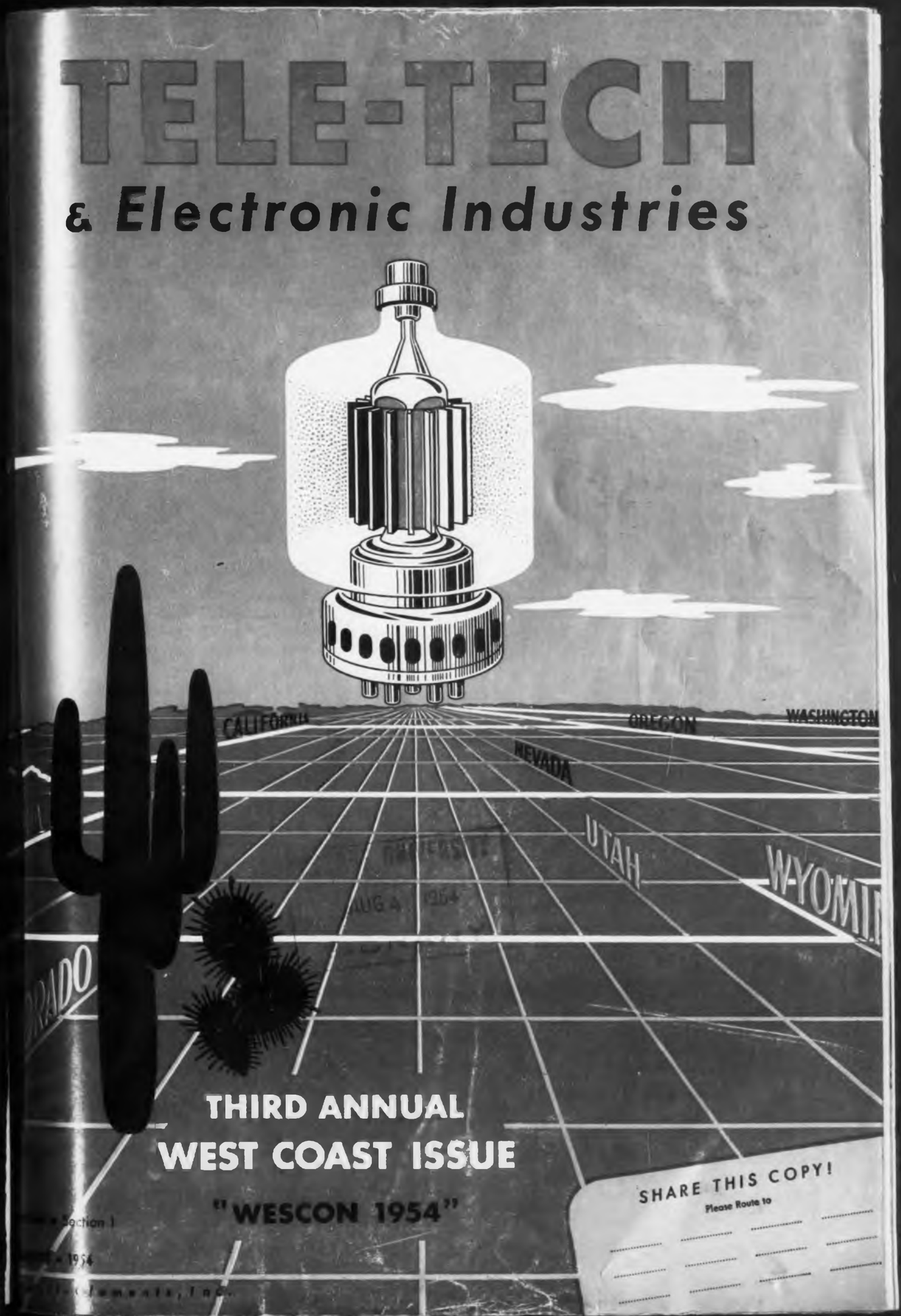
TELE-TECH

& Electronic Industries



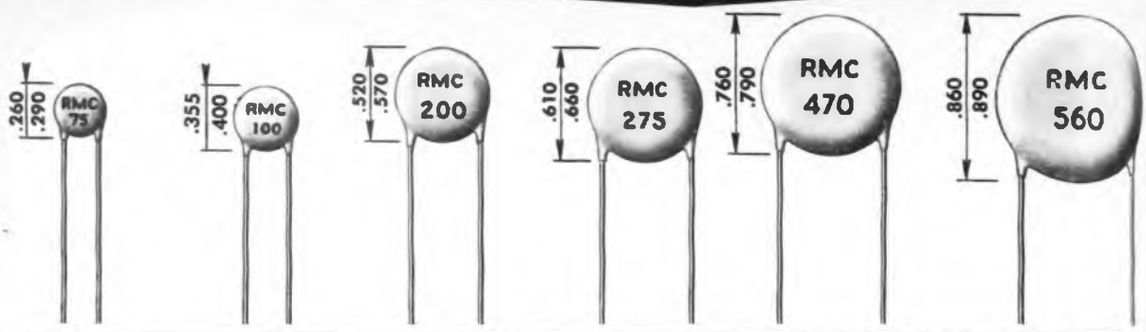
THIRD ANNUAL
WEST COAST ISSUE

"WESCON 1954"

SHARE THIS COPY!
Please Route to

Greater STABILITY | Smaller SIZE | Greater STRENGTH

RMC Temperature Compensating DISCAPS®



TC	1/4 Dia.	5/16 Dia.	1/2 Dia.	5/8 Dia.	3/4 Dia.	7/8 Dia.
P-100	1- 3 MMF	4- 9 MMF	10- 20 MMF	—	—	—
NPO	2- 12	13- 27	28- 47	48- 62 MMF	63-100 MMF	101-150 MMF
N- 33	2- 12	13- 27	28- 47	48- 62	63-100	101-150
N- 75	2- 15	16- 27	28- 56	57- 68	69-110	111-150
N- 150	2- 15	16- 30	31- 60	61- 75	76-140	141-150
N- 220	3- 15	16- 30	31- 75	76- 90	91-130	131-190
N- 330	3- 15	16- 30	31- 75	76-100	101-150	151-190
N- 470	3- 20	21- 40	41- 80	81-120	121-200	201-240
N- 750	5- 25	26- 56	57-150	151-180	181-300	301-350
N-1500	15- 50	51-100	101-200	201-250	251-330	331-560
N-2200	47- 75	76-120	121-200	201-275	276-470	471-560

Temperature coefficients up to N-5200 available on special order.

SPECIFICATIONS

POWER FACTOR: Over 10 MMF less than .1% at 1 megacycle. Under 10 MMF less than .2% at 1 megacycle.
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 1750 V.D.C.
CODING: Capacity, tolerance and TC stamped on disc
INSULATION: Durez phenolic-vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megohms
LEADS: No. 22 tinned copper (.026 dia.)
TOLERANCES: ±5% ±10% ±20%

The capacity of these condensers will not change under voltage.
These capacitors conform to the RTMA specification for Class 1 ceramic condensers.

RMC Type C temperature compensating DISCAPS are universally recognized as the ideal money-saving replacement for tubular ceramic and mica capacitors. Rated capacities will not change under voltage. Smaller size permits compact circuit designs. Greater mechanical strength assures rugged assemblies and lower costs in production line operations. Rated at 1000 working volts, Type C DISCAPS are available for a wide range of applications and cost no more than ordinary 600 volt capacitors.

Whatever your ceramic capacitor problem, standard or specialized, RMC engineers are prepared to solve it for you. Take advantage of a wealth of experience by writing today.

DISCAP CERAMIC CAPACITORS

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.
DISTRIBUTORS: Contact Jobbers Sales Co., P. O. Box 695, Fairlawn, N. J.

TELE-TECH
& Electronic Industries

AUGUST, 1954

FRONT COVER: GOLDEN WEST COAST—This is the time of the year when the eyes of the electronic industries are focused on the Pacific Coast states with special interest, for it's time for WESCON 1954. The amazing growth of the annual Western Electronic Show and Convention to be held Aug. 25-27 in Los Angeles is representative of the rapid development of the region's electronic industries. See pages 61, 64 and 65. The complete Directory of West Coast Manufacturers is presented in Section Two of this issue. The Directory of West Coast Reps and Distributors is on page 106.

SECTION ONE:

SECTION TWO: WEST COAST ELECTRONIC INDUSTRIES DIRECTORY

DEPARTMENTS

TELE-TECH & ELECTRONIC INDUSTRIES*, Vol. 13, No. 8. Published monthly by Caldwell-Clements, Inc. M. Clements, President; M. H. Newton, Assistant to President; John J. Borghi, Vice President and Secretary; M. B. Clements, Treasurer. Accetance under sction 34.64 Postal Laws and Regulations authorized at Bristol, Conn., June 9, 1954. Additional acceptance at New York, N. Y. 75¢ a copy. Annual Subscription Rates: United States and possessions: $7.00; Canada: $8.00; All Other countries: $10.00. Please give title, position and company connection when subscribing.

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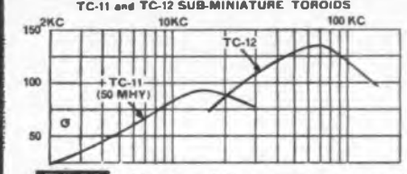
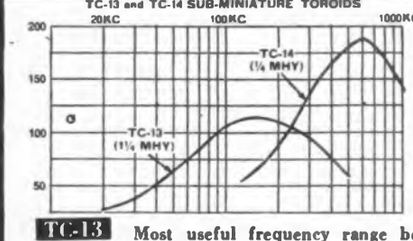
In Filter Networks & Toroids Your Specialist is "Burnell"



TC-11 Most useful frequency range lies between 2KC and 25KC. Maximum available inductance 1 HY for lower end of frequency range.

TC-12 Most useful range between 15KC and 150KC, maximum inductance 500 MHYS at the lower frequencies.



TC-13 Most useful frequency range between 40KC and 400KC. Available up to 100 MHYS with best optimum characteristics below 10 MHYS.

TC-14 Recommended for 200KC to 1 megacycle. This is best employed at inductances less than 1MHY.

MINIATURE TELEMETERING FILTERS

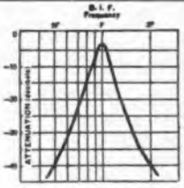
In view of the large number of filters that are employed in telemetering equipment, the size of the filters is a major contributing factor to the size of the equipment. As the approximate volume of a set of twenty standard telemetering band pass filters is 1500 cubic inches, even for ground based equipment this bulk can be objectionable. This is particularly true of mobile station. Our cognizance of this led to the development of a series of miniaturized filters that necessitates practically no sacrifice of desired attenuation characteristics.

The tremendous advantage of these new filters can be seen from the fact that a set of the same twenty filters would have a volume of less than 300 cubic inches representing a reduction by volume of 80%. Every telemetering filter now being supplied in the standard case is also available in the new miniaturized version.

INTERSTAGE FILTERS

These are economical band pass filters designed to operate either from a triode plate or cathode follower to the grid of a tube. A voltage gain of ten or more can be provided depending upon the desired band width. Range of center frequencies available lies between 60 cycles and 50,000 cycles.

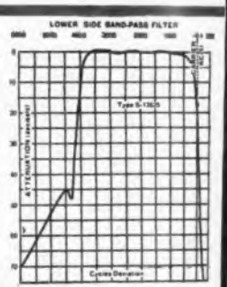
Base dimensions: 1-3/16 x 1-11/16



WE ARE PROUD OF OUR RECORD AS A MOST PROGRESSIVE FIRM IN THE ENGINEERING AND MANUFACTURING OF FILTER NETWORKS AND RELATED COMPONENTS. ENGINEERS AND ENGINEERING BUYERS AUTOMATICALLY THINK OF "BURNELL" IN RELATION TO FILTER DESIGN PROBLEMS AS WELL AS PRODUCTION REQUIREMENTS FOR FILTERS OR TOROIDS.

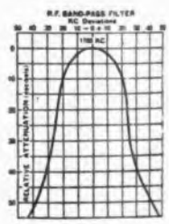
TO ACHIEVE THIS ENVIABLE POSITION WE CONSTANTLY STRIVE FOR THE DEVELOPMENT OF NEW AND BETTER PRODUCTS THAT WOULD BEST SERVICE OUR CUSTOMER'S NEEDS.

SINGLE SIDE BAND FILTERS



Shortly after these side band filters were introduced to the communications industry by Burnell & Company, a new interest in side band reception arose. Although other types of side band filters have been manufactured for some time, their use was limited because of extremely high cost, limited availability, and excessive volume. In attempting to overcome all of these disadvantages, our engineering staff concentrated on the development of a set of filters which would employ high quality toroids instead of crystal elements previously employed in such filters. As the effectiveness of a side band filter depends primarily upon how close the cut off frequency can be placed to the carrier frequency (and still provide sufficient attenuation) it was necessary first to determine the optimum carrier frequency at which the high Q of the toroids could permit a sharp enough rate of cut off and high enough attenuation to the opposite side band. It was for this reason that a choice of the 25kc carrier was made.

R. F. BAND PASS FILTERS



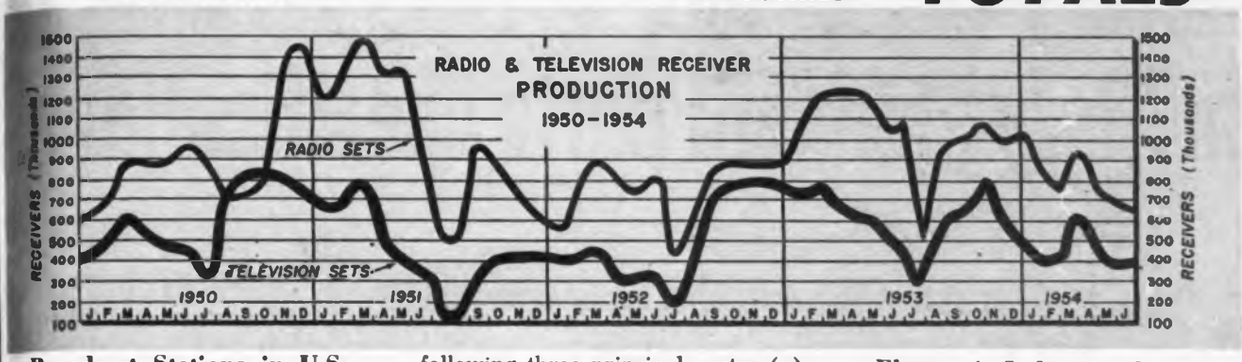
Until quite recently toroidal band pass filters were not too practicable at frequencies beyond the I. F. range. However, since developing toroids with much higher Q at radio frequencies than hitherto obtainable, we have extended the range of our filters to as high as two and three megacycles. A number of these attenuation filters have been able to replace types formerly employing expensive crystal elements. An additional important factor is the great reduction in size over R. F. filters, usually constructed with air core or "iron slug" coils.

Write for new and enlarged 16 page catalog 102A

Burnell & Co., Inc.
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

Exclusive Manufacturers of Communications Network Components

ELECTRONIC INDUSTRIES TOTALS



Broadcast Stations in U.S.

	AM	FM	TV	
Stations on Air	2533	532	265 VHF 125 UHF 7 UHF Educ.	Comm'l.
Under Construction (CPS)	137	59	78 VHF 114 UHF 24 UHF Educ.	Comm'l.
Applications Pending	182	10	187 VHF 26 UHF 18 UHF Educ.	Comm'l.

Statistics of Communications Industry in U.S.

A new volume containing financial and operating data relating to communication carriers subject to the Communications Act of 1934 has recently been completed at the FCC. Available through the Supt. of Documents Wash., D.C. (50 cents per copy), the book is divided into the following three principal parts: (a) General Tables—Telephone and Telegraph, (b) Telephone Carriers, (c) Domestic and International Telegraph Carriers. The financial and operating data is complete for the year 1952.

British Radio Exports

Figures below have been made available in connection with the forthcoming British National Radio Show (Aug. 24-Sept. 4, 1954) at Earls Court, London, and show how the value of radio exports have grown during postwar years

Year	Value (Pounds)
1946	7,700,000
1947	10,250,000
1948	12,000,000
1949	12,000,000
1950	17,800,000
1951	22,200,000
1952	24,500,000
1953	25,800,000

Electronic Industries Safer!

The following figures from the National Safety Council are based on the number of disabling injuries per 1,000,000 man-hours:

Industry	Freq.* Rate	% change from 1952
Communications	1.22	—10
Electrical Equipment	2.88	—15
Automobile	3.39	— 6
Aircraft Manufacturing	3.58	—15
Cement	3.81	—18
Steel	3.90	— 4
Tobacco	4.37	—13
Chemical	4.53	—11
Rubber	4.61	—23
Shipbuilding	5.33	+ 1
Textile	5.51	—14
Misc. Manufacturing	6.26	+ 3
Storage & Warehousing	6.45	— 1
Printing & Publishing	6.54	—20
Railroad Equipment	6.77	+ 6
Machinery	6.92	—19
Glass	6.96	— 9
Sheet Metal	7.07	+ 9
ALL INDUSTRIES	7.44	—11

TELEVISION OWNERSHIP BY STATE

Several readers have requested TV set density figures. The compilation below has been made available through the CBS Television Research Dept. whose survey was completed Nov. 1, 1953. By the end of 1954 the number of receivers in use is estimated to be 31,500,000.

STATE	TOTAL FAMILIES	TV FAMILIES		STATE	TOTAL FAMILIES	TV FAMILIES	
Alabama	824,700	280,470	34%	Nebraska	427,300	177,410	42%
Arizona	253,100	107,570	43	Nevada	60,600	11,930	20
Arkansas	535,500	102,020	19	New Hampshire	162,600	84,690	52
California	4,029,500	2,809,640	70	New Jersey	1,568,100	1,374,790	88
Colorado	456,100	196,790	43	New Mexico	202,000	43,770	22
Connecticut	630,300	479,210	76	New York	4,800,100	3,712,620	77
Delaware	101,600	75,110	74	North Carolina	1,056,400	395,960	37
District of Columbia	246,900	197,710	80	North Dakota	161,200	13,320	8
Florida	968,800	337,350	35	Ohio	2,517,800	1,957,490	78
Georgia	955,500	389,720	41	Oklahoma	692,300	312,040	45
Idaho	180,100	24,820	14	Oregon	546,500	132,320	24
Illinois	2,828,700	1,862,390	66	Pennsylvania	3,102,200	2,276,640	73
Indiana	1,294,700	799,700	62	Rhode Island	243,800	217,720	89
Iowa	826,700	399,770	48	South Carolina	554,600	194,410	35
Kansas	662,400	212,600	32	South Dakota	189,000	17,890	9
Kentucky	830,100	354,110	43	Tennessee	915,900	381,190	42
Louisiana	790,100	278,770	35	Texas	2,412,800	1,068,520	44
Maine	260,000	67,970	26	Utah	207,600	120,320	58
Maryland	732,600	588,650	80	Vermont	108,500	25,930	24
Massachusetts	1,424,300	1,109,610	78	Virginia	919,100	510,970	56
Michigan	2,023,500	1,417,930	70	Washington	828,800	387,060	47
Minnesota	900,000	437,020	49	West Virginia	529,600	229,320	43
Mississippi	587,400	119,370	20	Wisconsin	1,045,000	518,880	50
Missouri	1,306,300	677,160	52	Wyoming	93,100	6,750	7
Montana	197,700	9,100	5	U. S. TOTAL	47,191,500	27,506,500	58

First 5KW engine-generator set built to military standard parts specifications!

the new ONAN

5VB-4M

5KW, A.C.

Generator designed and tested in accordance with MIL-G-10228 (CE). Engine qualifies to MIL-E-11275A, 10 HP Class, on standardization of high mortality parts.

WINTERIZED MODEL

Equipped with engine heater and rugged sheet-metal housing to protect generating set against wind, rain and snow. Delivers full rated output at ambient temperatures from +125° to —65° F. Weight 500 lbs.

Built and tested for military service!

The Onan Model 5VB-4M meets all specified test requirements for Military Type II, Class A engine-generator sets. It's built to withstand braking and dropping shocks, to resist high humidity, to start at extreme temperatures and to operate at all angles up to 15° from horizontal.

After 1,000 hours of operation with full rated load, and under test conditions of 107° F. and 5,000-foot altitude, *the Model 5VB delivers more than 150% of rated output at rated voltage, frequency and power factor.*

The skid-mounted set has an actual dry weight of 445 pounds and requires 25% less space than many conventional units. Design of the suction air-cooling system allows the generator set to be "buried" within a large piece of equipment *in space only slightly larger than actual generator-set dimensions.*

Prime mover on the 5VB is a new Onan high-compression, overhead-valve, two-cylinder, V-type gasoline engine delivering 19 H.P. (with accessories) at 3600 R.P.M. It is equipped for manual starting using integral, self-winding rope starter. Electric starting can also be provided.

Designed specially for field service as a source of power for communications, lighting and operating motor-driven equipment, the Onan 5VB combines the portability, rugged construction and dependable performance demanded in military service, *with the all-important advantage of being built with military standard parts.*

GENERATOR DESIGNED TO MIL-G-10228 (CE)

Specially designed direct-connected generator supplies multiple voltages (1 and 3-Phase) with voltage regulation within a total band width of 4%. A single rotary switch selects the required voltage and phase. Rated at 5KW with 60-cycle output, this model is also available with D.C. output up to 7½ KW in standard voltages.

Splash-proof generator is unusually accessible for inspection and adjustment. Equipped with all essential instruments conveniently located and protected from the weather.

OTHER ONAN GENERATING EQUIPMENT

Onan designs and builds engine and motor-generator sets including 400-cycle models for specialized electronic applications in military aircraft, communications, and commercial use. Onan Electric Plants in regular production range from 400 to 55,000 watts in all standard voltages . . . gas, gasoline and Diesel-driven models.

Write for complete specifications

(The Onan VB engine is also available separately as a prime mover in the military Class II, 10 H.P. basic size.)

Onan ELECTRIC PLANTS

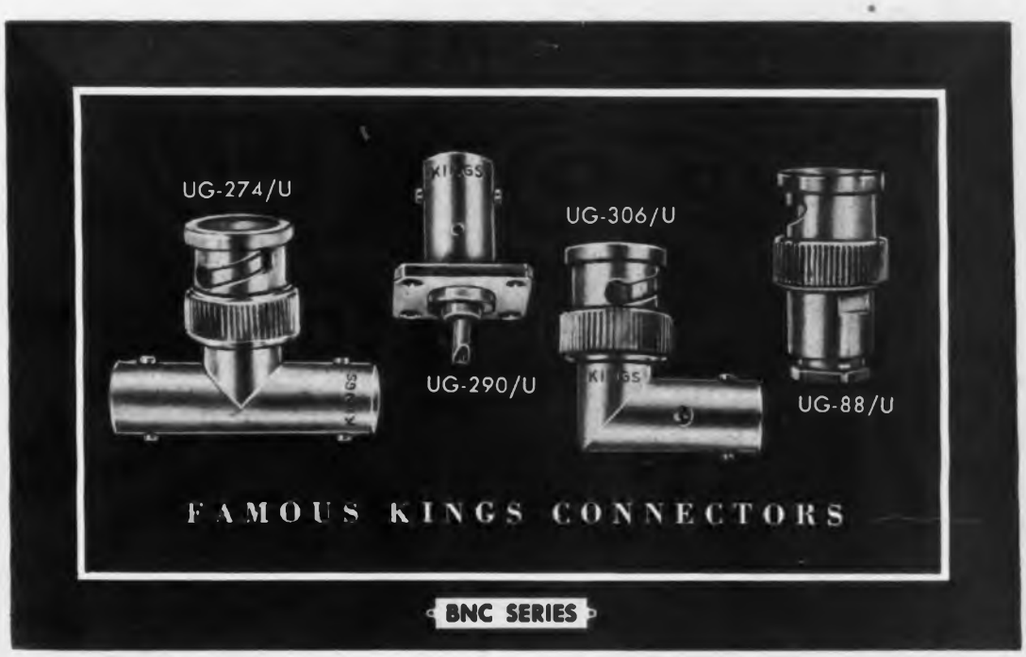
D. W. ONAN & SONS INC.

7890 UNIVERSITY AVENUE SOUTHEAST • MINNEAPOLIS 14, MINNESOTA

Famous Kings in History

FERDINAND V, 1452-1516, was the Spanish King of Castile and Leon. As Ferdinand II he was also King of Aragon. His policies, though severe, founded Spain's imperial greatness. He married Isabella of Castile. King Ferdinand is best-known to Americans because he and the Queen aided Christopher Columbus in his famed voyages of discovery.

In the field of electronics, industries all over America have discovered that they can always depend upon Kings Connectors for both standard and special applications. Because of the highest standards of manufacture, plus long experience, the Kings organization can meet your own specific connector requirements, whatever they may be. You'll be glad you called on Kings first.



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40 MARBLEDALE ROAD, TUCKAHOE 7, N. Y.

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MANUFACTURING

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

OPERATION

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

THE ELECTRONIC INDUSTRIES DIRECTORY

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

As We Go To Press...

Variable Toroids Now Available

A new series of "Rotoroids"—variable toriodal inductors—provide a continuous three-to-one maximum-to-minimum inductance range with 180° shaft rotation. These hermetically sealed units are permeability tuned, and require no dc saturating current. The choice of nominal inductance is virtually unlimited.

The manufacturer, Burnell & Co., 45 Warburton Ave., Yonkers, N.Y., reports that the presently available Rotoroids are electrically equivalent to standard toroids made by the company. The firm also reveals that two miniature Rotoroids will be placed in production within a month. Typical Rotoroid applications include tunable audio oscillators, variable impedance devices, servo systems, variable phase shift networks, adjustable filters, electrochemical controls, and telemetering devices.

CBS Announces New Color TV Picture Tube

CBS made its bid for leadership in the color tube race recently with the unveiling of a 19-in. direct-viewing, all glass, color television picture tube. The new tube, designated the CBS-Colortron "205," from the square-in. area of its viewing surface, is said to provide a picture approaching the size of the conventional 21-in. b&w tube.

Structurally, the tube employs a curved shadow mask and tricolor screen originated by CBS-Hytron, with a three-beam electron gun designed for electromagnetic convergence. More accurate convergence is said to result from electromagnetic as opposed to electrostatic means.

Charles F. Stromeyer, CBS-Hytron president, demonstrates new color TV tube. (l to r) face plate with phosphor dot screen, shadow mask, glass funnel, and three-beam electron gun

The additional screen area has been gained by positioning the three supports for the shadow mask above and below the desired screen area. The sides of the mask and screen are thus left free of interference.

The tricolor screen is printed directly on the face of the tube, eliminating "pincushioning," or bowing inward of the four sides of the picture.

Production plans are aimed at 10,000 tubes per month by late September.

See p. 134 for details.

New Computation Center

The analog computation center opened recently near Princeton, N.J., by Electronic Associates Inc. meets the demand for a headquarters where members of industry can solve their problems in management operations control, dynamic systems analysis, applications engineering and simulation. The center provides a staff of scientists available for problem analysis as well as equipment, which may be rented on an hourly, weekly, or monthly basis for problem solution.

In announcing the opening, Lloyd F. Christianson, pres. of Electronic Associates Inc. pointed out that now, for the first time, computation facilities are available to the smaller companies unable to afford computers of their own.

For each problem, the Center assigns the necessary scientists, engineers or mathematicians experienced in the use and applications of analog computers. At the conclusion, a comprehensive report, with specific recommendations, is made.

Analog computation center opened by Electronic Associates provides facilities for small companies unable to afford computers of their own. Complete problem patch panels are preset and inserted

RCA to Produce Ferrites

The Tube Div. of RCA has announced its first commercial ferrite cores. It will also custom produce ferrites to manufacturers' specs. Production at the Camden, N. J., plant will be supplemented by a new plant in Findlay, Ohio.

New G.E. Organizations

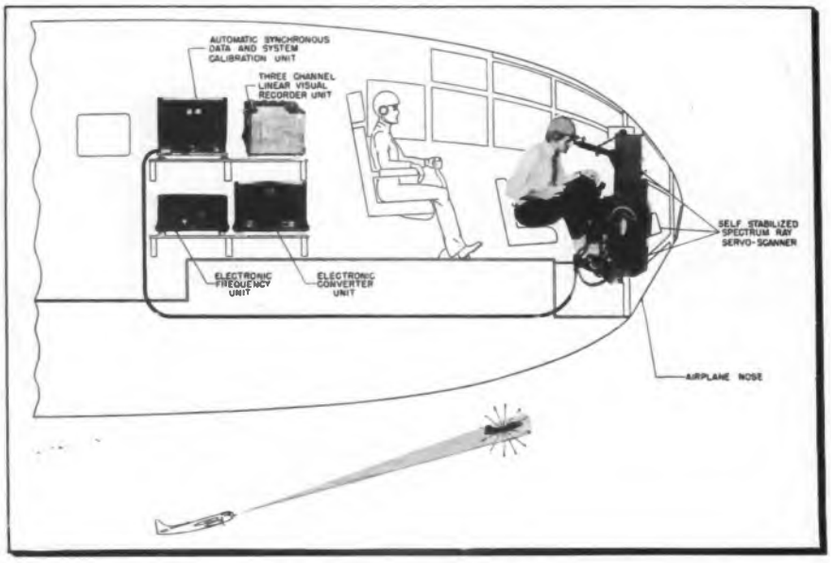
In line with the company's decentralization program, G. E. has announced the formation of two new organizations, a Meter Dept. and an Instrument Dept. Headquarters for the Meter Dept. will be in Somersworth, N. H. The Instrument Dept. will remain at Lynn, Mass.

MORE NEWS on page 14

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

Air Force Flying Lab Detects Missiles

New electronic equipment capable of detecting and analyzing energy radiating from any missile in flight has been delivered to the Air Force by Servo Corp. of America. The stratospheric lab employs a double monochromator which splits black light. System has advantage over radar because it can not be detected by enemy



System for spotting enemy aircraft uses spectrum scanner to detect radiation

Four New TV Stations Join Bell Network

The Long Lines Dept. of A.T.&T. reports that WISH-TV, Indianapolis, Ind.; KCBD-TV and KDUB-TV, Lubbock, Texas, and WDBO-TV, Orlando, Florida have been connected to the nationwide TV facilities of the Bell system.

With the addition of these four stations, network TV programs now reach 301 stations in 191 cities in the U.S.

RADIOACTIVE

Small lead chambers, shown here at El-Tronics, Inc., Phila., weigh 130 lbs. each, are used to transport radium. Keeping them presentable for repeated shipments is simplified by using Krylon

DuMont West Coast Depot

The Cathode-Ray Tube Div. of Allen B. DuMont Labs. plans to open new sales, service and warehouse facilities at 2545 S. Yates Ave., Los Angeles, effective Sept. 1. In the interim headquarters will be at 1235 E. Olympic Blvd., Los Angeles.

Remote Control Seen For High Power Stations

The National Association of Radio and Television Broadcasters will petition the FCC to extend remote control to high power and directional stations after sufficient data has been obtained, it was announced by A. Prose Walker, manager of engineering for the NARTB.

In citing the great economic merits, Walker pointed out that one station had realized savings in salary and overhead within 90 days after the installation of remote control. It was estimated that the equipment had paid for itself within seven months.

As to the reliability of remote control equipment, actual case histories of stations using such equipment showed that breakdowns were even less frequent than when the transmitters were attended.

Commenting on the practical limits of remote control, Walker foresaw remote operation of even the highest-powered broadcast transmitters within a short time. A plan for such operation is now being drawn up by the NARTB for submission to the FCC.

Transistorized Power Line Carrier Developed

A completely transistorized power line carrier is being tested on Potomac Edison's Marlowe-Frederick line by engineers of the Westinghouse Electric Corp. The operational tests started last year are expected to correlate field results with extensive laboratory tests already completed.

The equipment under test is designed for telegraphic functions, such as relaying and telemetering. The transmitter consists of a master oscillator, buffer amplifier, and output amplifier; the receiver has high-frequency amplifier, detector, and relay-operating stages. Both point-contact and junction transistors are used.

Dual-Purpose Portable

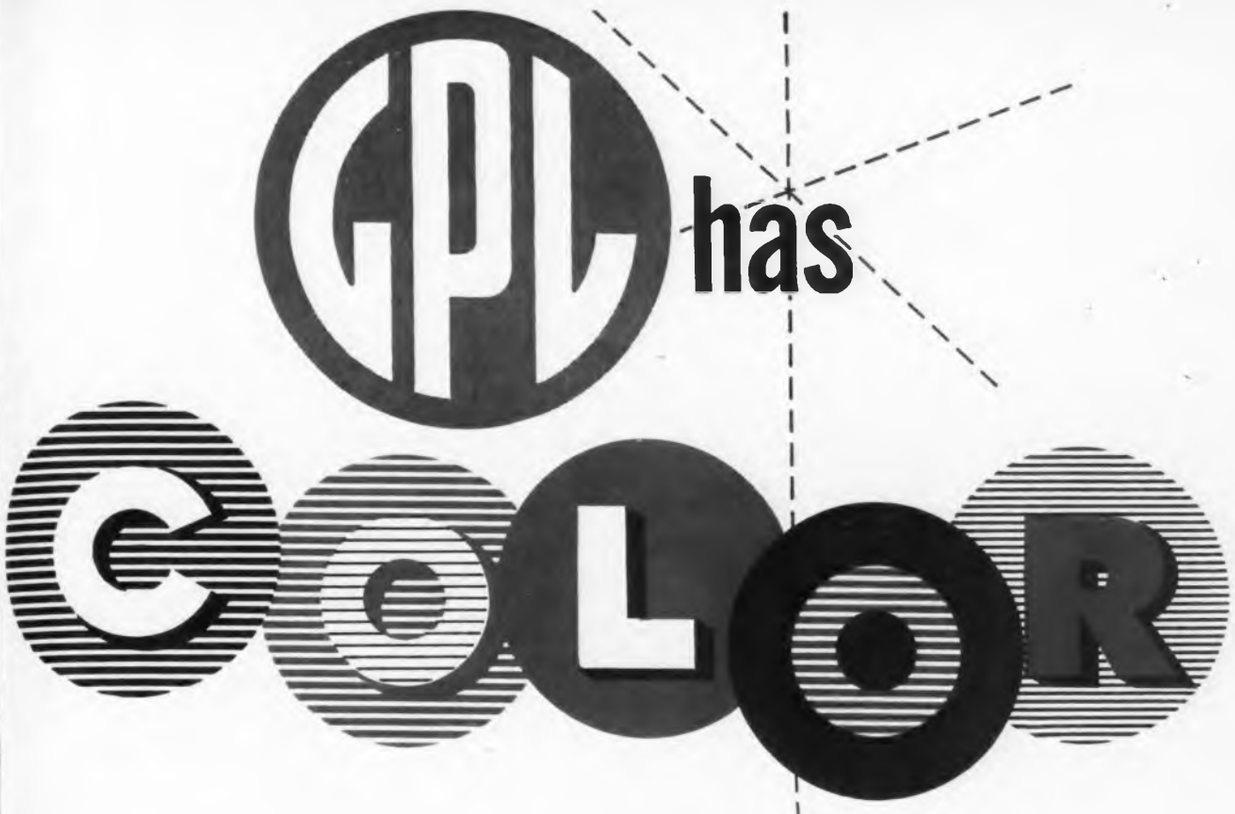
Raytheon Mfg. Co., Waltham, Mass. has announced a new portable radio, the GM 114A, which doubles as a marine direction finder to help boatsmen determine their positions at sea.

Fair mariner adjusts knob-shaped directional antenna to find direction of station

The "fix" is obtained by an adjustable, knob-like antenna which projects 2-in. above the case.

The radio covers the commercial broadcast band, the 1700-3400 KC "Marine" band, and the 200-415 KC "beacon" band. A cheaper 2-band model is also available.

MORE NEWS on page 16



COMPLETE GPL-WICKES COLOR TV SIGNAL GENERATING AND TEST EQUIPMENT FOR:

TELECASTING • RESEARCH • PRODUCTION • EDUCATIONAL

GPL now distributes color television operating and testing equipment designed and manufactured by Wickes Engineering and Construction Company, well known pioneers and specialists in this field.

The GPL-Wickes equipment is designed for strict adherence to the requirements of NTSC systems and for convenience in practical use. A careful program of quality control and final testing in the Wickes plant insures accuracy and reliability for research, testing, or on-the-air uses.

This equipment compliments the GPL line of monochrome television equipment which has become known for its advanced design and high standards of performance.

COLOR CONSULTATION SERVICE

GPL engineers will be glad to assist in determining your requirements. Color equipment is available in complete packages for station conversion or individual units to meet your requirements, with early delivery.

SPECIFICATIONS ON REQUEST: Write, wire or phone for specification sheets and prices.

The GPL-Wickes equipment available for prompt delivery includes:

- **INTERLACE SIGNAL GENERATOR**
- **COLOR BAR GENERATORS**
- **COLOR CODER**
- **CONVERGENCE DOT GENERATOR**
- **MULTI-BURST GENERATOR**
- **AMPLITUDE LINEARITY TESTER**
- **VIDEO DISTRIBUTION AMPLIFIERS**
- **PULSE DISTRIBUTION AMPLIFIER**
- **REGULATED POWER SUPPLYS**
- **VECTOR DISPLAY EQUIPMENT**
- **ENVELOPE DELAY TRACER**
- **COLOR VIDEO MONITOR**
- **PHASE CORRECTION NETWORKS**
- **CROSSOVER FILTER**

General Precision Laboratory

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As We Go to Press . . . .

Taping Gun Speeds Harness Wrapping

Electrical harness wrapping can be speeded up from 2 to 10 times, using plastic tape dispensed by a new taping gun marketed by Minnesota Mining and Mfg. Co., St. Paul, Minn.

Weighing less than 20 oz. the "Scotch" taping gun, model E-2, has

Tape gun speeds electrical harness wrapping

a capacity of 36-yds. in the circular magazine. A slender, curved tip serves as a needle to thread the tape around wires on a cable layout board or in spots difficult to reach.

New Gudeman Lab

The Gudeman Co. has opened new lab and production facilities at 9200 Exposition Blvd., Los Angeles 34, Calif., under the direction of Donald H. Allen, to produce pulse transformers and delay lines.

NEW COLOR YOKE

New magnetic deflection yoke for 19-in., 3-gun color TV tubes introduced by General Instrument's F. W. Sickles Div. is held by company's vice-president, Edgar Messing. High efficiency and close convergence are prime features

COMING EVENTS

Aug. 25-27—Western Electronic Show and Convention. Los Angeles and San Francisco IRE sections and WCEMA sponsored. (Show) Pan-Pacific Auditorium, Los Angeles. (Convention Hq.) Ambassador Hotel, Los Angeles, Calif.

Aug. 25-Sept. 4—National Radio Show, Earls Court, London. (Preview for overseas guests on Aug. 24)

September—First International Scientific Radio Union, Amsterdam, Holland.

Sept. 1-16—Golden Jubilee Meeting of the International Electrotechnical Commission, University of Pennsylvania, Philadelphia, Pa.

Sept. 5-9—International Frankfort Fair, Frankfort, Germany.

Sept. 13-24—International Instrument Congress and Exposition. Commercial Museum and Convention Hall, Philadelphia, Pa.

Sept. 15-17—IRE-MIT Symposium on the Information Theory, co-sponsored by the AIEE and URSI, Massachusetts Institute of Technology, Cambridge, Mass.

Sept. 15-21—ISA First International Instrument Exposition, Convention Hall, Philadelphia, Pa.

Sept. 16-18—Joint Electron Tube Engineering Council General Conference, Chalfont-Haddon Hall, Atlantic City, N. J.

Sept. 28-30—1954 National Packaging and Materials Handling Competition, sponsored by the Soc. of Industrial Packaging and Materials Handling Engineers. Chicago Coliseum, Chicago, Ill.

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

Oct. 4-6—Tenth Annual National Electronics Conference, Hotel Sherman, Chicago, Ill.

Oct. 11-15—AIEE Fall General Meeting, Morrison Hotel, Chicago, Ill.

Oct. 13-15—Joint Meeting of RTCM and IRE Professional Gp. on Communications Systems. Somerset Hotel, Boston, Mass.

Oct. 13-17.—1954 Annual Convention, Audio Engineering Society. Hotel New Yorker, N. Y.

Oct. 18-20—RETMA Radio Fall Meeting, Hotel Syracuse, Syracuse, N. Y.

Oct. 18-22—42nd National Safety Congress and Exposition, Conrad Hilton, Congress, Morrison and La Salle Hotels, Chicago, Ill.

Oct. 21-23—8th New England Conference of the American Soc. for Quality Control. Ten Eyck Hotel, Albany, N. Y.

Oct. 26-28—2nd National Conference on Tube Techniques, sponsored by the Working Group on Tube Techniques of the Dept. of Defense. Western Union Auditorium, 60 Hudson St, N. Y. C.

Oct. 27-30—30th National Convention of the National Assoc of Education Broadcasters. Hotel Biltmore, New York.

Nov. 4-5—East Coast Conference on Airborne and Navigational Electronics, sponsored by the Baltimore section of IRE and IRE Professional Group on Aeronautical and Navigational Electronics. Sheraton-Belvedere Hotel, Baltimore, Md.

Nov. 10-11—AIEE Conference on Electronic Instrumentation and Nucleonics in Medicine, Morrison Hotel, Chicago, Ill.

Nov. 10-12—18th Annual Time and Motion Study and Management Clinic, sponsored by the Industrial Management Society. Sherman Hotel, Chicago, Ill.

Nov. 12-13—National Symposium on Quality Control Methods in Electronics, sponsored by the Professional Group on Quality Control of IRE and Electronic Technical Comm. of the American Soc. for Quality Control. Hotel Statler, New York.

Nov. 18-19—6th Annual Electronics Conference, sponsored by the Kansas City Section of IRE, Hotel President, Kansas City, Mo.

Nov. 21-22—Automatic Control Equipment Exhibition. Waldorf-Astoria Hotel, N. Y. C.

Nov. 29-Dec. 4—First International Automation Exposition, 242nd Coast Artillery Armory, New York, N. Y.

Dec. 8-10—4th Annual Eastern Joint Computer Conference and Exhibition, jointly sponsored by the AIEE. IRE, and ACM. Bellevue-Stratford Hotel, Phila. Pa.

ACM: Assoc. for Computing Machines.
AES: Audio Engineering Society.
AIEE: American Institute of Electricaal Engineers.
IRE: Institute of Radio Engineers.
ISA: Instrument Society of America.
NACE: National Assoc. Corrosion Engineers.
NARTB: National Assoc. of Radio and TV Broadcasters.
RETMA: Radio-Electronics-TV Manufacturers Assoc.
RTCM: Radio Technical Commission for Marine Services
URSI: International Scientific Radio Union
WCEMA: West Coast Electronics Manufacturer's Association
WESCON: Western Electronics Show & Convention.

Nameplate Firm Opens California Office

E. T. Turney, Jr., President of North Shore Nameplate Co., Bayside, N. Y., has announced the establishment of the West Coast Nameplate Co., 418 W. Los Feliz Rd., Glendale 4, Calif., under the direction of C. V. Wilgus.

New West Coast Firm

Electro-Instruments, Box S, Old San Diego Sta., San Diego 10, Calif., has been formed, reports President Jonathan Edwards. Plant at 3796 Rosecrans will make digital voltmeters and data processors.

MORE NEWS on page 32

Check this list of TRANSISTOR APPLICATIONS already in hand at...

HYDRO-AIRE Inc.
3000 WINONA AVENUE, BURBANK, CALIFORNIA
Subsidiary of Crane Co.

Is there an application here that is significant to your operation or product design? If so, our Transistor Application Engineers are ready to confer with you.

Hydro-Aire is manufacturing point-contact and junction Transistors to the very high standards of quality control for which all Hydro-Aire products have become famous. In addition, it is an essential part of the program to explore with energy and imagination the ever-widening field of new uses constantly opening up for Transistors. This is why it is in your interests to keep in touch with us, so that you will benefit from our work both in current applications and applications that will be developing in the coming months.

PLEASE WRITE ON YOUR COMPANY LETTERHEAD:

As We Go to Press . . .

