N. Y. —GGA, GGH, GGI

Oregon Electronic Mfg. Co., 2232 E. Burnside St., Portland 15, Ore.—GGH, GGI

Owen Labs., 412 Woodward Blvd., Pasadena 10, Calif. —GGH

Pacific Mercury Television, 5955 Van Nuys Blvd., Van Nuys, Calif.—GGG, GGH, GGI

PCA Inc., 6368 DeLongpre Ave., Hollywood 28, Calif. —GGH, GGI, GGJ

Pedersen Electronics, P. O. Box 572, Lafayette, Calif. —GGH, GGI

Penn Boiler & Burner Mfg. Corp., Fruitville Rd., Lancaster, Pa.—GGF

Perkin Eng'g Corp., 345 Kansas St., El Segundo Calif.—GGA, GGG, GGH, GGI

Perma-Power Co., 4721 N. Damen Ave., Chicago 25, Ill.—GGI

Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.—GGH

Polytechnic Research & Development Co., 55 Johnson St., Brooklyn, N. Y.—GGI

Portable Electric Tools, Inc., 340 W. 83rd St., Chicago, Ill.—GGB, GGE, GGH, GGI

Power Equipment Co., 55 Antoinette St., Detroit 2, Mich.—GGA, GGH

Process & Instruments, 60 Greenpoint Ave., Brooklyn 22, N. Y.—GGH, GGI

Radiart Corp., 3455 Vega Ave., Cleveland 13, Ohio—GGC, GGI

Radio Sonic Corp., 186 Union Ave., New Rochelle, N. Y.—GGG, GGH, GGI, GGJ

Raypar, Inc., 7810 W. Addison, Chicago, Ill.—GGI

Ready-Power Co., 11231 Frend Ave., Detroit 14, Mich.—GGF

Resdel Eng'g Corp., 2351 Riverside Dr., Los Angeles 39, Calif.—GGE, GGI, GGJ

Rixon Electronics, 3303 Ferndale St., Kensington, Md.—GGH

Schauer Mfg. Corp., 4500 Alpine Ave., Cincinnati 36, Ohio—GGA, GGH

Scott, Inc., Hermon Hosmer, 385 Putnam Ave., Cambridge 39, Mass.—GGI

Sealtron Co., The, 9701 Reading Rd., Cincinnati 15, Ohio—GGH, GGI

Servomechanisms, Inc., Post & Stewart Aves., Westbury, N. Y.—GGE

Shevers, Inc., Harold, 123 W. 64th St., New York 23, N. Y.—GGD, GGE, GGG, GGH

Shura-Tone Products, Inc., 440 Adelphi St., Brooklyn 17, N. Y.—GGG

Sierra Electronic Corp., 1050 Brittan Ave., San Carlos, Calif.—GGC, GGD, GGE, GGG, GGH, GGI, GGJ

Sola Electric Co., 4633 W. 16th St., Chicago 50, Ill. —GGD, GGE, GGH

Sorensen & Co., 375 Fairfield Ave., Stamford, Conn.—GGA, GGD, GGE, GGG, GGH, GGI

S.O.S. Cinema Supply Corp., 602 W. 52 St., New York 19, N. Y.—GGB, GGC

Spellman Television Co., 3029 Webster Ave., New York 67, N. Y.—GGH, GGI

Sperry Gyroscope Co., Great Neck, L. I., N. Y.—GGH, GGI

Square Rool Mfg. Co., 391 Saw Mill River Rd., Yonkers 2, N. Y.—GGE, GGI

Stancil-Hoffman Corp., 1016 N. Highland Ave., Hollywood 38, Calif.—GGJ

Standard Electronic Research Corp., 2 East End Ave., New York 21, N. Y.—GGD, GGE, GGH, GGI

Standard Electronics Corp., 285 Emmet St., Newark 5, N. J.—GGG, GGH

Standard Transformer Corp., 3580 Elston Ave., Chicago 18, Ill.—GGA, GGH

Sterling Instruments Co., 13331 Linwood Ave., Detroit 6, Mich.—GGG, GGH, GGI, GGJ

Superior Electric Co., 83 Laurel St., Bristol, Conn. —GGG, GGH

Syntronic Instruments, Inc., 100 Industrial Rd., Addison, Ill.—GGH

Taffet Radio & TV Co., 2530 Belmont Ave., New York 58, N. Y.—GGG, GGH, GGI

Telechrome, Inc., 88 Merrick Rd., Amityville, L. I., N. Y.—GGH, GGI

Telectro Industries Corp., 35-16 37th St., Long Island City 1, N. Y.—GGA, GGG

Telemarine Communications Co., 536-542 W. 27th St., New York 1, N. Y.—GGH

Teletronic Labs., 1835 W. Rosecrans Ave., Gardena, Calif.—GGG, GGH, GGI, GGJ

Tel-Instrument Co., 50 Paterson Ave., E. Rutherford, N. J.—GGH

Transformer Technicians, Inc., 2608 N. Cicero Ave., Chicago 39, Ill.—GGA, GGH, GGI

Transitron, Inc., 154 Spring, New York, N. Y.—GGC

Transmitter Equipment Mfg. Co., 345 Hudson St., New York 14, N. Y.—GGH, GGI

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- Floor model—26" W x 22" D x 66 7/8" H
- Operating pressure adjustable up to 50 PSI
- Serves up to:
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  10,000 ft. 3 1/8" Transmission Line.
  3,500 ft. 6 1/8" Transmission Line.