Electronic Thermometer For Clinical Use

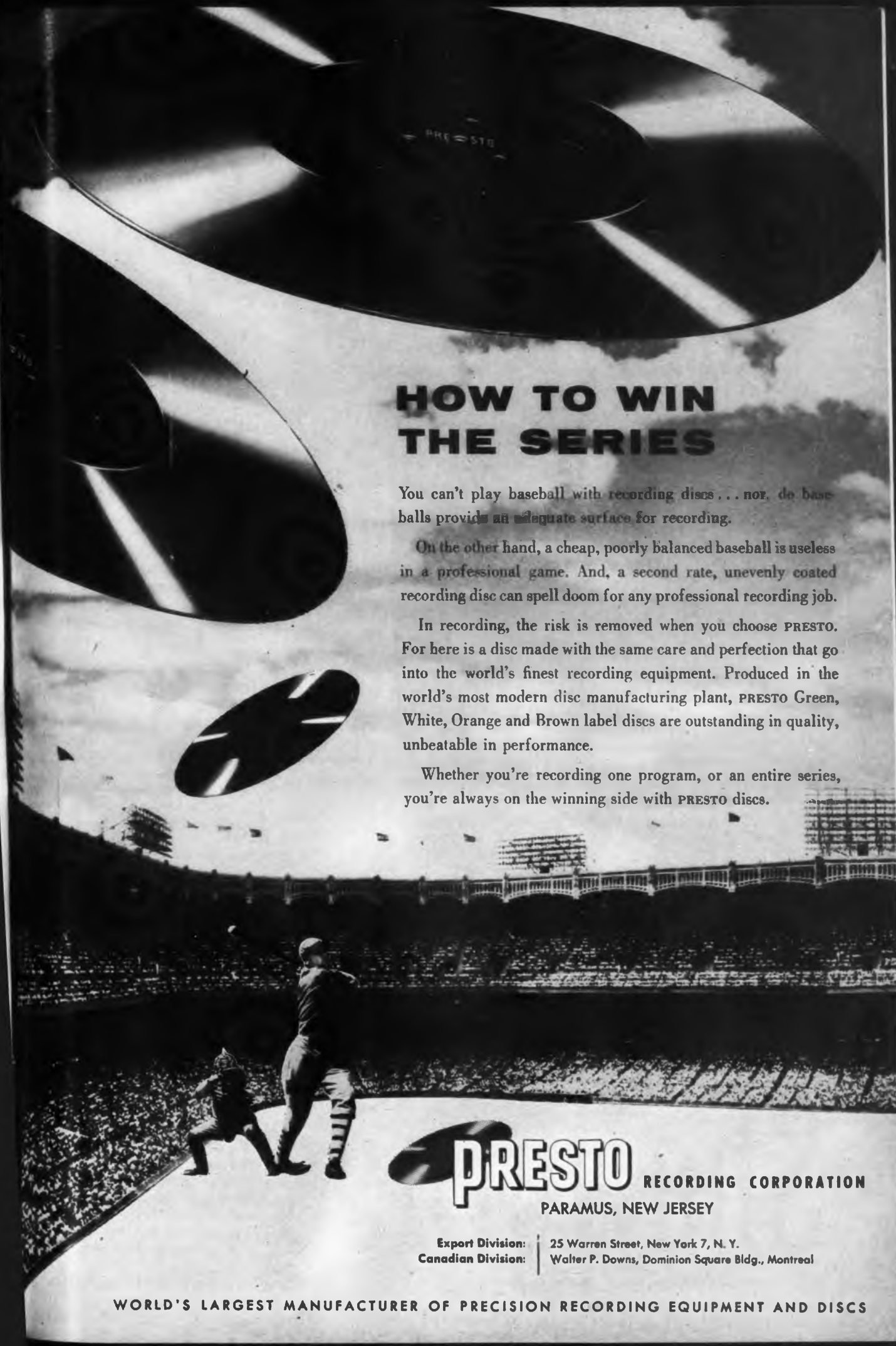
The Surgeon General's Office in Washington, D. C., has announced an electronic thermometer for clinical use manufactured by the Burlington Instrument Co., Burlington, Iowa. This new instrument is intended to replace the familiar glass stem mercury filled thermometer in use for the last 86 years.

The "Swiftem" thermometer consists of three parts. First is a small

Electronic thermometer takes reading in 3 to 5 seconds. Unit employs thermistor in tip

tapered stainless steel tube which is applied to the patient just as if it were the conventional glass thermometer. In place of a mercury filled tip as in the glass thermometer, the stainless steel tube has in its tip a very small piece of material -whose electrical resistance changes rapidly with changes in temperature. This stainless steel tube called a probe is plugged into a miniature soscket such as is used in hearing aids. A thin, flexible electrical cord is the second important element and the third is the indicating instrument itself, to which the electrical cord is connected. The instrument is housed in a molded plastic case and is about the size of a photographic exposure meter. The instrument is calibrated in degrees Fahrenheit the same as the glass thermometer.

The remarkable speed of 3 to 5 seconds to obtain a reading with the Swiftem coupled with high accuracy contrasts sharply with the minimum of three minutes required with a mercury thermometer and less accuracy. To the busy physician this means he can save from 30 to 90 minutes a day.



HOW TO WIN THE SERIES

You can't play baseball with recording discs . . . nor, do baseballs provide an adequate surface for recording.

On the other hand, a cheap, poorly balanced baseball is useless in a professional game. And, a second rate, unevenly coated recording disc can spell doom for any professional recording job.

In recording, the risk is removed when you choose PRESTO. For here is a disc made with the same care and perfection that go into the world's finest recording equipment. Produced in the world's most modern disc manufacturing plant, PRESTO Green, White, Orange and Brown label discs are outstanding in quality, unbeatable in performance.

Whether you're recording one program, or an entire series, you're always on the winning side with PRESTO discs.

PRESTO RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Walter P. Downs, Dominion Square Bldg., Montreal

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS

TELE-TIPS

SEPTEMBER is "Sight-Saving Month," and the Society for the Prevention of Blindness grimly reminds us that 27,000 more Americans will become blind this year—half of them needlessly. Although we're a month ahead of schedule, it may not be too early to write to the society at 1790 Broadway, New York 19, N.Y. for their folder, "Your Wonderful Eyes."

COMMERCIAL TV has been approved by the British House of Commons, and is expected to be on the air next year. The Labor Party opposition warns that if it is returned to office it may modify or abandon the whole project.

SCHOOL CHILDREN watch TV about 20 hours per week, but 81% of them report that video programs do not interfere with their homework, according to a report, "Television and Youth," prepared by Prof. T. C. Battin of the Univ. of Florida, and made available by NARTB.

HUMIDITY may be measured quickly and accurately by means of a new hygrometer developed by Arthur D. Little, Inc., for the Signal Corps. It consists of a polystyrene strip coated with carbon powder in a water-sensitive binder. The binder absorbs water when air is moist, forcing the carbon particles apart and causing a greater measured resistance. Time lag is less than a second.

LIGHTING terminology used in TV studios is being standardized in a new glossary under preparation by the SMPTE. Equipment and instrumentation are next on the standardization list. Station participation in this program is being solicited by H. M. Gurin, TV Studio Lighting Committee, SMPTE, 55 W. 42 St., New York 36, N.Y.

"JIGGERS, THE BOSS" light in a new intercom system made by the DuKane Corp. insures employee privacy. It is integrated with an "executive priority" device which permits the top man to over-ride or

(*Continued on page* 44)

CHATHAM advance-designed yesterday

—in industry-wide use today!

AMPLIFIERS • REGULATORS • INERT GAS AND MERCURY RECTIFIERS • MERCURY, INERT GAS AND HYDROGEN THYRATRONS

CHATHAM
SPECIAL-PURPOSE TUBES

- **3B28 RECTIFIER**
  Rugged half-wave Xenon filled rectifier. Operates in any position. Ambient temperature range —75° to +90°C. Inverse peak anode voltage 10,000, average current .25 amps. Filament 2.5v., 5 amp.
- **4B32 RECTIFIER**
  Ruggedly built, half-wave Xenon filled rectifier. Ambient temperature range —75° to +90°C. Inverse peak anode voltage 10,000, average anode current 1.25 amp. Filament 5v., 7.5 amp.
- **VC-1258 MINIATURE HYDROGEN THYRATRON**
  for pulse generation. Handles 10 kw peak pulse power.
- **6336 TWIN TRIODE**
  for voltage regulation. Features high plate dissipation, hard glass envelope.
- **6394 TWIN TRIODE**
  Similar to 6336 except 26.5 volt heater instead of 6.3 volt heater.
- **5594 XENON THYRATRON**
  Operates over wide ambient temperature range —55°C to +90°C.

STANDARD TYPES DIRECT FROM STOCK
PLUS SPECIAL DESIGNS BUILT TO REQUIREMENTS

Chatham specializes in the development of general and special purpose tubes for both electronic and industrial applications. Many of the tubes originally developed by Chatham to fill a specialized need, now number among the most widely used tubes in the industry. For complete information on Chatham tubes—either stock items or types built to your requirements—call or write today.

CHATHAM ELECTRONICS CORP.

Executive and General Offices: LIVINGSTON, NEW JERSEY
Plants and Laboratories: NEWARK and LIVINGSTON, NEW JERSEY

TELE-TIPS

(*Continued from page* 38)

suspend busy connections at his discretion. The system is reportedly eavesdrop-proof, and the signal light indicates when the boss has used his priority key. The designers consider the light something of an electronic substitute for the old-fashioned office boy who, in a more unhurried era, could be relied upon for a *sotto voce*, "Jiggers, the Boss!"

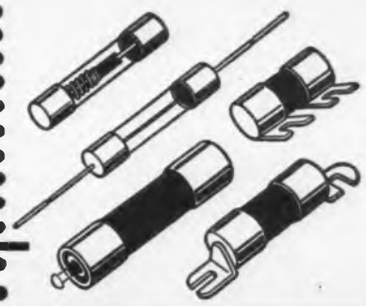
"THE 'FREEZE' reserved to two networks the almost exclusive right to broadcast in all but 12 of the 63 markets which had television service. It meant that the two other networks did not have and have not had since the fall of 1948 more than a ghost of an opportunity . . ."—Dr. Allen B. DuMont before U.S. Senate Subcommittee on Communications.

GENTLEMEN, PLEASE! Engineering authors help to further technical progress when they write an informative article on their developments. They also build a professional reputation. But more harm than good is done when classified material is inadvertently included. So for the benefit of all concerned, contributors to scientific periodicals should make sure that an authorized security officer clears the article before it is submitted. This precaution can save an otherwise innocent neck.

SOUND BOX only 6 x 6 x 6 in. has been developed by Armour Research Foundation to evaluate electron tubes and other components subject to vibrational and acoustical disturbances in airborne equipment. Operating as a reverberant chamber, 150 db sound levels may be produced with only a modest power input. As a source for this jet engine sound level, a random noise generator and audio oscillator are employed.

WEATHER plays a vital role in the degradation of plastic materials. Monsanto scientists conclude that styrene is strongly affected by sunlight, and that weather resistance is significantly improved by the addition of pigment. Phenolic compound shows very little change in strength and electrical properties in semi-tropical weather—if it is aged in a hot dry climate.

For "Trouble-Free" Electrical Protection—



You can rely on BUSS FUSES!

Accuracy and dependability are built in every BUSS fuse at the factory and will be there no matter when the fuse is called upon to operate.

For every BUSS fuse normally used by the Electronic Industries is tested in a sensitive electronic device that rejects any fuse that is not properly constructed, correctly calibrated and right in all physical dimensions.

Proper construction prevents poor contact heating, correct calibration makes certain that the fuse will carry its rated current.

This insistence on perfection results in quality, 'trouble-free' fuses. That's why manufacturers and service organizations rely on BUSS fuses for dependable electrical protection under all service conditions.

If at any time you have an electrical protection problem, let BUSS save you engineering time. At your service are the facilities of the world's largest fuse research laboratory and its staff of engineers ready to help you select the right fuse or fuse mounting . . . and if possible, one already available from local wholesalers' stocks.

For More Information • Mail this Coupon

BUSSMANN Mfg. Co.
(Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.
Please send me bulletin SFB containing facts on BUSS small dimension fuses and fuse holders.

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LETTERS . . .

Editors, TELE-TECH:

I have read your recent editorial "Fear of the Unknown" with much interest.

Undoubtedly, had it been possible in the early stages of development for the major picture tube manufacturers to get together and pool their joint knowledge with a view to developing a single standardized color tube, this would probably have resulted in considerable saving in research expense and might even have developed the ultimate color tube, or at least a satisfactory color tube sooner.

However, at this stage of the game this does not seem to be possible. The various major manufacturers are too deeply involved going down paths of their own for them to be willing to pool their knowledge with others. However, by accident perhaps the equivalent of what you suggest may actually still happen.

What I mean is this: One of the various color tubes now under development—and I do not mean any particular one—because I wouldn't know which one it would be as yet —will undoubtedly before many months stick its head out in front of the pack. Whichever one it is, it will have to be one that can be manufactured in quantity on automatic machinery at a reasonable cost—and a reasonable cost is getting more and more to mean substantially under $100.

DON G. MITCHELL
Chairman of the Board
Sylvania Elec. Prods. Inc.
1740 Broadway
New York 19, New York

Editors, TELE-TECH:

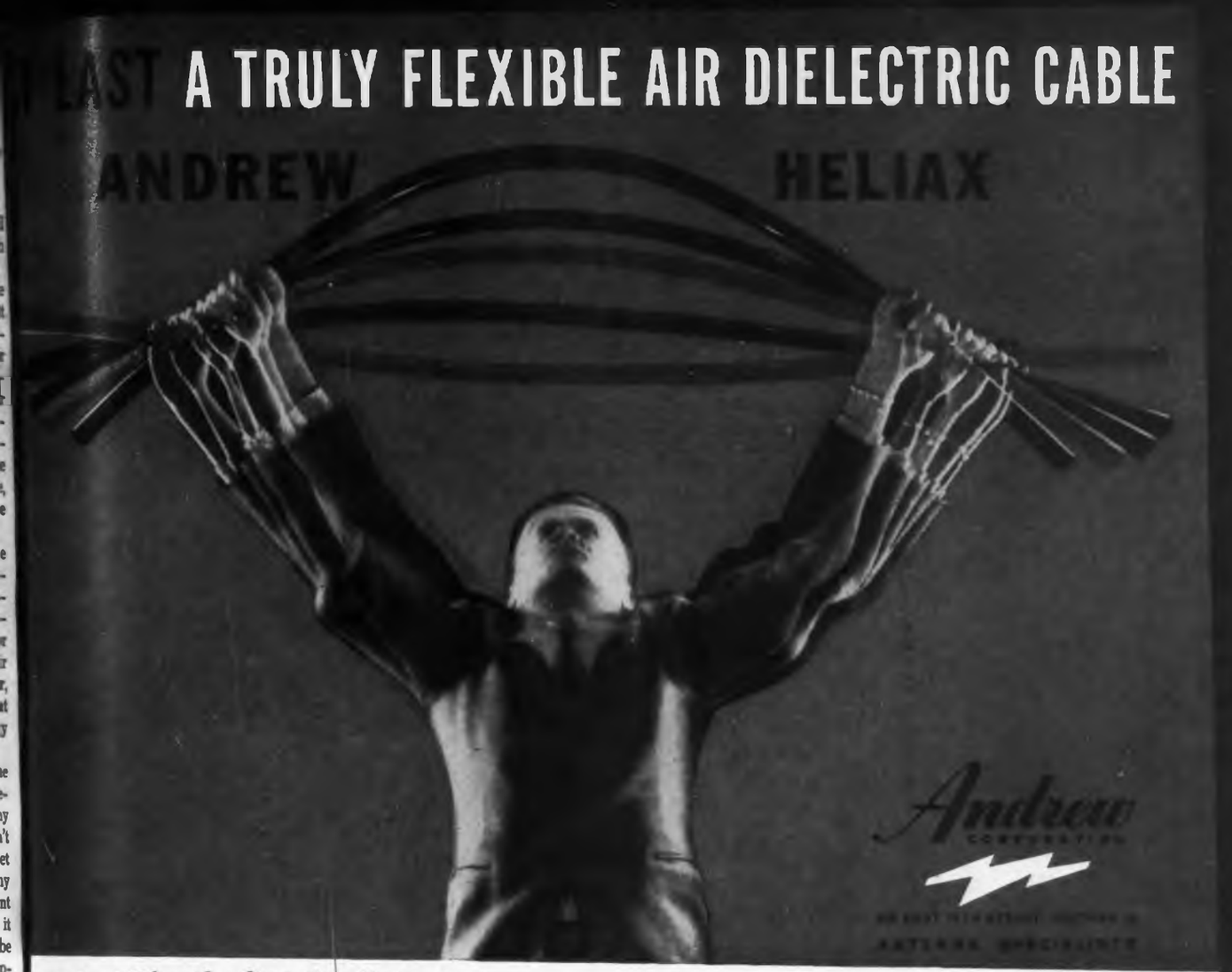
Your editorial "Industry Danger Signals" appearing on page 91 of your Electronic Industries Directory Issue of June 1954, is one of the best of its kind we have ever had the opportunity to read.

We, being a manufacturer of T.V. components, namely Deflection Yokes, congratulate you for bringing the foul conditions of the T.V. Industry out into the open.

We sincerely hope that your article may be effective to the point where some stabilization can be achieved.

R. E. KEILUHN
Allied Manufacturing Corp.
605-07 61st Street
West New York, N. J.

A TRULY FLEXIBLE AIR DIELECTRIC CABLE



important "for the first time" story...

e has long been cable easy to install.

e has long been highly efficient cable.

IAX is the first cable to deliver both characteristics. It is as flexible in application as solid dielectric cable, but has the same ency as copper air dielectric. HELIAX is superior in design, in efficiency and in electrical performance at microwave and wer frequencies, yet it is comparable in cost to lower frequency cables.

LIAX will be on display in Booth 532 at the Wesco Show.)

of installation (HELIAX can be pulled through conduit and bent itedly without changing its characteristics) means substantial savings stallation costs.

AX is crush proof, may be removed from one installation, coiled and talled. Now available in 7/8" size in continuous lengths. Soon available ger sizes. Send the coupon for detailed specifications.

ANDREW CORPORATION • 363 EAST 75th ST. • CHICAGO 19, ILLINOIS

Gentlemen:

Please send bulletin 70-A, giving technical details and specifications on your 7/8" diameter flexible HELIAX cable (Type HX-0).

NAME_____

POSITION_____

COMPANY_____

ADDRESS_____

BOOKS

Handbook of Microwave Measurements

Edited by Moe Wind and Harold Rapaport. Published 1954 by Polytechnic Institute of Brooklyn, 55 Johnson St., Brooklyn 1, N. Y. 1000 pages. Price $12.00.

This two volume study of microwave techniques is one of the most comprehensive and practical works on the subject published to date. It was prepared by the Polytechnic Institute of Brooklyn for the Signal Corps, and contains highly informative contributions by 25 authors. Volume I contains the text, and Volume II the associated illustrations. The subject matter is clearly broken down into 20 sections, each describing the measurement methods and related considerations of the following quantities: Frequency and wavelength; SWR; attenuation; power; Q; impedance; breakdown; propagation; spectrum; dielectric constant; leakage; junctions; couplers; noise; receiver characteristics; klystrons; magnetrons; duplexing tubes; and antennas. Helpful appendices cover use of the Smith Chart, Rieke Diagram, transmission line charts, and impedance matching techniques.

It is questionable whether the separation of the illustrations from the text is quite desirable, but the important consideration is the instructional value of the book's contents. In this latter respect, the authors and editors are to be congratulated for producing an extremely fine and much needed publication. This handbook is to be highly recommended, and doubtlessly will be regarded by many engineers in microwave development and production as a most essential addition to their technical library. AJF

Fundamentals of Transistors

By Leonard Krugman. Published 1954 by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 144 pages. Price $2.70.

As a concise introduction to the transistor art, this book should prove helpful to those engineers not readily conversant with the subject. It describes how the transistor operates, and examines performance of the semiconductor with grounded base, emitter, and collector, respectively. The volume covers transistor amplifier, oscillator and high frequency applications. AJF

WCEMA Directory

Sixth edition of Product list and Membership Roster of the West Coast Electronic Manufacturers Association. 44 pages include data on products, facilities and personnel of 164 member firms. Available on company letterhead request from Don Larson, General Manager, WCEMA, 339 S. Robertson Blvd., Beverly Hills, Calif.

TELE-TECH
& Electronic Industries

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

Look to the West

It's a satisfying feeling to see an entire industry grow up in a new section of our country. That's exactly what has happened to the electronic industry on the West Coast. Not so long ago the electronic output of the Pacific Coast states didn't amount to a row of tubes, figuratively speaking. Back in 1946 the West Coast Electronic Manufacturers Association put on a show, and a handful of exhibitors turned out to display their wares in 50 booths.

But there were straws in the wind presaging monumental growth. For one thing the population of the West Coast, particularly California, was growing at a much faster rate than the rest of the country—48.8% compared to 14.5% for the U.S. during the 1940-1950 period. Today the West Coast boasts over 16,000,000 people. There were plenty of capable, enterprising engineers and executives. Universities were invaluable information centers. And most important, the vigorous competition that has marked the history of the electronic industries gave promise of new forces arising.

With these indications manifest, the editors of *Tele-Tech & Electronic Industries* foresaw the phenomenal growth of this region and undertook to focus special attention on the West Coast each year at the time of WESCON. This is what's happened. Many East Coast companies have opened plants in the West. Engineers constitute a larger percentage of the West Coast population than they do nationally. Right now some 569 manufacturers, 111 reps and 260 distributors are active in the West Coast electronic industries. From 170 WESCON booths in 1951, the number rose yearly to 220, 370, and this year it achieves a high of over 500. From near obscurity seven years ago, the West Coast grew to the point that it now is credited with 12% to 15% of the industry's entire output.

The West Coast is a striking example of accelerated growth . . . and it doesn't show signs of slowing down.

Off Dead Center

Heartening Color-TV news came from CBS-Hytron last month in the announcement that their Newburyport Mass. plant was in production on a new 19-in. trigun shadow-mask type tube. (See pages 13 and 134) The current price of $175 for this tube is realistic and will come down as industry demand permits the stepping up of production. The news that broadcasting networks plan an increasing tempo of color programs starting in early Fall is also encouraging.

But television receiver manufacturer's "Fear of the Unknown," as reported in our editorial columns last month, still has to be overcome. None of the presently available designs, including CBS' new "205," are operationally interchangeable. And more than that . . . in the absence of an "all-industry" committee (as we have recommended previously), there appears to be no organization which can act as a vehicle to permit the exchange of ideas that could lead to operational interchangeability.

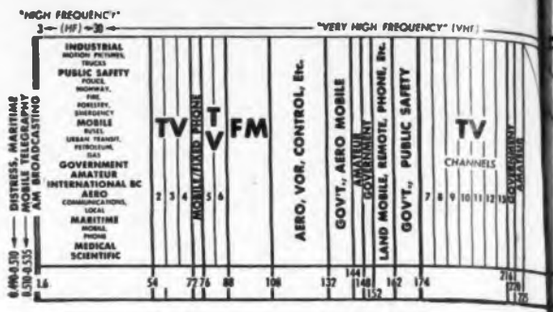
The color tube situation can be considered akin to having six different types of electric wall outlets in a home. Today there are about six major tube manufacturers with individual color designs who have important production facilities available. Obviously some degree of standardization on color reproducers must be achieved in order to achieve a practical and manufacturable series of products, and to get color-TV off dead center more quickly.

Only the Beginning

Perhaps the most dramatic scientific report to come to our attention of late is one from a University of Chicago scientist who described how a 10 million billion volt particle from outer space struck a photographic plate sent aloft in the course of high-altitude research. Energy levels of this magnitude dwarf those produced in our most powerful betatrons and synchrotrons by monstrous proportions. It is a clue of vast resources still untapped. It is a preview of new concepts and methods with which electronic engineers will have to cope as the fund of scientific knowledge accelerates in growth. In the decades to come we may take advantage of the perfect vision hindsight affords and chuckle over the naivete and crudity of our present techniques. But looking forward from today we can only admit we have just scratched the surface, and marvel at the wonder to come.

RADARSCOPE

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



DON'T BE SURPRISED if a new line of extremely low-priced radio receivers hits the mass market before Christmas. When they do, these sets will sell for half the price of the most inexpensive radio on the market today.

TAPE RECORDER owners with machines capable of handling reels no larger than 7 in. will welcome the forthcoming introduction of half-mil magnetic tape. This thin tape permits about 2400 ft. to fit on a 7-in. reel, instead of the usual 10-in. reel required. Critics of the idea see serious problems in possible print-through from layer to layer, and greater susceptibility to stretch.

COLOR TV tube developments designed to bring costs down have been coming thick and fast. After the head of one leading company saw the simple low-cost tricolor version a competitor had developed, he is reported to have junked his own "latest" tube—despite the fact that a Niagara of money had been poured into it. Prospects are that a limited stability will soon be arrived at, and that a considerable number of color sets with large screens will be rolling off the production lines by October.

RECENT SURVEY by *Fortune* on the prospects for a four-day work week turned up a wide reluctance to comment on the subject. Industrial leaders kept mum on the basis that to concede the coming of the four-day week would be to grant a bargaining point beforehand; to predict dire circumstances might make them look as foolish as the men who anticipated havoc with the coming of the five-day work week. Labor leaders generally were silent because they didn't want to detract interest from the growing issue of the guaranteed annual wage.

EXPORT of radio-TV equipment and components is on the rise despite the growth of foreign competition, reports Sprague's W. M. Adams, Chairman of the RETMA International Dept. Foreign shipments of electronic apparatus totaled $247,839,764 during the calendar year 1953.

MOST AVID readers of American technical periodicals are the Russians. Although they are trailing us in many commercial aspects, their military electronic developments are nothing to scoff at. Cutting through the maze of propaganda concerning prior invention of almost anything conceivable, study of Soviet publications, particularly mathematical works, indicate that they are abreast of us in fields such as computers and electronic controls.

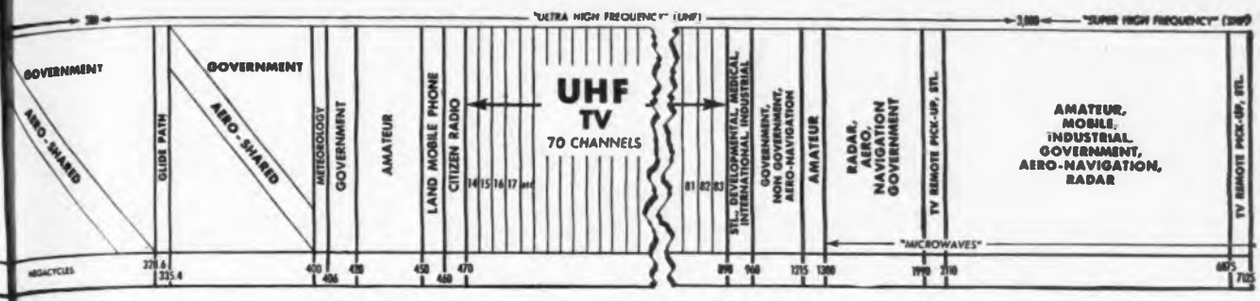
RADIO-TV business is in for a healthy manufacturing and sales boost this fall, forecasts R. S. Alexander of Wells-Gardner, Chairman of the RETMA Set Div. Curtailed production during the past year has enabled set makers to enter the second half of this year with production and inventories in balance.

ELECTRON TUBES

Compactness and ruggedness are major features of "Stacked tubes" developed by Sylvania Electric Products. Conventional tube at top is compared with new type in a ceramic envelope. Both use the same 9-pin miniature basing, but the stacked type is half the height, not including glass type's tip. The new tube culminated in a development contract with the U. S. Navy's Bureau of Ships, and limited production is in progress at the company's Product Development Laboratories, Kew Gardens, N.Y. **Details on page 65**

SECURITY

SCIENTISTS have rarely had such divided and strongly felt opinions as they have on the Oppenheimer case. As has been widely publicized, President Eisenhower ordered a "blank wall" to be placed between the atomic scientist and secret data. Suspension of security



clearance was upheld by a special review board (2 to 1) and the Atomic Energy Commission (4 to 1), based on certain acts and associations by Dr. Oppenheimer, none of them including actual divulging of information. The justice and desirability of classifying the famous scientist as a risk will be debated for some time to come, but irrespective of the right or wrong of the matter, great harm has been done. The schism in the scientific family has left many disgruntled at a time when enthusiastic effort is almost a prerequisite to survival. To prevent a repetition of the case, a number of responsible scientists have proposed that the entire security program be reviewed with an eye toward making this unpleasant but necessary safeguard a protective barrier which will not alienate the very men who produce the knowledge which must be safeguarded.

ENGINEERING MANPOWER

CHALLENGING INDICTMENT of our Selective Service policy comes from the Engineering Manpower Commission and Scientific Manpower Commission at a time when reports are filtering through that technically trained Soviet manpower is making vast strides. In describing how our own practices are working at apparent cross purposes, the Commission notes:

"President Eisenhower stresses the vital importance of science and technology in every speech and directive concerned with our economic welfare and military strength. The Congress legislates that 'adequate provision for national security requires maximum effort in the fields of scientific research and development, and the fullest possible utilization of the Nation's technological, scientific, and other critical manpower resources.' The Departments of Labor and Commerce analyze our needs and prepare lists of critical occupations and essential activities in conformance with this provision of the law. The Office of Defense Mobilization gauges our ability to meet the specialized manpower requirements of stepped-up and full mobilization. Our universities train specialists in every critical professional field, with generous support from industry, which also gives them in-job training for greater technological usefulness and accomplishment—all, seemingly, for one purpose: to supply 1400-1500 (8%) of the 18,000 men monthly that Selective Service is currently delivering to the Army, where few of these skills can be put to the highest use for the national health, safety, and interest.

"Meanwhile, in Russia, 'this stream of trained experts is going to increase in volume.'"

MILITARY

ELECTRONIC ARMAMENT in any future war will utilize radiation detection equipment for aircraft and marine locating. Dual reason is that radar jamming techniques and radar source finding equipment has made use of radar somewhat risky. On the other hand, instruments capable of spotting infra-red and similar sources send out no signal of their own, and are less susceptible to jamming. This explains much of the strong military interest in optical and thermometric devices.

TRANSISTOR MICROPHONE

Performer Joan Diener demonstrates new wireless microphone which frees actors from restricting cables and booms. Unit developed by NBC uses eight 2N34 RCA transistors, weighs under 8 oz. total, and measures ⅝ x 2 x 3¾ in. Less than 100 μμw of power at 530 kc is radiated from antenna worn around waist. Loop wire around studio picks up induction field. Battery needed is 45-volt alkaline type, provides 10 ma for the unit to develop 50 mw, and runs for five hours. Area of coverage is 5000 sq. ft. Biggest problem is noise from lights, elevators and other sources capable of inducing spurious signals in system. **See page 155**

West Coast Societies

Role of electronic organizations in rapid growth of Western industry highlighted. How these groups serve engineers and manufacturers employing 65,000 people

By E. P. GERTSCH, President
Gertsch Products, Inc.
11846 Mississippi Ave.
Los Angeles 25, Calif.

UNDOUBTEDLY, the electronic industry of the West would not be the second largest in the country if it were not for the organizations and societies which have worked toward that end. Before and during the early days of World War II, Western electronic manufacturers found that, if nothing else, they had one thing in common. That was a long train or plane ride to the major buyers of the East, particularly in Washington. Being relatively small, these manufacturers and specialists in the electronic business of the Coastal States found that they must unite to compete on a basis equal to their Eastern counterparts. The united efforts were displayed in the organizations which have since grown in size and activity to be the force that has been most important in bringing success and national recognition to the industry of the West.

Best estimates are that the electronic research, development, and manufacturing organizations of the three Coastal States of Washington, Oregon, and California now employ approximately 65,000 people. This compares with a 12,000 employment during the year of 1946, or a 440% increase during the past eight years. The year 1946 was used for comparison in order to eliminate the unusual industry growth occurring during World War II.

Now let us consider the various organizations and societies of the Western electronic industry, all of which operate independently as well as together in many functions of joint interest.

Wescon

One cannot think of West Coast electronics without thinking of the Western Electronic Show and Convention. WESCON is unique in one particular way. That is, it is probably the only organization of its type representing the merger of the engineer and the manufacturer on an absolutely equal basis. It is a separate and individual operation, a non-profit corporation, jointly sponsored by the West Coast Sections of the Institute of Radio Engineers and the West Coast Electronic Manufacturers Association. It is an annual affair alternating between the San Francisco and Los Angeles areas. Its purpose is to sponsor, manage, and promote the WESCON with the sole aim of providing the finest possible technical convention and product show in the electronics field. In the writer's opinion, this has been accomplished, as WESCON is second only to the national IRE show and convention in attendance and number of exhibitors.

Wescon attendance has increased 500% since 1946, while the number of exhibitors has increased 925%. On the basis of booth sales for 1954, and estimated attendance, it appears that WESCON's further growth is definitely assured.

Mr. Gertsch is president and one of the original founders of the West Coast Electronic Manufacturers Association. He has served several times as a WCEMA director and as vice chairman. During the past four years he has been active as owner and manager Gertsch Products, Inc., Los Angeles. Positions prior to this period include works manager of Hoffman Radio Corp., chief engineer of Air Associates Radio Div., and superintendent and engineer with RCA Victor. Mr. Gertsch, an electrical engineering graduate from the University of Utah, class of 1930, is a senior member of the IRE and a member of Theta Tau engineering fraternity.

Institute of Radio Engineers

The IRE is so well known that it is not necessary to discuss, even briefly, its history and aims. Its position in the organizational set-up of the West Coast electronics industry, however, is of note.

The major Seventh Region or West Coast Sections of IRE are concentrated in the Los Angeles and San Francisco areas. Los Angeles is the largest, and is, in fact, the second largest in the nation. From statistics available it appears that the Seventh Region of IRE has kept pace with the electronic industry. For example, the Los Angeles Section has increased 340% in membership since 1946. Member engineers within the Seventh Region now account for over 17% of the national membership of IRE. Indications are that this organization growth will continue in line with the area trend, particularly since such a large percentage of West Coast products carry high engineering cost and development work.

In addition to its normal functions of serving the technical and professional needs of its membership, IRE on the West Coast participates in several activities on a cooperative basis with other organizations. Among these are its co-sponsorship of WESCON with WCEMA, outlined above, its annual Technical Conference in cooperation with various electronic manufacturers, the spearheading of the Electronic Components Symposium, now grown to a national scope, its Professional Group activities, and its Student Relations Programs.

WCEMA

The West Coast Electronic Manufacturers Association, born in wartime at the suggestion of a Signal Corps colonel, whose major interest was to increase the output of military electronics, has today become a major factor in Western electronics. Since 1946, WCEMA membership has increased more than 500%, today listing a membership of 164 companies, of size varying from six to 14,000 employees.

It is doubtful that the mere handful of founding fathers of WCEMA had visions of the growth that would take place in less than 12 years. Now, membership in WCEMA extends from Seattle on the north to San Diego on the south.

(*Continued on page* 136)

WESCON 1954

Three-day conclave in Los Angeles to feature 500 exhibit booths and presentation of more than 100 technical papers. Attendance of 20,000 expected

THE "City of the Angels" plays host to the largest electronic industry meeting ever held on the West Coast when WESCON (Western Electronic Show and Convention) convenes Aug. 25-27 in Los Angeles' Pan-Pacific Auditorium and Ambassador Hotel. About 20,000 engineers and industry leaders are expected to attend. More than 500 exhibit booths have been reserved, compared to 370 last year, and it has been necessary to add an 11,000 sq. ft. annex. (See accompanying exhibitor list and floor plan.)

More than 100 technical papers are to be presented in 27 sessions. (See below for list of papers.)

WESCON is sponsored jointly by WCEMA (West Coast Electronic Manufacturers Association) and the Los Angeles and San Francisco Sections of IRE. The "Reps," NEDA, and other groups lend active support. Each year the show rotates between Los Angeles and San Francisco.

The efforts of many people, too numerous to mention, have gone into making WESCON 1954 a notable success. Presented on this page are the eight-man WESCON Board of Directors, the business manager, and the recording secretary. For further information, write to WESCON, 344 N. La Brea Ave., Los Angeles 36, Calif.

Technical Papers Program

NEW DEVELOPMENTS IN TELEMETERING

Session Chairman: R. E. Rawlins, Lockheed Aircraft

"Delay Line Controlled Subcarrier Discriminator"—K. A. Morgan and R. F. Blake, Naval Research Lab.

"A Temperature Stable Transistorized V. C. O."—F. M. Riddle, Jet Propulsion Lab., Cal. Tech.

"A Transistorized FM/FM Telemetering System"—R. E. Colander and C. M. Kortman, Bendix Aviation Corp., Pacific Div.

"A High Performance R. F. Preamplifier and Multicoupler"—W. S. Knowles, formerly of Applied Science Corp. of Princeton, and K. M. Uglow, Consulting Engineer, Washington, D. C.

"Slope Modulator for FM Magnetic Recording of Analog Data"—L. W. Erath and F. C. Smith, Jr., Southwest Industrial Electronics.

APPLICATION OF COMPONENT PARTS

Session Chairman: M. Barry Carlton, Coordinator of Reliability Office of Assistant Secy. of Defense.

"Short Time Ratings for Paper Capacitors"—W. M. Allison, Sprague Electric.

"Rotating Components and Their Application to Advanced Electronic Systems"—R. N. Brown, Kearfott Co.

"Appraisal of Wire Wound Potentiometers"—J. A. Csepely, Westinghouse Electric.

"Relay Characteristics and Application"—C. F. Cameron, Oklahoma A & M College.

PROFESSIONAL GROUP ON ELECTRONIC COMPUTERS

"A Dependent Variable Analog Function Generator"—C. J. Savant, Jr., North

(*Continued on page* 116)

Pan-Pacific Auditorium, Los Angeles, location of 1954 WESCON exhibits, on display Aug. 25-27

W. Hershberger
WESCON Chairman

Leon B. Ungar
Secy.-Treas.

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Vice-Chairman

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Record. Secy.

Techniques for Electronic

Fig. 1: Dog's brain with four mapped areas from which electrical responses to sounds were obtained. Location of response region depends on frequency and intensity of sound stimuli

To advance medical treatment and explore application to computer design, brain electrical response to auditory stimuli is investigated

By A. R. TUNTURI, Director
Navy Acoustic Research
University of Oregon
Portland 1, Oregon

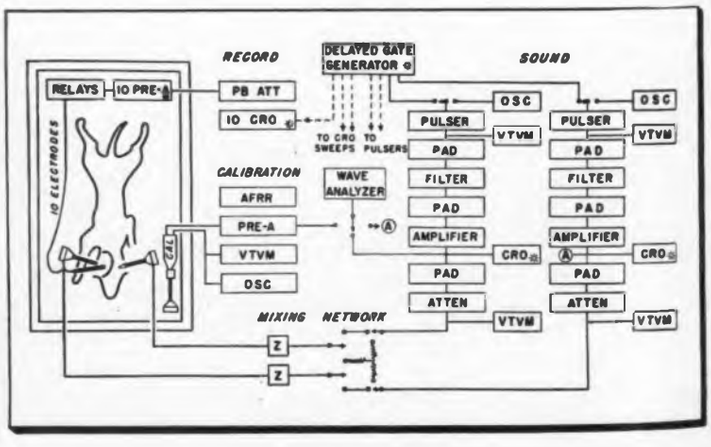
THE brain is an enormous universe, when one considers the large amount of information that it is capable of handling during its lifetime, the large amount of information it contains in its memory, and the enormous complexity of its structure and function. Although anatomists and physiologists have studied it for many years very little progress has been made on the way it handles information. For diagnosis and treatment of neurological diseases, and the possible importance of applying the knowledge of how the brain works to the development of mechanical brains for guided missiles, study of the brain is important.

Mapping of the brain in its crudest sense began perhaps about a couple centuries ago. At that time anatomists described the brain's holes, grooves, bumps, projections and what-nots with unrestricted terminology, resulting in a confusing picture. Another era of mapping of the brain began with the discovery of the microscope, and with the discovery by the two Nobel Prize winners, Golgi and Cajal, that the nervous system was made up of single units consisting of cells which gave the nervous system the general structure of a reticulum or network. Following this discovery and extending to the present time, more and more of this network characteristic has been uncovered so that it is now possible to form a fairly coherent map of this network of nerve cells. Then as late as the 1930's the electrical sign of the nerve impulse was discovered. Today a great deal of mapping of the networks in the brain is performed by means of cathode-ray tubes, ink writers and the like. Thus we come to the subject of electronic mapping of the brain. The general problem of the mapping of the brain can be regarded as concerned with the determination of the major pathways of the networks over which nerve impulses are transmitted from one location to another.

Brain Structure

The brain is a highly complicated structure somewhat similar to a telephone network consisting of trunk lines and exchanges. In the nervous system trunk lines are those

Fig. 2: (l) Room adjoining soundproof room where animals are tested holds "huge kluge" containing 10-channel oscilloscope-camera recorder, master control unit, sound generator and calibration equipment. Fig. 3: (r) Huge kluge system arranged for typical experiment



Mapping of the Brain

nerves and nerve pathways that carry impulses for considerable distances, and the exchanges are those groups of nerve cells and their projections which form the complicated networks or circuits for analysis and memory. There are certain regions where the trunk lines are more abundant (white matter) and other regions where the analyzing circuits (grey matter) are more numerous. The cerebral cortex is an example of the analyzing system where the trunk lines terminate and new trunk lines originate. The ramifications are so minute in the cerebral cortex that there may be as many as 5,000 connections or contacts in a cubic millimeter of the tissue. To understand the phenomena which one observes in the experimental work on the nervous system it is necessary to take a look (Fig. 5) at the nerve cell or neuron which is the unit of structure in the nervous system.

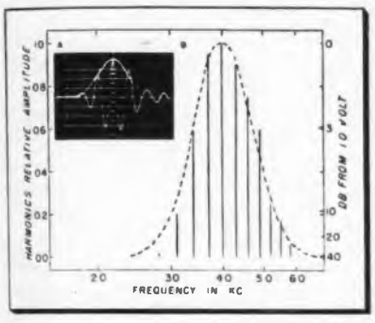


Fig. 4: Oscillogram and spectrum of auditory signal, called probability pulse or tone pip

The nerve cell, or neuron, consists of a piece of protoplasm with a swelling about 35 microns in diameter and two or more projections about one micron in diameter, some having a length of as much as one meter. It is through these projections that the nerve impulse is transmitted from one part of the nervous system to another. The nerves make contact with each other either on the projections or on the swelling. These contacts allow transmission of the nerve impulses only in one direction. This polarity is important in the design of computer networks. The networks of the brain are formed by the conglomeration of these neurons and their projections. Although some of the connections are fairly well ordered, a great many of them are of a random character. We have very little knowledge of the statistical distribution functions of these random connections. The statistics are extremely important because the nervous system was not put together as an accurately designed device and there is a great deal of evidence that the behavior of the nervous system is, at least in part, if not all, in the form of an analog device.

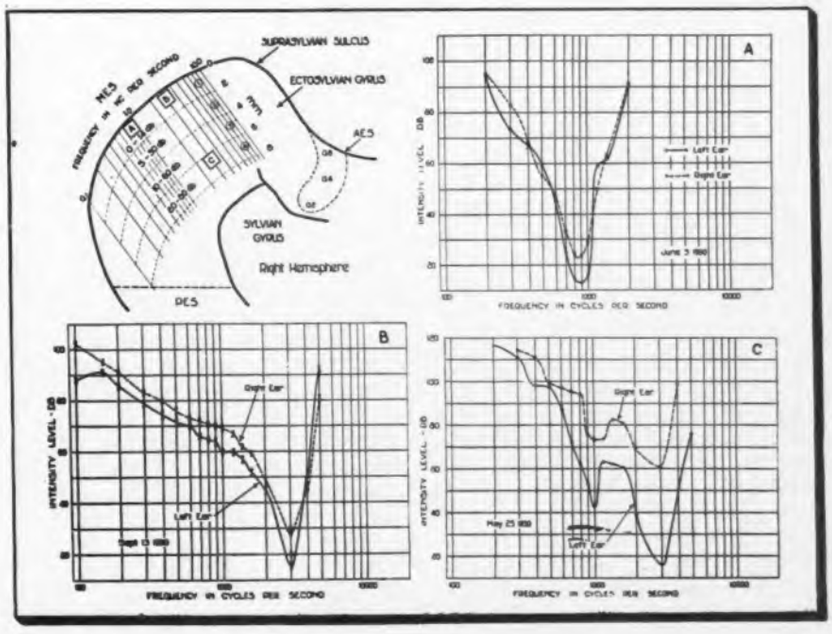
The characteristic of the nerve impulse, which each one of these neurons and their projections show, is an electrical field in the surrounding medium due to the passage of minute currents across the membrane of the nerve cell. The field of the nerve impulse, since it is in a volume conductor, in general, obeys the laws of electrical field as it is expressed by the Laplacian equation. It is not possible to record the entire field from each of the individual nerve fibers, first because electrodes can not be made small enough and, secondly large electrodes will not record the field of individual units. We generally use large electrodes to record potentials from groups of cells or nerve fibers; a sort of summed potential of numerous nerve cells. This does not allow always a high degree of precision, nor does it give an insight as to what the individual neurons are doing. However, it serves to map out connections in a rather coarse manner in the nervous system. Most of the work in mapping of the brain has been done with the large types of electrodes.

Fig. 5: Nerve cell or neuron structure

Electrical Activity

The electrical activity of the brain is manifest in many ways, depending on where the electrodes are placed. The electroencephalogram is obtained by placing the electrodes on the scalp and recording from the unanesthetized subject a time-amplitude varying picture of electrical activity. The electrodes are too far

Fig. 6: Location and spectra of nerve fibers activated. Strychnine magnifies response



Brain Mapping (Continued)

Fig. 7: Oscillograph recordings show variation of brain potential over surface locations

Fig. 8: Unanesthetized animal activity does not resemble previously considered potentials

away to give much knowledge as to the underlying activity of the brain. By putting the wires directly on the brain somewhat similar electrical activity is obtained, but it is more localized in its origin. This allows mapping connections to a reasonable degree of precision. Likewise, wires can be stuck into the brain to record from a deeper structure. Small wires, called micro-electrodes (measuring one to three microns at the tip), have been used from time to time for obtaining records from single neurons. Their usefulness is limited because it takes hours before a single satisfactory record can be obtained. The best method at the present time of recording appears to be the use of large wire electrodes, either in contact with the surface or inserted into the substance of the brain.

Nerve Pathway

Electronic mapping of the brain consists of amplifying by electronic devices, these small voltages, displaying them on a suitable indicator, and from this data constructing a map showing the location of a nerve pathway. The brain potentials have a magnitude of from 10 to 300 μv, and therefore require low noise level and high gain amplifiers. The method of display varies. People use various devices such as galvanometers, ink writers, intensity modulation of lights and the cathode-ray oscilloscope. With the CRO, moving film can be used or the sweep of the oscillograph can be employed as the time base. In our problem we have found that the time amplitude pattern has been the most useful. To obtain the records one can use a single channel, moving the wire electrode for successive observations or one can use multi-channel equipment to observe simultaneously. For several years we have used a 10-channel CRO, consisting of 3-in. tubes with the same linear time base on each one. We are now installing an additional 50-channel CRO, which will allow us to record from 60 different parts of the brain simultaneously. Our tubes possess P7 screens which permit visualization of the trace for some period after the initial sweep.

The 10-channel instrument is photographed on 35 mm film which is subsequently printed with 10 records on 8½ x 11 in. paper. The 50-channel instrument will be photographed with a 4 x 5 in. aircraft camera. These pictures have a great deal of information in them, amplitude and time wise. Since we are interested in the brain principally as a communication device, the electrical map itself is of little interest to us, except that it contains the information from which we are trying to interpret how the brain handles information. What we are really interested in is the set of measurements obtained from these signals and their relevance to the communication aspects of the system. Thus, one of our major problems that we are struggling with now is that of data measurement and reduction.

Communication Channel

To regress a moment, we should consider briefly what a communication channel is and why it is pertinent to our problem. Our work on the nervous system has been concentrated on the connections from the ear to the cerebral cortex of the brain, or as it is referred to, the auditory system. Thus we identify the sending end of the communication channel with a space A which is the sound field consisting of physical characteristics of sound such as frequency spectra, time relationships, and the relative intensities that are necessary for auditory communication. The receiving end of our communication channel, or space B, is the representation in the auditory cortex by virtue of spatial arrangements of the nerve connections, delay times, and other manifestations of nervous activity. A coding process in the ear transforms the information in the auditory signals into information in the nerve impulses which are transmitted from the ear to the cortex. It is the representation in space B of the representation in space A that we are primarily interested in.

Equipment Setup

To obtain the data, a soundproof room is used with ear phones and couplers by which sounds are delivered to the ears of the animals. Wire electrodes which are pressed against the brain, and are used to pick up the brain potentials. The brain potentials are amplified by 10 preamplifiers. Condenser microphones are used to calibrate the ear phones. The amplified brain potentials are fed by the wires along the wall to another room where the "huge kluge," shown in Fig. 2, is located. The "huge kluge," as someone has aptly called it, consists of the 10-channel recording unit, the master control unit, and the sound generator and calibration equipment. Going from left to right in the picture one sees first the single frame 35 mm camera for recording photographically the 10 channel cathode-ray oscillograph. The rack behind the camera contains the sound calibration gear. The next rack has the final amplifiers, pulsers, and mixing panels. The third rack contains three sine wave generators, one thermal noise generator and the automatic frequency response recorder. The fourth rack is the filter rack and has two half-octave filters. The fifth one is an amplifier section. The sixth is the master control unit which generates rectangular pulses with all sorts of time relations for synchronizing the activity of the sweeps and sound gates. The final rack is the 10-channel CRO. The two extra oscillographs on the right are used for monitoring the sound signals. All the sounds are generated and the recording is done in this room.

A 50-channel CRO is being installed. This equipment has fifty 3-in. tubes with two sweep expanders to allow three sweeps for each record. This will give us a total of 60 recording channels from the brain.

A schematic of the huge kluge is shown in Fig. 3 arranged for a typi-

(*Continued on page* 146)

"Stacked Tubes" in Production

Radically new design permits elements to be assembled on top of each other on jig and riveted in single operation to facilitate automatic production. Excellent reliability under extreme temperature and vibration conditions

A REVOLUTIONARY concept of an electron tube, believed to have vast potentials, has been announced by Sylvania Electric Products Inc. The new development, known as the "stacked tube," is the result of several years' study by the Sylvania Research Laboratories, culminating in a development contract with the U. S. Navy's Bureau of Ships, and limited quantities are now being made at the company's Product Development Laboratories, Kew Gardens, L. I., N. Y.

The new tube features a ceramic envelope or cap, instead of the usual glass bulb, and the various parts are "stacked" one atop the other in the assembly process, a procedure radically different from conventional methods. A further feature is the use of ceramic spacers, instead of mica. These design innovations not only make possible the tube's unique performance and reliability, but also enable high mass production because of design simplicity.

Assembly is a simple stacking operation, and sealing is done with a "bell-jar" system, a glass dome under which the stacked parts are placed, air-evacuated, and the tube envelope sealed over the stacked parts. These stacking, sealing, and evacuating procedures, not only provide excellent reliability, but also lend themselves to completely automatic production methods. Contributing to the tube's ruggedness is the substitution of ceramic spacers for mica spacers. In extreme operating conditions, mica has a tendency to spall and flake under vibration and shock.

Whereas an outstanding feature of the new development is the ceramic envelope, the stacked structure of the tube lends itself to the use of enther a glass or ceramic envelope, depending upon the ultimate application. The ceramic envelope would be used for severe environmental conditions where glass has not proved feasible, but glass would be utilized for other applications.

The complete mount of the new tube is assembled on two small pins. First a plate, a spacer ceramic, a grid, a spacer ceramic, a cathode, a spacer ceramic, and so until the top is reached. When the stack is completed, the small pins are then electrically riveted, giving a compact tight mount assembly.

The ceramic material used for the envelope and stem is aluminum oxide. Sealing the envelope and stem together is a single-step process. No mica is used in the mount, and it can, therefore, be placed on a ceramic stem and sealed in a ceramic envelope under temperatures of about 950°, substantially higher than mica can withstand. Aside from sealing the tube, this process also provides a high "baking-out"temperature which sealing glasses could not withstand. The finished tubes consequently have less gas to begin with, and, therefore, have a longer gas-free life. The tube can be strapped directly to the equipment chassis, or it can be socketed. Lead wires can also be soldered directly to the pins.

(*Continued on page* 156)

Compactness of "stacked tube" is demonstrated by comparison with match. Ceramic envelope (l) and assembly (c) are placed in bell jar device for evacuation to produce finished tube (r)

Exploded view of "stacked tube" parts (top) shows progression on two small pins of plate, spacer ceramic, grid, spacer ceramic, cathode, and so on until top. Cathode support assemblies (bottom) show conventional vacuum tube type at left, and new type. Wire loops of cathode fit over rivet insulator posts, and two ceramic washers at the top then are lodged over the loops

Equipment for Testing

Radiation and impedance data may be plotted with one-tenth the number of man-hours ordinarily required in hand plotting. Modified graphic recorder facilitates measurements

TESTING time being a major factor in production costs of cavity recessed helical antennas, the equipments to be described are designed to appreciably reduce the expense of recording pattern and impedance data, while improving overall accuracy of the tests.

Recently, two complete sets of radiation and impedance data were taken for a certain antenna over a 160% band of frequencies. Hand plotting these data required 5½ man-hours' time, whereas only 0.6 man-hours were necessary to complete the same data with the assistance of the test setup illustrated in Figs. 1 and 2.

Automatic graphic recording of VSWR vs. frequency occurs directly beneath the ground plane, while pattern and axial ratio measurements are recorded by the equipment shown to the left of the ground plane.

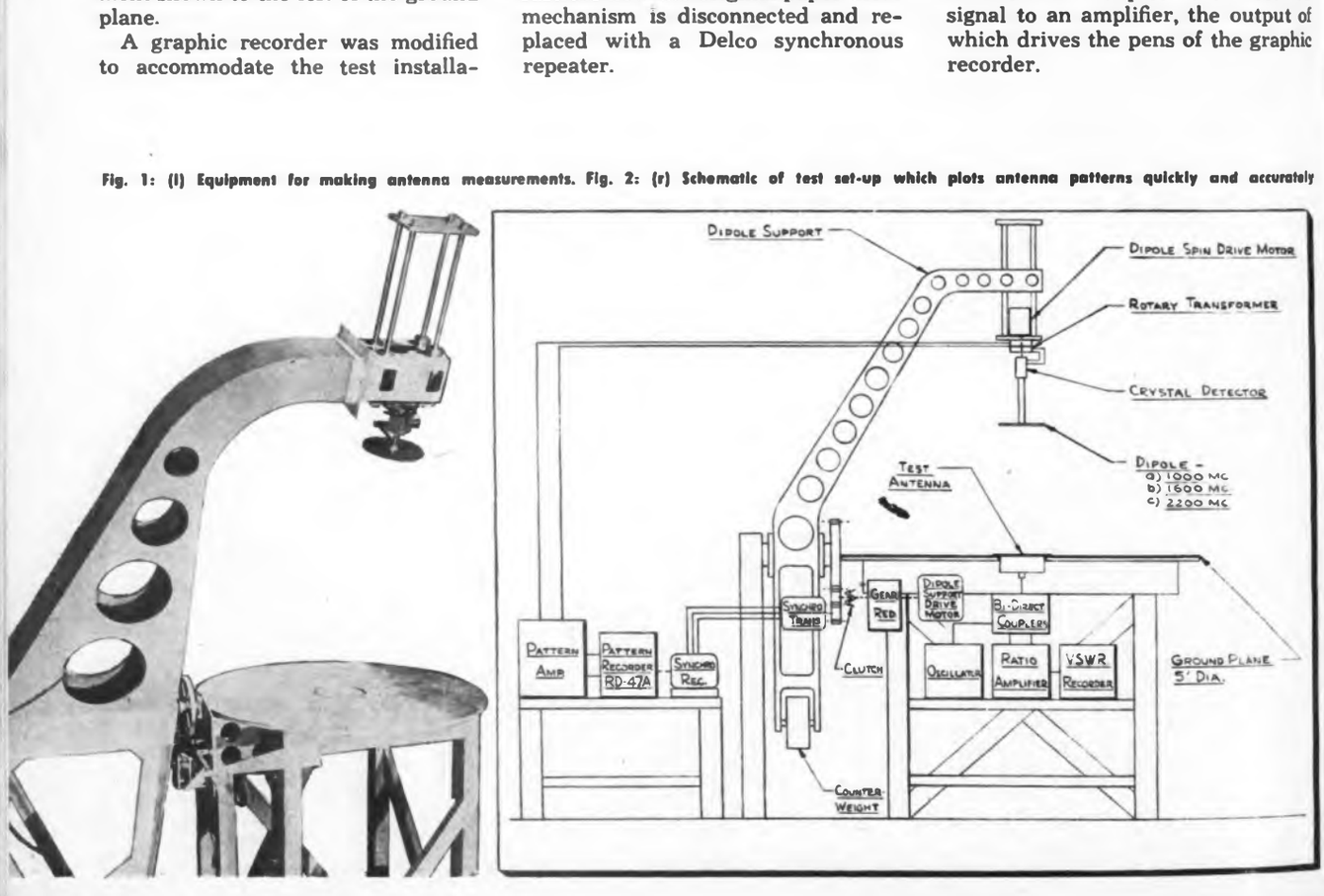
A graphic recorder was modified to accommodate the test installation. Mechanical considerations required that a dual pen device be employed, in addition to two individual marker pens. Each of the four pens is individually actuated as described in the procedural portions of this paper. Fig. 3 shows the pattern recorder with cover removed to illustrate how the original paper drive mechanism is disconnected and replaced with a Delco synchronous repeater.

By CARROLL W. BRADFORD
Dalmo Victor Co.
San Carlos, Calif.

The antenna under test mounts at the center of a 5 ft. dia. horizontal ground plane, horizontal positioning being employed to minimize spurious reflections from adjacent objects. A balanced coaxial receiving diploe, suspended so that it may swing over a 5 to 8 ft. radius above the ground plane's center, has bearing mounts which permit the dipole's rotation about its own axis. Using $2D^2\gamma$ as minimum separation criterion between test antenna and sampling dipole, only 2.3 ft. of separation is necessary at the upper frequency of 2600 MC. with a cavity diameter of 8 in., thus a reasonable safety factor is afforded by employing a minumum 5 ft. separation.

Received power from the dipole is detected with a 1N23B crystal at a level commensurate with proper square law operation. A rotary transformer couples the rectified signal to an amplifier, the output of which drives the pens of the graphic recorder.

Fig. 1: (l) Equipment for making antenna measurements. Fig. 2: (r) Schematic of test set-up which plots antenna patterns quickly and accurately



Elliptically Polarized Antennas

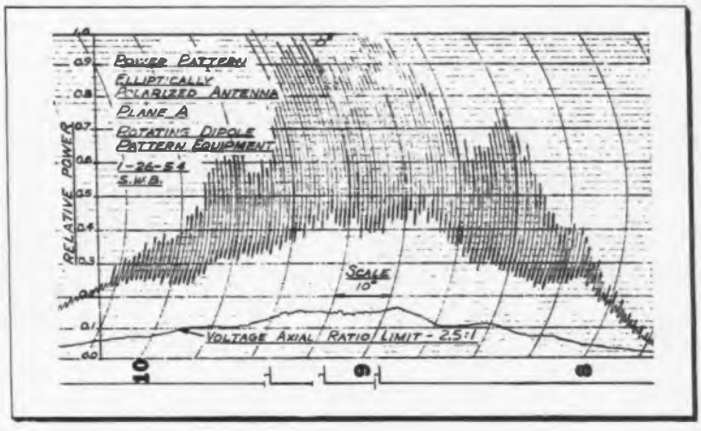
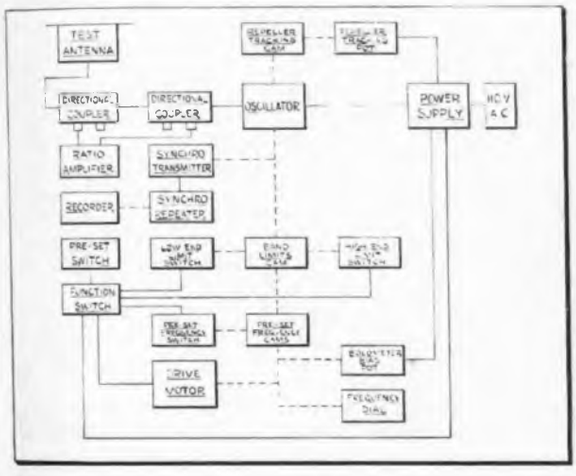


Fig. 3: (l) Pattern recorder with synchronous repeater replacing original paper drive. Fig. 4: (r) Pattern for elliptically polarized antenna



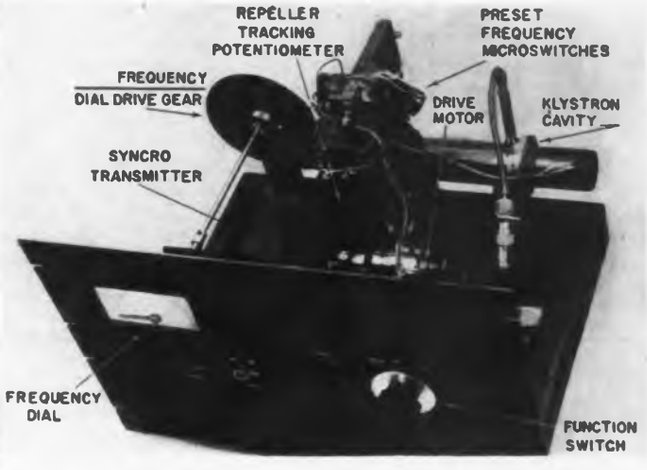


Fig. 5 (l) Block diagram of antenna measuring system. Fig. 6: (r) Signal generator with modified cavity plunger which extends range to 2600 mc

The plywood boom supporting the dipole may be driven either manually or electrically, and pivots on an axis through the center of the ground plane, carrying the dipole through 190° of arc over and across the test antenna. A synchro transmitter geared to the boom drive, operating in conjunction with a repeater at the recorder paper drive mechanism allows calibration of Esterline-Angus No. 4300-C paper at 10° per chart division. A linear amplifier pattern receiver drives the "Relative Power" recording pen.

Fig. 4 illustrates a representative pattern measured for an elliptically polarized antenna. As the dipole rotates through the planes of the major and minor axes of the voltage polarization ellipse, a maximum and minimum response is recorded. As the rotating dipole travels through 190° of arc, a complete record of voltage maxima and minima in the plane under observation is traced on the recorder paper.

With reference to the pen functions of the graphic recorder, one signal pen delineates the following record:

1. Power pattern in the plane of the major axis of the voltage polarization ellipse (envelope of maximum response).
2. Power pattern in the plane of the minor axis of the voltage polarization ellipse (envelope of minimum response).
3. Power axial ratio (excursion from maximum to minimum).

The second signal pen records the specification limit on axial ratio, while the marker pens provide identification upon the paper's edges at 0° and ±10° for boresight reference. For the antenna tests shown in Fig. 3, the specification on voltage axial ratio was 2.5:1, or 7.95 db. The pattern amplifier incorporates a peak reading voltmeter circuit which follows the outside envelope of the pattern, attenuates it 7.95 db. and supplies data to the second recorder pen. This pen records the axial ratio specification limit, shown in Fig. 4 as not having exceeded 2.5:1. Had this specification been exceeded, the pattern pen's lower excursion would have crossed over the line traced by the specification pen.

The rotational speeds of the various components were fixed by con-

Polarized Antennas (Continued)

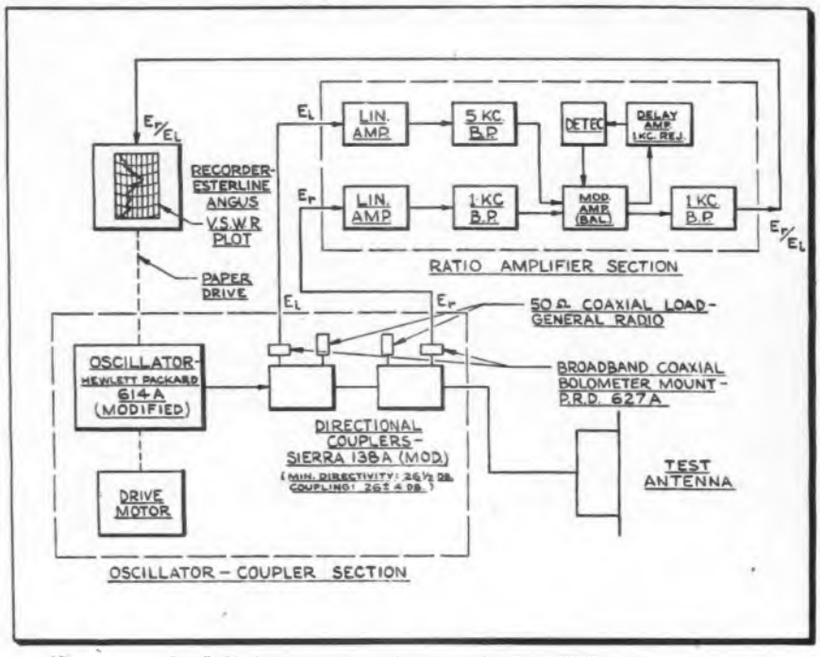


Fig. 7: Block diagram shows functional details of VSWR plotter

sideration of the desired patterning time, in addition to recorded response. A pattern is completed in 2 min., corresponding to boom rotation of 180°/2 min., or ¼ RPM. Synchro gearing was utilized to elicit graph paper major division spacing equivalent to 10° calibrations. Dipole rotation was chosen to produce a maximum number of cycles/degree with good inking, resulting in a figure of 1 cycle per degree, or 180 cycles per two minutes. Since one revolution of the dipole produces two electrical cycles, the dipole rotates at 45 RPM, and the pattern pen must follow at 1.5 CPS. The recorder shown in Fig. 3 is capable of a response of 10 CPS.

Fig. 1 illustrates a typical test set-up. Note the reflector placed behind the dipole to improve its forward gain and to provide shielding from boom reflections. To further check the effects of unwanted reflections from the boom's lower structure, the boom was covered with microwave absorbent material, although the difference between patterns taken with and without the absorbent material are insignificant.

The rectangular box above the dipole reflector is a mu-metal housing for the rotary transformer, and is necessary to prevent adjacent power line pickup.

Impedance Measurements

The same oscillator is used for both radiation and impedance tests. Oscillator power passes through two directional couplers, where incident and reflected waves are sampled, fed to the inputs of a ratio amplifier, and the output plotted by an Esterline-Angus Model AW graphic recorder.

Fig. 5 shows the basic mechanical configurations of the device. The signal source is comprised of the oscillator section of a Hewlett-Packard Model 614-A Signal Generator, modified to the requirements of the system. The 5837 klystron and associated cavity were removed from the signal generator and were mounted as shown in Fig. 6, provision being made to extend the cavity's upper

(*Continued on page* 165)

How West Coast Firm Meets Labor Shortage

PERSONNEL directors in Southern California's mushrooming post-war electronics industry are tempted to view their companies' soaring sales curves and corresponding production requirements with the same kind of mixed emotions experienced by the man who watches his mother-in-law drive over a cliff in his new Cadillac.

Business is booming—profits are breaking all previous records of the youthful industry, new plants are being built at a phenomenal rate, and training programs are being accelerated. But the fact remains, constant depletion of a limited manpower pool possessing the highly developed skills essential to many of the intricate processes inherent in the electronic field, has sorely taxed the duodenal tracts of personnel directors who find it difficult to continually explain to operating executives why manpower supply falls short of production needs.

Employee Benefits Program

It is no longer enough to provide only an attractive working environment, the finest tools, or wages that meet the going rate in comparable jobs in the same area. Competition for suitable new employees is as intense as is the continuous need to solicit enduring employee loyalty in an effort to reduce turnover rates.

Consolidated Engineering Corp., Pasadena, Calif., manufacturer of electronic analytical and measuring instruments, believes it has found a partial answer through the establishment of one of the nation's most comprehensive employee benefits programs. Consolidated points to its steady increase in number of employees from 13, in 1937 when the company was formed, to a personnel roster that now numbers over 1000 people, and a turnover rate that has been consistently below the average for the industry.

Unusually broad insurance and medical benefits, which include a $5,000 major medical feature, a carefully conceived profit-sharing and retirement plan, three group life insurance programs, one of which is provided to the employee without cost, paid vacation and sick leave, and some of the most attractively landscaped plant facilities in the nation are among the ingredients contributing to the success of

(*Continued on page* 167)

Plant Noise Surveillance

Monitoring system for jet aircraft plants guards against personnel injury and community disturbance from high engine noise level

By JOHN K. HILLARD
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THE testing of jet engines at an engine manufacturing plant and at the time of installation in an air frame creates two noise problems:

1. The protection of operating personnel from physical impairment.

The criterion for physical disability is not sufficiently complete at this time so that precise damage risk limits can be set. However, if workers are consistently employed in an environment of high noise there is a strong possibility that hearing damage will result. In these cases it see advisable to have a record of the environmental noise.

2. The determination of the amount and reduction of the noise in the neighborhood of the installation to acceptable level.

The nature and magnitude of the interference depends upon several factors. Some of these are as follows:

1. The number of jet engine testing cells in operation.
2. The amount of attenuation provided initially in each test cell.
3. The rate of fuel consumption per engine.
4. The nature of the surrounding terrain.
5. Wind and temperature conditions.

Community noise survey monitor systems are now being used so that the plants have a continuous indication of the sound level and spectrum of the noise. See Fig. 1.

At the same time an automatic warning system is provided when the level exceeds a certain specified amount at all community microphone monitor locations.

The system is divided in two parts:

1. The microphone pickup units, associated amplifiers, and power supplies for each check area.
2. The sound control center at the plant where the receiving amplifiers, analyzers, recording equipment, warning lights, and audio monitor is provided.

These two basic parts of the system are several hundred feet to a few miles apart and are connected by leased telephone circuit facilities. Specifications for such a system are as follows:

1. The overall equipment shall be capable of a minimum dynamic range of 50 db.

(*Continued on page* 190)

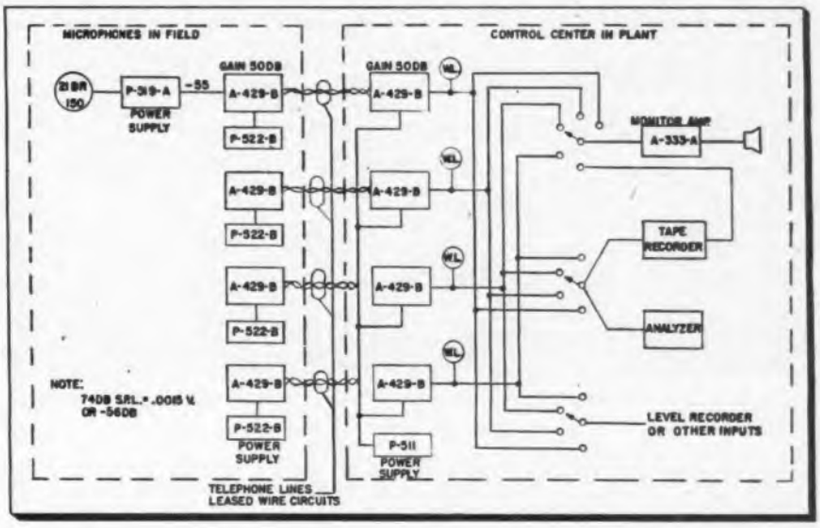
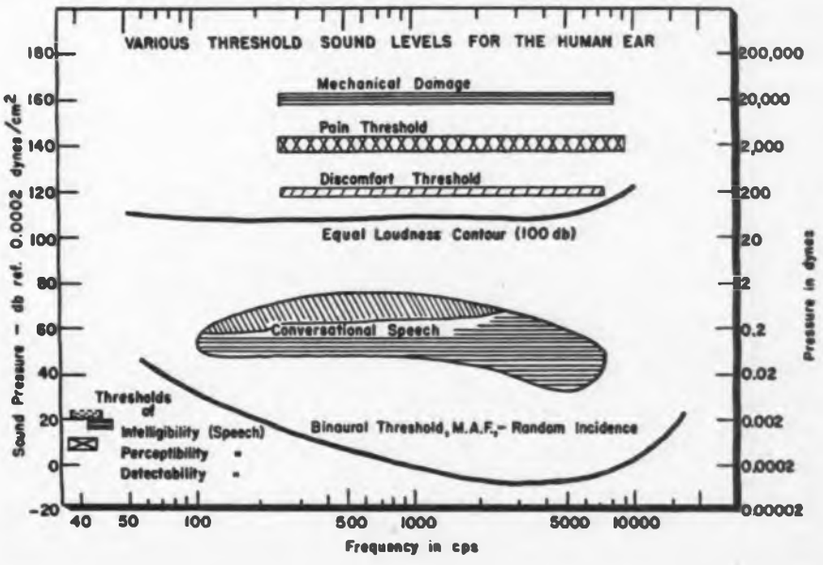


Fig. 1: Community noise monitor system provides continuous indication of sound level

Fig. 2: Threshold sound levels encountered by personnel in aircraft engine plants

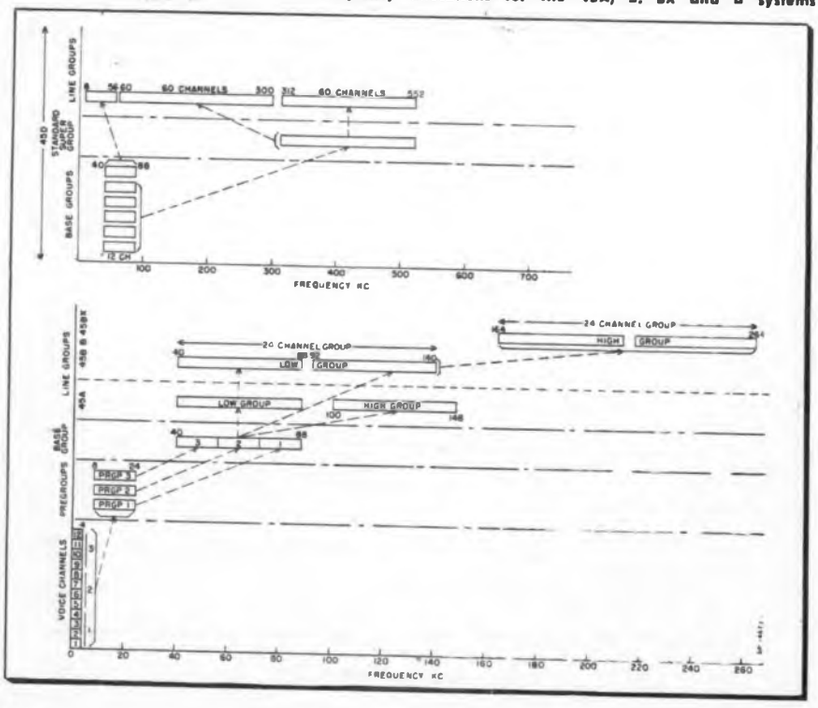


New Carrier System Links All Tra

Open wire, cable, radio and microwave circuits can be directly interconnected to form a single toll route with '45-class' terminal equipment

Fig. 1: Two complete 48-channel terminals for Type 45BX system for multiplexing wide band radio

Fig. 2: Modulation plan and basic frequency allocations for the 45A, B, BX and D systems



By W. S. CHASKIN
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RAPID expansion of long distance telephone facilities in recent years has, to a large extent, been made possible by the availability of modern carrier telephone equipment. Many new and different types of carrier systems have been designed to fully utilize the practical frequency range of every physical circuit. With these various systems, up to 16 carrier-derived voice channels can be transmitted over a single open-wire pair by utilizing frequencies up to about 150 KC. Up to 24 channels are transmitted over symmetrical cable pairs using frequencies up to 264 KC.

In addition, the expanding field of multichannel microwave radio has still further increased the requirements for carrier equipment. Transcontinental microwave systems transmit hundreds of telephone channels over a single radio circuit, and many shorter routes use microwave for transmission of the smaller channel groups which make up an essential part of all toll telephone networks.

Network Planning

The increasing use of carrier systems on different transmission media has posed a number of problems for engineers concerned with telephone network planning. One of the major problems has been the procurement of carrier equipment which would permit the use of more than one method of transmission between the end terminals of a single toll route. For example, it is often desirable to transmit a multichannel group part way by open wire line and part way by cable or radio. Unless the carrier equipment used is capable of operation over both media, it would be necessary to terminate the carrier channels at the junction between them. In an open wire-micrawave route, for example, an open wire carrier system would

Transmission Media

be used on the open wire section. At the junction, the channels would have to be brought down to voice frequency, transferred to a radio carrier system, and converted back to carrier frequency for transmission to the ultimate end terminal. Not only is this method costly because of the complete carrier terminals at the junction between wire line and radio, but it also results in impairment of transmission quality since some degradation of the transmitted speech results from the extra stages of modulation and demodulation required. Although impairment is slight, it can be avoided completely by inter-connection.

To overcome the disadvantages inherent in the use of different types of carrier systems for different transmission media, a new class of carrier equipment has been developed for universal application to all common transmission media. This new equipment class utilizes a single type of basic channelizing equipment which can be arranged in a number of ways to provide the proper transmission levels and frequency ranges for open wire, cable or radio circuits. A typical system arrangement of this new equipment, which has been designated '45-class' is shown in Fig. 1.

Transmission Characteristics

Specific 45-class systems are distinguished in two ways. The number of modulation steps varies with the number of channels and the final frequency allocation desired; and the system regulating and equalizing arrangements vary with the characteristics of the transmission medium.

Three interrelated engineering developments have helped to obtain practical realization of the universal application aspect for the 45-class systems. These are:

1. A modulation plan providing standardized channel groups for open wire, cable, and radio systems.
2. Simple interconnectors for junctions between different transmission media so multichannel groups can be interconnected between the various systems at carrier frequencies.
3. Miniaturized plug-in components and subassemblies which permit standard chassis and equipment self arrangements to be used for a wide variety of equipment options.

Modulation Plan

The modulation plan for all 45-class systems utilizes two multichannel groups as shown in Fig. 2. The first (called a pregroup) consists of four channels occupying the frequency spectrum from 8 to 24 kc. The second (called a basegroup) consists of three pregroups modulated to occupy the spectrum from 40 to 88 kc. By further group modulations, basegroups can be shifted to any position in the frequency spectrum required by the different transmission media.

Interconnection

The use of standard pregroups and basegroups in all 45-class carrier systems allows simple interconnection at carrier frequencies between different types of systems. In the modulation and demodulation processes in all systems employing 12 or more channels, there is a common step of modulation in which the channels are arranged in groups of

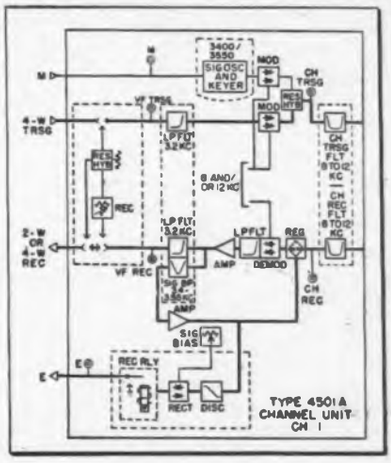


Fig. 3: Block diagram of channel terminal unit

12 at the basegroup frequencies of 40 to 88 kc. At this stage of modulation, 12-channel groups can be interconnected with very little additional equipment. Groups of four channels can also be interconnected if desired at the pregroup frequencies of 8 to 24 kc.

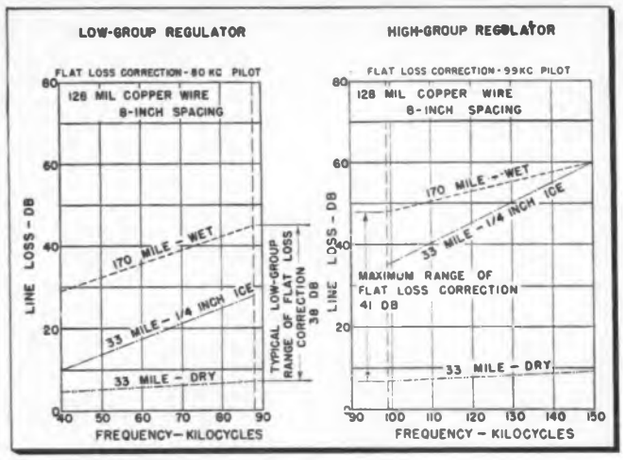
Carrier frequency interconnection eliminates all of the individual channel equipment. Consequently it is much less expensive than the voice frequency connections which would be necessary with previous types of carrier equipment.

Plug-In Construction

Full realization of a universal carrier system would be impossible without some kind of unitized plug-in construction. Each equipment arrangement would have to be individually engineered and manufactured; and once manufactured could not easily be rearranged to accommodate changing toll circuit layouts. In 45-class carrier equipment, these major obstacles have been largely overcome by the development of unitized plug-in construction to an extent not previously achieved in carrier manufacture.

Two important advantages accrue

Fig. 4: (l) Basic chassis and plug-in assemblies for terminal unit Fig. 5: (r) System regulator unit and line group amplifier



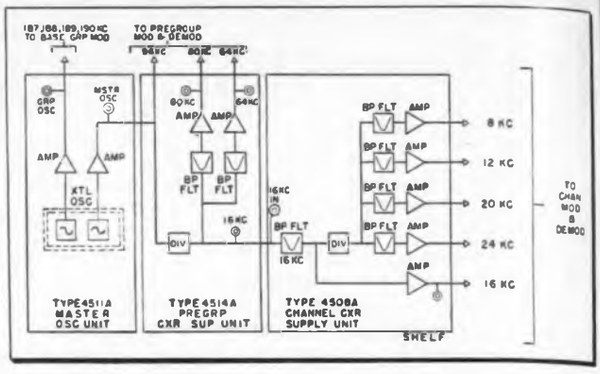


Fig. 6: (l) Attenuation varies with weather on open wire lines
Fig. 7: (above) Diagram of West-East and East-West system regulators

Carrier System (Continued)

from this extensive use of plug-in construction. First, interchangeability of various subassemblies allows a wide variation in equipment arrangements to meet different operation requirements. Second, the cost, both in initial investment and subsequent maintenance, is less. Fewer spare parts are required and, when repair becomes necessary, the defective unit can be replaced with a spare while it is sent to a centralized repair depot for service. Interruption of service is reduced to a minimum.

45-Class Systems

Four different arrangements of 45-class terminal equipment are either in production, under development, or planned. These four systems will meet all important requirements for carrier equipped open-wire lines, cable, or radio circuits. Frequency allocations for all of these systems are shown in Fig. 2. The 45A 12-channel open wire line system and the 45BX 48-channel radio system are now in volume production. The 45B 24-channel cable carrier system is now undergoing extensive field tests prior to finalization of design. The 45D radio system, providing 60-channel supergroups for heavy traffic routes, is undergoing active engineering development.

Design Problems

One of the principal design requirements for 45-class systems was to produce highly compact equipment which could reliably provide proper transmission quality. To achieve this objective, full advantage was taken of recent progress in the design and manufacture of miniaturized electronic components. For example, tantalytic capacitors, miniature paper capacitors, and miniature toroidal inductors are used extensively throughout.

Many man-hours of labor went into producing the best possible packaging arrangements with the net result being that the equipment occupies approximately one-fifth the rack space required by previous systems of equivalent performance. This reduction in size was accomplished without degrading the performance of the equipment or sacrificing reliability and life expectancy.

Channel Terminal Unit

The channel terminal unit shown in Fig. 4 is a basic building block element in all 45-class systems. Because of this multiple use, particular attention was paid to making the unit as flexible as practical. Circuitry has been developed to obtain maximum component utilization compatible with straightforward design.

A block diagram of the channel terminal unit is shown in Fig. 3. Voice frequencies enter the panel on either a two-wire or a four-wire basis by a choice of plug-in elements. On the transmitting branch, the voice frequency bandwidth is restricted either to 3100 CPS or to 3400 CPS, depending on whether out-of-band frequency shift signaling is to be used, by a low-pass filter packaged as a plug-in subassembly along with a receiving low-pass filter and a signaling pick-off filter. From the transmitting low-pass filter, voice frequency energy is converted upwards in frequency by a simple germanium diode modulator. Two such modulators are included in the transmitting branch. The second modulator is used to modulate the output of the signaling oscillator and keyer unit. Carrier power to the modulator in the message transmitting branch is deliberately restricted to provide desirable limiter characteristics. Purpose of the two modulators in the transmitting branch is to reduce interaction between voice frequency and signaling energy at high message input signals. This is particularly important because the signaling frequencies are also used to operate an individual channel flat gain regulator at the receiving end. The proper sideband is selected by a transmitting band filter which is housed in a plug-in subassembly along with a receiving band filter. One of four different filter subassemblies is used, depending on the channel position in the frequency spectrum from 8 to 24 KC. Attenuation slopes of these band-pass filters are made symmetrical to permit changes of sideband location. Conversion to either upper or lower sideband is made by moving the channel carrier frequency from one end of the band to the other.

Single Demodulator

Demodulation is also accomplished by a germanium diode modulator. A single demodulator is used for both signaling and voice. This is possible because, in the receiving branch, sufficient carrier power may be supplied to the modulators to obtain linear characteristics for normal operating levels. A simple low-pass filter following the demodulator suppresses upper sidebands and therefore reduces the load handling requirements for the receiving amplifier. Output of the receiving amplifier is fed to parallel connected

(*Continued on page* 185)

Locked Oscillators for Test Equipment

As a frequency controller, frequency multiplier or power amplifier these circuits can prove valuable in the design of frequency measuring equipment

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A locked oscillator is an oscillator which is controlled absolutely in average frequency by some synchronizing signal. This synchronizing signal may be the same frequency as the oscillator output frequency or bear some harmonic relationship to this frequency. Used in the latter manner, locked oscillators may be used as either a multiplier or divider of the synchronizing frequency. In some systems the output of the locked oscillator is very much larger than the synchronizing input and in this way the locked oscillator becomes a power amplifier of good sensitivity. Furthermore, most locked oscillators tend to discriminate against unwanted signals away from their operating frequency. Spurious signals which are present in the synchronizing input and are far enough removed from the actual operating frequency are greatly attenuated in the output of the locked oscillator.

Heterodyning Action

These features make the locked oscillator a desirable circuit to use in frequency measuring equipment of the heterodyne type. Accurately known frequencies may be generated by mixing harmonics of a standard crystal source with a low frequency oscillator. The desired frequency from the mixing process can be used as synchronizing signal for a locked oscillator which serves not only to discriminate against unwanted mixing products, but to amplify the desired mixing product and provide it or its harmonics for use in the output of the frequency measuring equipment. An oscillator may be synchronized to a high order harmonic of a standard signal and thus provide a new harmonic sequence directly related to that of the standard crystal and extending its frequency range. They may also be synchronized at some sub multiple of a control frequency and their uses in this manner for timing, gating, etc. are well known. There are certain disadvantages associated with locked oscillators. In the absence of a synchronizing signal they still tend to produce an output. If the parameters in the circuit drift far enough the oscillator may jump out of synchronization and produce a spurious output. They may tend to synchronize on a wrong harmonic or wrong sub-multiple of the control frequency in the case where they are being used as multipliers or dividers. There is usually a certain amount of phase jitter associated with the output signal with respect to the synchronizing signal. The amount of jitter depends upon the system being used as well as the parameters in that particular system. There is always the static phase error in the output as referred to the synchronizing input.

Phase Jitter

Most of these disadvantages are of no major consequence in frequency measuring and generating equipment. Checks can always be made to be certain that the oscillator is synchronized properly and at the right frequency. Phase jitter can be objectionable if it is large enough to cause noticeable frequency deviations in the output. Static phase error is of no importance. Drifts in static phase can cause error if measurements of a high order of accuracy are being made. Since frequency change is the derivative of phase, a rate of change of phase of 2π radians/sec. will produce a frequency error of 1 CPS. Locked oscillators can tolerate only a given amount of phase shift between the output and the synchronizing input. If this amount is exceeded the oscillator will jump out of synchronization. Therefore, if the oscillator remains locked, these frequency errors are

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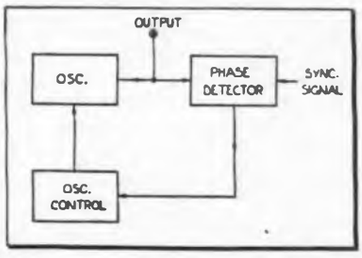


Fig. 1: (above) Simple feedback locking

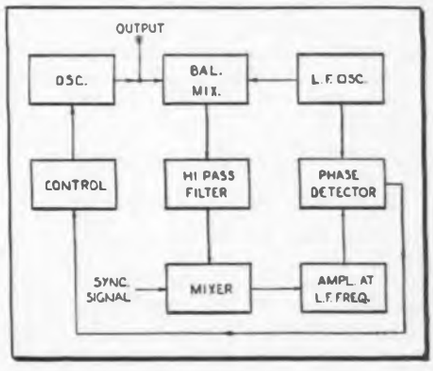
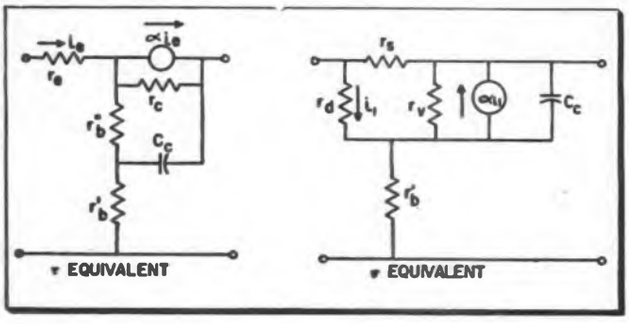


Fig. 2: (r) Double mixer feedback system

Fig. 3: (l) Direct reading VHF frequency meter

Fig. 4: (below) Microwave frequency multiplier

Surface-Barrier Transistor



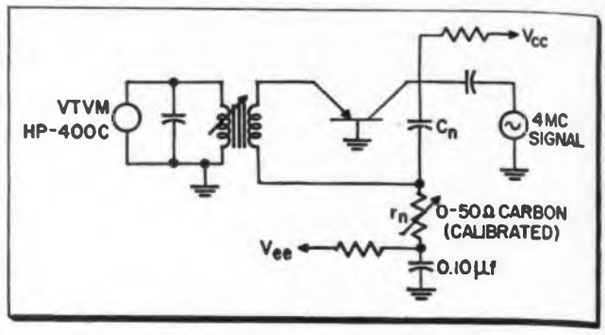


Fig. 1: (l) Surface-barrier transistor equivalent circuits, T and pi types. Fig. 2: (r) Set-up for making r_b' measurements

New semiconductor permits high-frequency operation at low power levels. Testing and design techniques presented for bandpass amp, oscillator, mixer and flipflop

IN the latter part of 1953, the development of a revolutionary new semi-conductor device, the surface-barrier transistor (SBT), was announced[1-4]. This new transistor is of special interest to the design engineer because he now has available a transistor that is capable of high-frequency operation at low power levels. The surface-barrier transistor has been used in such typical circuits as bandpass amplifiers, wide-band low-pass amplifiers, oscillators, mixers, and high-speed switching circuits.