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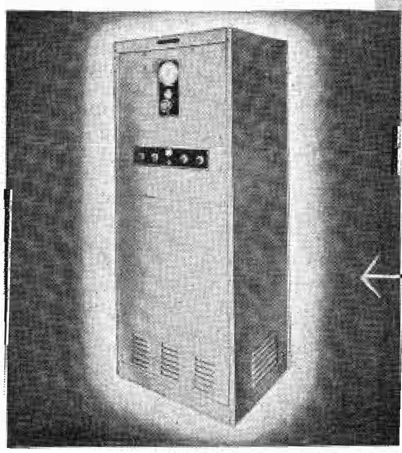

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U. S. Motors Corp., 584 Nebraska St., Oshkosh, Wis. —GGF
U. S. Recording Co., 1121 Vermont Ave., N. W., Washington 5, D. C.—GGG
Universal Electronics Co., 2012 S. Sepulveda Blvd., Los Angeles 25, Calif.—GGA, GGH
Utility Electronics Corp., 231 Grant Ave., E. Newark, N. J.—GGH
Varo Mfg. Co., 1801 Walnut St., Garland, Tex.—GGE, GGG, GGH
Vickers Elec. Div., 1815 Locust St., St. Louis, Mo. —GGD, GGE, GGH, GGI
Vokar Corp., 7300 Huron R. Dr., Dexter, Mich.—GGC
Walkirt Co., 145 W. Hazel, Inglewood, Calif.—GGH
Welch Electric Co., 1221 Wade St., Cincinnati 14, Ohio—GGA, GGD, GGE, GGG, GGH, GGI
Wincharger Corp., E. 7 at Division, Sioux City 2, Iowa—GGB, GGF
Wirt Co., 5221 Greene St., Philadelphia, Pa.—GGI

33—Fixtures

Cabinets ....HHA
Clocks and chronometers ....HHB
Consoles ....HHC
Custom work ....HHD
Equipment, fire detection & fighting ....HHE
Racks, disc storage ....HHF
Racks, equipment ....HHG
Racks, tape storage ....HHH
Screen rooms ....HHI
Transportation packing ....HHJ

Abalon Precision Mfg. Corp., 540 Casanova St., Bronx 59, N. Y.—HHA, HHG
Ace Engineering & Machine Co., 3644 N. Lawrence St., Philadelphia 40, Pa.—HHI
Ainslie Electronic Products, Inc., 312 Quincy Ave., Quincy 69, Mass.—HHA, HHC, HHD
Airplane & Marine Instr., Clearfield, Pa.—HHG
A & M Woodcraft, Inc., 419 W. 49th St., New York 19, N. Y.—HHA
Allied Allegri Machine Co., 141 River Rd., Nutley 10, N. J.—HHD
Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif.—HHC, HHG
American Time Corp., 134 Chestnut St., Springfield, Mass.—HHB
Bardwell & McAlister, 2950 N. Ontario St., Burbank, Calif.—HHA, HHC, HHD
Barry Corp., 700 Pleasant, Watertown, Mass.—HHG
Bogen Co., D. 29 9th Ave., New York, N. Y.—HHC
Bud Radio, Inc., 2118 E. 55th St., Cleveland 3, Ohio—HHG
Brooks & Perkins, Inc., 1950 W. Fort St., Detroit 16, Mich.—HHA, HHC, HHD
Castlewood Mfg. Co., 1440 S. 12th St., Louisville 10, Ky.—HHA
Central Stamping & Mfg. Co., Polo, Ill.—HHA
Dahlstrom Metallic Door Co., 440 Buffalo St., Jamestown, N. Y.—HHA, HHG
Dietz Co., Henry G., Coral Designs Div., 12-16 Astoria Blvd., Long Island City 2, N. Y.—HHD
Dimco-Gray Co., 207 E. 6, Dayton, Ohio—HHB
Dittmore & Freimuth Co., 2517 E. Norwich St., Cudahy, Wisc.—HHD
Doehler Metal Furniture Co., Inc., 192 Lexington Ave., New York 16, N. Y.—HHA
Du Mont Labs., Inc., Allen B., 1500 Main Ave., Clifton, N. J.—HHA, HHC, HHD, HHG
Edo Corp., 1310 111th, College Point, N. Y.—HHA
Electronic Associates, Long Branch Ave., Long Branch, N. J.—HHC, HHD
Electronic Development Lab., 43-07 23rd Ave., Long Island City 5, N. Y.—HHA, HHC, HHD, HHG
Elmor Co., 29 E. Madison St., Chicago, Ill.—HHB
Equipment & Service Co., 6815 Oriole Dr., Dallas 9, Tex.—HHC
Erwood, Inc., 1770 W. Berteau, Chicago, Ill.—HHD
Falstrom Co., 53 Falstrom Ct., Passaic, N. J.—HHA HHC, HHD
Feiner & Sons, Inc., P., 522 W. 45th St., New York 19, N. Y.—HHA, HHD
Gamewell Co., The, 1238 Chestnut St., Newton Upper Falls 64, Mass.—HHE
Gates Radio Co., 123 Hampshire St., Quincy 1, Ill. —HHA, HHC, HHG
General Electrosonics, Inc., 32 W. 22 St., New York 10, N. Y.—HHD
Grant Pulley & Hardware Co., 31-93 Whitestone Pkwy., Flushing, L. I., N. Y.—HHG
Gorrell & Gorrell, 336 Old Hook, Westwood, N. J.—HHD
Hartman Engineering Co., 117 Oakland St., Springfield, Mass.—HHD
Hindle Transformer Co., Woods Church Rd., Flemington, N. J.—HHD
Houston-Fearless Corp., 11801 W. Olympic Blvd., W. Los Angeles 64, Calif.—HHC, HHD
Hughey & Phillips, 4075 Beverly Blvd., Los Angeles 4, Calif.—HHE
Hycon Mfg. Co., 2961 E. Colorado St., Pasadena 8, Calif.—HHA, HHD, HHG
Insuline Corp. of America, 36-02 35 Ave., Long Island City 1, N. Y.—HHG
Kolton Electric Mfg. Co., 123 N. J. Railroad Ave., Newark 5, N. J.—HHA
Langevin Mfg. Corp., 37 W. 65 St., New York 23, N. Y.—HHC
Lindgren & Assoc., Erik A., 4515 N. Ravenswood Ave., Chicago 40, Ill.—HHI
Lord Mfg. Co., 1635 W. 12 St., Erie, Pa., HHG