Equivalent Circuit

As an aid in designing SBT circuits with predictable performance, an adequate equivalent circuit must be adopted. Two equivalent circuits (Fig. 1), a π type[2] and a conventional T, were tested. It was found that the π best describes the surface-barrier transistor. The main advantage of the π equivalent circuit is that its resistances are independent of frequency. This was verified by the agreement between measured and calculated values of input impedance vs. frequency. (The active current generator, alpha, is the only frequency-dependent parameter in the π equivalent circuit.) Furthermore, the emitter diode resistance of the π, r_d, closely follows the theoretical kT/qI_e relationship (k is Boltzmann's Constant, T is the absolute temperature, q is the electronic charge, and I_e is the dc emitter current) whereas r_e, in the T equivalent circuit, varies widely. Equations relating the T and the π equivalent circuits are given below.

$$r_d = r_e + r_b''(1-\alpha_o)$$

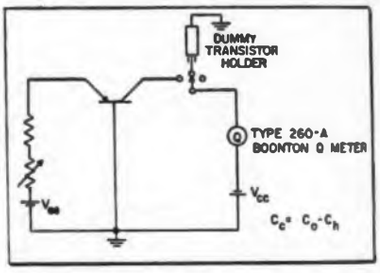


Fig. 3: Circuit for C_c measurements

$$r_v = \frac{r_e}{r_e} r_d$$

$$r_s = \frac{r_e}{r_b''} r_d$$

where r_d = emitter-diode resistance (kT/qI_e)

r_v = output-barrier reverse resistance

r_s = shunt resistance due to space-charge layer widening of the output barrier

α_o = short-circuit, low-frequency current gain

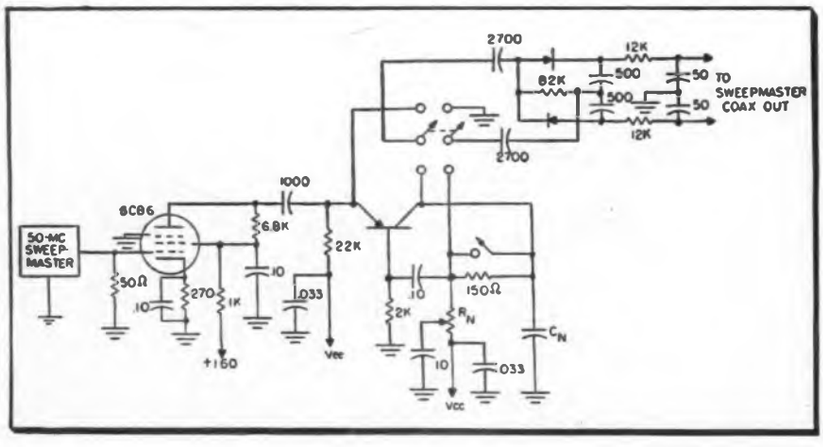
C_c = collector capacity

r_b' = bulk spreading resistance of the base region

r_b'' = low-frequency component of base resistance due to space-charge layer widening

r_e = series emitter resistance

Fig. 4: Schematic of 50 mc alpha cut-off bridge. Neutralization eliminates load reactive effect



Measurements and Applications

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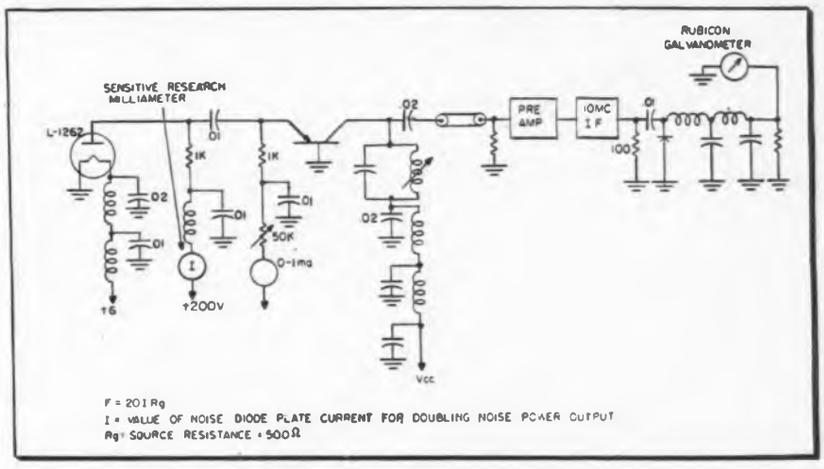


Fig. 7: Circuit for measuring transistor noise figure employs noise diode for high frequencies

r_c = collector resistance
$f_{c\alpha}$ = frequency at which alpha is 0.707 α_o
I_{co} = collector current with zero emitter current

Measurement Techniques

The low-frequency parameters of the surface-barrier transistor are measured on a conventional commercially available bridge circuit (such as Transistor Products model T-61). The parameters of eight typical surface-barrier transistors are listed in Table 1. A great similarity can be noted between these units. For alpha cutoff frequencies between 50 and 60 MC, the barrier-to-barrier spacing is on the order of 0.0002 inch ±5%. This indicates that the fabrication process is capable of holding tolerances measured in fractions of a wavelength of light. The figure of merit for a bandpass amplifier is[2]

$$G_p = \frac{\alpha_2}{8} \frac{1}{(2\pi f C_c r'_b)^2}$$

where G_p is the power gain, and α is the common-base current gain at the frequency f. The figure of merit for a wide-band, low-pass amplifier with equal source and load impedance is

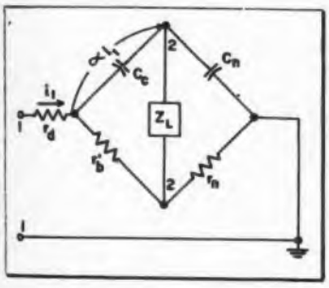
$$\text{Gain} \times \text{Bandwidth} = \alpha_o f_{c\alpha}.$$

Consequently, three parameters,

$$C_c,\ r'_b, \text{ and } f_{c\alpha},$$

describe the high-frequency performance of the surface-barrier transistor.

As can be seen from Table I, the collector capacitance of SBT's are very small. Therefore, it is necessary to eliminate the capacity of the



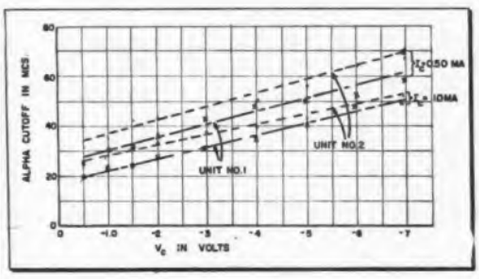
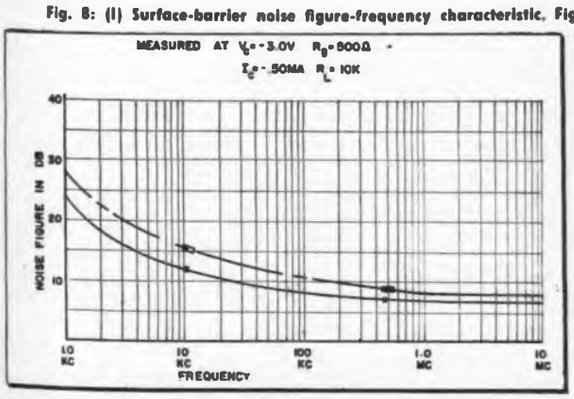
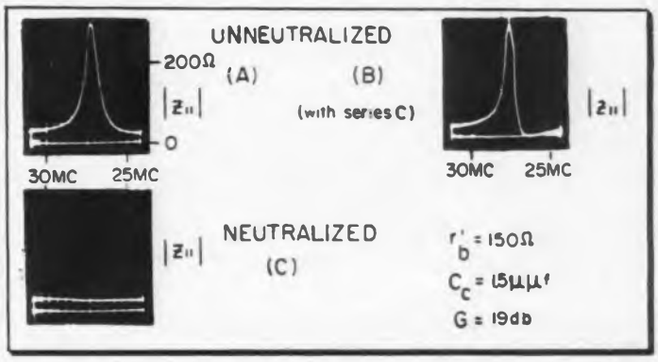
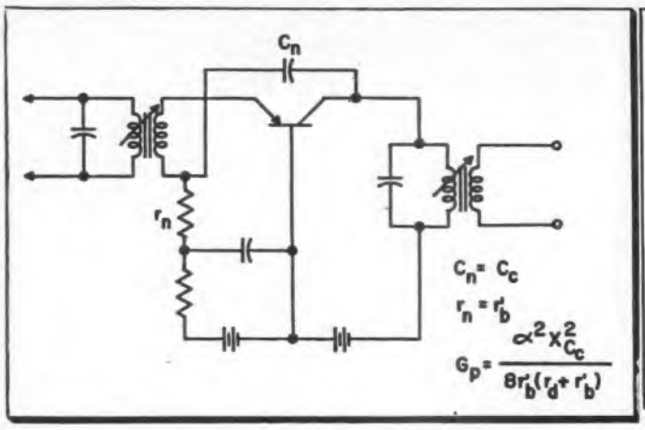


Fig. 5: (l) Neutralized bridge ac equivalent circuit. Fig. 6: (r) Alpha cut-off characteristic

Fig. 8: (l) Surface-barrier noise figure-frequency characteristic. Fig. 9: (r) Emitter input impedance-frequency response of tuned amplifier







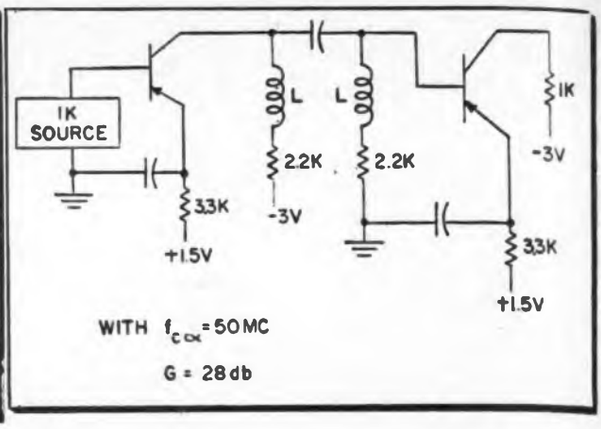


Fig. 10: (l) Neutralized bandpass amplifier. Fig. 11: (r) Surface-barrier transistor two-stage video amplifier. Gain is 28 db

Barrier Transistor (Continued)

transistor holder C_h in measuring C_c because C_h, which is about 1.35 μμf, can be tuned out by means of an external reactance. By using the circuit shown in Fig. 3, the capacity of a dummy transistor, C_h, and the output capacity of the SBT under test, C_o, are measured separately. C_C is then determined by subtracting C_h from C_o.

Typical neutralized bridge circuits for measuring

$$r'_b \text{ and } f_{e\alpha}$$

are shown in Figs. 2 and 4. Neutralization is necessary to eliminate the effect of a reactive component of load current at high frequencies (due to the relative magnitudes of

$$r_b' \text{ and } X\, c_c).$$

The ac equivalent of these circuits is shown in Fig. 5. The SBT π equivalent has been used; r_e and r_v are not included because they are negligibly large. When the bridge is balanced,

$$r_b' C_e = r_n C_n$$

the only output-producing source is the active current generator, and the open-circuit impedances are

$$Z_{11} = r_d + \frac{(2 - \alpha)\, r_b'}{1 + j\, r_b'/X_{c_e}},$$

$$Z_{12} = 0,$$

$$Z_{21} = -j\, \frac{X_{c_e}}{2},$$

and

$$Z_{22} = \frac{r_b' - j\, X_{c_e}}{2}$$

Because $Z_{12} = 0$, the accurate measurement of $f_{e\alpha}$ and r_b' is simplified.

In measuring r'_b (Fig. 2), r_n is varied for a null on the VTVM. At the null point, $r'_b = r_n C_n / C_c$.

In measuring

$f_{c\alpha}$ (Fig. 4),

r_n is set at the position which causes

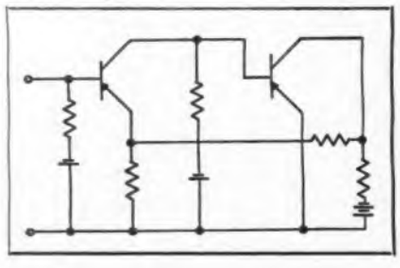


Fig. 12: Two-stage feedback amplifier

the input impedance to be unchanged when the load is shorted. The input frequency is increased to a value such that alpha is 0.707 α_o. This frequency is, by definition, $f_{e\alpha}$. The variation of $f_{e\alpha}$ with V for two typical surface-barrier transistors is shown in Fig. 6. A voltage dependency of approximately 5.0 MC/v is noted for these units.

A figure of merit relating device noise to a known thermal noise present in a resistor is called noise figure. Several methods exist for measuring noise figure. A cw method is used at low frequencies (below 100 KC) and a noise-diode method at high frequencies (above 400 KC). The latter method (Fig. 7) is by far the more accurate and reliable since it is independent of the gain and the noise bandwidth of the measurement system. At low frequencies the SBT noise figure varies inversely with frequency, but from 455 KC to 10 MC SBT noise figure is independent of frequency. A plot of noise figure vs. frequency for two typical surface-barrier transistors is shown in Fig. 8.

Applications

The necessity for bandpass amplifiers capable of operating in the

(*Continued on page* 162)

TABLE I

SBT Parameters

measured at V_c = —3.0 v and I_e = —0.50 ma

Unit	α_o	$f_{c\alpha}$ (MC)	C_o (μμf)	r_b' (Ω)	T-Equivalent r_e (Ω)	T-Equivalent r_e (K Ω)	T-Equivalent r_b'' (Ω)	I_{co} (μa)	π-Equivalent r_d (Ω)	π-Equivalent r_v (meg Ω)	π-Equivalent r_s (K Ω)	10-MC Noise Figure (db)
C-238	.830	52	2.7	52	19	145	170	5.0	48	.376	41.0	...
C-239	.920	55	2.7	67	19	270	470	1.5	56.7	.805	32.6	...
C-242	.915	60	2.1	67	26	195	370	1.0	57.5	.412	30.3	...
C-245	.860	48	2.0	73	19	200	255	1.0	54.8	.576	43.0	7.0
C-248	.866	55	2.1	70	7	260	350	.50	54	2.00	40.1	6.5
C-249	.934	60	2.7	81	7	210	780	.60	58.5	1.76	15.8	4.9
C-250	.880	52	2.4	60	15	310	340	.50	55.8	1.15	50.8	5.2
C-251	.947	50	2.1	170	11	500	1050	1.0	66.7	3.03	31.8	4.6

Grids for Single-Gun Color Tubes

The West Coast plant of Chromatic TV-Labs, Inc. has swung into mass production of Chromapacs, the color structures that are the heart of the single-gun Chromatron, or Lawrence tube.

1 At right is a 22-in. metal Chromatron, at left, a developmental 21-in. rectangular glass model. Rectangular glass bulb is better suited for mounting in receiver cabinets.

2 Color phosphor "ink" is applied to glass target plate by silk-screen process. Squeegee passed over stencil forces color through spaces, printing the desired parallel strips

3 After printing on target plate, phosphor is baked and coated with silicate. A plastic film is then applied by floating on a water surface, which is allowed to drop

4 Plates are mounted in a vacuum tank for aluminizing. Aluminum is vaporized under vacuum conditions creating a film on the exposed glass surface of the target plate

5 Whether glass or metal, color TV bulbs are of two-piece construction to allow mounting of the color structure near the face of the tube. Metal flanges hold sections

6 This demountable vacuum system and test equipment for viewing and testing color grid structures assures top performance of units delivered to widespread licensees

7 Face plate sealing machine seals the glass face plate to the stainless steel ring of a 22-in. round metal tube. Tubes shown here are samples being made in lab

8 Glass lathe inserts single electron gun into base of 22-in. tube. These functions are now being undertaken by licensees. Chromatic production is limited to grid units

9 Dynamic tests of finished Chromatrons call for complex color generation equipment though deflection systems for receivers will be the same as for b&w sets

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

Simple Bracket Makes Log-Keeping Easy Job

FULTON H. TRAVIS, KREW, Sunnyside, Wash.

EVER feed a standard log sheet into your typewriter, bat out the schedule, then unwind it, run in your times and certifications with a pen, then wind it back into the typewriter . . . and on through the shift?

Try a simple plate which rides down within an eighth of an inch of the platen and swings back out of the way when not wanted. The log sheet goes into the platen, the writing platform slides down, as illustrated and when it's in place, the log can be typed and the writing platform, which rides with the carriage, provides backing for pen notations. The end result—a typed and written log in a single operation, without the annoyance of removing the sheet every few lines for penned notations.

Writing platform folds back when not in use

To gain stiffness on the aluminum sheet (obtained by removing acetate from an old transcription) it's necessary to allow enough material over —about ⅜ of an inch on each side— to be turned down at right-angles to the working surface. To get a smooth fit on the platen, the right-angle section must be tapered as shown, to match the curve of the platen. When not in use, it is flipped back out of the way, like the paper bales on standard typewriters.

$$$ FOR YOUR IDEAS

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

Plastic Spray Saves Work

JOHN F. CLEARY, WFBL, Syracuse, N. Y.

NEXT time storage batteries get you down clean them up, tops, sides, all over. Cover the vent holes with tape, and then spray the batteries all over with the new Krylon acrylic spray. Next maintenance trick they will still be shining like new so, just flick a cloth or clean paint brush across the tops. After shining up the name plates on motors, generators, transmitters, and other equipment, give them a shot of acrylic spray too. They'll stay bright for quite some time.

If your hands get dirty with the sludge off plastic electrical tape after taping hand tools, such as pliers; or you want to keep other taped objects, taped splices, taped plugs in good condition and looking new try the same acrylic spray. For protecting decals and panels it works wonders. After decaling a panel and letting the decals dry for an hour or so, use masking tape where necessary and spray the panel.

Use the recommended cautions when spraying: keep the spray moving at all times, this is very important; do not spray too close to object being sprayed, or too much will be applied over too small an area and the spray will run. Use the spray in a well ventilated area and allow 5 to 10 minutes between sprayings. For maximum protection and beauty more than one spraying is advised.

Remote Insurance

DONALD M. WHEATLEY, Chief Engineer, WJOY, Burlington, Vt.

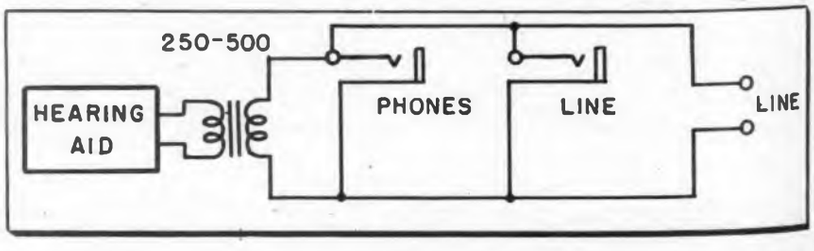
WHEN a remote kit is taken into the field a spare is an inconvenience but added insurance. To get around this headache an emergency remote kit was devised using a hearing aid with a built in mike. The headphone was removed and the output fed into a matching transformer and then to line. The unit was made with two headphone jacks and binding posts, as one of our regular remote kits uses a phone plug and others use binding posts. The transformer and jacks were mounted in a small tin can which had been slotted to hold the hearing aid. The can was then wrapped with electrical tape to dress up the looks. The entire unit is self contained, and while the quality is only fair it can be the difference between no program and a program if the regular remote kit fails while in the field.

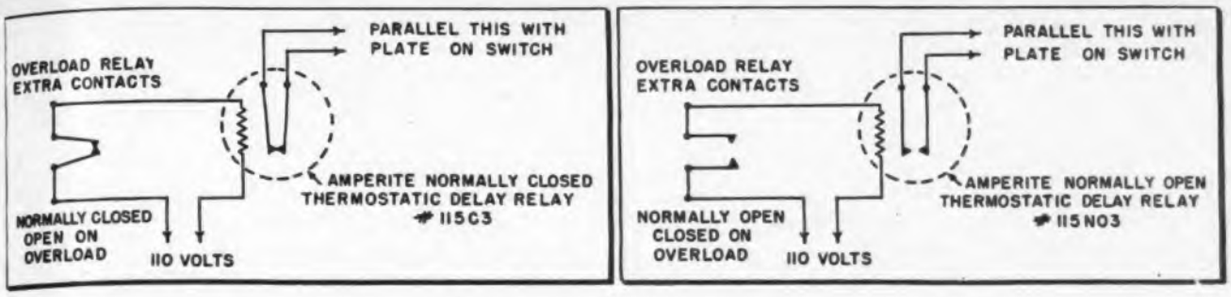
Automatic Overload Reset

STAFFORD E. DAVIS, Chief Engineer, KGVL, Greenville, Texas

THE heart of our automatic reset equipment is a thermostatic Amperite relay. This reset equipment will work on any transmitter that has an extra set of contacts on the overload relay. If the relay does not have extra contacts, one can make existing contacts do double duty and release one pair, or use an additional relay in parallel with the

Hearing aid and matching transformer form inexpensive emergency remote kit





Automatic reset circuit designed around thermostatic relay puts transmitter back on the air within 3 secs. after overload condition occurs

existing relay for the automatic reset equipment. It makes no difference if these contacts close or open on an overload. Two circuits, with parts needed, are shown so that the equipment will work either way.

Our equipment really works overtime, especially during electrical storms. It takes 3 seconds for the equipment to put the transmitter back on the air once it is off due to an overload condition. This three second period is ample for static electricity to pass to ground, or for any other overload condition to have passed.

Multi Mike Input to Console

WILLIAM NARAMORE, WGSM, Huntington, N. Y.

IN our recording studio, which uses a Gates 52-CS Studioette, we had need for more microphones. This problem was overcome by using the Gates turntable pre-amp. with a double-pole-double-throw switch using the turntable gain control for control of both microphones.

Air Monitor Problem & Baby (Transmitter) Sitter

MANLY ST. JEAN, WPIN, Chief Engineer, St. Petersburg, Fla.

TWO studios, two announcers and TV gave rise to two problems when the two studios and two announcers were six miles apart yet "ON AIR" simultaneously and even converse with each other on the same program!

Studio 1 is at the transmitter where its announcer with Restricted Operator License must watch the Gates 1-D transmitter. We must alert him to any variations of power line voltage or arcs in the transmitter that do not open the circuit breakers. (Sometimes the Gates 1-D will arc in the tank condenser of either the final, or driver,—it stays on the air but with a power reduction of 50 to 75 per cent. Studio 2 is downtown where its announcer must hear everything and wear air monitor earphones when at the mike.

Two lines are leased between studio 2 and studio 1 transmitter. Line 1 carries program of studio 2, and line 2 carries air minitor back to studio 2, while the phantom is used for talk circuit and other things. At the transmitter the 6H6 air monitor rectifier was modified to two completely different and

(*Continued on page* 108)

Contact between distant yet simultaneously operating studios was achieved with this circuit, which provides for indication of transmitter breakdown

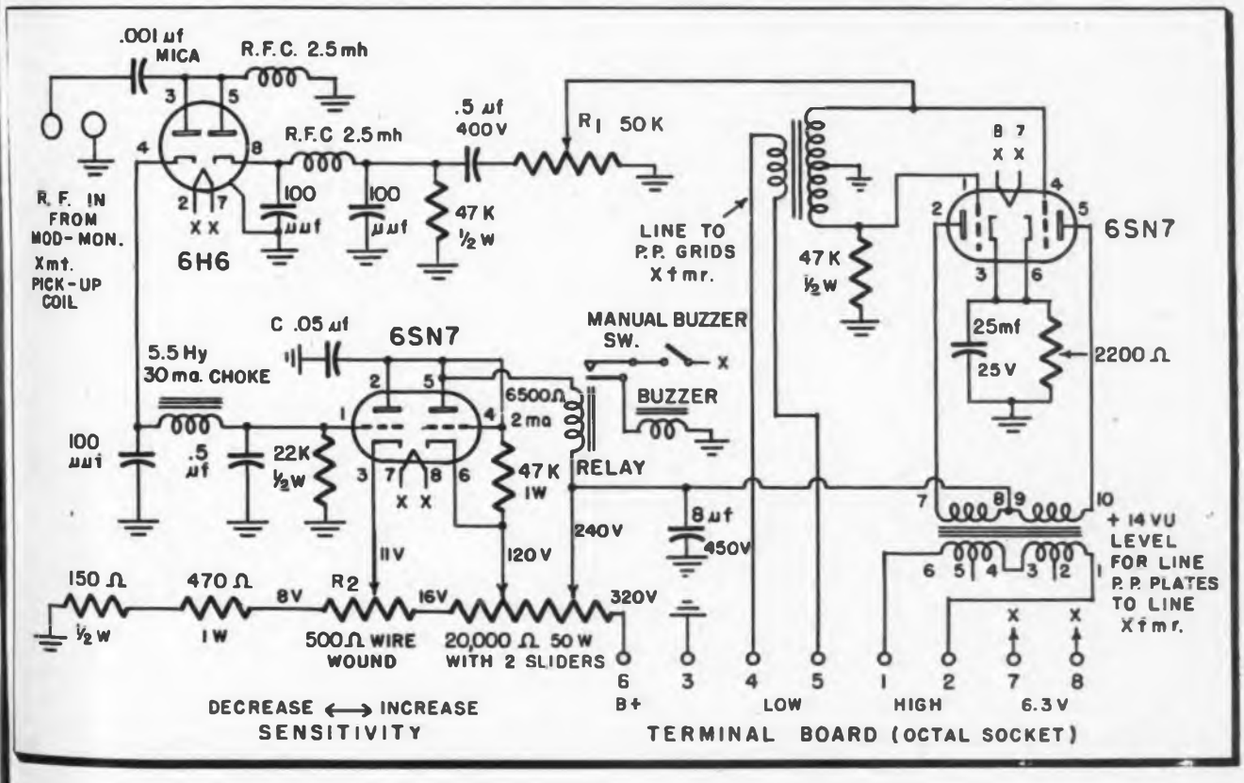


Fig. 1: Ceramic-to-metal for high temperatures

Advance Work in Ele

Research directed at reducing the number of mechanical failures in transmitting and receiving tubes is coming up with a number of interesting design changes

By HAROLD E. SORG
Director of Research and Patents
Eitel-McCullough Inc.
San Bruno, Calif.

LET us first set up the following definition: "Electron tube reliability is the probability that a tube will give satisfactory performance for a specified period of time, when used in the manner and for the purpose intended."

This definition takes into account the fact that in some applications, as in missiles, the required life span of the tube may be relatively short and thus, the importance of other factors will outweigh that of life hours in the socket. This definition may seem an oversimplification, but it is submitted here as a working definition and to provide some sort of frame of reference.

Types of Failures

Considerable effective work is presently being done in military surveillance programs, collecting data on electron tube failures in the field. These data are generally reported under two classifications: Mechanical failures and electrical failures. The first of these includes such things as envelope and seal failures, mechanical faults, heater defects and shorts or opens. These are considered catastrophic failures —that is, the tube functions up to a point and then fails abruptly. The second, or electrical category, constitutes failures due to tube characteristics, such as cathode emission, transconductance, or the like, having shifted or dropped out of electrical limits during the operational life of the tube.

The distribution of failures between the above classifications varies widely, depending, as one would suspect, upon the particular tube type and also upon the environmental conditions. For example, if tubes are subjected to more severe environmental conditions, such as shock, vibration and higher ambient temperature, the mechanical type of failure increases. If the environment is favorable, losses due to mechanical failures decrease relative to those attributable to electrical failures.

It is worth while observing at this point that, while it is desirable to reduce the number of tube failures in all categories, the most urgent problem lies in the mechanical type failures. With this type of failure the equipment suddenly and without warning fails to function.

Envelope

For a long time we had been convinced that the envelope itself was responsible for many of the difficulties. The electron tube inherited its glassware from the older lamp industry. Many electron tubes today still look like electric light bulbs. It is true that metal has replaced part of the glass in some tube designs, but the glass-to-metal seal problems remain. Glass is bad for several reasons. One obvious thing is that it is fragile and breaks easily. This introduces handling problems and limits ability to withstand shock and vibration.

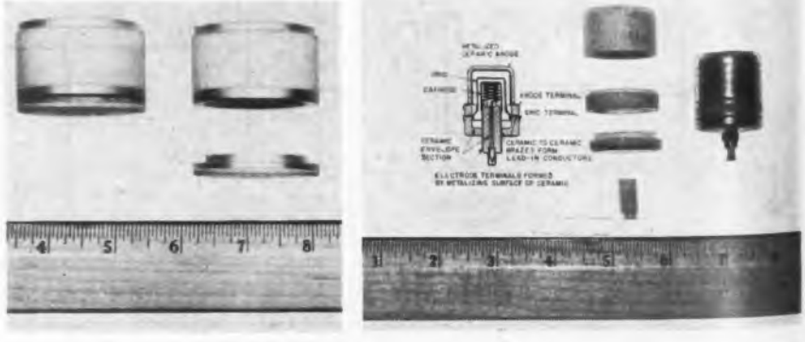
Another factor is that glass and glass-to-metal seals have limited operating temperatures, which puts a severe restriction on the operational environment. Likewise, the temperature limitations imposed by glass make it difficult to do a good outgassing and exhaust job during tube manufacture. Another thing is that electrolysis in glass causes premature seal failure. Still another and less obvious factor is that glass is not stable chemically under elevated temperatures and electron bombardment, which produces a source of contaminants unhealthy for the cathode during tube life. Some different kind of envelope material was clearly desirable.

Ceramics

Ceramic of proper composition is a logical choice, because it has the essential properties of electrical insulation and vacuum tightness. The better ceramic bodies of the high alumina type, such as Coors A1-200, have many advantages compared to glass. They are very strong mechanically, having tensile strengths of the order of 25,000 p.s.i. They will withstand high temperatures of over 1500° C, and they are stable chemically. Another advantage from the standpoint of tube fabrication is that ceramic bodies can be produced to precise dimensions and lend themselves well to improved automatic tube assembly operations.

Work on ceramic tubes at Eimac started in 1946. The first years were spent on developing and perfecting ceramic metalizing techniques, i.e., applying a metallic film to the ceramic body so that the metalized ceramic can then be brazed to another part, such as metal. We prefer a

Fig. 2: (l) Ceramic-to-ceramic eliminates metal parts. Fig. 3: (r) An experimental all-ceramic triode



Electron Tube Reliability

process of metalizing in which metal powder is sintered to the surface of the ceramic. Refractory metal powders are used to permit high temperature brazing. Various metalizing processes have also been developed by others in this country. After arriving at a suitable metalizing procedure, we perfected ceramic-to-metal brazing techniques.

Ceramic-to-metal Seals

Fig. 1 shows a variety of ceramic-to-metal seals. These seals are made with high melting point brazing alloys, such as copper-gold, copper-silver, and the like. The desire here was not only to provide tube structures which would operate in elevated ambient temperature environments, but also to enable bake-out at high temperatures on exhaust during tube manufacture.

Very early we developed another type of structure which we call a ceramic-to-ceramic seal as shown in Fig. 2. This permitted great simplifications in tube design, because we used the brazed joint itself as a lead-in conductor. The next step was to metalize the outer surface of the ceramic adjacent the joint to provide a terminal. It thus is possible to eliminate all the metal parts in the envelope. New methods at Eimac comprise applying the metalizing materials by printing processes. The vacuum tube is thus arriving at a stage comparable to printed circuit techniques.

Fig. 3 shows an early developed triode of all-ceramic construction. The ceramic envelope sections are self-jigging and are assembled in stacked relationship. After mounting of the internal electrodes, the entire envelope is brazed together in one operation. It is interesting to note that the anode itself is formed by a metalized section of the envelope. This is possible because ceramic bodies are fairly good thermal conductors and a considerable amount of heat can be dissipated through the wall of the tube.

Extensive tests have been run on this kind of integral anode structure. We also have a small test tube using for convenience a stem having cathode and grid of a planar triode known as the 2C39A. The upper part of the tube is simply a ring of ceramic having a metalized ceramic disk brazed to the top and forming the anode, the braze serving as the anode lead-in conductor. The anode disk diameter is ¾ in. Such tubes are operating satisfactorily on life with anode dissipations up to 20 watts.

Transmitting Triode

Fig. 5 illustrates a 450-watt ceramic triode in the power tube category compared to an Eimac 450T of like characteristics. The ceramic version has an external metal anode and an envelope comprising two ceramic pieces, one cylindrical and the other disk-shaped. The grid lead-in is at the brazed joint between the ceramic sections, and the filament leads are at pins through the ceramic disk. Reduction in size of the ceramic version compared to the glass tube is notable.

Fig. 4 shows an improved ceramic version of the 450-watt tube having a coaxial stem. The tube has fins brazed as an integral part of the anode and will dissipate the 450 watts without forced cooling of any

(*Continued on page* 170)

Fig. 5: 450 watt ceramic triode compared to 450T

Fig. 6: 20 kw tetrode has ceramic-to-metal seals

Fig. 7: Ceramic version of 2C39A, 100 w. triode

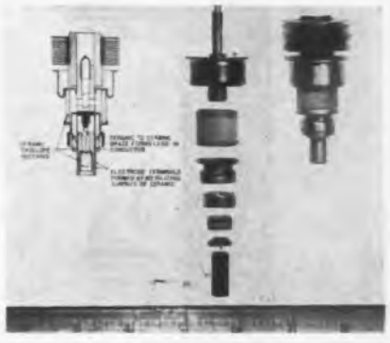
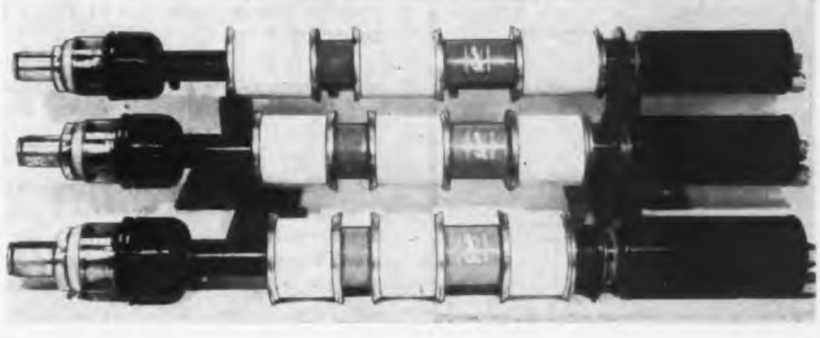


Fig. 4: Improved 450 watt ceramic triode

Fig. 8: Power klystrons for UHF TV frequencies



New Antenna Coupler for UHF

By ***ROBERT I. STAINBROOK***
Hoffman Laboratories
Los Angeles, Calif.

By permitting the simultaneous operation of up to six transmitters from a single antenna, this new coupler greatly reduces antenna congestion and boosts station efficiency

IN communication centers where numerous transmitters, receivers, and other equipment are used, the large number of antennas usually required results in such congestion that it is difficult to obtain the unobstructed locations necessary for efficient antenna operation. A situation of this type created an urgent need in naval radio communications aboard ship for a system permitting the simultaneous operation of several transmitters and/or receivers on a single antenna. From this need resulted the antenna coupler of Fig. 1. which was developed in conjunction with the Naval Research Lab. and produced by Hoffman Labs Inc., Los Angeles, Calif.

Fig. 1: Automatic antenna coupler (CU-255/UR)

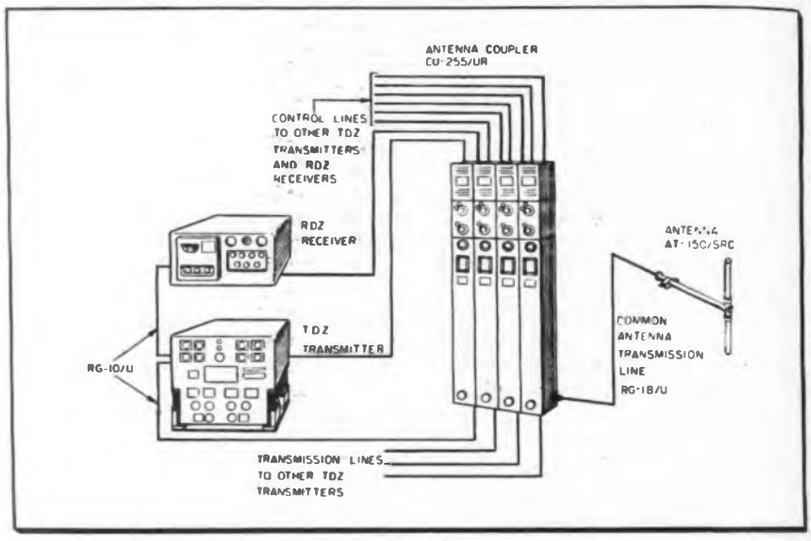


Fig. 2: Typical shipboard installation. Long, thin construction permits mounting on bulkhead

These couplers, the CU-255/UR an automatic coupler, and the CU-332A/UR, a manually-adjusted model, provide the circuitry necessary to perform the following functions:

1. They properly couple several simultaneously operating radio transmitters or receivers to a single antenna.
2. They provide an efficient transfer of energy between the antenna and the individual transmitters and receivers.
3. They match the impedance of the antenna system to the impedance of the particular transmitters and receivers.
4. They tune the antenna system to any frequency between 230 to 390 MC.
5. They provide adequate channel isolation to minimize interaction between independent equipments.
6. They reduce the total number of antennas required for numerous communication circuits.

Increased Range

These antenna couplers when arranged in a group of from two to six units provide a system in which two to six radio transmitters, receivers, or transmitter-receiver systems can be operated simultaneously on a single antenna within the frequency range from 230 to 390 MC. See Fig. 2. One antenna coupler is required for each transmitter, receiver, or transmitter-receiver system. They are intended for use either aboard ship or at shore stations. These antenna couplers not only affect a reduction in the number of UHF communication antennas required in communication centers, but also increase the communication range through improved radiation patterns by having the few antennas required installed in unobstructed locations. In addition, these equipments provide an

efficient power-coupling, impedance-matching, and filtering system.

The automatic antenna coupler (CU-255/UR) is designed for use primarily with transmitters and receivers which provide the "autotune" type of automatic selection of ten preset channels. It can also be manually tuned, as required when presetting the ten channels. Subsequent automatic selection of any one of these channels is effected when the channel is dialed on any transmitter, receiver or remote control equipment which includes the necessary "autotune" type circuitry.

The manually adjusted coupler (CU-332A/UR) is the same as the automatic model except that it provides for manual operation only. It must be manually reset for each change of frequency in the associated transmitter or receiver. This antenna coupler is intended for use with any UHF transmitting or receiving equipment which does not provide the necessary control voltages or facilities for the "autotune" type of automatic operation.

Multiple Operation

Each antenna coupler serves to couple one receiver or transmitter to the coaxial transmission line to the antenna. They are designed for use in multiple, as shown in Figs. 2 and 3. Within each coupler, a section of coaxial line is cut away lengthwise to expose the inner conductor. This cut-away line is referred to as the "semi-coaxial" antenna line. When the coupler is connected in an antenna system, this cut-away section of line is connected in series with, and becomes a part of, the antenna transmission line. See Fig. 3.

A coupling stub adjustable to a quarter wavelength over the frequency range from 227 to 396 MC is positioned close to the cut-away or semi-coaxial section of line so that, when the stub is tuned and correctly located along the line, there will be an efficient transfer of r-f energy between the stub and the line. The end of the antenna transmission line opposite the antenna is short-circuited so that, when the stub is the correct electrical distance from the short circuit; r-f energy coupled into the line from the stub will flow

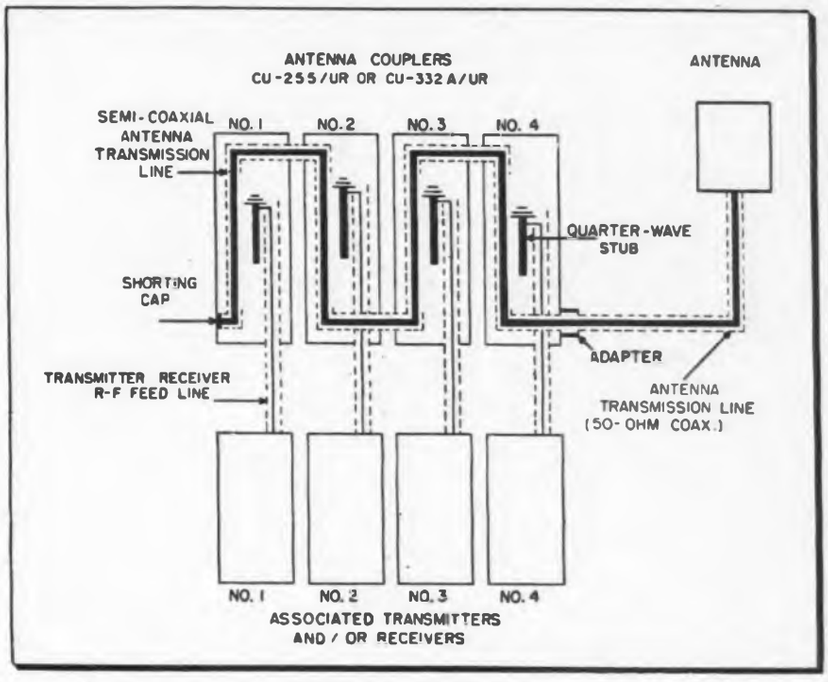
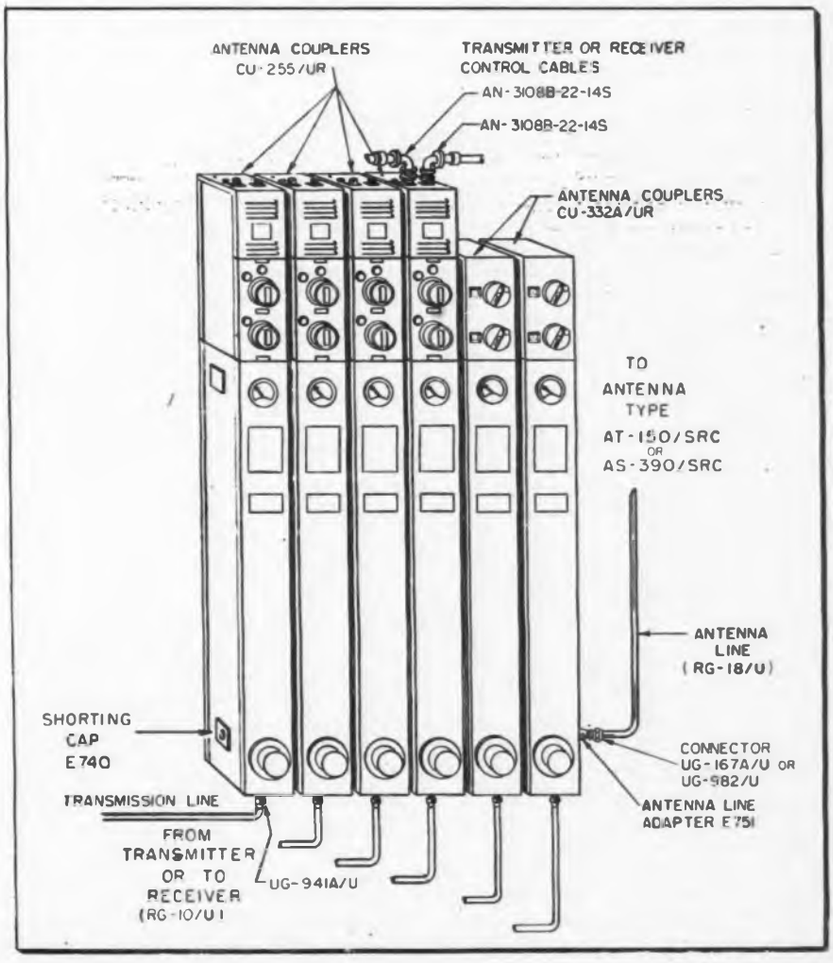
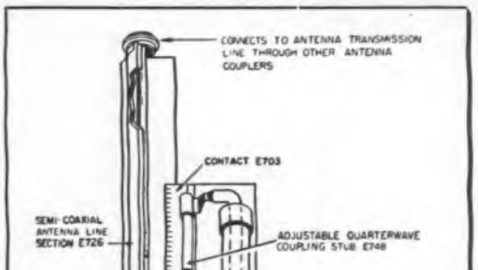


Fig. 3: With coupler connected to system, "semi-coaxial" section is effectively in series with line

Fig. 4: Grouping of 4 automatic and 2 manual couplers. Minimum frequency spacing is 15 MC





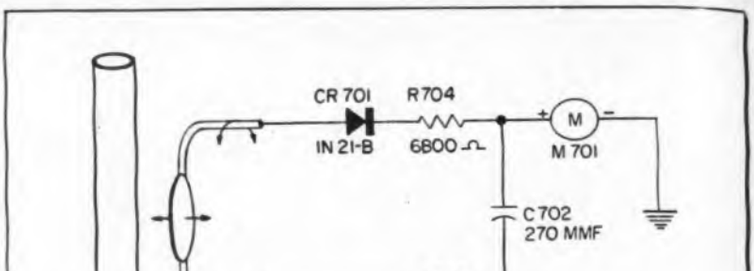


Fig. 6: (l) Diagram of the RF Coupling Section. Fig. 7: (r) Reflectometer rectifies the wave reflected from the coupling circuit back toward transmitter. 0 reading on meter denotes properly tuned coupler.

Antenna Coupler (Continued)

toward the antenna, or conversely, energy coming from the antenna will be coupled into the stub. The transmitter or receiver is connected to the quarter-wave stub through a coaxial line called the "transmitter-receiver r-f feedline."

In a transmitter system, power from the transmitter is fed through the r-f feedline to the quarter-wave stub, coupled from the stub to the antenna transmission line, and, hence, to the antenna. When a receiver is used, the signals picked up by the antenna are fed down the antenna transmission line where they are coupled to the quarter-wave stub and fed through the transmitter-receiver r-f feedline to the receiver.

Tuning Indicator

A reflectometer circuit including a pick-up probe, rectifier, and meter is included for use as an indicator for tuning the coupler when used with a transmitter. In a receiver installation, the tuning meter on the receiver is used as an indicator for tuning the coupler.

The r-f coupling section of the unit contains a section of air-dielectric coaxial line cut away lengthwise so as to expose the inner conductor. Adjacent to and parallel to this cut-away line is a quarter-wave stub coupling element, or coupler as shown in Fig. 3 which is adjustable to a quarter wavelength at any frequency from 230 to 390 MC. R-f power is transferred from this coupler to the exposed inner conductor of the main line as a result of the mutual coupling between them when the coupler is tuned to resonance. The lower end of the main line in unit No. 1 in the system is short-circuited. The quarter-wave stub is mounted on a platform which can be moved along the main line, thus permitting adjustment of the position of the stub with respect to the short circuit. The electrical length and the position of the stub determine respectively the resistance and the reactance presented at the transmitter-receiver feed-line input terminal. These two variables make possible accurate impedance-matching between the coupling circuit and the line to the transmitter or receiver even though the antenna may present as much as a 2-to-1 mismatch with respect to the 50-ohm line used in the system. This results in maximum transfer of power from transmitter to antenna or from antenna to receiver.