Marconi's Wireless Telegraph Co., 23-25 Beaver St., New York 4, N. Y.—HHD
Montgomery Mfg. Co., 202 Main St., Owensville, Ind. —HHB
Motiograph Inc., 4431 W. Lake, Chicago, Ill.—HHG
Multi-Metal Co., 1340-50 Garrison Ave., New York 59, N. Y.—HHA, HHD, HHG
O'Brien Electric Co., 6514 Santa Monica Blvd., Hollywood 38, Calif.—HHA, HHC, HHD, HHF, HHG, HHH
Olesen Co., Otto K., 1534 Cahuenga Blvd., Hollywood 28, Calif.—HHA, HHC, HHD, HHG
Par-Metal Products Corp., 32-62 49th St., Long Island City 3, N. Y.—HHA
Radia Sonic Corp., 186 Union Ave., New Rochelle, N. Y.—HHD
Radio & Television, Inc., 119 W. 57 St., New York 19, N. Y.—HHA, HHC
REF Mfg. Corp., 393 Jericho Turnpike, Mineola, N. Y.—HHA
Rowe Industries, 1702 Wayne, Toledo, Ohio—HHD
Sanders Bros. Mfg. Co., 409 W. Main St., Ottawa, Ill.—HHA, HHD
Scientific Wood Cabinet Co., 80-86 Holmes St., Belleville 9, N. J.—HHA
Sealtron Co., 9701 Reading, Cincinnati, Ohio—HHD
Self Winding Clock Co., 205 Willoughby Ave., Brooklyn 5, N. Y.—HHB
Shura-Tone Products, Inc., 440 Adelphi St., Brooklyn 17, N. Y.—HHA, HHC
Smith Mfg. Co., Nathan R., 105 Pasadena Ave., S. Pasadena, Calif.—HAB
S.O.S. Cinema Supply Corp., 602 W. 52 st., New York 19, N. Y.—HHA
Sound Laboratories, 323 E. 48 St., New York 17, N. Y.—HHD
Sound Sales & Engineering Co., 2005 LaBranch, Houston 3, Tex.—HHD, HHE, HHG
Standard Electronics Corp., 285 Emmet St., Newark 5, N. J.—HHG
Telechrome, Inc., 88 Merrick Rd., Amityville, L. I., N. Y.—HHD, HHG
Telechron Dept., General Electric Co., Ashland, Mass. —HHB
Topping Mfg. Co., 90 Ramona Ave., San Francisco 3, Calif.—HHA
Transmitter Equipment Mfg. Co., 345 Hudson St., New York 14, N. Y.—HHC, HHD
United Wood Specialty Mfg. Co., 951 Broadway, Fall River, Mass.—HHA
University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y.—HHA
Wadsworth Mfg. Associates, 509 Balsam St., Liverpool, N. Y.—HHD
Wilder Mfg. Co., Mechanic St. & Erie R. R., Port Jervis, N. Y.—HHG

34—Books & Data Services

Manuals, engineering	JJA
test equipment	JJB
tube	JJC
TV maintenance	JJD
Reference books, condensed	JJE
Reports & Digests, FCC	JJF