Operating Characteristics

Frequency Range—	227.5 to 396.4 MC
Insertion Loss—	for single coupler—0.65 db for each of 6-unit group—0.66 db for each of 6-unit group with 15 MC separation—0.8 db
Power Isolation—	minimum isolation level—16.20 db with 15 MC separation over the band
Interaction—	with 15 MC separation—0.2 db
Cross Modulation—	(in terms of decreased S/N ratio) 227.5 to 311.95 MC with 5 MC separation—1 db with 8 MC—negligible 311.95 to 396.4 MC with 6 MC separation—4 db negligible

When used with a transmitter, the unit is tuned to a frequency by adjusting the length of the stub and its position with reference to the short circuit until the reflectometer output meter shows a reading of zero. This indicates that the coupling-circuit impedance matches the 50-ohm line to the transmitter; hence, no energy is reflected back to the transmitter. This condition is also optimum for transfer of energy from the antenna to a receiver.

Physical Construction

Each coupler consists of three major parts, namely, the r-f coupling section, contained in the main body of the unit; the reflectometer; and the tuning section. These parts are demountable, and all internal components are made accessible by removal of the side shields. The couplers are designed with a view to the least objectionable space requirements for installation aboard ship; that is, it is made tall and thin so that, when several are grouped together as shown in Fig. 4, the group can be installed on the bulkhead between the vertical ribs of the ship. The automatic tuning section provides a means for tuning the (CU-255/UR) coupler automatically and remotely in conjunction with a TDZ transmitter to ten preset channels.

RF Coupling Section

The coupling cavity is enclosed by the framework and side shields of

(*Continued on page* 178)

Timing System for Guided Missiles

TIME is a common denominator in the range instrumentation of guided missiles. From the nerve center of the A. F. Guided Missile Range in Cape Canaveral, Florida the dual timing Signal System (Fig. 1), developed by the Electronic Engrg. Co. of Calif., is providing accurate timing signals for test flights being conducted over the 1,000 mi. range from Florida to Puerto Rico.

This unit consists of two separate time signal generating systems, plus the console which controls the operation of the two systems. Each leg of the system produces 30 different outgoing timing signals with 13 different available pulse rates and 4 time codes. This assortment of signals is necessary for the operation of the electronic firing system and the wide variety of instrumentation equipment, consisting of radars, theodolites, special cameras and tracking telescopes, and telemetering equipment. Each of these devices has its own specialized purpose, and therefore, a particular time signal or time code is required for its use.

Fig. 1: Dual Timing Signal System installation at A.F. Guided Missile Center, Cape Canaveral, Fla.

To understand why a timing system is necessary, visualize the scores of different instruments located on the islands making up the 1,000 mi. test range. Launched from Cape Canaveral, the missile is tracked by radar, photographed by an assortment of cameras, and subjected to many other kinds of external observation throughout its time of flight. The missile is radioing to the nearest ground station in the range a mass of data which is sent through a

(*Continued on page* 168)

New Military Field Radio

A NEW field radio equipment developed by Bell Telephone Labs. for the U. S. Army Signal Corps and manufactured by Western Electric is now being delivered for extensive military use. Radio Set AN/TRC-24, the military designation, is a multi-channel communication relay that links points 25 or 30 miles apart by radio transmission, similar to the principle in the Bell System relay links now serving the nation's TV networks.

Testing the new AN/TRC-24 Transmitter made by Western Electric for Army Signal Corps.

By cascading the equipments in multi-link fashion the relay can be extended to great distances. It replaces or supplements in the Army the relay sets of older design and more limited capabilities, and is used in some cases in place of Western Electric "Spiral-Four" cables, as between communication points not readily accessible due to terrain.

Since the requirements of all military groups was represented by the Signal Corps in guiding the development work, it is believed other military services also will employ this new equipment.

The AN/TRC-24 consists of complete transmitter and receiver components, from power source to antenna and carries spare parts for emergency and maintenance purposes. It provides FM transmitting and receiving facilities in the range 100 to 400 MC for relaying a broad band signal of 250 to 68,000 CPS over a line of sight path of transmission. One link would require only one radio set at each end, but where multi-link coverage is desired, one set would be used at each end of the system and two sets would be used at each relay or intermediate point connected "back to back."

The AN/TRC-24 Radio Set can be used as a single link or multi-link radio circuit between attended wire repeaters, between an attended wire repeater and wire terminal equipment, or between wire terminal equipments. In general, it is used with four or twelve channel carrier trunk systems using Spiral-Four cable connections.

The antenna consists of two half wave dipoles, which may be polarized horizontally or vertically. It has a 5 to 9 db gain with front-to-back ratio of 10-20 db or more. Two antennas may be used on one 45-ft. mast at intermediate relay points. The transmitter has a power output of 100 watts, with tuning calibrated directly in channel numbers. The receiver has a 30 MC i-f, with automatic frequency control, automatic gain control with a manual sensitivity adjustment and a 1600 CPS signalling tone.

Determining Capacitor Leakage

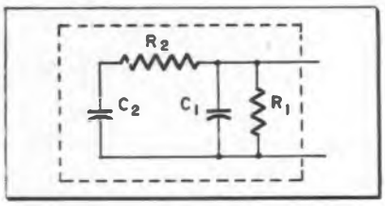


Fig. 1: Equivalent circuit for capacitor

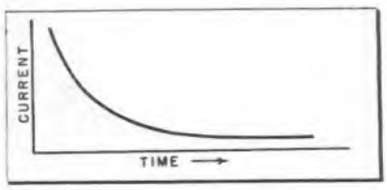


Fig. 2: C_2 current decreases logarithmically

The performance of precision equipment can be seriously impaired if the designer fails to consider these characteristics. Tests on common capacitors yield valuable design data

By ED MOLLOY
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Beckman Instruments Inc.
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THE determination of capacitor quality is difficult in several respects. The capacitor value can be established through the use of frequency generators and suitable detection systems, but leakage resistance and dielectric soak characteristics are more difficult to measure. The difficulties encountered have led to confusion in respect to capacitor quality and the performance of precise amplifiers can be impaired because sufficient information about capacitors is lacking.

Equivalent Circuit

The equivalent circuit for a capacitor is shown in Fig. 1 where C_1 is the working capacitor and R_1 represents the leakage resistance; the series components R_2, C_2 represent the "soak" capacitor and time constant.

The usual method of evaluation is to apply a voltage to the unit and observe the current in one of the leads for some time thereafter; the characteristic curve shown in Fig. 2 indicates that the charging current for C_2 decreases logarithmically with time until a steady dc current remains which is interpreted as the leakage current of C_1 thru R_1. If it is desired to measure the leakage current of the capacitor, sufficient time must lapse after the voltage is applied to assure equilibrium of C_2 before making the current measurement to indicate leakage thru R_1. The initial part of the curve supplies information about R_2C_2, but yields no value for either component.

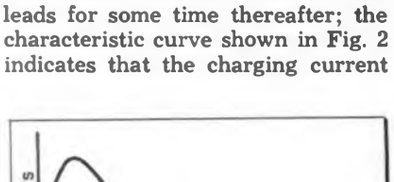


Fig. 3: Peak indicates ratio of C_2 to C_1

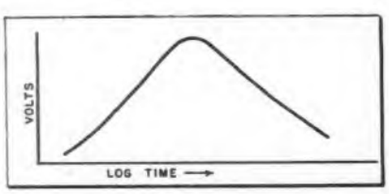


Fig. 4: Semi-log plotting improves curve

Test Method

The method employed for this investigation is to connect the capacitor to a voltage source for a time long compared to the time constant R_2C_2, then short the unit for one minute, remove the short and from time to time make observations of the voltage across the terminals by a high impedance voltmeter. Under these conditions the general shape of the function appears as in Fig. 3.

The first portion of the curve denotes the change in voltage across C_1 as a result of charging by C_2 through R_2. The last part of the curve is the result of the leakage resistor R_1 acting as a shunt or C_1 and C_2 in parallel. If R_2 is small compared to R_1 (which seems to be the case in all experimental data) then the two halves of the curves are relatively pure functions and the magnitude of the peak is an indication of the size of C_2 compared with C_1.

If the graph is plotted on semi-log

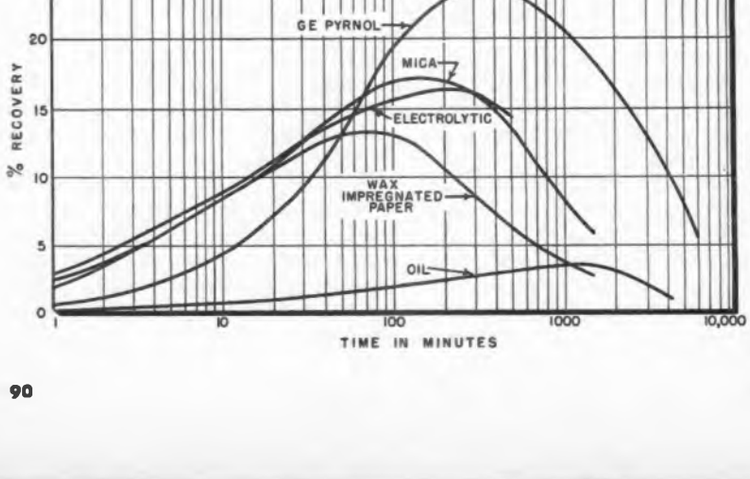
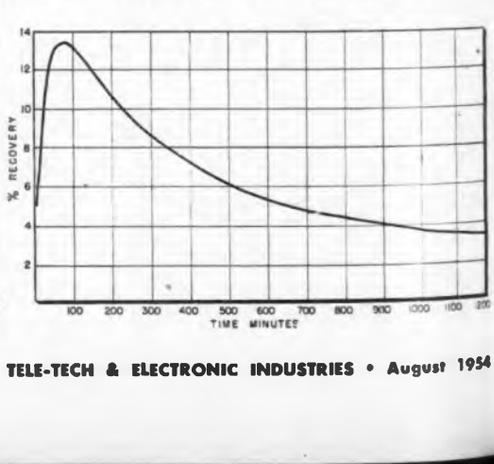


Fig. 5: (l) Performance of various conventional capacitors.

Fig. 6: (below) Typical results plotted on linear time base



Resistance and Dielectric Soak

paper, the interpretation is improved. (See Fig. 4).

Comparison

Tests were conducted on several types of common capacitors; oil filled, wax impregnated paper mica, polystyrene and Mylar dielectric and Mallory F.P. electroytic capacitors. The results are shown in Fig. 5. Fig. 6 represents a typical set of results plotted against a linear time base.

From a study of the graphical information, it is apparent that this technique can serve as a useful tool in the evaluation of capacitor components. For instance, it is quite clear that Mylar film capacitors do not approach polystyrene dielectric capacitors for "low soak". And while the leakage characteristics of wax impregnated capacitors are poor at higher temperatures compared to oil filled capacitors, the soak effect is more nearly constant as a function of temperature.

In an effort to more thoroughly evaluate the experimental data a mathematical solution to the problem was sought. The equivalent circuit of Fig. 8 was used.

Where C_2 is the working capacity, R_2 is the leakage resistance and C_1 and R_1 represent the "soak" components. SW_1 and SW_2 are switches with normally open contacts. The switches are closed briefly, then opened and the voltmeter reading is

(*Continued on page* 161)

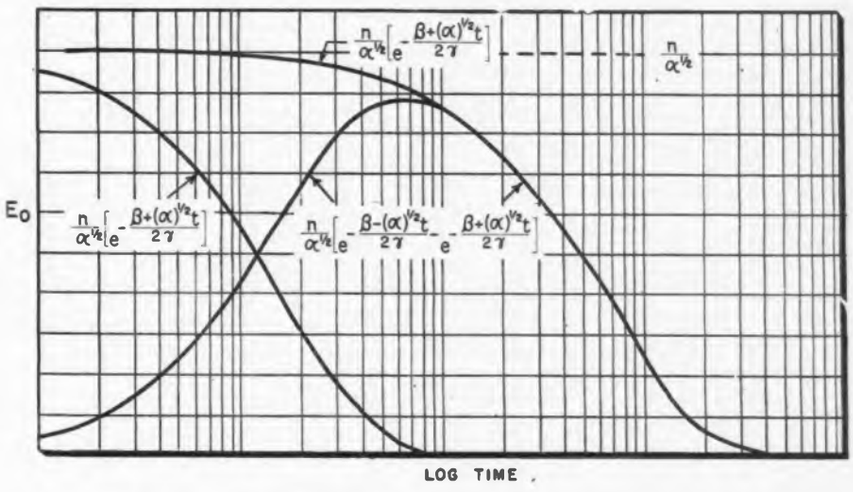


Fig. 7: Resultant and two functions derived from the equivalent circuit of Fig. 8 and calculations

DYSEAC—New Electronic Computer

DYSEAC, a high-speed digital computer designed to serve as the experimental nucleus for a complex data-processing network, has been completed by the National Bureau of Standards. The flexibility with which this machine controls and responds to a variety of external devices, which may include one or more full-scale computers of similar design, should enable scientists to explore diverse new areas of interest. Examples include the automatization of industrial and commercial operations, or any field where rapid information-processing and real-time control systems are necessary.

DYSEAC utilizes electronic circuit techniques similar to those used in SEAC. These dynamic circuitry techniques involve the performance of all logical operations by diode gating, the use of electrical delay lines for all incidental pulse storage, and the use of transformer-

(*Continued on page* 112)

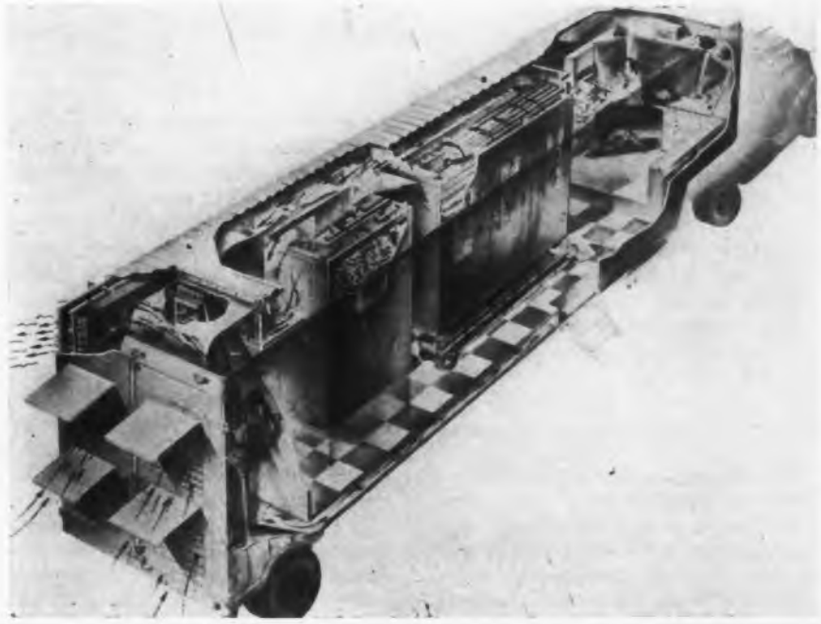


Fig. 1: Cutaway of 40-ft. DYSEAC trailer shows forward part containing control console and magnetic wire input-output. Three center cabinets are computer proper. Immediately behind are cabinets containing 512-word acoustic delay line memory. Air conditioning shipment is at rear

New 7-11 KMC Signal Generator

By ARTHUR FONG
Development Engineer
Hewlett-Packard Company
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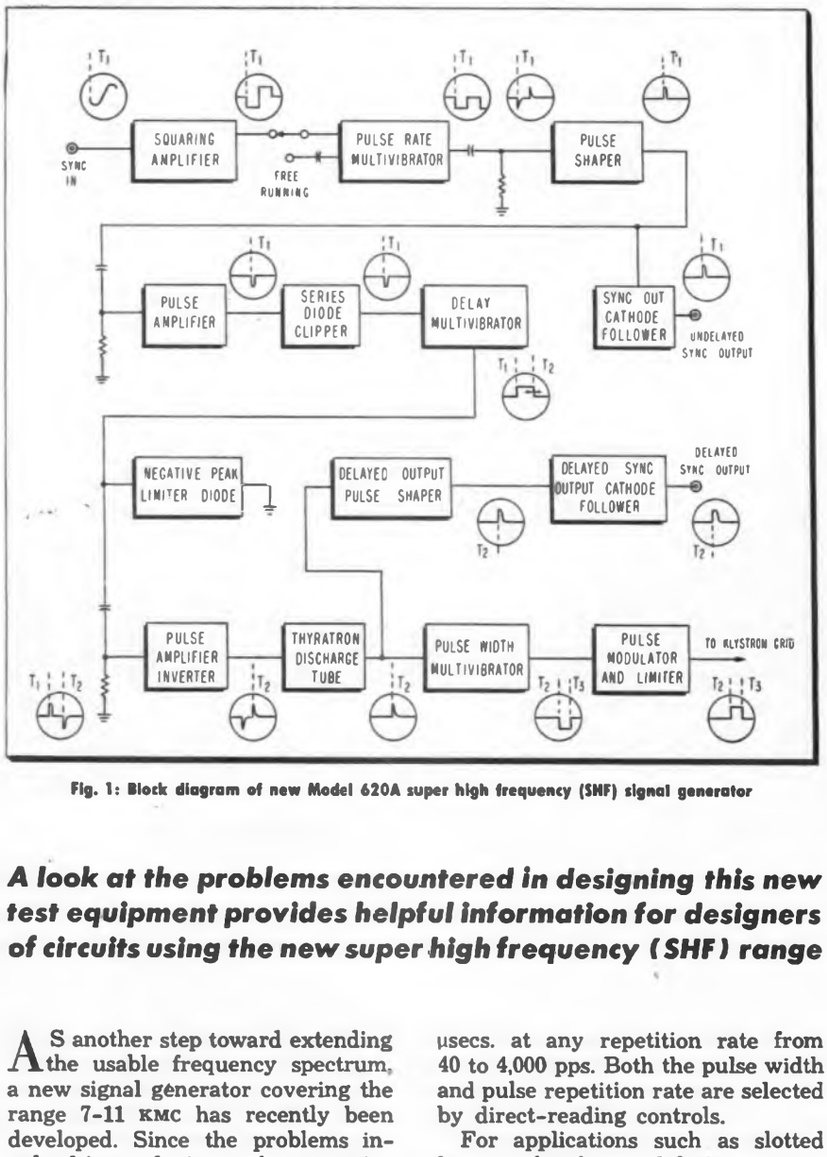

Fig. 1: Block diagram of new Model 620A super high frequency (SHF) signal generator

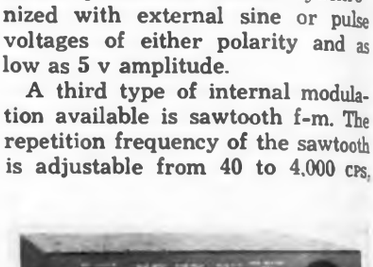

Fig. 2: Model 620A (SHF) Signal Generator

A look at the problems encountered in designing this new test equipment provides helpful information for designers of circuits using the new super high frequency (SHF) range

As another step toward extending the usable frequency spectrum, a new signal generator covering the range 7-11 KMC has recently been developed. Since the problems involved in producing such test equipment will be characteristic for any circuits operating in this frequency range, a review of the considerations which influenced its design should prove interesting.

Modulator Circuitry

The flexibility of the modulation system is such as to enable the generator to be used for nearly any application desired for a signal source in this frequency region. For radar work and other pulse type applications, the modulation system includes a pulser so that any r-f pulse width is obtainable from ½ to 10 μsecs. at any repetition rate from 40 to 4,000 pps. Both the pulse width and pulse repetition rate are selected by direct-reading controls.

For applications such as slotted line work, the modulation system provides for a square-wave modulated r-f output which is adjustable over a range of from 40 to 4,000 cps. The repetition frequency of the square-wave modulation is selected by the same direct-reading controls that select the repetition frequency for pulse modulation.

The modulator further provides two synchronizing pulses of at least 25 v peak amplitude into 1,000 ohms. One of these pulses begins concurrently with the start of the pulsed r-f output. The other sync pulse is adjustable over a range from 3 to 300 μsecs. ahead of the r-f output in order to position the sync pulse suitably for external triggering purposes. The rise time of the sync pulses is less than 1 μsec. The modulation system can also be synchronized with external sine or pulse voltages of either polarity and as low as 5 v amplitude.

A third type of internal modulation available is sawtooth f-m. The repetition frequency of the sawtooth is adjustable from 40 to 4,000 CPS, while the r-f deviation is adjustable up to at least ±3 MC. Both the external synchronization feature and the sync out pulse feature are available for use when internal sawtooth modulation is used.

The oscillator portion of the signal lated externally by pulses (a-m) or by external sine or sawtooth voltages, r-f deviations of up to ±5 MC externally-applied modulating voltages for frequency modulation. On are obtainable. The deviation is adjustable by the same panel control that adjusts deviation when using internal f-m.

A block diagram of the modulator circuit is shown in Fig 2, which illustrates the operation with a sine wave synchronizing input.

RF Oscillator Design

The oscillator portion of the signal generator uses a type 5721 reflex klystron with a ¾-wave coaxial-line resonator (Fig. 3). To make the oscillator cover a wide frequency range, the repeller voltage must be

Yields Valuable Design Hints

varied and, at the same time, to make the oscillator direct-reading in frequency, it must be tracked with the position of the resonator tuning plunger. These two requirements are met by using a system which mechanically links the plunger mechanism to a potentiometer which selects the proper repeller voltage.

The complete 7 to 11 KMC frequency range for the oscillator is covered by using two repeller modes: the 3¾ mode from 7 to 9 KMC and the 4¾ mode above 9 KMC. The tuning mechanism includes a sensitive switch that provides a step in repeller voltage at approximately 9 KMC in order to accommodate the mode change. The resonator is operated in the ¾-wavelength mode throughout.

A cross-sectional drawing of the resonator is shown in Fig. 3. The oscillator tube is axially mounted within the coaxial cavity and makes firm contact with the outer wall of the cavity. The upper grid structure of the tube is mounted within the inner conductor and makes firm contact thereto through slotted fingers on the inner conductor. The movable plunger makes contact to the outer wall by means of long-life contact fingers.

λ-4 Mode Suppression

As in all cavity resonators the system will prefer to oscillate in the lowest resonant mode, in this case the quarter-wave cavity mode. If at all possible it is advantageous to operate in the quarter-wave cavity mode; however, as frequency increases one finds that in this mode the mechanical placement of the plunger is the limiting factor. For example, if one were to place the shorting plunger directly against the glass envelope of the klystron, the top frequency would be only approximately 6,000 MC. It is therefore necessary to use the three-quarter wave cavity mode to obtain the desired 7,000 to 11,000 MC range.

Fig. 4 (a) illustrates the effect of the quarter-wave resonance with a short circuit plunger of ordinary variety. This chart can be directly compared with Fig. 4 (b) where a plunger of special design was used. It will be seen that the quarter-wave cavity mode has been completely suppressed in Fig. 4 (b). To accomplish this a plunger using a new suppression technique was evolved. This technique leaves the resonator without recesses, slots, chimneys, tuning probes or protuberances of any kind except for the output couplings.

An examination of the undesired 1,1 mode disclosed that its frequency was everywhere below 6,000 MC, considerably below the 7,000-MC lower frequency limit of the generator. In considering this fact, an arrangement was devised whereby the space between the inner surface of the plunger and the surface of the inner conductor was designed to appear to the resonator as a low-pass filter having a cutoff frequency of approximately 6,500 MC. The filter consists of a number of low- and high-impedance line sections in cascade. The filter is terminated at the back of the plunger with a powdered iron mixture to absorb the energy passed by the filter.

The use of such a low-pass filter prevents the undesired mode from supporting itself and thus is an effective suppression measure. At the same time the relatively high ca-

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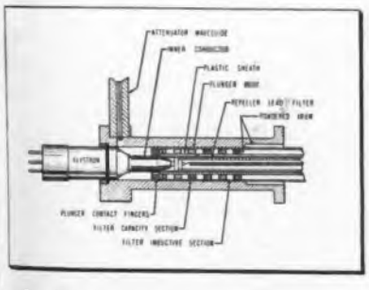


Fig. 3: Cross-sectional view of resonator

Fig. 5: Enlarged view of pick-up loop

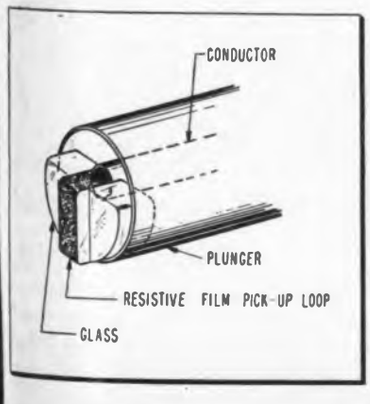
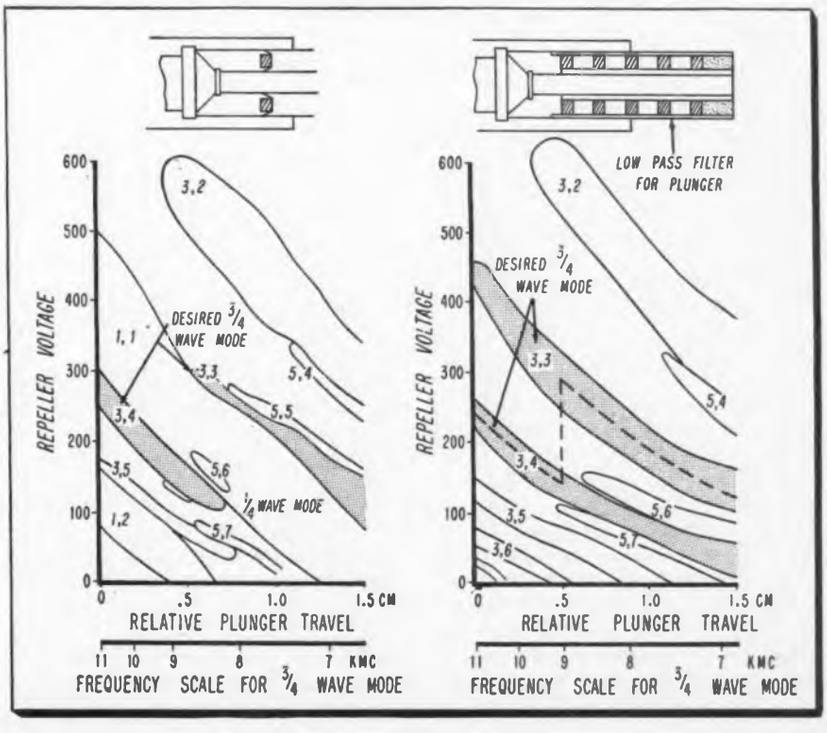


Fig. 4: λ/4 mode operation was suppressed by use of new type plunger



Magnetic Recording—

A review of the methods presently available for magnetic recording of audio, instrumentation and digital data. Magnetic tape is seen most serious limiting factor.

By ***WALTER T. SELSTED and ROSS H. SNYDER***
Ampex Corporation, Redwood City, Calif.

PULSE WIDTH MODULATION

WITH this technique the intelligence to be recorded modulates the duration of a series of uniformly spaced pulses, generated within the electronics of the recorder, the commonest type using a pulse repetition rate of approximately 1,000 PPS, and a quiescent pulse length of approximately 500 μsec. Intelligence modulates this pulse length from a minimum of about 100 μsec. to a maximum of about 900 μsec. These pulses may be recorded on tape in several ways: 1) Incoming pulses may be differentiated, and the pulses thus derived impressed on the record head, marking the leading and trailing edge of each pulse, later to be reconstructed. 2) The square pulses may be impressed directly on the record head so that the reproducer head produces a pulse at each flux change. Both methods are employed without bias.

This type of recording is most suited to the handling of low frequency analog information such as the output of thermocouples, strain gauges, pressure gauges, velocity indicators, etc. The frequency spectrum of such instruments is generally limited to less than 100 CPS. This recording technique is especially applicable to aircraft and other vehicular instrumentation.

Multi-Channel Operation

The advantages of this method are several: 1) By commutation techniques it is very convenient to record large numbers of separate channels of low frequency information on a single magnetic track. For example, when a commutation rate of two samples per second is used, a frequency response of approximately 0 to 1 CPS on each channel, a total of 30 channels of information may be recorded on a single mag-

(*Continued on page* 174)

DIRECT RECORDING

DIRECT recording is that type of recording in which the audio signal, with suitable pre-emphasis, is impressed upon the record head with an associated biassing signal consisting of high frequency ac. While primarily used for audio recording, this method is also suitable for those instrumentation purposes in which the information is to be analyzed on a logarithmic basis rather than on a direct amplitude basis.

The prime advantages of direct magnetic recording are, 1) a very high dynamic range, which was among the characteristics which first brought wide attention to the magnetic technique, 2) excellent frequency response, and 3) relatively low distortion. These characteristics are so widely understood, that more emphasis will be placed here on the defects and limitations of direct magnetic recording when it is applied to purposes other than audio, such as instrumentation and data recording.

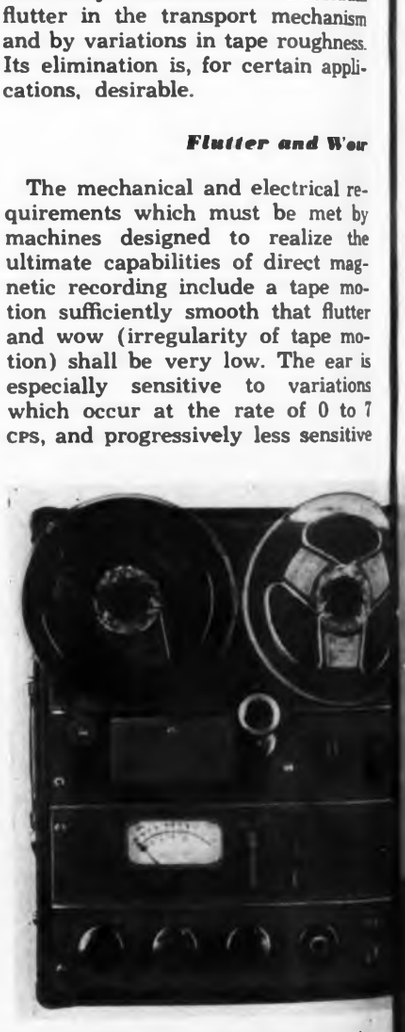
Direct magnetic recording of certain kinds of scientific information, such as noise and vibration analyses, is very satisfactory. Wherever interest is in the relation between frequency and logarithm of amplitude, this recording method would be the logical choice.

Dropouts

For all of its many desirable characteristics, direct magnetic recording possesses certain limitations, which have led to the development of other techniques for specialized purposes. The direct method lacks precision in the reproduction of absolute amplitude variation, since occasional "dropouts" of as much as 80% may occur because of the nature of the recording medium. The ultimate limit on precision in the reproduction of absolute amplitude variations is imposed by the medium itself, of which more will be said later in this report. Furthermore, the lowest frequency which may efficiently be recorded by the direct method is limited; those purposes in which dc variations and very low frequency ac effects are of interest require other recording means. Direct recording is also characterized to some extent by "modulation noise" or "noise behind the signal." This is caused by a combination of residual flutter in the transport mechanism and by variations in tape roughness. Its elimination is, for certain applications, desirable.

Flutter and Wow

The mechanical and electrical requirements which must be met by machines designed to realize the ultimate capabilities of direct magnetic recording include a tape motion sufficiently smooth that flutter and wow (irregularity of tape motion) shall be very low. The ear is especially sensitive to variations which occur at the rate of 0 to 7 CPS, and progressively less sensitive



Portable direct recorder, for audio applications

to variations which occur between 7 and about 200 CPS, above which these variations may be regarded as

(*Continued on page* 173)

State of the Art

FM RECORDING

THIS technique involves feeding to the record head one or more carrier frequencies upon which are superimposed by FM the intelligence to be recorded. When only one channel of information is to be recorded, a single carrier is recorded at saturation level without bias, using a relatively wide frequency deviation. When several carriers are to be recorded on a single magnetic track, each must be recorded not above approximately that level at which 1% distortion occurs due to the approach of tape saturation, using bias, and generally with deviations of only a few % each.

The application of FM recording is most advantageous with any sort of electrical signals in the spectrum from 0 to some upper limit which is usually approximately 20% of the carrier frequency, this being determined by the tape velocity. Such equipment is especially usable for multi-channel recorders of the type needed in geophysical explorations. The method is also used for the recording of transient phenomena, vibration, strain and stress studies, analog data such as pressure, temperature, velocity, altitude, etc.

Advantages

Among the advantages of FM recording are: 1) phase, amplitude, and frequency may all be faithfully recorded and reproduced on an absolute basis, in contrast with direct recording, in which "dropouts" and other effects impose severe limitations; 2) such recordings deteriorate insignificantly with storage. Accidental erasure, especially with saturation level recordings, would have to be almost complete before any material deterioration of the signal would occur. This is contrasted with recordings of the direct type, in which relatively small accidental magnetic effects may seriously damage the shorter wave lengths recorded; 3) the FM technique permits the recording and accurate reproduction of frequencies down to 0 cycles; 4) amplitude effects caused by tape conditions have little or no effect on the accuracy of the recording; 5) "print-

(*Continued on page* 176)

This precision recorder boasts 80 db signal-to-noise ratio, records 4 channels on a single ½ in. tape

DIRECT PULSE RECORDING

THIS technique involves the magnetizing of the medium at discrete points in a discontinuous fashion. Two types of direct pulse recording are in common use: 1) Short areas of the moving tape are successively magnetized, or left neutral. 2) The record head is maintained at a constant high flux density in an arbitrarily assigned polarity in the absence of information, bits of information being recorded by alternate reversals in the polarity of the recording signal.

The application of this technique is primarily to the recording of digital information wherein the data can be represented by groups of pulses. This includes any memory storage apparatus for any class of digital information. This type of system is commonly used with magnetic drums for short term memories, and with tape for long term large quantity memory systems. The principal current use of this technique is in connection with computers and other high precision electronic systems.

High Accuracy

The advantages of the technique include the following: 1) Extreme precision may be achieved: indeed, by the application of readily available techniques of automatic accuracy-checking, almost any desired degree of accuracy may be attained. Accuracies of the order of one error in many million parts are readily achievable. 2) The precision of informational storage is almost independent of the speed stability of the transport. 3) The technique is of particular advantage since digital information otherwise stored in written form may conveniently be recorded on a re-usable medium. 4) Information may be removed or replaced rapidly, on a partial or whole basis. 5) The technique lends itself readily to the rapid and automatic location of information inside a large storage volume. 6) Ex-

(*Continued on page* 175)

An Analysis of Resistance Te

A general transfer function is realized by this method of network synthesis which utilizes a lattice terminated in resistance at both the input and ouput

By LOUIS WEINBERG
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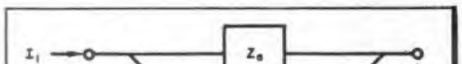
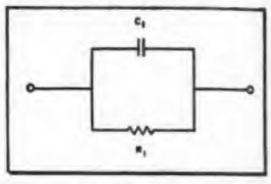
AT the present time many practical applications of modern network synthesis are being made, and as the principles of synthesis further disseminate to the engineers in the laboratories we can expect the rate of growth of such applications to increase. These engineers will of course demand procedures that yield practical forms of networks. In many electrical designs a balanced form of network like a lattice may be called for. To make the lattice network practical—that is, to allow it to be driven by a source with a finite non-zero internal resistance and to work into a resistive load—it is necessary to design the network so that it possesses a resistance at both its input and output terminals. Often there are also parasitic capacitances to worry about so that it is useful to have, in addition to the resistive terminations, shunt capacitances at both the input and output terminals. Finally one would like to be economical and use low-Q coils in building the network: it would therefore be attractive if the design required no pure inductances—that is, every inductance present should have an associated series resistance.

In this article a solution to the problem of realizing a general transfer function by a lattice network is given. This problem is an important one in modern network design, and has been treated in a number of papers.[5-1] A method is presented here for realizing a general transfer impedance, transfer admittance, or dimensionless voltage ratio as a lattice terminated at both ends in resistance.

The first part of this method may use either one of the two procedures[4,5] for realizing an open-circuited lattice. The procedure explained in this paper starts with the technique of partial fraction expansion[1]; it will be clear to the reader how the other method[5] may be similarly adapted.





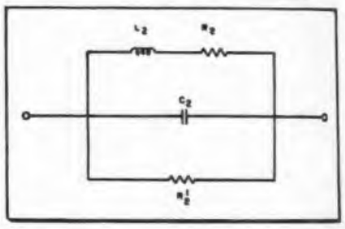


Fig. 1: (above) Open-circuited lattice network. Fig. 2: (right above) For term containing real pole. Fig. 3: (r) For terms with complex conjugate poles

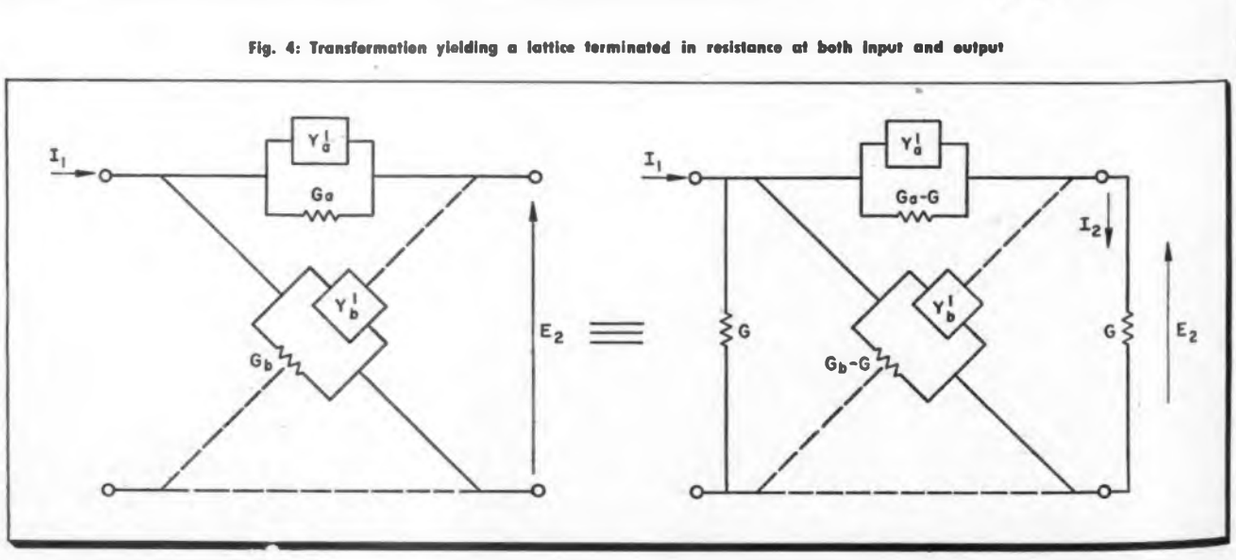
Open-Circuited Lattice

It was previously shown[4] that a general transfer impedance, which can always be written within a multiplicative constant in the form

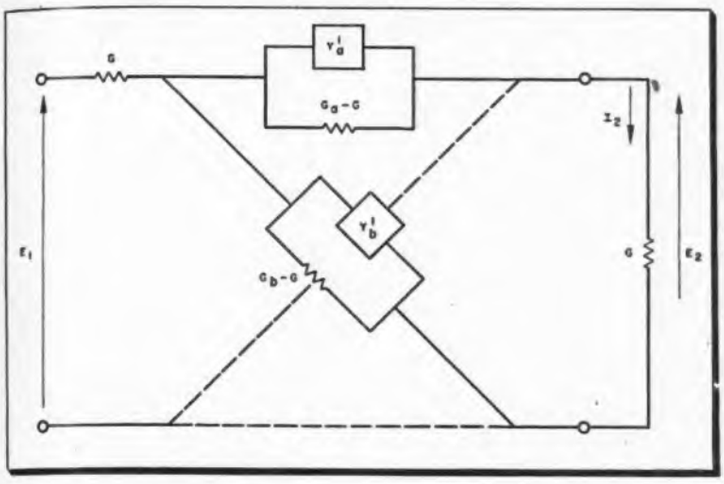
$$Z_{12} \equiv \frac{E_2}{I_1} = \frac{p(s)}{q(s)}$$

$$= \frac{s^m + a_{m-1}s^{m-1} + \ldots + a_1 s + a_0}{s^n + b_{n-1}s^{n-1} + \ldots + b_1 s + b_0}, \quad (m \leq n+1) \tag{1}$$

Fig. 4: Transformation yielding a lattice terminated in resistance at both input and output



Terminated Networks



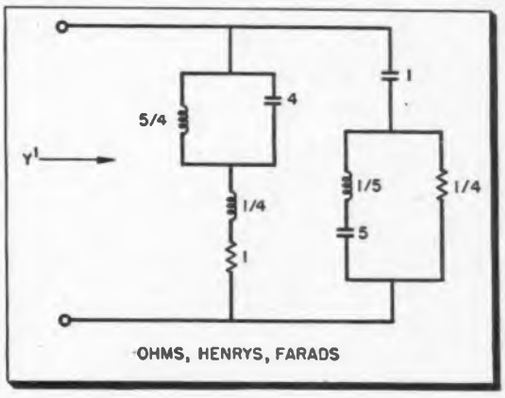


Fig 5: (l) Lattice of Fig. 4 from Thevenin's theorem.
Fig. 6: (above) Lattice corrected for predistortion

may be realized as the open-circuited lattice shown in Fig. 1 for which

$$Z_{12} = \frac{1}{2}(Z_b - Z_a). \qquad (2)$$

If the poles of Z_{12} are simple and its numerator is of lower degree than the denominator, the partial fraction expansion of the impedance of each of the lattice arms has the form

$$Z = \sum_{\mu=1}^{n} \frac{k_\mu}{s - s_\mu}. \qquad (3)$$

Considering complex conjugate poles as combined into one term, we find that each of the partial fraction terms has the significant positive real characteristic, that is, the terms are separately realizable by inspection. Thus the two types of terms that occur are given by

$$z_1 = \frac{k_1}{s - s_1} = \frac{\alpha_1}{s + a} \qquad (4)$$

and

$$z_2 = \frac{k_2}{s - s_2} + \frac{\bar{k}_2}{s - \bar{s}_2} = \frac{\alpha_2 + j\beta_2}{s + \sigma_2 - j\omega_2} + \frac{\alpha_2 - j\beta_2}{s + \sigma_2 + j\omega_2} = \frac{2\alpha_2(s + d_2)}{s^2 + \sigma_2 s + |s_2|^2}, \qquad (5)$$

where a, α_1, α_2, d_2, and σ_2 are real and positive constants, and d_2 is not greater than $2\sigma_2$. These terms are immediately realizable in the forms shown in Figs. 2 and 3, and the complete lattice has arms containing a series connection of such networks.

When m = n one or both of the expansions for the lattice arms contains a constant term, and when m = n + 1 at least one of the arms will contain a pole at infinity. Corresponding to these terms a series resistance and a series inductance, respectively, will be present in the lattice arms. For a Z_{12} that possesses multiple poles the method of realization explained in reference 4 introduces a constant term into each of the lattice arms. We shall see that this precludes obtaining a shunt capacitance at both input and output when m < n; however, the method of reference 5 permits the desired capacitance to be obtained for this case.

Real Part Of Z

We now show that the real part

$$\text{of } Y = \frac{1}{Z} \text{ for } s = j\omega,$$

denoted hereafter by Re [Y(jω)], has no zeros for all real values of ω including infinity, where Z represents the form of the driving-point impedance of each of the lattice arms; that is, the lattice arms have nonminimum-conductive driving-point admittances. As a result a conductance may always be removed from each of the lattice arms without destroying the positive real quality of its driving-point function.

Since z_1 and z_2, given respectively in (4) and (5), represent driving-point impedances, their real parts along the j axis are never negative. It is furthermore clear from inspection of (4) that the real part of z_1 is nonzero at the origin and decreases monotonically to a zero value at infinite frequency. Similarly, for terms of the form of z_2, inspection of (5) shows that Re [$z_2(j\omega)$] is also finite and nonzero at the origin and has a zero value at infinite frequency, though its intermediate variation is not monotonic. It, too, possesses no zero in the real part for finite frequencies. If we consider the given Z_{12} as a proper fraction with simple poles, then each of the lattice arms is of the form given by (3) and the real part of Z is the sum of the real parts of the two types of terms considered above. Suppose we now write

$$Z = \frac{m_1 + n_1}{m_2 + n_2}, \qquad (6)$$

where m_1 and n_1 represent respectively the even and odd parts of the numerator, while m_2 and n_2 play the same roles for the denominator. Then

$$\text{Re } [Z(j\omega)] = \left. \frac{m_1 m_2 - n_1 n_2}{m_2^2 - n_2^2} \right|_{s = j\omega} \qquad (7)$$

and the above reasoning yields the conclusion that the numerator $(M_1 m_2 - n_1 n_2)$ possesses no zeros for real ω and is therefore always positive. The total function Re [Z(jω)] has a zero at infinity. As for

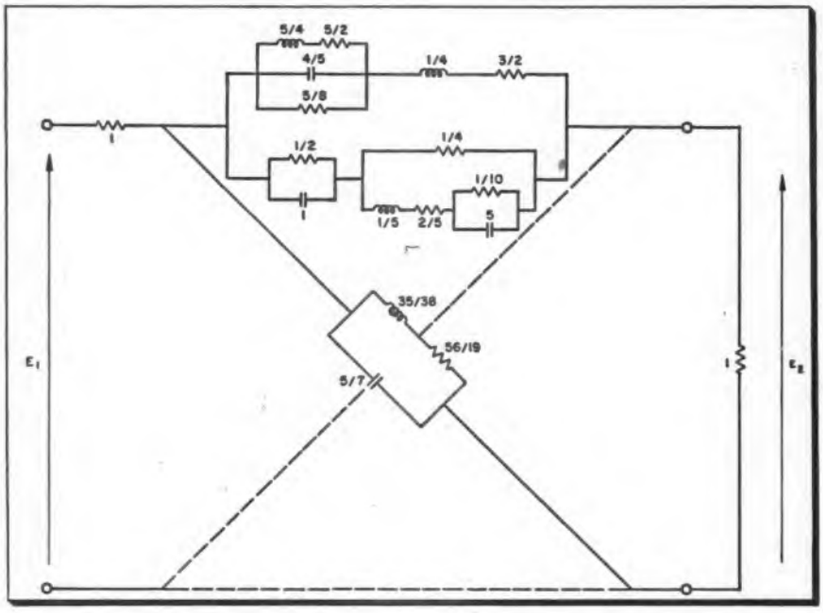


Fig. 7: Network realized by applying Thevenin's theorem to the lattice of Fig. 6

the admittance $Y = \frac{1}{Z}$, its real part is given by

$$\text{Re}\,[Y(j\omega)] = \left.\frac{m_1m_2 - n_1n_2}{m_1^2 - n_1^2}\right|_{s\,=\,j\omega} \qquad (8)$$

from which we note that it has the same numerator as Re $[Z(j\omega)]$. Therefore Re $[Y(j\omega)]$ is always positive and nonzero except possibly at infinite ω. But it is also nonzero at infinity, for the degree of the denominator will be greater than that of the numerator in (8) only when Z possesses no other terms except one or more of the form of z_2 in each of which the constant d is equal to 2σ. Since it is always possible[4] to make d less than 2σ, we may state the conclusion: the Re $[Y(j\omega)]$ is always positive and nonzero for all (finite and infinite real) values of ω.