Antenna Research Laboratory, Inc., 797 Thomas Lane, Columbus 14, Ohio—JJA, JJB
Associated Electronics Co., 132 Nassau St., New York 7, N. Y.—JJA, JJC, JJB, JJE, JJF
Booth Co., Arthur E., 4124 Beverly Blvd., Los Angeles 4, Calif.—JJB
British Industries, 164 Duane St., New York 13, N. Y. —JJA
Caldwell-Clements Manuals Corp., 480 Lexington Ave., New York 17, N. Y.—JJA, JJC, JJB, JJE
Coyne Electrical & Radio School, Educational Book Publishing Div., 500 S. Paulina St., Chicago 12, Ill.—JJD
DuMont Labs., Inc., Allen B., 1500 Main Ave., Clifton, N. J.—JJA, JJB, JJC, JJD, JJE, JJF
Eastman Kodak Co., Rochester 4, N. Y.—JJE
Eitel-McCullough, Inc., 798 San Mateo Ave., San Bruno, Calif.—JJC
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General Electric Co., Electronics Div., Electronics Park, Syracuse, N. Y.—JJB
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Pickard & Burns, 240 Highland Ave., Needham 94, Mass.—JJA
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Reynolds Electronics Corp., 507 West St., New York 14, N. Y.—JJA
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Rinehart Books, Inc., 232 Madison Ave., New York, N. Y.—JJA
Rosen Engineering Products, Inc., Raymond, 32 & Walnut Sts., Philadelphia 4, Pa.—JJA
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Telecommunications Reports, 1208 National Press Bldg., Washington 4, D. C.—JJF
Thordarson-Meissner Mfg. Div., Maguire Industries, Inc., 7 & Belmont, Mt. Carmel, Ill.—JJE
U. S. Dept of Commerce, Nat'l Bureau of Standards, Washington, D. C.—JJA, JJB, JJD, JJE, JJF
Van Nostrand Co., 250 4th Ave., New York, N. Y. —JJE
Wiley & Sons, Inc., John, 440 Fourth Ave., New York 16, N. Y.—JJA

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35—Armed Forces & Civilian Depts.

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Receivers, communication	KKI
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Shoran	KKK
Sofar	KKL
Sonar	KKM
Supplies, power	KKN
Transmitters	KKO
Transmitters, HF broadcast	KKP

Accurate Engineering Co., 2005 Blue Island Ave., Chicago 8, Ill.—KKN
Acme Electric Corp., Water St., Cuba, N. Y.—KKN
Acorn Electronics, Box 348, Gibson City, Ill.—KKN
Aerocoil, Inc., 507 26th St., Union City, N. J.—KKA, KKG, KKF, KKJ, KKN, KKO
Aero Electronics Co., 1512 N. Wells St., Chicago 10, Ill.—KKA, KKB, KKC, KKF, KKJ, KKK, KKN, KKO

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American Television & Radio Co., 300 E. 4th St., St. Paul, Minn.—KKN
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Bliss Electronic, Box 123, Sussex, N. J.—KKN
Bogen Co., David, 29 9th Ave., New York 14, N. Y.—KKA, KKB, KKI, KKN, KKO
Bone Engineering Corp., 701 W. Broadway, Glendale 4, Calif.—KKB, KKF, KKJ, KKN
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Bunnel & Co., J. H., 81 Prospect St., Brooklyn 1, N. Y.—KKA, KKB, KKC, KKD, KKF, KKI, KKN, KKO, KKP, KKM
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C. G. S. Laboratories, Inc., 391 Ludlow St., Stamford, Conn.—KKA, KKI, KKM
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Clarke Instruments, 919 Jesup-Blair Dr., Silver Spring, Md.—KKA, KKF
Collins Radio Co., 855 35 St., N. E., Cedar Rapids, Iowa—KKA, KKB, KKI, KKJ, KKO, KKP
Columbus Electronics Corp., 229 S. Waverly St., Yonkers, N. Y.—KKJ
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Constable Engineering Co., J. M., 101-05 77 St., Ozone Park 17, N. Y.—KKJ, KKN
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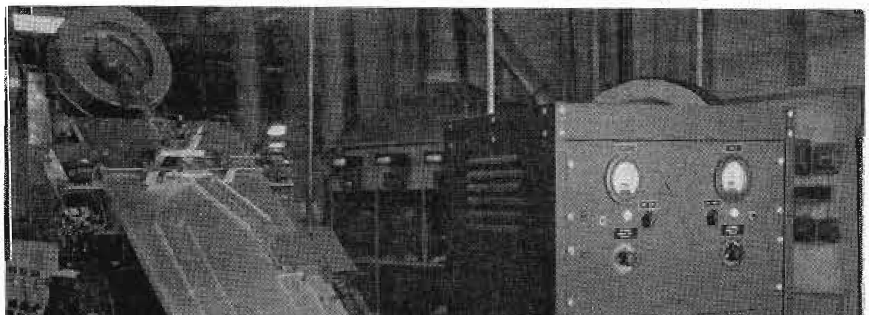
AUTOMATIC TESTING of SELENIUM RECTIFIER PLATES



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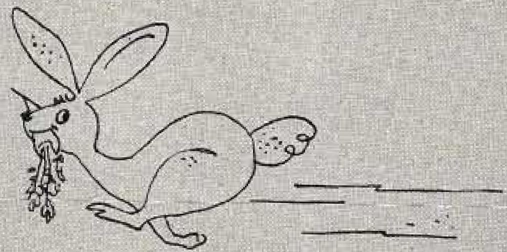