For Multiple Poles

Restricting the discussion to a proper fraction containing only simple poles represents no loss in generality, for the same conclusion applies in the other cases. If multiple poles are present in the given transfer impedance Z_{12}, a term whose real part is positive and nonzero for all ω is added to the lattice arm impedances. If in Z_{12} the degree of p is equal to the degree of q, a constant is added to one or both of the lattice arm impedances. Finally, if the degree of p exceeds that of q, none of the transfer functions is physically realizable with a resistance termination at both input and output, as is demonstrated below.

It has been shown[3] that a transfer voltage ratio is not physically realizable if the degree of its numerator is greater than the degree of its demoninator, that is, if a pole at infinity is present. But we desire networks terminated in resistance at both input and output. For such networks the same rational function within a constant multiplier represents the transfer voltage ratio, the transfer admittance and the transfer impedance. Thus all three types of transfer functions are unrealizable in the form of the desired network if the degree of the numerator exceeds that of the denominator. Another way of seeing this is to note that if an open-circuited lattice is synthesized whose transfer impedance is given by such an improper rational fraction, then at least one of the impedances of the lattice arms must have a pole at infinity. Consequently a conductance cannot be removed from the corresponding admittance because its real part will have a zero at infinite frequency.

Completing the Synthesis

The open-circuited lattice that has been derived may now be converted to the desired form. We have seen that the real part of each of the lattice-arm admittances will have one or more positive nonzero minima; we now determine the smallest minimum of both admittances and denote them respectively by G_a and G_b. It is then possible to obtain an equivalent lattice[5] by removing from each of the arms a conductance of value less than the smaller of G_a and G_b and placing it in parallel with the input and output terminals of the lattice. This transformation, shown in Fig. 4, thus yields the desired resistance terminations for Z_{12}. To obtain

$$K = \frac{E_2}{E_1} \text{ and } Y_{12} = \frac{I_2}{E_1}$$

requires merely an application of Thevenin's theorem to the input; this yields the network of Fig. 5 for which:

$$K = \frac{E_2}{E_1} = K\frac{GE_2}{E_1} \qquad (9)$$
$$= GZ_{12}$$

and

$$Y_{12} = \frac{I_2}{E_1}$$
$$= \frac{GE_2}{E_1} \qquad (10)$$
$$= GK$$
$$= G^2Z_{12}.$$

It is clear from the above equations that the constant gain factor achieved for the transfer voltage ratio is directly proportional to G. This makes it desirable, if one is interested in gain, to remove as large a conductance as possible from the arms. However, one may be more interested in using low-Q coils for the realization of the lattice arms, which problem we discuss below; in this case it is necessary to retain a large conductance in each of the lattice arms.

Bott-and Duffin Method

For realizing the remainder of the lattice arms, that is, the admittances Y'_a and Y'_b in the network of Fig. 5, we may use the Bott-and-Duffin procedure[6]. This yields a network containing pure inductances but no mutual inductance. However, we desire that every inductance possess an associated series resistance; to achieve this we substitute a new variable (s-h) where h is a suitably chosen real positive constant; that is, we make use of the technique of predistortion introduced by Darlington[7].

Predistortion requires that for each arm admittance we first determine the equation of the curve in the

(*Continued on page* 140)

New Electronic Products

CAPS AND SOCKET

Caps and socket combinations for octal and noval size high voltage tubes feature rolled outer edges. Assemblies are designed for screw-mounting to condenser studs or stand-offs. Available

with general purpose black or low-loss mica phenolic insulators. Noval caps have $1\frac{5}{16}$ or $1\frac{1}{2}$ in. major rim diameters. Octal units have insulating fibre liners. Laminated and molded miniature seven and nine pin "Wire Wrap" sockets are available with terminals for high speed solderless lead attachment. **Methode Manufacturing Corp., 2021 W. Churchill St., Chicago 47, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

KLYSTRON

The VA-94 K-Band reflex Klystron is a low-voltage local oscillator type tube designed especially for missile and radar applications up to the 17 KMC frequency range. At 300 v beam potential, the unit provides a minimum of 20

MW power output and 55 MC bandwidth. A small screw tuner enables frequency adjustment at a slow tuning rate. Features include the convenience of waveguide output, matched load operation, miniature size of 2 x 1¼ x 1¼ in., and 4 oz. weight. **Varian Associates, 611 Hansen Way, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CONVERTER

An analog-digital converter recently announced, was especially designed for data handling or digital computers. Present models include 7, 13, 17, and 19 digit units—all 2 in. in diameter—vary-

ing from $2^{49}\frac{9}{64}$ to $4^{13}\frac{3}{16}$ in. in length. Input torque is under 0.2 oz./in. Current carrying capacity, 2 ma per pick-off brush. Digit output frequency can vary from 500 CPS to 1 MC or higher. Operates independently of voltage, temperature, frequency, and frequency limitations over a wide range. Weight 8 oz. **Librascope, Inc., 1607 Flower St., Glendale, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PLASTIC

Developed to eliminate difficult melamine machining properties, a new plastic, designated "Phenolic Grade Y-2401," lies approximately midway between paper-base phenolic (NEMA Grade XXX) and paper-base melamine (NEMA Grade XX-M). Arc resistance, 113 arcs/min. 15 KV, 30 ma, ⅜ in. gap. Specimens ⅛ in. thick. Can be punched in thicknesses ⅛ in. thick. Sections up to ⅜ in. can be shaped by shaving dies. The material is available in 39 x 47 in. sheets in thicknesses of $\frac{1}{32}$ to 1 in. inclusively. **National Vulcanized Fibre Co., Wilmington, Del.**—TELE-TECH & ELECTRONIC INDUSTRIES.

SOLDER FLUXES

The "Alpha" extended line of external solder fluxes, it is said, includes a flux for every purpose of the electrical, electronics, and printed circuit industries—ranging from the mild non-corrosive rosin type to the strong, highly-active stainless steel type. All are scientifically formulated for maximum wetting, rapid fluxing, and minimum corrosive after effects. All have water-soluble residues, and each lot is laboratory approved and identified by number to assure an accurate flux quality check. **Alpha Metals, Inc., 56 Water St., Jersey City 4, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

POWER DIODES

Seven junction type power diodes are announced: Nos. 1N91, 1N92, and 1N93 are the types in the foreground of the illustration. Nos. 1N151, 1N152, and 1N153 are single diodes shown mounted

on a cooling fin. Two diodes, No. 1N158 —indicated by arrows—are connected in series on a cooling fin. Type 1N153, for example, with a peak inverse voltage rating of 300 v is capable of delivering 0.5 amps into a resistive load with a voltage drop of only 0.7 v. **Semiconductor Division, Radio Receptor Co., Inc., 251 West 19th St., New York 11, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CONNECTORS

Plugs developed for high-altitude atmospheric pressure conditions, and aluminum hoods for positive cable support and strain relief are now available for use with "E-Z" release Continental connectors. The hoods have either top

or side cable openings. Hex nuts on the hood activate the bayonet receptacles and permit easy disconnection of the units with a screw driver. Illustrated engineering literature is available. **Electronic Sales Div., DeJUR-Amsco Corp., 45-01 Northern Blvd., Long Island City 1, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Components and Tools

ROTARY SWITCH

The new "Eldec" sub-miniature rotary switch is 0.908 in. long and has a maximum diameter of 0.875 in. Weighs less than ¼ oz. including the knob. For use in low current applications. Manu-

factured in 1, 2, and 3 pole units; 15 terminals per switch. Available in 2, 3, and 4 gang. Maximum working voltage. 300 v RMS. Maximum working current, 1 amp. Maximum working power, 100 w. Maximum contact resistance, 0.05 ohm. Breakdown voltage, 1500 v RMS. **Electro Development Co., 6006 W. Washington Blvd., Culver City, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

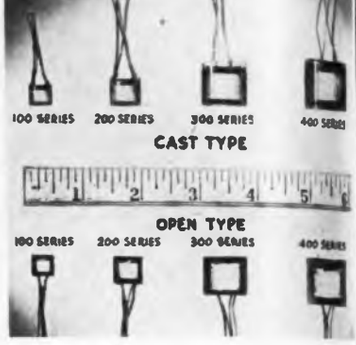
CAPACITORS

Two lines of subminiature metal-clad capacitors have silicone end seals to provide maximum resistance to thermal and physical shocks. One line with solid dielectric is for operation from

—55 to 125° C, without derating. Second line has liquid dielectric, operates from —55 to 85° C, and are 20% smaller than comparable oil-filled units. Both lines supplied in various capacities and with dc working voltages of 100, 200, 400 and 600 v., tab or exposed foil designs. **General Electric Co., Schenectady 5, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TRANSFORMERS

A new 32 model line of subminiature transformers, especially designed for transistor and other miniaturized circuit applications, ranges from ⅜ x ⅜ x 1 1/32 in. to ¾ x ⅞ x 1 in., with power



capabilities ranging from less than 1 mw. to over 100 mw. Each of four different series sizes has input, interstage, choke, and output models. Each of the 16 basic units is manufactured in both open type and cast construction. All 32 models operate satisfactorily over the temperature range of —25° C. and 100° C. **Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Texas.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CAVITIES

A recently announced line of high-precision reference cavities cover six frequencies. The units, essentially, are fixed-frequency, vacuum-sealed, transmission-type tubes. They are primarily used as frequency determining references and frequency stabilizers in radar

beacon applications. Temperature stability from 100° C is ±0.3 MC; 0° C to —55° C is ±1.0 MC. By cushioning the tube within the block, resonant frequency is held to ±0.1 MC under vibration, and shock up to 50 G's. **Bomac Laboratories, Inc., Salem Road, Beverly, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PRECISION RESISTORS

Grouped type of precision resistors are made up of from two to six lug type "Riteohm" resistors arranged end-to-end in a molded resin body. Units are available in lengths to 3 in., in individ-

ual resistor wattage ratings of ¼, ½ and 1 watt, and in resistances up to 1.95 megohms. Tolerances as close as ±0.1% are available. Individual resistors of group consist of enameled alloy wire on steatite bobbins. **Ohmite Mfg. Co., 3664 Howard St., Skokie, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

NEEDLE-NOSE PLIERS

Special plier for precision work is designed with extra long nose, severely tapered to a point less than 1/16 in. Replaceable tempered steel spring keeps plier in open position. Overall length

is approximately 6¾ in. Refer to No. 301-6-SCP-L for plier with leaf spring. No. 301-6-SCP for plier without leaf spring. Pliers with cutters are 203-6-SCP-L (leaf spring) and 203-6-SCP (without leaf spring). **Mathias Klein & Sons, 3200 Belmont Ave., Chicago 18, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Technical Products

TUBE CAP

The "Hot Spot" in-line tube cap is recommended for applications of extremely high tube temperature. Especially designed for molding into the high voltage anode lead, the cap is an

integral unit sealing the wire holes—thus preventing arc-over at these points. Excessive tube heat from maximum current drain under "Black Tube" conditions is met by a similar cap designed with extra long "Nylon" sleeves. These extra long sleeves safeguard the polyethylene insulation. **Alden Products Co., 117 North Main St., Brockton, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

RESISTOR

The Type 38042 encapsulated resistor measures 2 x 1 x 1¼ in. The wire wound resistive element is precisely positioned in the epoxy body for consistent and accurate capacity effect to chassis on which it is mounted by 8-32 machine screws. Terminals are turret type. Resistance values are ⅒th ohm

to 3 megohms. The outstanding feature of the unit is that it affords complete enclosure from the elements. Terminals are the only exposed metal parts. Withstands salt spray tests. **Cinema Engineering Co., Div. of Aerovox Corp. 1100 Chestnut St., Burbank, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

VECTOR DISPLAY

The Model VDE-3A is a completely rack-mounted monitoring and test instrument that displays in vector form the chrominance components of standard color bar signals. It also checks the

accuracy of the color signal, the drift in color coders and associated equipment. The display oscilloscope overlay is calibrated in degrees and amplitude. Scales are provided for "I" and "Q." The unit comprises a DK-1 decoder and keyer, a BCO-2 burst-controlled oscillator, a RS-1 display oscilloscope and a PS-2 regulated power supply. **Wickes Engineering and Construction Co., 12th & Ferry Ave., Camden 4, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

MINIATURE PENTODE

New 9-pin miniature pentode tube for communications equipment, 404A, features long operating life achieved by "Polioptic" manufacturing process which prevents contamination of tube elements. In Polioptic process, chamfered button stem and envelope are op-

tically polished to form good seal, allowing use of lower temperature during final seal. Heater rating is 6.3 v., 0.3 amp. Max. anode voltage is 180 v., anode dissipation 3 watts. **American Radio Co., 445 Park Ave., Dept. 135, New York 22, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES.

PHOTOCELL

The B2M selenium photoelectric cell measures $^{23}/_{32}$ x $^{7}/_{16}$ in. and is mounted by a self-contained bracket extension. The active area is only 0.26 sq. in., yet it generates an average output of 60 μa at 100 foot candles illumination. The

unit can be connected directly to a 0-1 milliammeter by its 6 in. pigtail leads and used as a light measuring device. Further, it can be operated as a "sun battery" to convert solar energy into a power supply for transistorized equipment and portable devices. A number of cells can be mounted in series or series-parallel to produce higher output power. **International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

CONNECTORS

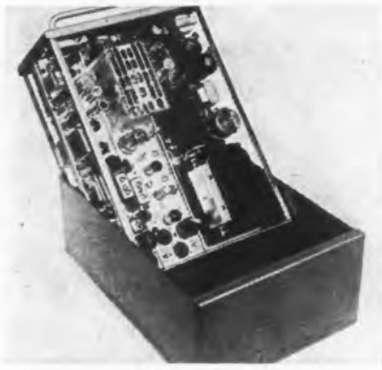
Two new rack, panel, and chassis connector series occupy approximately 35% less area than the standard DPD series. The shell of type DPA measures 2 x 1 x $^{23}/_{32}$ in.; the DPX, $2^{5}/_{16}$ x 1⅛ x 1⅛ in. Straight and angle 90° junction shells with integral clamps are available for the DPA type. Contact arrange-

ments currently available include standing 5, 10 amp and coaxials (5 amp) up to a total of 32 contacts with two DPA and seven DPX layouts. Insulation materials used are the latest high dielectric strength melamine or Diall 51-01. **Cannon Electric Co., 3209 Humboldt St., Los Angeles 31, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

New Electronic Products

COMMUNICATIONS UNIT

The Type MRT-10 () series communication unit consists of a separate transmitter, receiver, and power supply mounted in a single housing. Operating in the frequency range from 25 to 50 MC,



it is designed for mobile two-way communication in fixed station, marine, aeronautical, and other types of service. Frequency range in 3 bands, 25-30.5 MC, 30-38 MC, and 37-50 MC. Transmitter power output, 40 w (nominal), crystal multiplication 12 times, output impedance 52 ohms (nominal). Receiver audio output, 4 w (nominal) at less than 10% distortion. **Bendix Radio Div. of Bendix Aviation Corp., Baltimore 4, Md.**—TELE-TECH & ELECTRONIC INDUSTRIES.

ALUMINUM TOWERS

TM series of semi-portable guyed aluminum towers for communications systems are designed in accordance with RETMA standard TR-116. They are supplied in 10-foot sections up to

200 ft. Rapid assembly with no tools is made possible by "Cam-Lok" connectors. Erection or dismantling accomplished by three men in less than one day. Towers are also supplied with splice plates for permanent installations. Available separately or as part of system package. **Prodelin, Inc., 307 Bergen Ave., Kearny, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES.

GENERATOR

Model 608D VHF signal generator covers the frequency range from 10 to 420 MC. Residual FM is less than on 1.0 kc; drift less than 0.005%. Sensitivity measurements to 0.1 μv. A directly set

and read output of 0.1 μv to 0.5 v is available through the instrument range. A built-in crystal calibrator provides frequency checks accurate within a few kc every 5 MC. The instrument provides flat response from 20 CPS to 1 MC, AM modulation to 80%. Other forms of modulation include internal, external, external-pulsed, and FM. **Hewlett-Packard Co., Dept. P, 395 Page Mill Road, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

TERMINATIONS

A series of primary standard calorimetric wattmeter terminations have been extended to cover the spectrum from 100 to 26,500 MC. Model MC-1B, with associated adapters, covers the

range from 2,600 to 26,500 MC. Model MCX-1A, a coaxial type, covers the range from 100 to 3,000 MC. The MCL-1A L-Band waveguide unit covers the range from 1,120 to 2,600 MC. All models feature very low residual VSWR, primary standard accuracy, and direct-reading of average power up to 600 w over a plurality of expanded scales. **Cubic Corp., Scott & Canon St., San Diego 6, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

X-Y RECORDER

The Model 2 "Autograph" X-Y recorder for use with 11 x 16½ in. standard graph papers features a flat-bed paper table for curve observation and labeling. The unit may be equipped

with curve follower attachment, or modified for digital point plotting; and, additional equipment, as keyboards, card and tape readers, are available. Maximum sensitivity on both axes, ½ mv/ in. Other specifications are similar to the original portable "Autograph" Model 1. Measures 23 x 16½ x 8½ in. **F. L. Moseley Co., 409 N. Fair Oaks Ave., Pasadena 3, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES.

I-F AMPLIFIER

Type 1216-A unit i-f amplifier with a type 874-MR mixer-rectifier and a suitable unit oscillator, provide a sensitive detector for signals in the frequency range from 25 to 5,000 mega-

cycles. Signal to be detected is heterodyned in the crystal mixer with a signal from a local oscillator to give a 30 MC difference frequency which is fed to the i-f amplifier. Bandwidth; 0.7 MC at 3 db down, 9.5 MC at 60 db down. Two separate internal power supplies are used, one for operating a unit oscillator. **General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES.

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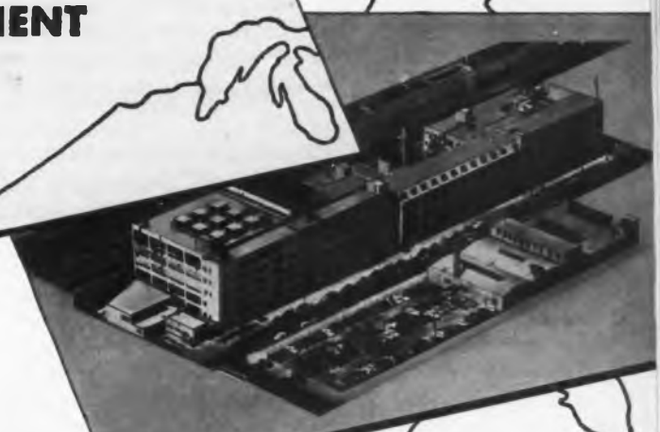

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WASHINGTON
News Letter

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

ROTATING CHAIRMANSHIP—The first Republican FCC commissioner appointed by President Eisenhower, Commissioner John C. Doerfer, has been named Chairman by Mr. Eisenhower for a one-year term, succeeding Chairman Rosel H. Hyde. Mr. Hyde, during his year at the Commission helm, achieved a notable record of accomplishments, particularly in reducing the backlog of television station applications. Commissioner Doerfer has an excellent background, having headed, for three years before he came to the FCC, the Wisconsin Public Service Commission, one of the nation's most efficient state regulatory bodies. In addition, Commissioner Doerfer during his FCC service directed for Attorney General Brownell a high-level government committee in the important work of streamlining governmental hearing procedures for all federal agencies, including the FCC.

SENSIBLE SOLUTION—While it had been a foregone conclusion there would be no Congressional legislation on UHF television before the adjournment, now slated for July 31, it had been previously reported the Senate Commerce communications subcommittee might issue a report on UHF TV that would be detrimental to the constructive progress of television. Under the excellent leadership of Senator Potter, Michigan Republican, the Senate subcommittee had decided the difficult problem of the overhauling of the allocation system for VHF and UHF television areas or markets should be a subject of intensive analysis jointly by the FCC and the technical leadership of the VHF-UHF and network television industry. This would lead to a realistic solution of the problem rather than an emotional and one-sided determination.

GLOBAL COMMUNICATIONS—Approximately 600 communications engineers recently attended the briefing on the international aspects of communications in Washington held under the auspices of the Institute of Radio Engineers—and from the standpoint of the nation's economic progress and defense it was possibly one of the most significant sessions ever staged by the IRE. Haraden Pratt, former IRE President and its present Secretary who served as the telecommunications advisor to Presidents Truman and Eisenhower, in discussing the 35-channel transatlantic telephone cable stated that while development of additional transoceanic cables may be slow because of the huge costs "achievement of a series of links girdling the globe is not an impossibility." George W. Gilman, Bell Telephone Laboratories Systems Engineering director, in another major address at the meeting, stated that in frequency conservation there was not much more to be done in research aimed at improved frequency stability but there was room for improvement in directive transmission and reception and in more effective organization and use of existing radio facilities.

LAW ENFORCEMENT VALUE—The increasing role and value of communications and electronics in law enforcement was described by Brig. Gen. David Sarnoff, RCA Board Chairman, in the graduation exercises of the FBI National Academy. Gen. Sarnoff pointed to the growing use of mobile radio equipment, microwave systems employed on the Pennsylvania and New Jersey turnpikes, radar as a speed detection device and television and radiophoto for rapid transmission of fingerprints and pictures which are such important tools for the police.

PUBLIC OFFICE HARDSHIPS—Constructive criticism of top-ranking government officials is certainly essential, but the airing of charges of bias and prejudice without previous investigation to determine whether they were well founded in facts, such as occurred in the Senate committee hearings on the reappointment of FCC Commissioner John C. Doerfer, appeared to be overstepping the boundaries of proper scrutiny of the conduct of an official. Commissioner Doerfer had to present his denial of the allegations by a disgruntled applicant for a television station which the latter widely publicized. The outcome—unanimous rejection of the charges by the 15-member Senate committee—was proof of their fallaciousness, but government officials should not have to be subjected to such attacks.

PRIVATE SYSTEMS—The major group in the mobile radiocommunications field are increasing their organizational strength to oppose the entrance of the telephone companies into their sphere of operations and during the past two months several steps in this direction were accomplished. The American Petroleum Institute, through the radio coordinating committees of that industry, was surveying a policy stand to oppose vigorously before the FCC utilization of present and future lease-maintenance radio communications services provided by telephone companies on petroleum frequencies. The state forestry conservation organization adopted a plan to establish continuance of state-owned and controlled radio services and the American Trucking Association's radio committee met June 22 to propose to the FCC the establishment of a common carrier motor radio service in place of the present highway truck radio service. The leading radio manufacturers in the mobile field such as RCA, GE, Motorola, Bendix and DuMont are ready to provide the groups seeking private systems with the latest types of equipment.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

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This section lists those representatives operating as independent "reps" who handle two or more lines and located in Calif., Ore., and Wash. They do not include factory staff salesmen. Asterisks (*) indicate membership in "The Representatives" of Electronic Product Manufacturers, Inc. Telephone numbers are given to speed contacts. Code after cities refers to location on map at right.

CALIFORNIA

LOS ANGELES AREA H-27

*Appleton Co Harry 136 San Fernando CA 1-2171
Barron-Jarvo 817 S Hoover St DU 3-5248
*Barstow & Doran 1406 S Grand Ave RI 6191
Bangbman Co E J 350 S Central Ave MA 9-1403
*Becker Co Herb 1140 Crenshaw Blvd WE 1-1257
Berman Co J 1141 LaCienega St BR 2-9138
Cohn S H 1769 S Holt Ave TE 0-4398
*Cochrane Co Irv M 408 S Alvarado DU 5-1715
Craig Ralph P 719 N Harper Ave WE 0468
*Davis Sales Co George 5259 E Beverly Blvd UN 3-3594
Dunkle B 3257 W 6 St
*Ealy & Hastings P O Box 264 (N Hollywood) ST 7-5621
*Edwards & Co Jackson 6047 Hollywood Blvd HO 5-1141
*Emmet F A 2837 W Pico RE 3-9111
*Feldman Co Henry 1244 S Grand PR 8803
Fox Associates 2519 W 7 St DU 3-2148
Hardie Co R H 134 N Edgemont DU 3-6851
*Harman Co W S 1638 S LaCienega Blvd BR 2-3321
*Hill Sales Co J T 800 W 11 St RI 7-5384
*Hitt Co W C 1169 S Broadway PR 2105
*Kittleson Co. 7614 Melrose Ave WH 1167
*Knight Co W Bert 10373 W Pico Blvd BR 2-5647
Koessler Sales 6907 Melrose Ave YO 6271
La Morse G D 1325 San Julian RI 6378
*Lasure Co Harry A 9041 W Pico Blvd CR 6-4185
*Loukota Co Douglas 10462 Magnolia Blvd (N Hollywood)
Lynch & Son C R 210 W 7 St VA 3805
Lynn & Brooks 3055 Wilshire Blvd DU 2-2255
*Marsh Co J W 4216 W Jefferson RE 2-0145
*Marshall Co G S 40 S Los Robles (Pasadena) SY 1-8345
*Marshank Sales 672 S Lafayette Pk DU 7-8235
Maynard Sales Co 6214 W Manchester OR 8-3150
*Miller Co Gerald B 1550 N Highland (Hollywood) HO 9-6305
Mitchell Co C N 256 S LaPeer Dr Beverly Hills CR 1-8382
*Healy Enterprises 7422 Melrose Ave WE 3-9201
Olander & Co Roland 7225 Beverly Blvd WY 0028
Osborne R E 1044 S Park View DU 8-1039
*Owens Co Lee H 2331 W Washington RE 0230
Perlmuth-Colman & Assoc 2419 S Grand Ave RI 7-4321
*Power Ralph L 767 Castelar St MU 5277
Renz Roy E 207 S Orange St (Glendale) CH 3-2047
*Rizzi Al J 2724 S Peck Rd (Monrovia) DO 6-2135
*Roberts & Assoc E V 5068 W Washington WE 8-2541
*Rupp Co V T 2230 W 11 St RI 3-4197
*Saul & Assoc Howard M 5015 San Vicente Blvd. WE 1-8901
*Selgel Co Samuel 1145 S LaCienega Blvd BR 2-4183
Slovers Edward S 5171 Hollywood Blvd HO 2-1105
Smedley A H Box 67-C (Pasadena) SY 8-1174
Spitzer T Louis 5777 W Pico Blvd WE 1-5566
Starr Edwin E 4101 Rhodes Ave (N Hollywood) ST 7-5879
*Stalaroff Co M A 4614 Northridge Dr AX 3-6219
*Stone Assoc Carl A 1102 S Western Ave RI 2-8103
*Strassner Co Conrad H 1863 N Western Ave HO 7-7086
Tivy George S 1148 S Grand Ave RI 7-7553
*Tobergen Co John H 2232 W 11 St DU 9-3173
Van Groos Co 14515 Dickens St (Sherman Oaks) ST 7-7882
Vermilye Co Charles 3440 Wilshire Blvd DU 2-5695
*Wallace D C & W H 1206 Maple Ave RI 7-0401
*Weber Co Wedge 1206 Long Beach Ave VA 2009
*Western Electronic Enterprises 3348 W Compton Blvd (Gardena) OR 8-4817
*Wiley Paul F 1632 Silverlake Blvd HO 3-8028
*Wood Co A M Box 150 (Elmonte) CU 3-1201

SAN FRANCISCO AREA C-19

Ault C E 625 Laurel Ave (Menlo Park) DA 5-4983
*Balchamber P A 1401 Middle Harbor Rd (Oakland) GL 1-4460
*Berman Co E L 758 Natoma St UN 3-0317
Brainard W V 721 Clementina St UN 1-2569
Detech & Co 341 10 St MA 1-2788
Eichorn & Melchior 501 Indiana St UN 1-8309
Frazar & Hansen Ltd 301 City St EX 2-5112
*French S P 721 Garland Dr (Palo Alto) DA 3-0597
Harris Sales Co L H 383 Brannan St YU 6-1084
Held Herman E 147 10 St UN 3-4250
*Hermans Co James P 1234 Folsom St MA 1-4166
*Hitt Co W C 1355 Market St KL 2-2311
*Howard G M 782 Bryant DO 2-6320
Kittleson Co 2166 Market St NE 1-5304
*Lewis Assoc Dean 219 9 St UN 3-1414
Logan Assoc 725 Greenwich GA 1-0076
*Logan Sales Co 530 Gough St NE 1-5127
Marshall Harry E 104 Olive St BR 3-2173
*Meyer & Rees 1355 Market St KL 2-2311
*Monithrop & Hunter 160 10 St NE 1-2625
Moxon Sales G E 422 LaJolla Ave (San Mateo) FI 5-2866
*Healy Enterprises 2830 Geary Blvd WA 1-2361
*Newman Harold L 420 Market St YU 6-3897
*Nickerson & Rodat 381 Brannan St YU 2-2982
*Nott & Co L A 1061 Howard St NE 1-4738
*Purdy Co W J 312 7 St UN 3-4321
*Ross Co David H 534 El Camino Real (San Carlos) LY 3-8224
*Sinai Arnold A 63 9 St UN 1-6259
Striker Co John E 1369 Laurel St (San Carlos) LY 3-5403

OREGON

PORTLAND D-6

*Burnham Co Don H 510 N W 19 Ave BR 3830
Hawthorne Electronics 700 SE Hawthorne Blvd FI 9375
Legg Co Richard 2118 SE Division St EM 8918
*Minthorne Co L L 7521 NE Glisan St KE 0010
*Weber Co Dale 234 Sherlock Bldg AT 5403

WASHINGTON

SEATTLE E-3

Backer Co Jos J 2321 2 Ave MA 8811
Carlson Co Fred W 2307 5 Ave EL 6630
*Haight Co Fred H 3212 Eastlake EA 1818
Howell Sales 1250 1 St S EL 4214
Jensen Co Verner G 2616 2 Ave EL 6871
*Lee Co Dave M 2517 2 Ave MA 5512
*Marsh Agencies 2601 1 Ave MA 8762
Merritt Co Ben 120 W Thomas GA 6644
Morris Co George D 3013 1 Ave EL 1344
*Northwestern Agencies 4130 1 Ave S EL 8882
*Parsons & Co C D 3028 1 Ave MU 3933
Porter Co Burt C 4310 Roosevelt Way NE 6828
*Stream Co S H 1612 Broadway EA 7515
*Wedel Co Frank 3215 Western Ave GA 0222
*Widdekind Co M K 216 1st Ave N EL 6981

DISTRIBUTORS

These are the names and addresses of organizations handling the distribution of radio-TV-electronic parts and equipment in Calif., Ore., and Wash. Asterisk (*) indicates membership in National Electronic Distributors Association (NEDA). Telephone numbers are given to speed contacts.

CALIFORNIA

ALHAMBRA H-27

*Coast Electronic Supply 527 W Main Co 3-4049

BAKERSFIELD G-24

Arbuckle J C 500 E 19 St 5-5816 Hdqrs Fresno
General Electric 1134 33 St 5-5514
Gough Industries 3125 Jewett St
Valley Radio Supply 716 Baker St FA 7-8831

BERKELEY H-27

Pacific Radio Supply 1940 Ashby Ave TH 3-8900

BURBANK H-27

Dean Co F S 1500 W Burbank Ch 8-4408 Hdqrs Long Beach
Pacific Radio Exch 4101 W Burbank Hdqrs Hollywood
Valley Electronic Supply 1302 N Magnolia Blvd

CATHEDRAL CITY J-27

Wholesale Electronic Specialists 537 Broadway

CHICO E-16

Radio Television Products 738 Cherry FI 2-8140

COMPTON H-27

Electronic Parts Distrs 1508 E Compton

EL CENTRO H-27

Alnza-Hoffman Distrs 1125 W Main 2307

EL MONTE H-27

Kimball-Stark 713 S Tyler FO 0-2594

EMERYVILLE C-19

General Electric Supply 5400 Hollis St MA 7141

EUREKA A-13

Commercial Radio & Elec 317 W 7 St HI 2-4179

FRESNO G-22

Arbuckle J C 2349 Kern 4-6355
Billings Wholesale Radio 260 Fulton St
DeJarnatt Whole B J 223 Fulton 2-2153
Dooley Harry 725 L St 2-4108
General Elec Supply 1234 O St 4-4746
Graybar Electric 101 Van Ness Ave 2-4175
Kierulff & Co 725 L St Hdqrs Los Angeles
Kinney & Faust 1740 Van Ness 6-8321
Mayberg Co L J 2930 Butler Hdqrs San Francisco
Ports Mfg Co 3265 Belmont 3-6728
Schiefer Sound 2121 Blackstone 7-7234
Westinghouse Elec 2608 Calif 4-5091

FULLERTON H-27

United Radio & Electr 122 W Pomona St

GLENDALE H-27

Hagerty Radio 6826 San Fernando Rd CH 8-2453
*Weatherford Co H V 6921 San Fernando RO 9-2281

HOLLYWOOD H-27

Hollywood Radio 5606 Hollywood HO 4-8321
Pacific Radio Exch 1407 Cahuenga HW 2-1393
Yale Radio Elec 6616 Sunset Blvd GL 4169

HUNTINGTON H-27

Martin Dist Co 2475 E Florence Ave

INGLEWOOD H-27

Acron Radio 4736 W Century

LONG BEACH H-28

Dean Co F S 969 American 6-5281
General Electric Co 840 W 12 St 68-8419
Gough Industries 838W12 Hdqrs Los Angeles
Graybar Electric 800 W 16 St 70-2911
Kierulff & Co 1760 Pacific Ave 6-8268
Ley Co Elwyn W 5550 Dairy Ave 20-5444
Lynde Electronics 1526 E 4 St 7-4807
Radio & TV Equip 2227 Pacific Hdqrs Santa Ana
*Scott Radio Supply 266 Alamitos 7-8629
Waller Inc H T 645 W 15 St 35-4844
Westinghouse Elec Supply 938 Pine Ave

LOS ANGELES H-27

Allied Radio Supply 7319 S Normandie Ave PL 2-3134
Bell Radio Supply 1311 W Florence Ave PL 2-7191
Calif Electronic Supply 11801 W Pico Blvd BR 2-2126
Cazazza J N Co 3535 S Broadway AD 1-9133
Dunkle Radio Parts 2506 W 8 St
*Federated Purchasers 911 S Grand TR 1761
Figart's Radio 6320 Comm Sieet Dr YO 6218
General Elec Supply 700 Turner St MA 7141
Gerstman Dist 745 E Pico
G.L. Electronics 905 S Vermont DU 7-5104
Gough Industries 560 S Mission Rd MA 6-2474
Graybar Electric 210 Anderson AN 3-7282
Henderson Co 628 N Alvarado DU 2-8301
Henry Radio Shop 11240 W Olympic Blvd BR 2-1401
Hollywood Electronics 7460 Melrose Ave WE 3-8208
Kierulff Electronics 820 W Olympic RI 7-0271
Los Angeles Radio 10215 Venice VE 8-3177
Martin Dist Co 2475 E Florence LO 5-7111
Minthorne Music 2920 W Pico Blvd RE 4-2177
National TV Supply 4032 S Figueroa AD 3-8058
Olympic Elec 1440 W Olympic DU 8-2233
Pacific Radio Exch 1407 Cahuenga Blvd HU 2-1393
Pacific Television 4032 S Figueroa AD 3-8058
*Papel Bros 2605 E 4 St AN 2-5151
Quality Dist 1235 E Olympic Blvd TR 9761
*Radio Equip Dist 1340 S Olive St PR 9151
Radio Parts Sales 5220 S Vermont TW 9178
*Radio Prod Sales 1501 S Hill PR 7471
Radio Spec 1956 S Figueroa PR 7271
Radio TV Sup 341 W 18 St RI 9131
Ravenscraft Co 2320 S Hill PR 1317
Shelley Radio 2008 Westwood AR 7-6741
United Radio & Elec 1924 S Grand RI 7-0441
*Univ Radio Sup 1729 S Los Angeles PR 9241
Victor Distr Co 2027 S Figueroa RI 7-4457
Westinghouse Elec Sup 905 E 2 MA 9-4161
Wholesale Radio & TV Sup 4305 S Figueroa AD 3-8171
Yale Radio Electric 6616 Sunset Blvd GL 4169

MAYWOOD H-27

Kierulff 6058 Walker Ave LO 5-5461

MODESTO F-20

Dunlap Whole Radio 1216 K St Hdqrs Stockton
Pacific Telotronic & Radio Sup 417 7 St 3-7751

NORTH HOLLYWOOD H-27

Hyser Sales 11423 Vanowen St
N Hollywood Radio 4212 Lankershim Blvd St 7-3063

OAKLAND C-19

Brill Co W D 198 10 St TE 2-6100
Cam Altschuler Co 6038 Telegraph Ave OL 3-7557
*Elmar Electronics 140 11 St HI 4-7011
Graybar Elec 1911 Union St GL 1-5451
*Millers Radio & TV 336 E 8 St TW 3-3848
Raycraft Co 568 3 St TW 3-9698
Wenger Co E C 1450 Harrison GL 1-1020
Westinghouse Elec 711 E 8 TE 4-9900

PALO ALTO C-20

Zack Radio 225 Hamilton DA 5-5678 Hdqrs San Francisco

PASADENA H-27

Dow Radio 1759 E Colorado RY 1-6683
Electronic Supply 2615 E Foothill RY 1-7188
Empire Electronic Dis 37 E Union St RY 1-7671

POMONA H-27

Anderson-Meggs 936 E Holt LY 9-2650

REDWOOD CITY C-20

Television-Radio Supply 415 Lathrop St Hdqrs San Francisco

RICHMOND C-19

Millers Radio & TV 319 37 St BE 5-4424 Hdqrs Oakland

RIVERSIDE J-27

Electronic Supply 2486 Blaine St 8420
Massey's Radio Supply 2992 B St

SACRAMENTO D-18

Brolil-Parts 2225 19 St GI 2-2983
Brown Co C C 1714 10 St GI 3-5931
Capitol Electronics 1714 10 St GI 3-5931
*Dunlap Whole 1628 "S" St GI 2-1031 Hdqrs Stockton
General Elec Supply 1131 "S" St GI 3-9001
Graybar Electric 1900 14 St GI 2-8976
*Kemp Co E M 1115 R St GI 3-4668
Radio Television Prod 2012 19 St GI 2-7691
*Sacramento Electronics 1219 "S" St GI 2-7679
Westinghouse Elec 1730 14 St GI 3-6525

SALINAS D-21

Peninsula TV & Radio 42 W Gabilan 2-6503

SAN BERNARDINO L-27

Arrowhead Radio & Television 1212 D St 2-5581
Electronic Equip 1123 W Base Line
Featherstone Radio & TV 1010 E St 81-1306
General Elec Supply 485 S "I" St
Gough Industries PO Box 222 Hdqrs Los Angeles
Graybar Electric 655 S "M" St
HIFI Supply 418 Baseline 2-5181
*Inland Electronic Supply 843 Colton Ave 6-5571
Kierulff & Co 1123 W Base Line Hdqrs Los Angeles

SAN DIEGO—J-30

Electric Supplies Dist 435 2 Ave

West Coast Electronic Industries

Electronic Equip Dist 140 B st BE 2-3155
General Elec Supply 668 3 Ave FR 9-0271
Gough Industries 3255 5 Ave WO 0659 Hdqrs Los Angeles
Graybar Electric 720 State St FR 1361
Kierulff & Co 2426 4th Ave
Radio Parts Co 2060 India BE 9-9361
Shanks & Wright 2045 Kettner F BE 9-0176
Silverstate Radio Supply 2361 India FR 9-6123
Western Radio & TV 1415 India St FR 0361

SAN FRANCISCO C-19
*Assoc Radio Distr 1251 Folsom St HE 1-0212
*Brown Co C C 61 9 St MA 1-7000
Century Distr 1111 Front St YU 2-1480
Ets-Hokin & Galvan 551 Mission St EX 2-0432
General Electric Supply 1201 Bryant St UN 3-4000
Graybar Electric 1750 Alameda St MA 1-5131
Kaemper & Barrett 1850 Miss UN 3-3080
*Meyberg Co L J 33 Gough St MA 1-3400
Offenbach & Romeo 1564 Market St KL 2-2100
*Pacific Whisle 1850 Mission St UN 1-4843
Pepkay Co G M 1201 Howard St KL 2-3488
Radio Parts Supply 281 9 St MA 1-0552
*San Francisco Radio 1284 Market UN 3-6000
*Smith & Crawford 789 Stevenson St UN 3-2045
Tel-Radio Supply 408 Market EX 2-2898
Tilton Industries 1850 Mission St UN 1-4843
Westinghouse Elec 201 Potrero UN 1-5051
*Wholesale Radio 140 9 St HE 1-3680
*Zack Radio Supply 1424 Market MA 1-1424

SAN JOSE C-19
Poulsenin TV & Radio 881 S 1 St CY 4-8781
*Quement Inc Frank 161 W San Fernando St CY 4-0464

SAN LEANDRO C-19
Styles & Engleman 2255 Bancroft Ave LO 9-9433

SAN RAFAEL C-19
Abbott Co E B 345 Francisco GL 3-1130

SANTA ANA I-28
Graybar Electric 301 French St
Hurley Electronics 1434 S Main KI 3-9237
Radio & TV 207 Oak KI 2-6741

SANTA BARBARA F-26
Channel Radio Supply 523 Anacapa 2-3429
Gough Industries 404 State St Hdqrs Los Angeles

SANTA MONICA H-27
Santa Monica Radio 117 Santa Monica EX 3-8231

SANTA ROSA H-27
Santa Rosa Electro 205 Sebastopol 4486-W

SHERMAN OAKS H-27
Oak Radio Supply 13454 Ventura ST 7-6666

SOUTH GATE H-27
Mac's Radio Supply 8320 Long Beach KI 4111

STOCKTON C-19
Delamatt Whsle B J 515 N Hunter Hdqrs Fresno
*Dunlap Whsle Radio 27 N Grant HO 6-7907
Kemp Co E M 50 N Wilson Way HO 9-5976
*Stockton Electronics 710 E Main St HO 6-8832

VALLEJO C-19
Walker Co R Lyman 1401 Hiway 40 VA 3-5321

VENTURA H-27
Dealer's Whsle 265 S Laurel MI 3-6147

VERNON H-27
Westinghouse Elec Supply 4601 S Boy L St KI 0141

WALNUT CREEK C-19
Gillers Radio 2497 Mt Diablo Blvd

WEST LOS ANGELES H-27
California Electronics 11801 W Pico BR 2-2126

OREGON

EUGENE D-7
*Carlson Hatton & May 96 E 10
Gilbert Bros 424 Charnelton St hdqrs Portland
Graybar Electric 2180 6 Ave 4-2224
United Radio Supply 712 W 6 Ave hdqrs Portland

KLAMATH FALLS
R F Supply 2367 S 6 St

MEDFORD C-10
*Walker Co V G 205 W Jackson 2-4558
Westinghouse Elec Supply Co 1233 Court St

PENDLETON
Harolds Radio Supply 320 SW Court Ave 1956

PORTLAND D-6
Appliance Whsle 600 N W 14 AT 6584
*Central Distr 1131 NW Couch AT 0146
Connelly Co F B 905 NW 12th Ave CA 1755
General Electric 300 N W 14 Ave BR 0651
Gilbert Bros 826 S W 2 Ave BR 5641
Graybar Electric Park & Flanders BR 6641
H & H Radio Supply 5210 NE Sacramento TR 0057
Instrument Lab 1728 SW Harbor Dr CA 6863
Johnson Co Lou 422 N W 8 St CA 9551
Marshall Wells 1420 NW Lovejoy BR 6421
North Pacific Supply 2344 NW 21 Pl CA 1011
Northwest Radio Supply 717 S W Ankeny AT 1021
Pacific Stationery 414 S W 2 CA 4221
*Portland Radio 1234 W Stark St AT 8647
Sackett Radio 1605 N W Everett BE 2423
*Stebbs Electric 33 N W Park Ave BR 5404
Television & Radio 720 SE Alder EA 1104
*Tracey & Co N W 10 & Glisan Sts BE 6263
*United Radio Supply 22 N W 9 Ave BE 6323

SALEM D-6
Westinghouse Elec 815 N W 12 Ave CA 9851
Gilbert Bros 353 N High St hdqrs Portland
Johnson Co Lou 1051 S Commercial hdqrs Portland

WASHINGTON

BELLINGHAM
Waltkus Supply 110 Grand Ave 274

BREMERTON
*C & G Radio Supply 1301 Pacific Ave 3-3370

EVERETT
*Pringle Radio Whsle 2514 Colby Ave

KENNEWICK
Wible Radio Supply Inc hdqrs Tacoma

SEATTLE E-3
Alaska Radio Supply 1846 Westlake N AL 8777
Associated Industries 1752 Rainier St MI 4400
Central Electronic 2023 7th Ave
Coast Radio 110 University St MA 9133
Connelly Co F B 1015 Republican St SE 4155
Electronic Supply 5601 Calif Ave
Fidelity Electric 960 Republican St SE 5100
Garretson Radio Supply 2416 2 Ave MU 4380
General Elect 1212 1 Ave S SE 6400
*General Radio 100 Wall St
Graybar Elec King & Occidental MU 0123
Instrument Lab 934 Elliott W AL 4940
Marshall-Wells 1258 1 SE 7447
*Radio Products Sales 1214 1st Ave MA 1035
Radio TV & Appl 500 Westlake Ave N MA 0787
*Seattle Radio Supply 2117 2 Ave SE 2345
Stusser Electric 2246 1st Ave S SE 5285
*Western Electronic 717 Dexter Ave AL 9000
Westinghouse Elec 1051 1 Ave S EL 7001
Westlake Electronic 511 Westlake N MA 6601
*Zobrist Co N E 2121 Westlake MU 2121

SPOKANE J-4
Columbia Electric S 123 Wall St RI 3131
Connelly Co F B S 124 Wall St RI 6174
Frank's Radio Supply 161 S Adams St MA 8108
Graybar Electric 152 S Post St RI 3151
General Electric S 122 Monroe TE 1421
Johnson Co E M W 615 1 Ave RI 5432
Northwest Electr N 102 Monroe MA 9289
Prudential Distr 318 W Trent Ave MA 6002
Spokane Radio Supply 305 W 2 Ave RI 8441
Standard Sales 1219 W 1 Ave RI 7196
Taylor Distributing E 206 Augusta EM 3301
Westinghouse Elec N 1023 Monroe EM 3371

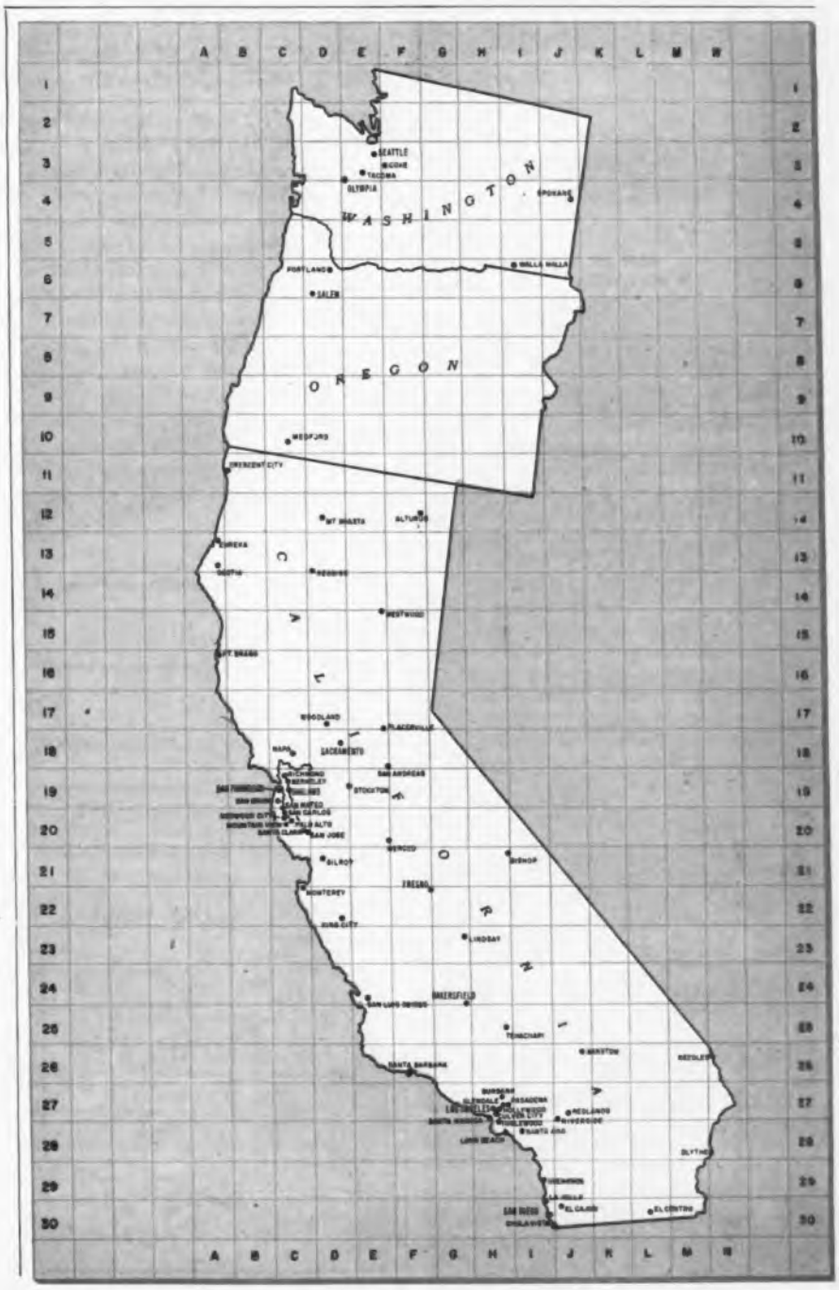
TACOMA E-3
*C & G Radio Supply 2502 Jefferson Ave BR 3181
General Electric 2316 South A St BR 8454
Graybar Electric 2112 A St Ma 0164
Stewart Co A T 711 Broadway BR 3174
Westinghouse Elec 1930 Pacific BR 8417
*Wible Radio Supply 2360 S Fawcett St BR 8395

VANCOUVER
Seelens Radio 310 W 8 St 4-2671

WALLA WALLA I-5
Kar Radio & Electric 12 & Pine Sts 4572

WENATCHEE
Mid-State Radio 611½ N Wenatchee Ave 510

YAKIMA
Lay & Nord 112 S 2 St 3-5591
Westinghouse Elec 210 W B YA 3-4701



CUES for BROADCASTERS

(*Continued from page 81*)

separate functions.

The second half of the 6H6 rectifier feeds audio through the volume control, pot R_{11}, then into one side of the secondary push-pull grid-to-line transformer. Thus from the audio section we now have two output levels: (1) the same low level for the audio rack's air monitor amplifier as before, and (2) a line level output of +14 VU which is fed along the spare program line to studio 2. Here it is equalized and fed to the input of its air monitor amplifier which has a switch to select "Line Tuner."

Tape Mechanism Circuit

DON V. R. DRENNER, Engineer, KGGF, Coffeyville, Kansas

ERRATIC performance in a new Magnecord PT63-AM tape mechanism led to the discovery that the published schematic was not correct. The machine ran constantly in the rewind mode of operation—the cause was a shorted condenser across the rewind switch. Examination of the components mounted on the sub-panel housing the bias oscillator revealed several that were not shown in the schematic. To assist other users, the corrected schematic of our machines, Serial No. 24951 et. seq., is shown. The condensers labeled a, b, and c, are across the contacts of the d.p.s.t. switches, and if shorted complete the circuits without manual operation of the function switch lever

Additional Note on Coaxial Line Leaks

W. A. MILLER, 522 San Pascual Avenue, Los Angeles 42, Calif.

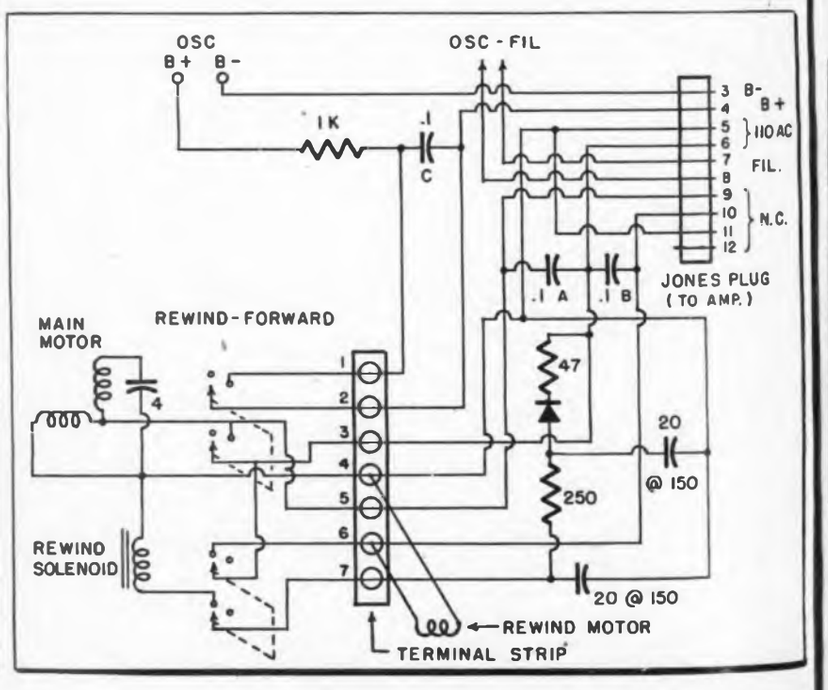
PRESTOLITE makes a Halide type leak detector that fits into a Prestolite handle, in place of the brazing tip, which is designed for the purpose of such leak detection. Suggest that all air or nitrogen be purged, or evacuated, from lines under test to make the operation more conclusive. This process has been used in the refrigeration industry for twenty years.

Preventing 45 rpm Disc Slippage

STEPHEN POPP, WIL, St. Louis 8, Mo.

I would like to submit what we at WIL believe to be an improvement over two articles published in reference to 45 rpm. disc slipping on turntables. We at WIL just cut out the necessary felt from the original turntables letting the humped portion of the 45 rpm disc fall into the well, thus no need to put on or take off an extra disc when changing to different type records.

Corrected schematic includes condensers A, B and C, which effectively shunt the d.p.s.t. switches.



audiotape
TRADE MARK

on Mylar* polyester film offers you these important new advantages

1. many times stronger
2. withstands extreme temperatures
3. impervious to moisture
4. maximum storage life
5. most permanent magnetic recording medium ever developed

Audiotape on "Mylar" polyester film provides a degree of permanence and durability unattainable with any other base material.

Its exceptional mechanical strength makes it practically unbreakable in normal use. Polyester remains stable over a temperature range from 58° below zero to 302° Fahrenheit. It is virtually immune to humidity or moisture in any concentration—can be stored for long periods of time without embrittling of the base material.

The new polyester Audiotape has exactly the same magnetic characteristics as the standard plastic-base Audiotape—assures the same BALANCED PERFORMANCE and faithful reproduction that have made it first choice with so many professional recordists all over the world.

If you have been troubled with tape breakage, high humidity or dryness, Audiotape on "Mylar" will prove well worth the somewhat higher price. In standard thickness (1½ mil), for example, the cost is only 50% more than regular plastic base tape.

Ask your dealer for our new folder describing Audiotape on "Mylar". Or write to Audio Devices, Inc.

PHYSICAL PROPERTIES

"Mylar" polyester film compared to ordinary plastic base material (cellulose acetate)

PROPERTY	1 Mil "MYLAR"	1.5 Mil "MYLAR"	2 Mil "MYLAR"	1.5 Mil Acetate
Tensile Strength, psi	25,000	25,000	25,000	11,000
Impact Strength, kg-cm	90	170	200	10
Tear Strength, grams	22	35	75	5
Break Elongation, %	80	95	105	20
Softening Point, °F	464-473	464-473	464-473	149-230
Moisture Absorption, % (at 100% RH)	0.3	0.3	0.3	9.0
Bending Modulus, psi	500,000	500,000	500,000	350,000
Flex Life, cycles at 0° F	20,000	—	—	500

audiotape
audiodiscs
audiopoints
audiofilm

AUDIO DEVICES, Inc.

444 Madison Ave., New York, 22, N. Y.

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

Survey of

New Products of the Month

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

COAXIAL TERMINATION. A miniature unit made by the Hansen Electronics Co., 7117½ Santa Monica Blvd., Los Angeles 46, Calif., by the tape resistor process as a terminating resistor is also applicable as a replacement for the conventional ½ w resistor.

THERMAL RADIOMETERS of two types, produced as portable units by Beckman & Whitley, Inc., 915 E. San Carlos Ave., San Carlos, Calif., are in the Model 188 series; one for total-hemispherical thermal radiation measurement, the other for net-exchange measurements.

QUICK SET THERMOREGULATOR, produced by Philadelphia Scientific Glass Co., 4 Eckard Ave., Abington, Pa., can instantly adjust from room temperature to 500° F. with a sensitivity of 0.02° F. 75 lbs. hydrogen pressure prevents sparking.

BREADBOARD CHASSIS, introduced by the Replacement Sales Dept. of the Cathode Ray Tube Div., Allen B. Du Mont Laboratories, Inc., 750 Bloomfield Ave., Clifton, N.J., consists of a 4 x 12 x 3 in. cadmium-plated frame mounted with 6-32 self-tapping screws and phenolic sub-chassis.

SLUG CERAMIC CAPACITOR, encased in casting compound, offered in the "Cartwheel" units by the Hi-Q Div. of Aerovox Corp., 740 Belleville Ave., New Bedford, Mass., are permanently sealed in one operation. For color TV primarily. Rated up to 30 kv.

LOW-MU POWER TRIODE, Type 6337, by Chatham Electronics Corp., 630 Mt. Pleasant Ave., Livingston, N.J., features high plate dissipation. Plate current is held within ±10% absent of drift. Capable of withstanding 500 G shock.

INSULATING MATERIALS for motors, generators, and transformers recently developed by National Vulcanized Fibre Co., Wilmington, Del., are called NACO Insulation and NACO-Mylar Combination Insulation. The former is a 100% rag base type of vulcanized fibre.

POT CORE made of Ferroxcube Type 3 ferrite material produces very small coil assemblies having moderate inductance values with relatively high Q. Data given in Bulletin FC-5109 available on letterhead request to Ferroxcube Corp. of America, Saugerties, N.Y.

TRANSFORMERS AND CHOKES announced by Audio Development Co., 2833 13th Ave., S. Minneapolis, Minn., measure ¾ x 15/16 x 1⅞ in. The miniature hermetically sealed units are available in standard steel and mu metal.

ROTARY SOLENOID, Model BD4, by G. H. Leland, Inc., 123 Webster St., Dayton 2, Ohio, is 1-9/16 in. in diam. Available in 25°, 35°, 45°, 67½°, and 95° rotation, either clockwise or counterclockwise. Starting torques to 5.39 lbs-in.

CONVERSION DRIVE ASSEMBLY. A 3-speed turntable conversion kit, introduced by Fairchild Recording Equipment Co., 154th at 7th Ave., Whitestone, L. I., N.Y., enables the easy conversion of certain two-speed transcription tables to three speeds.

SWEEP GENERATOR, WR-86A, for use in designing, production-line testing, and UHF TV equipment, replaces RCA's two laboratory-type UHF sweep generators, according to the Radio Corporation of America, Tube Div., Harrison, N.J.

"AIRBRASIVE UNIT," Model C, by S. S. White Dental Mfg. Co., Industrial Div., 10 East 40th St., New York 16, N.Y., can be used for precision cutting, drilling, etching, and light deburring on hard, brittle materials. With smallest nozzle, 0.008 in. lines can be cut.

CAPACITOR of a new type called "Flat Pan Ceramic" by the Sprague Electric Co., 233 Marshall St., North Adams, Mass., consists of one of four sections in a shallow metal pan filled with a phenolic resin for moisture protection. Ranges from 100 to 500 v dc.

TV LENS, 75 mm imported by Ponder & Best, 814 N. Cole Ave., Hollywood 38, Calif., provides faster focusing and higher resolving power then standard 50 mm. Lens speed, f1.9. Iris diaphragm steps down speed to f stop.

RADAR ANTENNA DRIVE, motor designed by Mission-Western Engineers, Inc., 132 W. Colorado St., Pasadena 1, Calif., is a new start and run ac induction type that conforms to government specifications MIL-M-1940.

AIRBORNE REFERENCE GYRO announced by Summers Gyroscope Co., 2328 Broadway, Santa Monica, Calif., accelerates to operational control speeds in 10 seconds. Withstands acceleration and shock up to 60 G. Operates without excessive drift up to 10 G at 1,500 CPS.

TETRODE TRANSISTORS, grown junction, for audio amplifier AGC circuits have been announced by Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Texas. The germanium hermetically sealed units have two base layer connections.

PULSITOMETERS, announced by Electronic Specialty Co., Contract Div., 3456 Glendale Blvd., Los Angeles, Calif., are designed for use as flashers or keyers in fire detection and overheated circuits of jet aircraft.

DC POWER SUPPLY, Model 500A, manufactured by Universal Electronics Co., 2012 S. Sepulveda Blvd., Los Angeles, Calif., is precision regulated to better than 0.06%. High voltage output range is 0 to 500 v. Current capacity, 0 to 500 ma.

CIRCUIT CONTROL RELAYS, Parts Nos. 9094 and 9194, by Leach Relay Co., 5915 Avalon Blvd., Los Angeles 3, Calif., are designed for electrical and electronic commercial and industrial control applications. Measure 3 x 1⅞ x 1-15/16 in.

WAVE ANALYZER Model 20 covers frequency range of 50 to 50,000 CPS. Calibration accuracy is 3%. Input voltage is 50 mv to 500 v. on dc to 600 v. Donner Scientific Co., 2829 7th St., Berkeley 10, Calif.

STRAIN GAGE TRANSDUCERS for pressure measurement are made by Electronic Engineering Assoc., 1116 Brittan Ave., San Carlos, Calif. Linearity is 2%; resonant frequency 8 kc; available in 7 ratings to 200 psi.

TETRODE TRANSISTORS for high frequency oscillators and amplifiers are produced by Germanium Products Corp., 26 Cornelison Ave., Jersey City, N.J. Types are RD-X302, RD-X301 and RD-X300.

ELECTRONIC SPOTWELDER utilizes capacitor discharge for high speed welding of metals and electronic components. Model 1015 weighs 35 lbs. Unitek Corp., 275 N. Halstead Ave., Pasadena 8, Calif.

LIQUID FLUX No. 30 is non-corrosive and non-resinous. This soft solder flux by Superior Flux & Mfg. Co., 1302 Ontario St., Cleveland 13, Ohio, contains no zinc, ammonium chloride or other strong acids.

PRECISION RATIOMETER announced by Cal-Tronics Corp., 11307 Hindry Ave., Los Angeles 45, Calif., determines impedance ratios or absolute values of resistors to five significant figures.

POWDERED METAL can electrify any liquid or moist material so it yields ac and dc indications. Material made by Chemalloy Associates, Santee, Calif., permits identification and evaluation of many substances.

HIGH-VOLTAGE TESTER Model 421 DC Hypot manufactured by Associated Research, Inc., 3758 W. Belmont Ave., Chicago 18, Ill., is rated at 0-10 kv dc and 0-500 microamps, providing continuously variable output. Insulation tests to 1000 megohms.

POWER SUPPLY with magnetic amplifier regulation of ±1% is rated at 10-32 dc at 50 amps. for ac input of 220 v. ±10%. Model MR 1032-50 is made by Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.

MINIATURE R-F FILTER No. C-646 provides minimum of 50 db rejection from 10 to 300 MC. It is designed for feed-through or coax mounting. Essex Electronics, 531 Springfield Ave., Berkley Heights, N.J.

COMPARATOR-PUNCH Model FCP-100 transcribes keyboard data onto punched paper tape. Speed is 15 characters per second. Automatic digit counting available. Soroban Eng'g. Co., Box 117, Melbourne, Fla.

SPECTRUM ANALYZER for X-band, U. S. Navy type UPM-33, civilian model TS-148/UP, has been redesigned to provide more rugged construction and simplified access for service. G & M Equipment Co., 7315 Varna Ave., N. Hollywood, Calif.

MAGNETIC AMPLIFIERS. Three new amplifiers—RG-60-D series—announced by Atlas Engineering Co., 3 Edgewood St., Roxbury, Mass., have three control windings, one to provide a lead (anticipation) signal when fed from a conventional differentiating network.

SOLVENT. Rho Solvent, produced by the Rho Co., Box 101, Mar Vista, Calif., breaks down most potting resins. Does not corrode most metals used in electronics. Non inflammable and requires no special equipment in application.

CAPACITORS in ceramic encasement have high moisture resistance properties. "Ceracaps" made by American Radionic Co., Inc., 33 Flatbush Ave., Brooklyn 17, N.Y., are of tubular type.

MAGNETIC FLUID TRANSMISSION, Model 795, by Raymond Engineering Laboratory, Smith St., Middletown, Conn., serves as a transmission link between the prime mover and the load in a servo actuator, or any device that requires power, compactness, and precision control.

DOT GENERATOR, Model 712, announced by Jackson Electrical Instrument Co., 16-16 S. Patterson Blvd., Dayton 2, O., produces color bars, white dots, or cross patch pattern. Also, provides complete NTSC color difference signal. Available soon.

MINIATURE TRANSFORMERS. New line of miniature hermetically-sealed transformers and chokes produced by Industrial Sales Div., Audio Development Co., 2833 13th Ave., S. Minneapolis, Minn. Measure 3/4 x 15/16 x 1 7/8 in. Available in standard steel and mu metal.

SERVO MOTORS that can operate at 160°C. are available at American Electronic Mfg., Inc., 9503 S. Jefferson Blvd., Culver City, Calif. Include BuOrd Mark VII and Mark VIII and 15 variations in a wide choice of plain or pinion shafts.

More New Products on p. 114

ASTRON Hy-Met®
scaled for small size, light weight

operation up to 125°C

Metalite Hy-Met* ASTRON capacitors are crafted to feature small size, light weight, and to operate up to 125°C for all types other than cardboard tubular MLL (100°C). ASTRON technicians process the fine quality materials that comprise the famous Hy-Met capacitor line with skillful attention to minute details. *Self-healing* Hy-Met capacitors accept momentary overvoltages and surges without permanent damage—possess high dielectric strength and vastly improved insulation resistance over conventional metallized paper types—are *effectively protected* from humidity—give *low r.f. impedance* due to small size—are ideal for R.F. filters and noise suppression. All these features are common to the Metalite Hy-Met *plus* the greater dependability and longer life derived from added care in construction and quality control. Write today for ASTRON capacitor and filter literature.

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ASTRON CORPORATION

255 GRANT AVENUE EAST NEWARK, N. J.

Export Division: Rocke International Corp., 13 East 40th St., N. Y., N. Y.
In Canada: Charles W. Pointon, 6 Alcina Ave., Toronto 10, Ontario

DYSEAC

(*Continued from page* 91)

coupled pulse amplifiers utilizing only one tube type for all amplification. In DYSEAC, this circuitry has been reduced to standardized packages. (see Fig. 2.) Only two types of etched-circuit plug-in packages are required as basic building blocks in this machine. Thus, it has been possible to use modular construction throughout the computer and to simplify design practice, construction, and maintenance.

DYSEAC is similar to SEAC in several other aspects. For example, it operates at a basic repetition rate of 1 MC, uses a serial mode of data representation, and employs a serial acoustic memory. However, its operating capabilities have been extended considerably beyond those of SEAC by the incorporation of several special logical design features. These features enable the computer to communicate in an extremely flexible manner with a large group of external devices performing many diverse functions. Among the devices which may be attached to the computer are those that store, tabulate, file, convert, display, and sense information; or devices that actuate mechanisms such as servo equipment in response to signals sent out by the computer as a result of information being processed within it. Even other full-scale computers employing the same digital language may be attached to this machine.

Arithmetic Powers

The arithmetic powers of DYSEAC have not been greatly expanded over those in SEAC. Instead, major design emphasis was placed on providing versatility of control facilities and latitude for expansion. It was deemed important to provide for future expansion of the high-speed internal storage capacity in case this becomes important for a particular application. Accordingly, the system has been provided with convenient means for supplementing the initial memory capacity of 512 words with additional storage units up to a total capacity of 4096 words.

The engineering features of DYSEAC are directly related to its intended use as a data-processing center that can be located at various operating sites without particular difficulty. The equipment is distributed between two 40-foot trailer

(*Continued on page* 126)

Survey of

New Products of the Month

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

DELAY LINES. Several designs added to its standard group, provides Neutronics Inc., 2908 Nebraska Ave., Santa Monica, Calif., with a complete range of minature lumped constant delay lines in a standard impedance range from 25 to 3,000 ohms.

POWER RECTIFIERS. McColpin-Christie Corp., 3410 W. 67th St., Los Angeles 43, Calif., have announced a new line of "Stavolt" dc power rectifiers. No tubes, lamps, carbon piles. or varistors are employed. Ten standard 28 v production models with capacities up to 1,000 amps.

TUBE SHIELDS, a new heat-dissipating series of subminiature units, announced by International Electronic Research Corp., 177 W. Magnolia Blvd., Burbank, Calif., have no resonances when shaken at 10 G from 0 to 2,000 cycles. Meet the conditions encountered in missile applications.

"QUAD KARDS" in standard 2 in. square segments can be furnished by Methode Mfg. Corp., 2021 W. Churchill St., Chicago 47, Ill., with or without conductors printed to specification. Have standard hole punchings for tube sockets, transformers, and conductors.

INTERFERENCE REDUCTION KITS by Hallett Mfg. Co., 1601 West Florence Ave., P.O. Box 59, Inglewood, Calif., meet all military radio interference specifications and fit the majority of commercial and automotive engines. Available for 4, 6, and cylinder engines.

DATA REDUCING DEVICE, Oscar F, designed by Benson-Lehner Corp., 2340 Sawtelle Blvd., Los Angeles, Calif., is a machine that enables the rapid semi-automatic reading of oscillagraphic and film records. Provides a link between graphical information and high speed computers.

AIRCRAFT BATTERY ELIMINATOR. by Opad-Green Co., 71 Warren St., New York 7, N.Y., tests and operates aircraft electrical and communication equipments. The Model K101F operates on 115 v ac, 60 CPS, single phase and provides a continuously variable output from 0 to 28 v dc.

NOISE FIGURE METER, Model NFT, by Electronic Research Associates, Inc., P.O. Box 29, Caldwell, N.J., accurately measures noise figures of transistors, transistor amplifiers, and related devices. Eliminates present manual step-by-step procedure.

CIRCUIT ANALYZER for testing aircraft electrical systems has been announced by DIT-MCO, Inc., 505 W. 9 St., Kansas City, Mo. Model 200 automatically analyzes 200 circuits in 20 seconds.

VARIABLE TRANSFORMERS by Superior Electric Co., Bristol, Conn., include "Powerstat" types 136 for 120 v., and 236 for 240 v. Also available in motor driven assemblies and ganged units.

WINDING MACHINES for making toroidal coils and variable transformers available through Rex Rheostat Co., 3 Foxhurst Rd., Baldwin, L.I., N.Y.

ARBITRARY FUNCTION GENERATOR, type G-1A, can relate output to input by any predetermined function of form y f(x). Produced by William Miller Instruments Co., 325 N. Halstead Ave., Pasadena 8, Calif.

MAGNETIC RECORDING HEAD for audio and computing is available from Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio. Model BK-1500 series is in cast resin blocks of 1 to 14 channels.

VACUUM TUBE CURVES on 8½ x 11 in. pads aid circuit design. Types made available recently are 5687, 5751, 5718. Others include 12AU7, 6L6, and 6AQ5. Technical Pub. House. 15-B Everett St., Cambridge 38, Mass.

TAPE REPRODUCER Model 814 CK for continuous automatic playing of 8 hours of prerecorded music from a single reel has been announced by Magnecord, Inc., 225 W. Ohio St., Chicago 10, Ill.

ELECTRONIC GENERATOR Model 1425 delivers 900 va from 80 to 135 v. or 160 to 270 v. Four ranges from 50 to 6000 CPS. Communication Measurements Lab., 350 Leland Ave., Plainfield, N.J.

DC POWER SUPPLY, Model PS-503, is capable of supplying 5,000 v dc at 300 μa. The transformer is hermetically sealed in an epoxy resin casting and operates on 30 KC. Ripple is less than 1% at full load. Measures 4 x 2⅝ x 5½ in. Servo Corp. of America, 20-20 Jericho Tpk. New Hyde Park, N.Y

MAGNETIC AMPLIFIER, "Stablevolt" Type A, utilizes no vacuum tubes or moving parts. Features dual magnetic regulation, 6, 12 and 28 v. models at up to 100 a. Magnetic Research Corp., 318 Kansas St., El Segundo, California.

DIFFERENTIAL REWIND "Gimmick" rewinds 16 mm and 35 mm film reels simultaneously with uniform take-up. Unit is placed on rewind spindle. S. O. S. Cinema Supply Corp., 602 W. 52 St., New York 19, N.Y.

TV CAMERA CHAIN by Kalbfell Labs., Inc., P.O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif., uses economical 16 mm lenses. Accessories allow remote control of pan, tilt, lens iris and focus.

MINIATURE CRT for industrial applications has 5-in. face and overall length of 7 in. It may be read in bright daylight. National Union Electric Corp., 405 Lexington Ave., New York 17, N.Y.

TIME DELAY RELAY Model 13100 for airborne equipment is 3 in. long, 1 in. diameter.. Weight is under 3 oz. Delay is 125 to 250 millisecs. Neomatic Inc., 9010 Bellanca Ave., Los Angeles 45, Calif.

POWER SUPPLY Model 2 by Audio Products Corp., 2265 Westwood Blvd., Los Angeles 64, Calif., increases flexibility of firms modular system. Output is 300 v. dc, 80 ma; —150 v. dc, 15 ma; 6.3 v. ac, 8 a.

CRYSTAL PHOTOCELL Type CL-1 employs cadmium sulphide as light sensitive element. 100 μa at 100 v. at 2 ft. candles. Light to dark current 60 db at 1 ft. candle. Clairex Corp., 50 W. 26 St., New York 10, N.Y.

WIRE WOUND RESISTORS, types WWL and WWA, manufactured by Dale Products, Inc., Columbus, Neb., are now being encapsulated for hermetic sealing. They are non-inductive, pi-wound on cores molded from the same material as the encapsulating resin.

SYNCHRONIZING GENERATOR, type 2204 for monochrome, and the type 2203 color synchronizing generator, manufactured by Tel-Instrument Co., Inc., 728 Garden St., Carlstadt, N.J., deliver six outputs for sync, blanking, drive and linearity.

SIGNAL-GAIN GENERATOR, for UHF testing, has been made available by Granco Products Inc., 36-17 20th Ave., Long Island City 5 N.Y. Compact and light weight, this generator features continuous tuning over UHF band and gain control.

SYNCHROS, weighing 1.8 oz. and having a maximum overall length of 1.281 in., are available from Clifton Precision Products Co., Inc., Marple at Broadway, Clifton Heights, Pa. These size 10 synchros feature 12 in. leads, with radial terminals or axial terminals.

ROTARY SWITCH, series No. 7551, manufactured by Ark-Les Switch Corp., 51 Water St., Watertown 72, Mass., is rated at 3 a. and 125 v. Applications include fans, drink mixers, ranges and other appliances requiring a rotary switch.

WIRE WOUND RESISTORS. Type EM, of the encapsulated miniature type, and manufactured in accordance with MIL-R-93 by the Brown Corp. Ltd., San Diego, Calif., are available in range from 10-30,000 ohms. Higher resistances on special order. Available from Electronics Div., Eastman Pacific Co. 2320 E. 8th St., Los Angeles 21, Calif.

SUB-MINIATURE RELAY, designated Class 33, is manufactured by Magnecraft Electric Co., 1442 E W. Van Buren St., Chicago 7, Ill. Open type model with DPDT contacts is 1 11/32 in. long, 11/16 in. wide and 1 in. high. Furnished for voltages up to 110 vdc and 6 contact arms per stack.

FREQUENCY TIME COUNTER, Model 3149, is designed for making direct frequency measurements, up to 150 KC, and time measurements under field conditions with laboratory accuracy. Features gold-plated switch contacts and turret-lug mounted components. Potter Instr. Co., Inc., 115 Cutter Mill Rd., Great Neck, N.Y.

HI-VOLTAGE SWITCH, a high-vacuum type, developed for switching purposes in dc pulse systems and radar. Designated part #NVS-300, it is a normally closed, single pole, double throw high voltage device. Naer Corp. 2301 S. Purdue Ave., W. Los Angeles.

VECTOR IMPEDANCE BRIDGE manufactured by Republic Engineering Co., Inc., Beltsville, Md., reads impedance directly in magnitude and phase angle. Tolerances are held to 1%, except resistance measurements to ½%.

COAX STRIPPER AND CUTTER, in two sizes, the #400 for RG8-U, and the #300 for RG59-U and smaller sizes, is manufactured by K. Miller Tool & Mfg. Co., Inc., 6 Cass St., Springfield 4, Mass. and marketed directly by them to industry.

SUBMINIATURE SWITCH ¾ in. sq. Brown-Hill wafer type has 1300 v. breakdown rating. Rotor blades and stator contacts are solid silver alloy. R-F Electronics, Inc., 291 NE 61 St., Miami, Fla.

Big Savings Ahead

2 New SYLVANIA SOCKETS save Assembly Time... Cut Costs ...Improve Performance!

1. **New Sylvania 7-pin Miniature Printed-circuit Sockets.** Contacts and center shield are shaped so that sockets can be stacked one upon another for automatic feeding and assembly. Small slots are used on the circuit board to receive the contacts, resulting in stronger chassis construction. Only one socket assembly need be stocked since terminals can be interconnected by printing the circuit on the chassis board rather than using a metallic connector on the socket itself.

Insulator is molded of general-purpose or low-loss phenolic. Contacts are brass or phosphor bronze, plated to suit your specification. Supplied with or without center shield. Now available in 7-pin construction with 9-pin miniature and other types to follow. Tube Shield Ground Strap can also be furnished.

2. **New Sylvania Solderless-type Sockets** for wire-wrapped connections are now being made in all 7 and 9-pin miniature sizes. Contacts are shaped to provide reliable connections with the use of present wire-wrapping tools.

For full information *concerning these or other Sylvania parts, or special quality components engineered to your own specifications, write to Dept. 4A-4408, Sylvania today.*

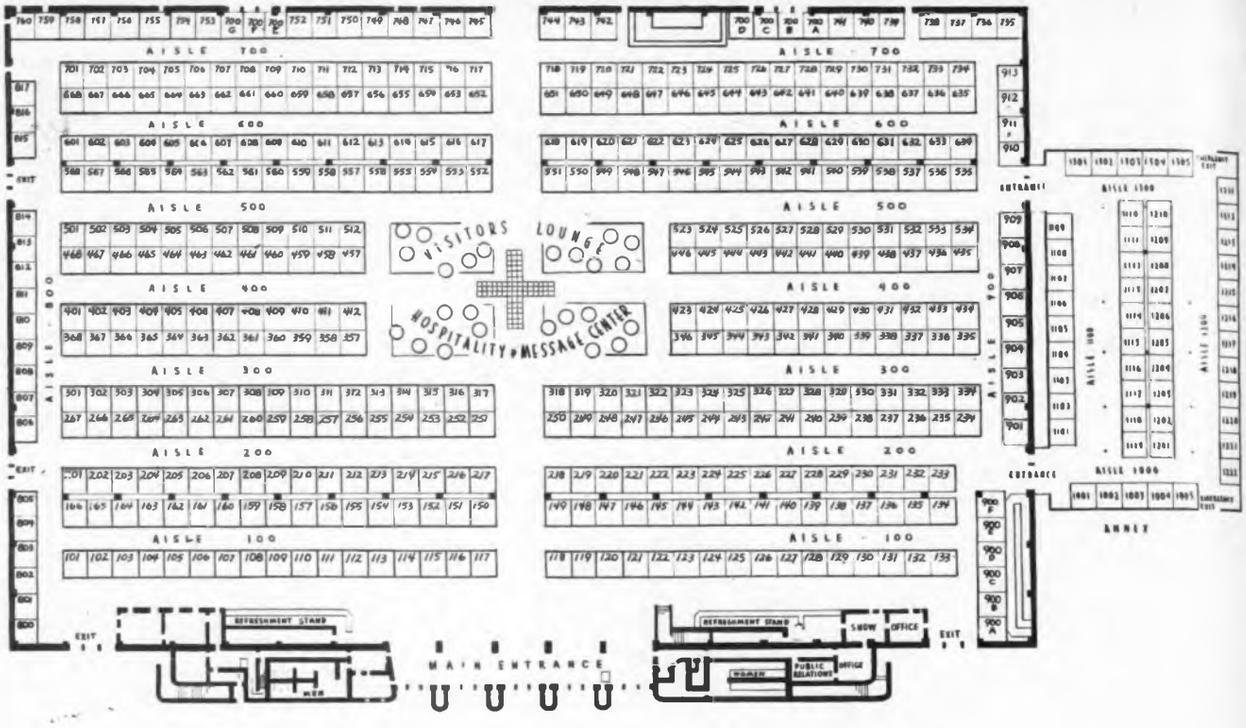
See the full story of Sylvania's Fabricating Services in Sweet's Catalog — Product Design File. Look for 1b/Sy

SYLVANIA

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

In Canada: Sylvania Electric (Canada) Ltd., University Tower Building, St. Catherine Street, Montreal, P. Q.

LIGHTING · RADIO · ELECTRONICS · TELEVISION



Floor plan and booth locations in Pan-Pacific Auditorium and adjoining annex

WESCON 1954 (Continued)

American Aviation, and R. C. Howard. Bell Tel. Labs.
"Automatic Iteration on an Electronic Analog Computer"—L. B. Wadel, Chance-Vought Aircraft.
"A Logarithmic Voltage Quantizer" by E. M. Glaser and H. Blasbalg, John Hopkins Univ.

TELEMETERING APPLIED TO AIRCRAFT

"A Phase Compensated Data Processing System for Piloted Aircraft"—H. E. Seibert, Convair.
"A Complete Telemetering System for the Flight Testing of Piloted Aircraft"—M. L. Van Doren, Douglas Aircraft.
"Versatile Automatic Data Separation Equipment for Pulse Multiplex Telemetering Systems"—I. P. Magasiny, Raymond Rosen Eng. Prod.

RECENT DEVELOPMENTS IN PARTS

"The User Looks At The Component Parts Problem"—A. M. Okun, Bell Aircraft.
"Packaging of Component Parts for High Intensity Vibration Environments"—M. G. Comuntzis, Jet Propulsion Lab.
"A Sensitive Nonmagnetic Relay"—Mullenbach Electrical Mfg. Co.
"Temperature Stabilization of Transistor Amplifiers"—R. B. Hurley, Convair.
"Reliable Electronics Through Protective Coating Techniques"—E. R. Gamson and A. Henesian, Stanford Research Inst.

COMPUTERS

"Transistor Flip-Flops for High-Speed Digital Computers"—E. U. Cohler, MIT.
"Computer-Programmed Preventive Maintenance for Internal Memory Sections of the E.R.A. 1103"—S. R. Gray, Engineering Research Associates Div., Remington Rand.

CIRCUIT DESIGN

"The Transistor Emitter-Coupled Amplifier"—D. W. Slaughter, Cal. Tech. Jet Propulsion Lab.
"Wideband Frequency Discriminators for AFC Systems"—L. S. Stokes, Hughes Aircraft & L. Mautner, ESC.
"A Transistorized Recorder for Transportation Shock & Vibration Studies"—R. I. Anderson, Electronic Eng. Co. of Cal.
"Measurements of a Series of Discrete Values of a Changing Current"—A. A. Windsor, U. of Cal.

TELEMETERING THEORY

"Interpretation of Sequential Samples from Commutated Data"—L. L. Rauch, Univ. of Mich.
"Frequency Response as a Function of Sampling Rates in Time Multiplexed Systems"—L Katz, Woburn, Eng.

MANAGEMENT

"Are Engineers People?"—A. M. Zarem, Stanford Research Inst.
"Some Factors Related to Management of an Applied Research Project"—H. Iams, Hughes Aircraft.
"More Engineering per Dollar"—B. Dempster, Electronic Engineering Co.
"Quality in Production"—R. Weller, Naval Air Missile Test Center.

COMPUTERS

"Efficient Linkage of Graphical Data and Digital Computers"—E. D. Lucas, Jr., Benson-Lehner.
"An Input-Output System for a Digital Control Computer"—L. P. Retzinger, Librascope.

VEHICULAR COMMUNICATIONS

"Effect of Front End Receiver Design on Overall Receiver Performance, and Resulting Systems Performance"—A. C. Manke, General Electric.

BROADCAST AND TV RECEIVERS

"Amplitude and Phase Compensation in Color Television Receivers"—E. L. Michales, Packard-Bell.
"The Planning and Performance of a Completely Integrated Source of Television Signals from Film"—A. D. Emurian, Philco.

(*Continued on page* 118)

EXHIBITORS and their BOOTH NUMBERS

Abbott Instrument & Engineering Co.	206-207
Ace Engineering & Machine Co.	760
Advance Electric & Relay Co.	308
Aerovox Corporation	546-547
Air Associates, Inc.	1218
Air-Marine Motors, Inc.	639
Aircraft-Marine Products, Inc.	444-445
Airpax Products Co.	750
Airtron, Inc.	463
Allied Chemical & Dye Corp.	1201
Altec Lansing Corporation	550-551
American Electric Motors, Inc.	265
American Lava Corporation	245
American Microphone Co.	326
American Phenolic Corp.	523-524
Ampex Corporation	112
Andrew Corporation	532
Harry Appleton Co., Inc.	667
L. H. Appleman	742
Applied Science Corp. of Princeton	647
Arco Electronics, Inc.	816
Aremac Associates	630
Arga Div., Beckman Instruments, Inc.	1114
The Arnold Engineering Co.	320-321
Assembly Products, Inc.	233
Audio Devices, Inc.	409
Audio Products Corporation	138
Automatic Electric Sales Corp.	345
Avery Adhesive Label Corp.	221-222
Ballantine Laboratories, Inc.	814
Barron-Jur Company	900A
Barry Corporation	3-4
Herb Becker Company	154
Belden Manufacturing Co.	635
Bendix Aviation Corp.	
Computer Division	745-746
Eclipse-Pioneer Division	711-712
Pacific Division	719-720
Radio Division	743-744
Red Bank Division	716-717
Scintilla Division	650-651
Bennett Products Mfg. Co.	606
Benson-Lehner Corp.	722-723
Berkeley Scientific Corp.	243-244
Div. of Beckman Instruments	
Jack Berman Company	502-503
Beta Electric Corp.	363
Bird Electronic Corp.	510
Bliley Electric Company	158
Bodnar Industries, Inc.	1211
Boesch Manufacturing Co., Inc.	702
Bogue Electric Manufacturing Co.	110
Bomac Laboratories, Inc.	461-462
Boonton Radio Corporation	507-508
Bourns Laboratories Instrument Sales Corp.	640
Browning Laboratories, Inc.	1301
Brubaker Manufacturing Co., Inc.	123
Brush Electronics Company	330
Burgess Battery Co.	128
Burlington Instrument Co.	115
Burnell & Company	427A
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Bussmann Manufacturing Co.	136
Calidyne Company	340-341
California Computer Products	700F
Cal-Tronics Corporation	201-202
Cambridge Thermionic Corp.	362

(*Continued on page* 119)

NEW!

Ohmite-compounded, special resin encloses *all parts*. Its coefficient of expansion closely matches that of bobbin, wire, and terminals.

Rigid steatite bobbin keeps pie windings in place.

Resistance wire welded to terminals insures perfect connections.

Bobbin is *completely* encapsulated — ends and even center hole.

OHMITE®

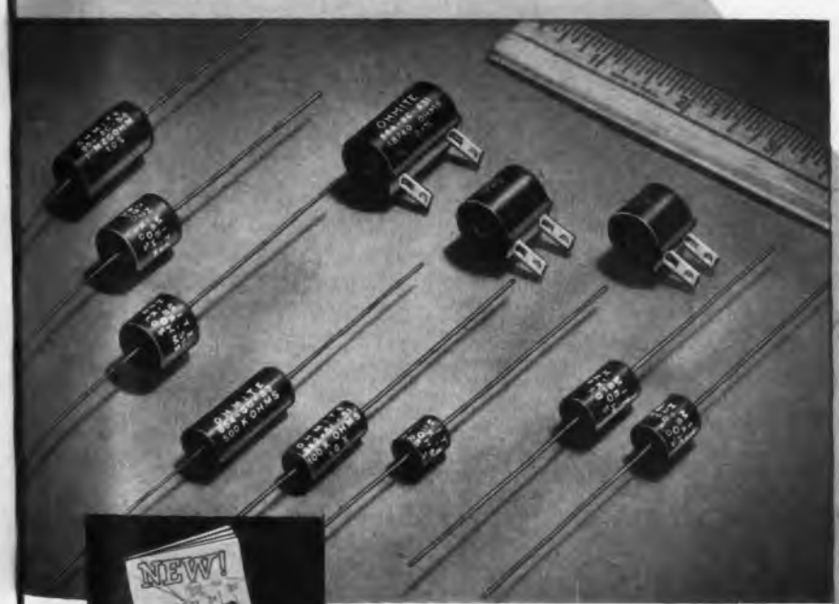
Proudly announces the

RITEOHM®

***completely* encapsulated**

precision resistor

type 85 and 86



Exceeds

MIL-R-93A

Amendment 2

at 125°C ambient

Now . . . a new Ohmite encapsulated, wire-wound, precision resistor, designed to provide absolute stability. Winding is protected against moisture or mechanical damage by a rigid steatite bobbin encapsulated in Ohmite-compounded, special resin. Resistance wire is welded to terminals. Axial-lead and lug types, in sizes from ¼ to 1 watt (125° C ambient) in a wide range of resistance values. Tolerances to ± 0.1%.