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Inet, Inc., 8655 S. Main St., Los Angeles 3, Calif.—KKN
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International Research Assoc., 2221 Warwick Ave., Santa Monica, Calif.—KKA, KKI, KKJ, KKO
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Key Electronics Corp., 20 W. 22nd St., New York 10, N. Y.—KKA, KKI
Kinetix Instrument Co., 902 Broadway, New York 10, N. Y.—KKA, KKB, KKC, KKF
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Kollmorgan Optical Corp., 2 Franklin Ave., Brooklyn 11, N. Y.—KKE
Kollsman Instrument Corp., 80-08 45 Ave., Elmhurst 73, N. Y.—KKA, KKB, KKE, KKF, KKG, KKI, KKJ, KKO
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Laboratory for Electronics, 75 Pitts St., Boston 14, Mass.—KKF, KKJ
Lambda Electronics Corp., 103-02 Northern Blvd., Corona 68, N. Y.—KKN
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Lawton Prods. Co., 624 Madison Ave., New York, N. Y.—KKJ
Leece-Neville Co., 5109 Hamilton Ave., Cleveland 14, Ohio—KKN
Lenkurt Electric Co., 1105 County Road, San Carlos, Calif.—KKA
Leonard Electric Products Co., 67 34th St., Brooklyn 32, N. Y.—KKK, KKN
Librascope, Inc., 1607 Flower St., Glendale 1, Calif.—KKB, KKE
Link Radio Corp., 125 W. 17th St., New York 11, N. Y.—KKA, KKO
Liston-Becker Instrument Co., 20 Beckley Ave., Stamford Conn.—KKJ
Loral Electronics Corp., 794 E. 140th St., New York 54, N. Y.—KKF
Lysco Mfg. Co., 1401 Clinton, Hoboken, N. J.—KKN
Magnavox Co., Bueter Rd., Ft. Wayne 4, Ind.—KKA, KKB, KKC, KKD, KKF, KKI, KKK, KKM KKO, KKP
Magnecord, Inc., 225 W. Ohio, Chicago, Ill.—KKA
Marconi's Wireless Telegraph Co., 23-25 Beaver St., New York 4, N. Y.—KKA, KKB, KKC, KKF, KKI, KKJ, KKO, KKP
Mark Products Co., 3547-49 Montrose Ave., Chicago 18, Ill.—KKJ
Maryland Electronic Mfg. Corp., 5009 Calvert Rd., College Park, Md.—KKA, KKB, KKI, KKN, KKO
Massa Labs., 3868 Carnegie Ave., Cleveland 15, Ohio—KKM
Maurer, Inc., J. A., 37-01 31st St., Long Island City 1, N. Y.—KKE, KKK
McColpin-Christie Corp., P. O. Box 19665, Los Angeles 43, Calif.—KKN
McElroy Mfg. Corp., Newton Rd., Littleton, Mass.—KKA
Melpar, Inc., 452 Swann Ave., Alexandria, Va.—KKA, KKB, KKF, KKJ, KKM, KKO
Mercury Electronic Co., Box 450, Red Bank, N. J.—KKN
Merix Chemical Co., 1021 E. 55th St., Chicago 15, Ill.—KKB
Micro Eng'g Corp., 6233 Hollywood Blvd., Hollywood 28, Calif.—KKE, KKF
Motorola, Inc., 4545 Augusta Blvd., Chicago 51, Ill.—KKA, KKF, KKI, KKN, KKO
Movie-Mite Corp., 1105 Truman Rd., Kansas City 6, Mo.—KKA, KKF
Munston Mfg. & Service, Inc., Beech St., Islip, L. I., N. Y.—KKA, KKB, KKC, KKD, KKF, KKI, KKJ, KKK, KKM, KKN, KKO
National Co., 61 Sherman St., Malden 48, Mass.—KKA, KKI
National Electronics Labs., 1713 Kalorama Rd. N. W., Washington 9, D. C.—KKA, KKF, KKJ, KKN, KKO
National Electronics Mfg. Corp., 42-08 Vernon Blvd., Long Island City 1, N. Y.—KKJ
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National Research Corp., 70 Memorial Dr., Cambridge 42, Mass.—KKJ
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Northern Radio Co., 314 Bell St., Seattle 1, Wash.—KKI, KKO
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Pacific Tranducer Corp., 11921 S. West Pico Blvd., Los Angles 64, Calif.—KKM
Packard-Bell Co., 12333 W. Olympic Blvd., Los Angeles 64, Calif.—KKA, KKM, KKO
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Pearce Simpson, Inc., 3023 Coral Way, Miami 34, Fla.—KKA, KKI, KKO
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Permoflux Corp., 4900 W. Grand Ave., Chicago 39, Ill.—KKA, KKB
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Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y.—KKA, KKF, KKJ
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Power Equip. Co., 55 Antoinette St., Detroit 2, Mich.—KKN
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Shoup Eng'g. Co., 221 E. Cullerton St., Chicago 10, Ill.—KKJ
Shure Brothers, Inc., 225 W. Huron St., Chicago 10, Ill.—KKA
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Sonar Radio Corp., 59 Myrtle Ave., Brooklyn 1, N. Y.—KKA, KKC, KKO, KKP
Sorensen & Co., 375 Fairfield Ave., Stamford, Conn.—KKN
Specialties, Inc., Skunks Misery Rd., Syosset, L. I., N. Y.—KKJ
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Square Root Mfg. Co., 391 Saw Mill River Road, Yonkers 2, N. Y.—KKA, KKB, KKC, KKD, KKF, KKG, KKH, KKI, KKJ, KKK, KKL, KKM, KKN, KKO
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Taffet Radio & TV Co., 2530 Belmont Ave., New York 58, N. Y.—KKA, KKI, KKO
TelAutograph Corp., 16 W. 61th St., New York 23, N. Y.—KKJ, KKO, KKP
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Teletronic Labs., Inc., 1835 W. Rosecrans Ave., Gardena, Calif.—KKN
Teletronics Lab. Inc., Kinkel St., Westbury, L. I., N. Y.—KKF, KKG, KKJ
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Trimm, 400 W. Lake, Libertyville, Ill.—KKA
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Varo Mfg. Co., 1801 Walnut St., Garland, Tex.—KKJ, KKN
Vickers Elec. Div., 1815 Locust St., St. Louis, Mo.—KKC, KKJ, KKN
Video Products Corp., Red Bank, N. J.—KKA, KKN
Vokar, 7300 Huron R. Dr., Dexter, Mich.—KKF, KKN
Wang Labs., 296 Columbus, Boston, Mass.—KKJ
Waters Conley Co., Rochester, Minn.—KKB
Waveline, Inc., P. O. Box 470, Caldwell, N. J.—KKF
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Westinghouse Electric Corp., Television-Radio Div., Sunbury, Pa.—KKF, KKO
Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.—KKA
Wheeler Labs., Inc., 122 Cutter Mill Road, Great Neck, N. Y.—KKF, KKJ
White Rock Mfg. Corp., White Rock, S. C.—KKA, KKI
Wilcox Electric Co., 1400 Chestnut St., Kansas City 1, Mo.—KKA, KKB, KKC, KKF, KKG, KKI, KKJ, KKM, KKN, KKO, KKP
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Workshop Assoc., Endicott St., Norwood, Mass.—KKF

36—Tools & Repair Materials

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Anchor Metal Co., 244 Boerum, Bklyn., N. Y.—LLD
Auburn Mfg. Co., 400 Stack, Middletown, Conn.—LLC
Bow Solder Products Co., 251 Freeman St., Brooklyn 22, N. Y.—LLD
Buchanan Electrical Prod., Hillside, N. J.—LLF
Bussmann Mfg. Co., University at Jefferson, St. Louis 7, Mo.—LLB
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Drake Electric Works, Inc., 3656 N. Lincoln Ave., Chicago 13, Ill.—LLE
Eagle Electric Mfg. Co., 23-10 Bridge Plaza S., Long Island City 1, N. Y.—LLB
Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J.—LLA
Elco Tool & Screw Corp., 1930 Broadway, Rockford, Ill.—LLA
Enthoven & Sons, H. J., 113 No Water St., Rochester 4, N. Y.—LLD, LLE
Federated Metals Div., American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.—LLD
Federal Screw Products Inc., 224 W. Huron St., Chicago 10, Ill.—LLA
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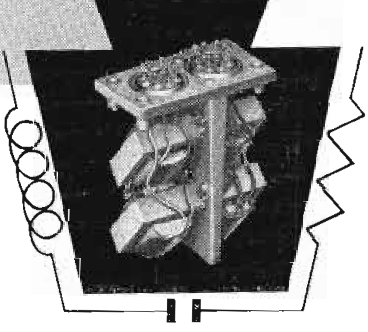

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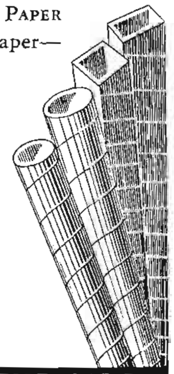

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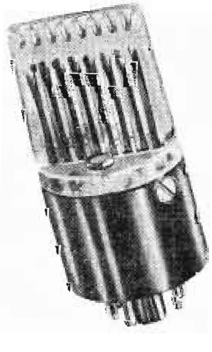

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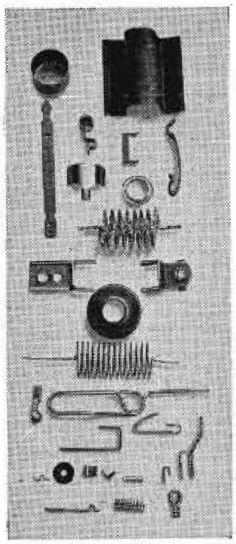

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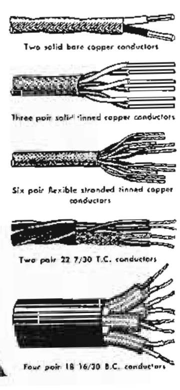

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Moody Machine Products Co., 42 Dudley St., Providence R. I.—LLG
Palnut Co., 61 Cordier St., Irvington, N. J.—LLA
Parker-Kalon Corp., 200 Varick, New York, N. Y.—LLA
Phillips Mfg. Co., 2816 Aldrich Ave. S., Minneapolis 8, Minn.—LLE
Pioneer Tool Co., 5008 W. Jefferson Blvd., Los Angeles 16, Calif.—LLG
Portable Electric Tools, Inc., 340 W. 83 St., Chicago, Ill.—LLG
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Reed & Prince Mfg. Co., 1 Duncan Ave., Worcester I, Mass.—LLA
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Saf-T-Flux Co., Box 64, Collegeville, Pa.—LLD
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Star Expansion Products Co., 147 Cedar St., New York 6, N. Y.—LLA, LLG
Stern Corp., 436-A Fourth, Pittsburgh, Pa.,—LLE
Stone City Machine & Tool Co., 1206 7th St., Bedford, Ind.—LLA
Sunrise Products, Box 173, Hawthorne, N. J.—LLE, LLG
Super Flow Solder, 90 State, Albany, N. Y.—LLD
Tinnerman Products, Inc., Box 6688, Cleveland 1, Ohio—LLA
Ungar Electric Tools, Inc., 615 Ducommun St., Los Angeles 54, Calif.—LLE
United Screw & Bolt Corp., 2513 W. Cullerton St., Chicago 8, Ill.—LLA
U. S. Eng'g. Co., 521 Commercial St., Glendale 3, Calif.—LLA
Vulcan Electric, 88 Holten, Danvers, Mass.—LLE
Wadsworth Mfg. Associates, 509 Balsam St., Liverpool, N. Y.—LLG
Waldes Kohinoor, Inc., 47-16 Austel Place, Long Island City 1, N. Y.—LLA
Weckesser Co., 5261 N. Avondale Ave., Chicago 30, Ill.—LLA
Weller Soldering Guns, 829 Packer, Easton, Pa.—LLE
Wildberg Bros., 742 Market St., San Francisco 2, Calif. —LLD

"Circuit Digests" in "Television Retailing"

The "TV-Electronic Technician" section of Caldwell-Clements' "Television Retailing" has been enlarged with the September issue and appears as a Second Section containing a number of "Circuit Digests" of leading makes of TV receivers.

These Circuit Digests for latest TV models, each complete on a single large sheet, present four-page reproductions of schematics, tube layouts, parts lists, and electrical and mechanical instructions from the manufacturers, besides general suggestions and tips on solving servicing problems common to all sets.

Up to eight "Circuit Digests" will be included in each month's Technician supplement in future issues, in addition to the usual servicing information in the main section of the magazine. In this way, the subscriber will shortly accumulate a collection of Circuit Digests and schematics covering all lines of new TV sets on the market.

News of MANUFACTURERS' REPS

Morris F. Taylor Co., 8416 Georgia Ave., Silver Spring, Md. has appointed Frank Van Gilder district manager for the eastern Pennsylvania territory. Merrill B. Lamont has joined the company as sales engineer.

B. F. Fitzner Co. has opened new offices at 8803 Michigan Ave., Detroit 10, Mich., to service accounts in Michigan, Ohio and Indiana and the manufacturers it represents.

Marshank Sales Co., 672 S. Lafayette Park Place, Los Angeles has completed a large-scale expansion program. The additions to the staff include: W. J. Monteforte, Peter Pohl, L. B. Winters, and I. R. Stern.

M. B. Squires Co., 1212 Grant Building, Pittsburgh, Pa. has been appointed sales representative for the Cornish Wire Co. on their full list of manufactured products in the Pittsburgh territory, encompassing western Pennsylvania, southeastern Ohio and northwestern Virginia.

JKM, Inc., 510 N. Dearborn Street, Chicago, Ill., has been appointed sales representatives in the Chicago area for Utah Radio Products Co., Inc., Huntington, Ind.

TELE-TECH

Advertisers — October, 1952

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.

BULLETINS

Magnetic Amplifiers

The first line of Magamp magnetic amplifiers produced by the Westinghouse Electric Corp., Pittsburgh 30, Pa., is described in a new 18-page booklet (TD-52-600). Curves, tables and wiring diagrams are included in sections which deal with component parts, applications and operating characteristics. Copies may be obtained from Westinghouse, Box 2099, Pittsburgh 30, Pa.

Introduction to Microwave

A 20-page booklet, entitled "An Introduction to Microwave," provides a semi-technical description of RCA microwave equipment. Chapter headings include: microwave radio; how it works; propagation characteristics, operational advantages, economic factors influencing choice of frequencies, and desirable design characteristics. Copies may be obtained from the Microwave Communications Section, Radio Corporation of America, Camden 2, N. J.

Digital Printing Counter

An electronic digital printing counter for counting, totaling and printing results from electronic computers, oscillogram readers, test instruments and transducers and a digital read-out machine are the subjects of new bulletins released by Clary Multiplier Corp., San Gabriel, Calif. Typical applications of both pieces of equipment are illustrated and described.

Dual Impregnating Unit

The Red Point Dual Impregnating Unit, designed for impregnation under vacuum of porous articles, such as electric windings, etc., is described in a brochure published by Red Point Products, 1907 Riverside Drive, Glendale 1, Calif. Use of the Red Point dual system is said to accomplish a perfect impregnation within the shortest period of time.

Motor Speed Controls

"Variac® Motor Speed Controls" is the title of an 8-page brochure being made available by the General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass. Technical data presented includes speed-torques curves and typical applications for all models.

TV Camera Chain

Allen B. Du Mont Laboratories, Inc., has published a new bulletin describing the company's universals image orthicon camera chain model TA-124-E. Copies may be obtained from the Television Transmitter Div., Allen B. Du Mont Laboratories, Inc., 1500 Main Ave., Clifton, N. J.

Toroidal Inductor

Precision wound high Q toroidal inductors are listed in Lenkurt's new four-page bulletin TL-P4. Five different types of coils are available with or without hermetically sealed cases. Included in the bulletin are Q curves and other design data for representative standard values of the varied coil types.

Information is also included about the effect of dc current on the inductance values of each type of coil. Copies of bulletin TL-P4 are available on request from Lenkurt Electric Sales Co., 1116 County Road, San Carlos, Calif.

Telephone Handsets

A combination file folder and catalog sheet, describing the Company's line of telephone handsets and accessories, has been released by the Connecticut Telephone and Electric Corp., 70 Brittania St., Meriden, Conn. The file folder is not only a compact, easy-to-use catalog but contains identifying photographs, descriptive data, wiring diagrams, cordage codes and connection assemblies for various handsets, headsets and wall or desk telephone sets, as well as components, both for military and commercial application.

Miniature Connectors

The Advance D-1 bulletin contains photos, data and dimensional drawings of the "D" series of Cannon connectors. Contact complement ranges from 15 contacts to 50. Suitable for rack and panel mounting, connectors in this series may be used as plugs on either side of the assembly by the addition of a junction shell, having an integral clamp. Copies may be obtained from the Cannon Electric Adv. Dept., 420 W. Ave. 33, Los Angeles 31, Calif.

Yours for the asking...

this new set of PYRAMID CAPACITOR *catalogs!*

CATALOG IMP-1 describes Pyramid's new line of molded plastic tubular capacitors. "IMPS" are rugged — impervious to moisture and withstand a temperature of 100° C.

CATALOG MP-2 gives detailed information on ultra-compact metallized paper capacitors. Minimum size and weight, and self-healing qualities are characteristics of these units.

CATALOG PG-1 lists miniature Glasseal capacitors. These tubular units perform at temperatures ranging from −55° C. to +125° C.

CATALOG J-7 is a 32-page compilation of paper, electrolytic, oil-paper and metallized paper capacitors. Complete dara on eighteen different types, including construction variations, sizes and prices are listed.

Free copies of these colorful, attractive publications are available on letterhead request to Dept. T2

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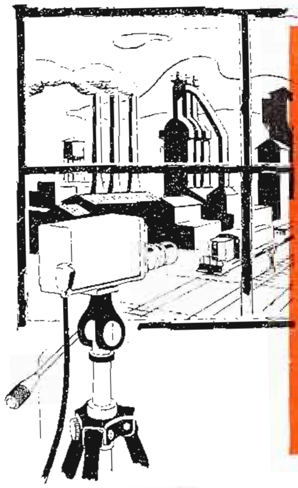
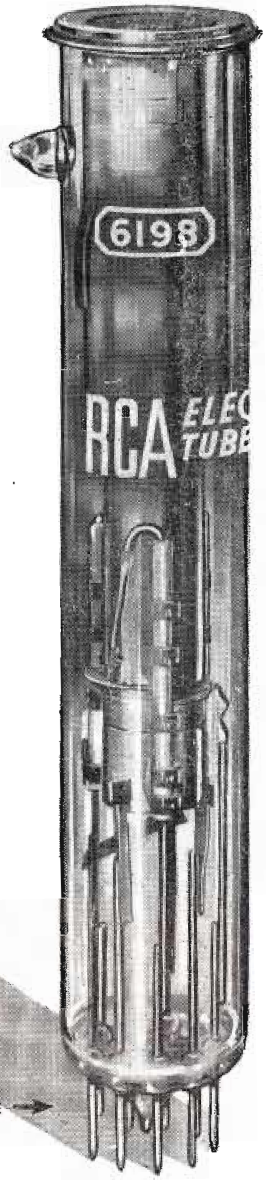
RCA VIDICON





TECHNICAL FEATURES

- ✓ Only 6¼″ long and 1″ in diameter
- ✓ Provides 400-line resolution
- ✓ Spectral response approaching that of the eye
- ✓ Sensitivity permits televising with 100-200 foot-candles of illumination
- ✓ Designed for use with commercially available camera lenses
- ✓ Operates with low dc voltages

ACTUAL SIZE →

NEW, small-size camera tube for low-cost industrial television

Now, the RCA-developed 6198 Vidicon extends the advantages of television coverage to countless industrial users . . . opens the door to simplified television camera designs.

The small size and simplicity of operation of this television camera tube facilitates the design of compact and low-cost television camera equipment — including equipment for closed-circuit, portable, and remote-control applications.

Produced in the same plant by the same skilled hands that make the RCA Image Orthicon camera tube, the RCA-6198 offers the detail of 400-line picture quality at low unit cost. It employs magnetic focus and deflection, and operates with relatively low dc voltages.

Utilizing a photoconductive layer as its light-sensitive element, the RCA-6198 has a sensitivity which permits televising scenes with 100 to 200 foot-candles of incident illumination. The photoconductive layer has a spectral response characteristic approaching that of the eye. The dimensions of the useful area of this layer are such that stock camera lenses can be employed. The size and location of the layer permit a wide choice of commercially available lenses.

The following components, designed for use with the RCA-6198 Vidicon, are also available:

RCA-216D1 Deflecting Yoke
RCA-217D1 Focusing Coil
RCA-218D1 Alignment Coil
RCA-233T1 Horizontal Deflection Transformer
RCA-234T1 Vertical Deflection Transformer

For complete data on the RCA-6198 Vidicon and associated components, write RCA, Commercial Engineering, Section JR57, Harrison, N. J., or contact your nearest RCA Field Office.

FIELD OFFICES: (East) Humboldt 5-3900, 415 S. 5th St., Harrison, N. J. **(Midwest)** Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill. **(West)** Madison 9-3671, 420 S. San Pedro St., Los Angeles, California.

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ELECTRON TUBES ***HARRISON, N. J.***