Write for New Descriptive Bulletin

Be Right with **OHMITE** **RHEOSTATS RESISTORS TAP SWITCHES**

OHMITE MANUFACTURING COMPANY, 3662 Howard Street, Skokie, Illinois (Suburb of Chicago)

WESCON Program

(*Continued from page* 116)

"Some Advances in Color Television Receivers"—A. V. Loughren, Hazeltine.
"A Color Camera for the NTSC System"—R. J. Stahl, Color Television, Inc.
"Improved Performance in Vidican Camera Systems"—J. P. Day, Kalbfell Labs.
"A Method for Determining the Q and Selectivity of Low-Loss Parallel Resonant Circuits"—R. C. Skar, Collins Radio.

SYSTEMS ANALYSIS

Session Chairman: L. Weinberg, Hughes Aircraft.
"Frequency Memory in Multiple-Mode Oscillators"—W. A. Edson, Stanford Univ.
"A Mathematical Analysis of a Series Circuit Containing Periodically Varying Resistance"—L. A. Pipes, Univ. of Calif. and U. S. Naval Ordnance Test Station.
"Analytical Determination of Response of Certain Time-Varying Linear Feedback Systems"—W. E. Mathews, Hughes Aircraft.
"An Optimized Cross-Correlation Type Tracking Filter for Missile Instrumentation"—L. Katz, Ralph M. Parsons Co.

VEHICULAR COMMUNICATIONS

"Some Basic Considerations in Selective Signaling Systems"—T. W. Sanders, Sanders and Sanders Electronic Engineering.
"Integration of Mobile VHF with Microwave Radio Solves Vexing Problems"—J. R. Neubauer, RCA.
Panel Discussion: "Communication Frequency Allocations"—moderated by Commissioner E. M. Webster, FCC.

AIRBORNE ELECTRONICS

"Simplified Aircraft Response Functions"—R. F. Drenick and R. B. Headley, RCA.
"A Servo Mechanism Approach to the Problem of Communication for Aircraft Control"—S. J. O'Neil, Air Force Cambridge Research Center.
"Cumulative Probability of Radar Detection"—L. Rider, T. Rooney and B. Rudwick, General Electric.
"A Thunderstorm Avoidance Radar for Civil Aircraft"—G. W. Church and C. L. Greenslit, Bendix Radio.

MICROWAVE THEORY AND TECHNIQUES

"Design of Broadband Waveguide Rotary Joints"—J. Guarraera and J. Fisch, Reeves Instrument.
"Design Considerations for Multichannel Coaxial-Line Rotary Joints"—J. D. Hall, Sperry Gyroscope.
"Theory and Design of a High Power Diplexing Filter"—F. S. Cole, Sperry Gyroscope.

MICROWAVE THEORY AND TECHNIQUES

"Microstrip—A Printed Microwave Transmission System"—H. F. Engelmann, Federal Telecommunication Labs.
"Precision Microwave Measurements of Waveguide Voltage Standing Wave Ratios"—I. N. Anderson, Airtron.

AIRBORNE ELECTRONICS

"PARAN—A Precision Automatic Ranging System"—R. W. Johnson, R. M. Parsons Co.
"Isolating Devices for Use with Tail-Cap Aircraft Antennas"—R. L. Tanner, Stanford Research Inst.
"Cooling Requirement Charts for Electronic Equipment"—L. J. Lyons, Heat Transfer Consultant.
"Rotating Machine Power Supplies for Airborne Applications"—A. A. Hagedorn, Hughes Aircraft.

ULTRASONIC ENGINEERING

"Ultrasonic Cleaning of Miniature Devices"—Q. C. McKenna, McKenna Labs.
"Composite Piezoclectric Resonators"—W. G. Cady, Cal. Tech.

ELECTRON TUBES

"Some Recent Improvements to the Design of Power Amplifier Klystron's"—D. H. Preist, Eitel-McCullough.
"Space Charge Waves in Crossed Electric and Magnetic Fields"—S. S. Solomon, U. of Cal.
"Non-Reciprocal Loss for Traveling-Wave Tubes"—J. S. Cook, Bell Labs.
"A UHF Backward-Wave Oscillator"—R. W. Grow and D. A. Watkins, Stanford U.
"Rippled-Wall and Rippled-Stream Amplifiers"—C. K. Birdsall, Hughes Aircraft

INFORMATION THEORY

"On the Modulation Levels in a Frequency Multiplexed Communication System by Statistical Methods"—R. L. Brock and R. C. McCarty, Boeing.
"Design and Performance of Phase-Lock Circuits Capable of Near-Optimum Performance Over a Wide Range of Input Signals"—R. Jaffe and E. Rechtin, Cal. Tech.
"On the Response of Linear Systems to Noise Inputs"—J. Hellfron, U. of Cal.
"Noise in Driven Systems"—J. M. Richardson, Hughes Aircraft.

AUDIO

"Recent Developments in Industrial and Community Noise Control Problems"—D. B. Callaway, District Industrial Sound Control.
"The 'Lipstik' Miniature Condenser Microphone System"—J. K. Hilliard and J. J. Noble, Altec Lansing.
"Progress Report on Magnetic Recording"—W. T. Selsted, Ampex.

ELECTRON DEVICES

"Transistors for High Power Applications"—J. S. Saby, General Electric.
"Recent Developments in Power Transistors"—H. T. Mooers, Minneapolis-Honeywell.
"Recent Developments in Silicon Fusion Transistors"—R. A. Gudmundsen, A. Wannlund, W. Waters and W. Wright, Hughes Aircraft.
"Recent Reliability Tests on Semiconductor Devices"—W. J. Pietnol, Bell Labs.
"Reliability of Quality Produced Transistors in Low Power Audio Applications"—F. M. Dukat, Raytheon.

SEMICONDUCTORS

"Junction Diodes—Features and Applications"—F. Finnegan, Raytheon.
"P-N-I-P Junction Triodes"—J. M. Early, Bell Labs.
"Junction Devices for Switching"—A. E. Anderson, Bell Labs.
"Temperature Stabilization of Transistor Characteristics"—S. Sherr, General Precision Lab.
"Noise Considerations for P-N-P Junction Transistors"—J. W. Englund, RCA.

NOTE: At press time, several papers are yet to be announced.

WESCON Exhibitors

(*Continued from page* 116)

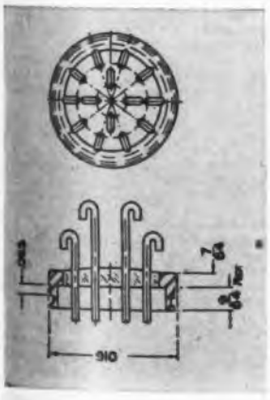
WESCON Exhibitors

(*Continued from page 119*)

Under overload conditions...

heat and pressure can't affect this lock-ring's grip—

HERMETIC'S new lock-ring for mounting hermetically sealed headers gives maximum mechanical security at lower cost!



A simple hole is all you need to mount this VAC-TITE* glass-metal bonded header. Hermetic's new lock-ring design assures mechanical security without requiring shaped recesses. The ring will hold against internal pressures far in excess of any which can be encountered in service, and all the advantages and flexibility of round headers are retained.

Stripping and re-use of headers is facilitated by the lock-ring and by the intrinsic nature of the VAC-TITE* seal.

In co-operation with the Armed Services, Hermetic has developed a variety of other header and plug types which do not depend on solder alone for mechanical security of headers.

*VAC-TITE is HERMETIC's new, vacuum-proof, compression-construction, glass to metal seal. In addition to special shapes, many standard sizes such as .800 O.D. and .900 O.D. multi-terminal headers and a large variety of individual terminals are available in VAC-TITE Compression Seals.

Write to Hermetic for assistance and samples to meet your problems.

See Us at the Western Electronic Show and Convention in Los Angeles — Booth 905.

Hermetic Seal Products Co.

33 South Sixth St., Newark 7, New Jersey

SEALED IN ... by HERMETIC HEADERS

FIRST AND FOREMOST IN MINIATURIZATION

WESCON Exhibitors

(Continued from page 120)

Or putting it another way, you get *more* than high-quality electronic equipment from Neely.

You get *expert help* with your specific instrumentation problems—whether they concern application or operation—from highly-trained Neely Field Engineers. You get *doorstep demonstrations* of the very latest electronic instruments—brought by Neely's exclusive, fully-equipped MOBILE LAB which constantly crisscrosses California, Arizona, Nevada, and New Mexico. And you get *swift service,* from one of six conveniently located Neely offices.

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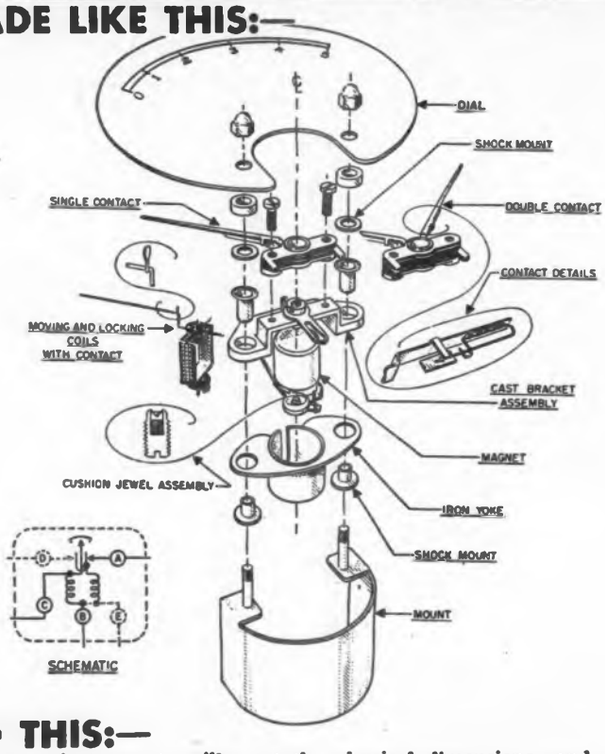
METER-RELAYS RUGGEDIZED SEALED

LOOK LIKE THIS:—

MADE LIKE THIS:—



DO THIS:—

These two instruments will meet the physical dimensions—and environmental limits of shock—vibration—temperature—humidity—of similar specification relays and meters. Samples are being tested for compliance. Prospective users can have a list of deviations.

Meter-relays are indicating meters with built-in relay contacts. One contact is carried on the moving pointer. The other is carried on a semifixed pointer. When the two pointers meet the contacts close and lock. Locking coil is wound directly over moving coil. Reset can be manual or automatic. It consists of opening locking circuit. Spring action in contacts kicks them apart forcefully. There are no pushers nor solenoids inside meter case.

Usual meter ranges can be supplied from 0-20 Ua. to 0-50 A., or, 0-5 Mv. to 0-500 V. All ranges can be supplied either AC or DC except low millivolts (under 0-250 Mv). These come only in DC because of limitations of instrument rectifiers. Higher voltage or current ranges are made with external multipliers.

Contact setting is adjustable from front to any point on scale arc. Or, it may be preset at any fixed point. Contact arrangements are (1) single high (2) single low (3) double, high and low. When used only as relays they can be made to operate on as little as 0.2 microamperes (3000 ohms) or 0.05 millivolts (20 ohms).

Bulletin 112 shows 11 circuits and lists components and specifications for meter-relays. Write or phone Bradley Thompson, Assembly Products, Inc., P. O. Box 191, Chagrin Falls 21, Ohio, telephone CHagrin Falls 7-7374.

WESCON Exhibitors

(*Continued from page 122*)

PERFORMANCE-WISE CERAMIC BUYERS ASK ABOUT press facilities

ALSIMAG®

Invariably this question is brought up by seasoned buyers. Experience has taught them that no amount of good intentions can compensate for inadequate production machinery. To such practical and fore-sighted men, the following facts are presented for consideration:

To meet customer requirements for quality tested AlSiMag ceramics, American Lava Corporation maintains lineups of modern high speed presses which can produce *in one three-shift working day over 9,000,000 uniform, accurate AlSiMag pieces* (more than enough, laid end to end, to reach from Philadelphia, Pa., to Washington, D. C.)*

Why risk dole delivery when you can command AlSiMag production facilities ready to serve you?

* Based on an AlSiMag part 1" square. Our presses can produce pieces up to 14" x 14" and, of course, much smaller parts than the size mentioned.

33RD YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

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A SUBSIDIARY OF MINNESOTA MINING AND MANUFACTURING COMPANY

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DYSEAC

(*Continued from page* 112)

vans. The major portion of the equipment—three computer racks, the memory cabinet, and the control console with input-output facilities—is installed in the computer van. (See Fig. 1.) The second van houses regulated dc power supplies and provides a general-purpose area for special equipment, storage, and work space. Each van also has its own air-conditioning equipment.

Overall Organization

The computer is organized around the high-speed memory. This unit receives and distributes to the other internal units the information (numbers and instructions) to which the most rapid access is needed for carrying out the work program of the machine. The memory communicates principally with five major units of the system. Of these, two are primarily concerned

Fig. 2: Standardized etched circuit package is one of two types used as basic building blocks. This delay line unit is one of nearly 800 such packages which provide for 90% of circuit, excluding memory and input

with internal processing activities and three with external relations. A continuous flow of digital information may be maintained simultaneously between the memory and the inward-looking and outward-looking types of units. The latter types, which serve to communicate with the external devices, include the input-output buffer, the external selector, the concurrent input-output control, the display staticizer, and the serializer.

The input-output buffer transmits information at the proper repetition rates from the external unit to the internal memory during an input operation and in the reverse direction during an output operation. The buffer receives words from the memory at the normal 1 MC internal repetition rate and then transmits them out, digit by digit,

TELEQUIPMENT NEWS

Published by the General Electric Company, Electronics Park, Syracuse, N.Y.

COLOR CAPSULE EDITION

NEW SLIDE SCANNER KICKS-OFF G-E'S PYRAMID PLAN FOR COLOR TV

E. H. LEDERER

● Recognition for much of the technical perfection of this slide scanning system immediately focuses an author's spotlight on E. H. Lederer, Mechanical Design Engineer. Of many contributions which Lederer made, his simplified optical wipe technique is particularly outstanding. In application, this development speeds slide changing to a point where normally used supplementary electronic equipment is eliminated. Mr. Lederer has specialized in Studio Engineering at G-E headquarters in Electronics Park for the past seven years.

The Editor, G-E Telequipment News, Section X4884, Electronics Park, Syracuse, New York

2" x 2" unit highly rated for performance, accessibility, safety, small size, and unique block-building features

If you want to be in on the ground floor of color telecasting, be ready to transmit network programs and be ready to cash in on the rapidly growing demand for local color commercials. The Pyramid Plan shows you how. General Electric is set now to supply this and every other level of your color pyramid needs with such outstanding equipment as the new slide scanning system. Note, particularly, that it is applicable to black and white programming as well as color.

There are several current exclusives in design of the PR 8-A slide scanner worthy of mention and imitation. First among these ...it has the fastest (F 1.9) nonshading optical systems in the industry today. Iris control permits use of slides having wide density range. Next, the automatic slide changer feature makes it easy to operate from either local or remote sources. And, slide carriages are provided to handle as many as 125 cardboard or 65 glass framed slides.

All adjustments for the lenses and mirror mountings can be made outside the cabinet. Thus, optimum alignment of the system is achieved with all extraneous light shut out. A unique and highly desirable function of the 2" x 2" slide changer is the outside to center, and center to outside mechanical and optical wipe action which occurs when changing slides. Normally, this is completed in less than .6 second and provides acceptable slide changeover. As a result of this high speed, added electronic equipment usually required for this action is not necessary.

Work was co-ordinated with Eastman Kodak and Bausch & Lomb

Both of these well known companies provided valued assistance in developing the scanner system. Final design consists of heavy ½" plate of high strength tempered aluminum alloy to which all lens, mirror mounts and slide changing mechanism are attached. This plate is mounted in a heavy 14-gauge steel reinforced cabinet. Alignment is no problem since permanent location of the plate in the cabinet permits compensation for uneven flooring or other mis-alignment conditions.

Universal Acceptance Predicted

This unit satisfies the most critical broadcaster's demand with award-winning features at a reasonable price. General Electric has attained its objective of manufacturing a slide scanner with exceptional appeal to small and large broadcasters alike.

GENERAL ELECTRIC

...mer Tube element (right) is located in a pedestal cabinet. This chassis is almost ...tical to the corresponding scanning source used in the 16 mm motion picture ... Both work into a common set of 3 photo-electric cells and associated dichroic ... splitters, filters and preamplifiers.

Slides are stacked above cabinet for automatic feeding. Raster control from the panel at lower left provides adjustment for accurate scanning. Operating safety assured with detailed interlocking and shielding. The combination of slide scanner plus two continuous motion film scanners occupies just 32⅓ square feet.

DYSEAC (Cont'd from p. 126)

at the proper measured rate appropriate to the external unit. The external unit itself (via the external selector) specifies the word format and the repetition rate appropriate to it.

The external selector, a high-speed switching device, selects the external unit with which an input-output operation is to be performed. It provides the signal required to complete the circuit connections for the lines carrying both the digital information and the control signals needed to operate the external unit. The external selector is capable of selecting among 48 external mechanical relay switches, but it can be expanded to handle 256 distinct information channels, such as individual parallel magnetic-drum channels or high-capacity magnetic filing systems.

The concurrent input-output control regulates the detailed progress of all input-output operations requested in the course of the internal program. It directs the flow of traffic between the memory and the input-output buffer, and between the buffer and the external selector.

Display Staticizer

The display staticizer and the serializer are specialized input and output organs adapted especially for real-time operations. The display staticizer is a register storing 28 binary digits in parallel for controlling, for example, a digital-to-analog converter that provides deflection voltages for a cathode ray-tube visual display. The serializer unit is provided for continuous external input devices. It can accept one full word of 45 binary digits delivered in parallel in the form of asynchronous pulses from an external unit, and can then transmit the word in synchronized normal serial form to any other units of the system capable of reading words out of the high-speed memory.

The arithmetic unit carries out arithmetic or logical choice operations. Arithmetical results are written directly into the high-speed memory, and control signals specifying the outcome of the discrimination operations are sent directly to the program-sequencing and control unit, where they serve to modify the choice of memory location from which the next instruction is to be read. An additional route of communication to the input-output buffer provides for the loading or printing out of the contents of the arithmetic accumulator register directly via the electromechanical typewriter or magnetic input-output units.

The remaining unit in direct communication with the high-speed memory is the instruction register. Instruction words are transferred, one at a time, from the high-speed memory into the instruction register. From this unit, information contained in different segments of the instruction word is selected by the program control unit and transmitted to various other internal units throughout the system, and simultaneously to the concurrent input-output control for checking against possible conflict with concurrent input-output operations.

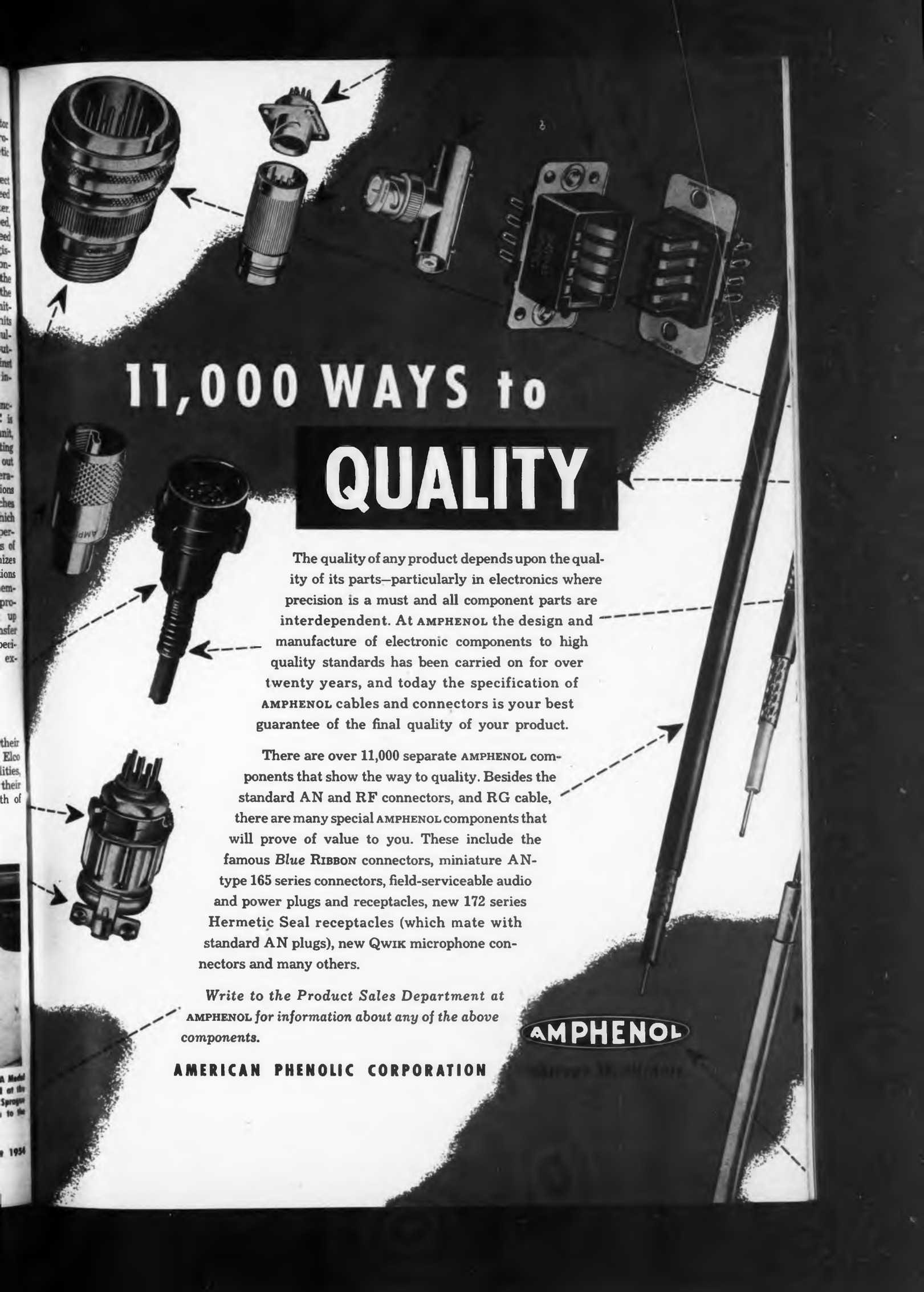
The last major unit in the functional organization of DYSEAC is the manual-monitor control unit, which is responsible for regulating and synchronizing the carrying out of joint internal-external operations. It interprets the conditions specified by the external switches on the switch panel, under which monitor operations are to be performed; it observes the progress of the internal program and recognizes when these specified conditions arise; and it delivers signals temporarily halting the internal program, if necessary by setting up the required special word-transfer routes and by initiating the specified interpolated internal or external operation.

New Quarters

In a move to combine all their operations under one roof, Elco Corp. has transferred all facilities, including its Varicon plant, to their new building on "M" St., south of Erie Ave., Phila., Pa.

MEDAL OF HONOR

Robert C. Sprague (l), receives the RETMA Medal of Honor from president Glenn McDaniel at the 1954 Annual Meeting in Chicago. Mr. Sprague was being honored for his contribution to the progress of the electronic industry



11,000 WAYS to QUALITY

The quality of any product depends upon the quality of its parts—particularly in electronics where precision is a must and all component parts are interdependent. At AMPHENOL the design and manufacture of electronic components to high quality standards has been carried on for over twenty years, and today the specification of AMPHENOL cables and connectors is your best guarantee of the final quality of your product.

There are over 11,000 separate AMPHENOL components that show the way to quality. Besides the standard AN and RF connectors, and RG cable, there are many special AMPHENOL components that will prove of value to you. These include the famous *Blue* RIBBON connectors, miniature AN-type 165 series connectors, field-serviceable audio and power plugs and receptacles, new 172 series Hermetic Seal receptacles (which mate with standard AN plugs), new QWIK microphone connectors and many others.

Write to the Product Sales Department at AMPHENOL *for information about any of the above components.*

AMERICAN PHENOLIC CORPORATION

AMPHENOL

RCA's New 21-in. Color Tube

A new and improved 21-in. tricolor kinescope with a picture area of 250 sq. in. has been developed by RCA, and will be demonstrated on Sept. 15. The tube has a round metal envelope, is relatively shorter than those produced previously, and is 25% lighter than 19-in. glass color tubes. A filter glass face plate and new gun provide improved picture contrast.

The most significant improvement is the new RCA curved shadow mask and mounting system, which make possible simplified mechanical mounting in the tube, and greater beam power input during operation without objectionable mask distortion. The phosphor dots are on the face plate. The manufacturer reports accurate and stable registration, and absence of color impurity around the picture edges.

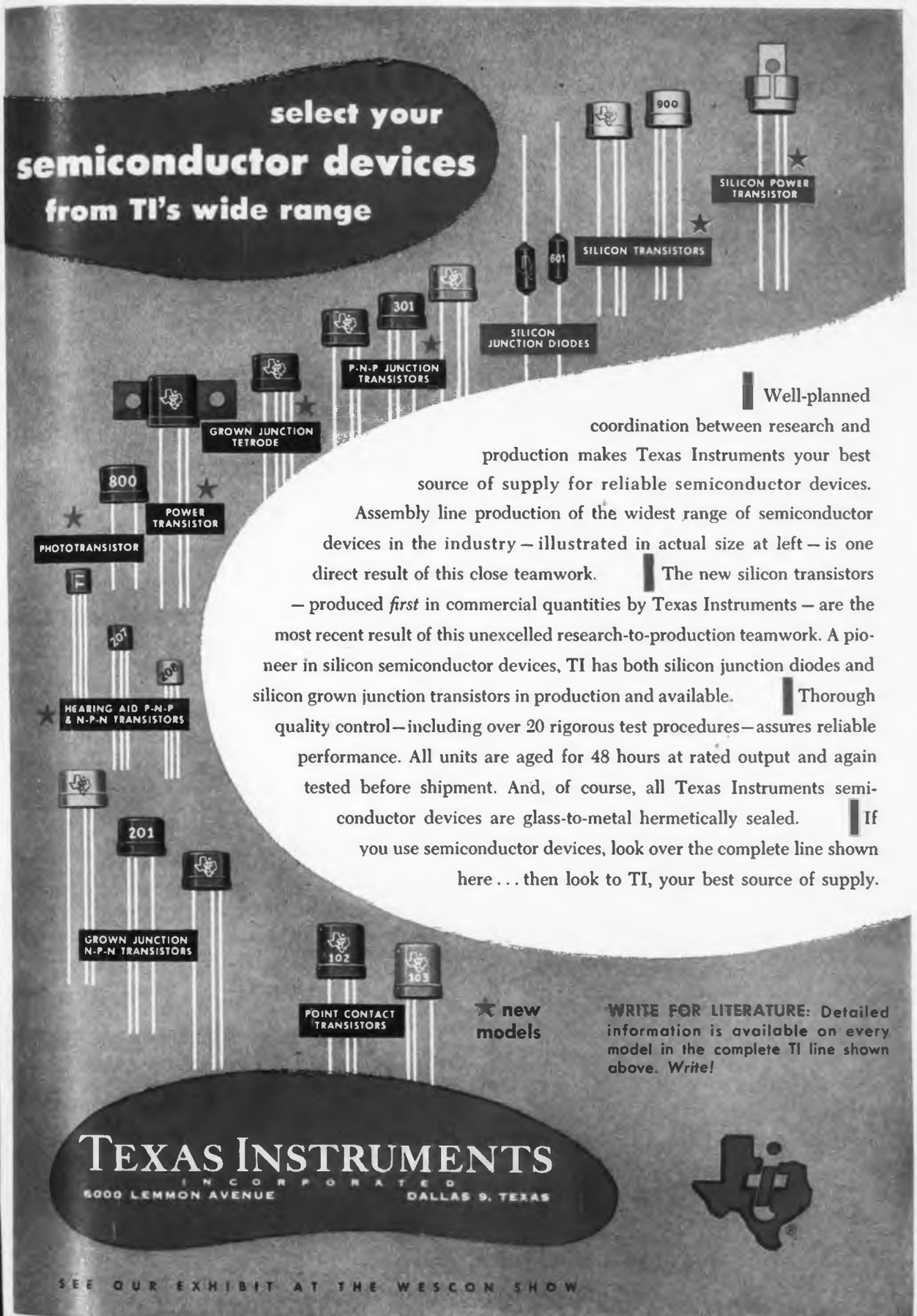
Introductory price of the tube to equipment manufacturers is $175.

WCEMA Scholarships Presented to 11 Schools

The West Coast Electronic Manufacturers Association has presented a total of twelve scholarships to eleven Western colleges and universities, for use by students entering the field of electronic engineering. The fund, made up of donations by firms which are members of the association, are presented each year to schools with departments or colleges of engineering.

SKY COMPASS

Reported to be the first practical instrument for accurate aerial navigation in high latitudes, this Sky Compass developed by Kollsman Instrument Corp., Elmhurst, N. Y., gives the true heading of an aircraft by determining the position of the sun when it is below the horizon, an important factor in Arctic regions



Well-planned coordination between research and production makes Texas Instruments your best source of supply for reliable semiconductor devices. Assembly line production of the widest range of semiconductor devices in the industry — illustrated in actual size at left — is one direct result of this close teamwork. The new silicon transistors — produced *first* in commercial quantities by Texas Instruments — are the most recent result of this unexcelled research-to-production teamwork. A pioneer in silicon semiconductor devices, TI has both silicon junction diodes and silicon grown junction transistors in production and available. Thorough quality control—including over 20 rigorous test procedures—assures reliable performance. All units are aged for 48 hours at rated output and again tested before shipment. And, of course, all Texas Instruments semiconductor devices are glass-to-metal hermetically sealed. If you use semiconductor devices, look over the complete line shown here . . . then look to TI, your best source of supply.

New Product Briefs

DELAY LINES now miniature standard with PCA, cover an impedance range from 500 ohms to 2,000 ohms. Standard 50 ohm and 100 ohm lines are still available in their original sizes at PCA Electronics Inc., 2180 Colorado Ave., Santa Monica, Calif. All lines meet MIL-T-27 specifications.

TELEMETERING FILTERS available at Hycor Co., Inc., 11423 Vanowen St., N. Hollywood, Calif. in a range of frequencies from 400 CPS to 70 KC and bandwidths of 7½% to 15%, have nominal impedance of 500/500 ohms, and frequency response greater. than 45 db.

WIRE STRIPPER announced by Technical Devices Co., 2350 Centinela Ave., Los Angeles 64, Calif., with proper cartridge, automatically cuts and strips both ends of any solid or stranded wire from 14 through 24 gauge in one operation.

ELASTOMER called "Tufsil," developed by Pacific Moulded Products Co., 905 E. 59th St., Los Angeles 1, Calif., is said to have tear strength up to 210 lbs/in. Maintains flexibility over a temperature range of −120° F to 600° F.

SAMPLING SWITCH for high-speed multichannel use operates to 10,000 contacts per minute. Series 4000 with motor drive. Series 6000 without motor. General Devices, P.O. Box 253, Princeton, N.J.

TWIN CONNECTORS of seamless copper accommodates two wires. MU 250 for 250MCM-6 wire, MU 350 for 350-4 wire, MU 600 for 600 MCM to 4/0 wire. Ilsco Copper Tube & Prod., Marlemont Ave., Cincinnati 27, Ohio.

POWER SUPPLY Model FR-2 provides line regulation of 0.01%. Four adjustable dc voltages for klystron modulation are provided to 5 kv. Clegg Labs., Inc., 142 S. Livingston Ave., Livingston, N.J.

VIDEO VTVM with range of 20 CPS to 10 MC, MV-22B, has been announced by Millivac Instrument Corp., 444 Second St., Schenectady 6, N.Y. Sensitivity is 70 μv., range to 1 kv. Accuracy 3.5% full scale.

TUBES recently announced by CBS-Hytron, Danvers, Mass., are three CTS-rated units designed for use as horizontal deflection amplifiers in TV receivers—designated, 6CU6, 12CU6, and 25CU6. They are interchangeable with the 6BQ6GT, 12BQ6GT, 25BQ6GT.

TV REBROADCAST RECEIVER, Model TR-1, announced by Clarke Instruments, Div., of National Electrical Machine Shops, Inc., 919 Jesup-Blair Dr., Silver Spring, Md., has been designed for use in direct pickup and rebroadcast of TV signals.

ELECTRIC RESISTANCE WIRE, produced by The Kanthal Corp., Amelia Pl., Stamford, Conn., is a low temperature coefficient wire with resistivity of 812 ohms per circular mil ft. at 20° C. Maximum working temperature 300-350° C. Tensile strength 120,000 psi. Designated Kanthal D-R.

BOLOROMETER PREAMPLIFIER, Model BA-1, by Weinschel Engineering Co., Inc., 10503 Metropolitan Ave., Kensington, Md., makes precision measurements of power ratios in the frequency range from 20 to 10,500 MC. Used to measure r-f ratios from 1 to 30 db with an overall accuracy of 0.10 db.

RECORDING SYSTEMS made by Kollsman Instrument Corp., 80-80 45th St., 45th Ave., Elmhurst, N.Y., are designed to record and reproduce frequencies up to 1. MC. Have a medium storage capacity of 60,000 impulses or binary digits on their magnetic coated drums.

CRYSTAL PHOTCELL, miniature, made by Standard Piezo Co., P.O. Box 164, Carlisle, Pa., operates small relay without amplification. Measures ¼ in. in diam., ¼ in. deep. Delivers 2 to 5 ma when exposed to 50 to 100 ft./candle light with approx. 100 v. across cell and load.

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Type ML-13 Units of this type are currently undergoing tests on experimental basis. The unit is hermetically sealed. Pin dimensions are the same as our Type ML-6. Height of can is 1½-inch.

Type ML-1A Range 2.0 - 15.0 mc. Supplied per mil Type CR-1A when specified. Holder is phenolic, gasket sealed. Holder size is 1¼" x 1⅛" x 27/64" with .125" diameter pins ⅜" long, spaced at .500".

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CBS' "205" Color Tube

LAST month CBS-Hytron announced that their new 19-in. aluminized glass envelope, tri-gun color picture tube was now in production at the plant in Newburyport, Mass. Termed the "CBS-Colortron 205," (RETMA type 19VP22) this new shadow-mask design offers viewers 205 sq. in. of picture area. The tube is electrostatically focused and incorporates an electromagnetic convergence system. A deflection angle of 62° is employed. Fig. 1 shows the outline drawing of the 205 while the exploded view in Fig. 2 illustrates the internal structure.

The steps employed in the manufacture of the 205 are very similar to those employed in the manufacture of black-and-white tubes. The stamped shadow masks are first blackened so that they will not reflect light and to radiate heat. The

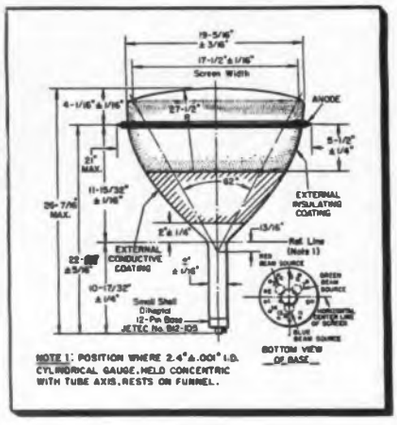

Fig. 1: Dimensional diagram of 205

glass hemisphere and funnel are turned and the metal sealing rings are shaved to assure perfect roundness. These units are then thoroughly washed.

Shadow masks and glass hemispheres are then paired and remain together during all subsequent manufacturing steps. In the application of color phosphors, the spherical faceplate first receives an overall coating of green. Following this, a photosensitive solution is coated over the phosphor. The mask is placed on its V-block type mount in the glass hemisphere. A light source, located at the position of the green electron gun exposes the photosensitive material through the shadow mask. A chemical solution then washes away the phosphor in the unexposed areas. The entire process is repeated for the red phosphor and finally for the blue. In all, the design employs 300,000 phosphor triads. Following the application of the phosphors, the face place is aluminized.

The electron gun structure for convergence is of particular interest. Three matched electron beam sources are triangularly spaced and with each gun tilted toward the common tube axis so as to provide proper beam convergence at the

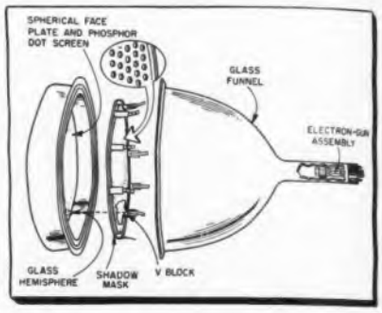

Fig. 2: Construction features

center of the screen. Three pairs of pole pieces are mounted in the tube above the anode and spaced 120° apart. Three external electromagnets, mounted on the tube neck, create magnetic fields which are induced into the pole pieces to provide dynamic convergence control of each of the three electron beams. Small dc fields may also be induced in these pole pieces to compensate for slight manufacturing variations.

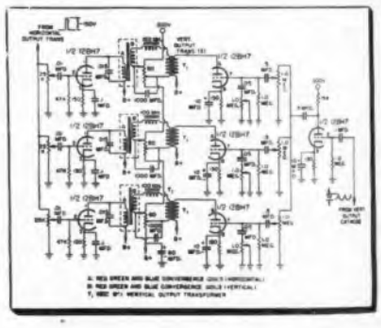

Fig. 3: Circuit for dynamic convergence

The electromagnets provide radial adjustment of each of the three beams. Since it may not always be possible to properly converge the three beams by radial adjustment only, an external blue-beam positioning magnet is used to provide tangential movement of the blue beam. The combination of the three external electromagnets and the blue-beam positioning magnet insures the realization of center convergence.

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Attenuator Range	120 db	120 db	120 db	120 db
Attenuator Accuracy	±2 db	±2 db	±2 db	±2 db
Output Impedance	50 ohms	50 ohms	50 ohms	50 ohms
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Pulse Width	0.5 to 10 microseconds			
Delay	3 to 300 microseconds			
Rate	40 to 4000 pulses per second			
Synchronization	Internal or external, sine wave or pulse			
Internal FM:				
Type	Linear sawtooth			
Rate	40 to 4000 cps			
Synchronization	Internal or external, sine wave or pulse			
Frequency Deviation	±2.5 MCS	±2.5 MCS	±6 MCS	±6 MCS
External Pulse Modulation:				
Polarity	Positive or Negative			
Rate	40 to 4000 pulses per second			
Pulse width	0.5 to 2500 microseconds			
Pulse separation	(For multiple pulses) 1 to 2500 microseconds			
Output Synchronizing Pulses:				
Polarity	Positive, delayed & undelayed			
Rate	40 to 4000 pps			
Voltage	Greater than 25 volts			
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West Coast Societies

(*Continued from page* 64)

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3. Sponsorship with AIEE, IRE, and RETMA, of the Electronic Component Symposium. This activity has been in existence for the past three years. Events are held on the West Coast during alternating years, and attract national attendance.
4. Cooperation with RETMA in the West Coast area in problems peculiar to the Western industry.
5. WCEMA Scholarship Fund. Under this program, funds are solicited from members and nonmembers alike, on a voluntary basis, for the pupose of establishing scholarships in schools of the area and thus encouraging more students to enter fields which will fit them for the electronic industry. A Board of Trustees allocates the funds to various schools for distribution to deserving students. Selection is left entirely to the judgment of the schools, with the only limitation that students planning to enter fields leading to electronic engineering be given the awards.
6. An annual Wage and Salary Survey is conducted by each council of WCEMA. This statistical compilation has been the basis for labor negotiations by many West Coast companies, and has afforded a fair and equitable means of negotiating and establishing rates by many newcomers to the area as well as established firms.
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West Coast Societies

(*Continued from page* 136)

chasing and procurement personnel with the products and facilities of WCEMA members.

AIEE

The American Institute of Electrical Engineers is one of our oldest professional engineering groups. Originally, their members consisted primarily of those engineers interested in power generation and transmission. This is not true today, at least on the West Coast. This group has a very aggressive and growing electronic section, which fosters groups having primary interests in communication. It appears from a rather casual survey that this particular group represents as much as 50% of the AIEE membership, and the percentage is growing at a rapid rate.

Aircraft Industry

The brief organizational discussion included above has been confined entirely to those organizations dedicated primarily to the electronic industry. No consideration has been given to the electronic phases of the vast West Coast aircraft industry, which utilizes electronic equipment on a very major scale. Practically every aircraft manufacturer on the West Coast includes within its organization a major electronic division. The organizations and societies included within the aircraft framework are of such a magnitude, both in number of societies and membership, that they would require and deserve a separate study of their organization makeup and their growth over the past years.

It is significant that this article has not mentioned any one individual. Probably that fact, more than any other, is the key to the success and growth of the electronic industry of the West. For it has not been any one individual, but rather hundreds and thousands working together in harmony and with unity of purpose that has brought about the greatest growth that any industry has seen since the invention of the automobile. And even that was a snail's pace growth compared with the time it has taken to bring the Western electronics industry into adulthood. Unity and cooperation through organizational efforts have been the driving forces and will continue to be as the assured further expansion takes place.

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- Film Camera
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Network Analysis

(*Continued from page* 98)

left half of the complex plane that represents the locus on which the admittance has a zero real part. For example, working with the series arm,

$$Y_1 = Y_a' + (G_a - G) = \frac{u_1(\sigma,\omega) + jv_1(\sigma,\omega)}{u_2(\sigma,\omega) + jv_2(\sigma,\omega)}, \tag{11}$$

we obtain the curve

$$\mathrm{Re}\,[Y_1] = 0 \tag{12}$$

$$\therefore u_1u_2 + v_1v_2 \equiv f(\sigma,\omega) = 0$$

Considering σ as an implicit function of ω given by $f(\sigma, \omega)$ and evaluating the derivative

$$\frac{d\sigma}{d\omega} = -\frac{\frac{\delta f}{\delta \omega}}{\frac{\delta f}{\delta \sigma}}, \tag{13}$$

we find the smallest minimum value of σ, that is, the point at which the curve is closest to the j axis. To each of the zeros and poles of Y_1 we may now add the positive constant h, which is chosen less than or equal to this minimum distance, without destroying the positive real quality of Y_1. Then, after realization of the arm by the Bott-and-Duffin procedure, the network obtained is corrected for the predistortion: for every L a series combination of L and a resistance of Lh ohms is substituted, while every C is replaced by a parallel combination of C and a conductance of Ch mhos. A similar procedure is followed for the diagonal arm.

Shunt Capacitance

Finally, if the given transfer function is a proper fraction, it is clear that the admittances of both of the lattice arms will possess a pole at infinity and a corresponding shunt capacitance in their network representations. Thus, a capacitance may be removed from each of the arms yielding an equivalent lattice with a shunt capacitance at the input and output terminals.

The steps in the synthesis procedure may now be summarized as follows:

1. Realize the given function as an open-circuited lattice by the method of reference 4 or reference 5.

2. Obtain an equivalent lattice with a shunt conductance at the input and output terminals. If the de-

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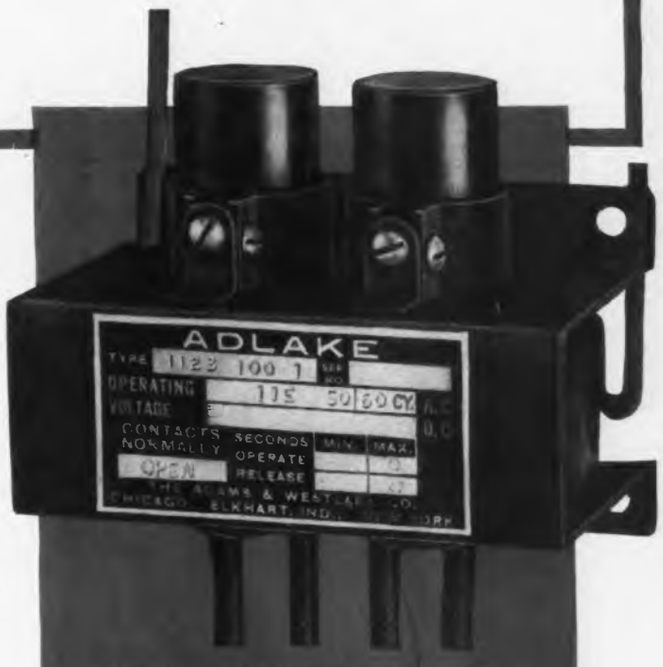

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Network Analysis

(*Continued from page* 140)

gree of the numerator of the given transfer function is lower than that of the denominator, also remove a shunt capacitance from each of the lattice arms.

3. Predistort each of the remaining lattice admittances as explained above. Then realize each arm by the Bott-and-Duffin procedure, after which the networks obtained are corrected for the predistortion.

4. If necessary use Thevenin's theorem on the input to obtain the given type of transfer function.

To demonstrate the complete procedure, we realize the non-minimum-phase voltage ratio

$$K = \frac{E_2}{E_1} = \frac{s^2 - s - 12.4}{10s^2 + 46s + 60}$$

as a resistance-terminated lattice.

First we represent the above function as the transfer impedance of an open-circuited lattice. Using the method of reference 4 we find

$$Z_b = \frac{s^2 + 6s + 10}{5s^2 + 23s + 30}$$

$$Z_a = \frac{7s + 22.4}{5s^2 + 23s + 30}.$$

The series impedance Z_a is immediately realizable by inspection as

$$\frac{1}{Z_a} = \frac{5}{7}s + 1 + \frac{7.6}{7s + 22.4}.$$

Upon attempting to remove a conductance of one mho from Y_b we obtain the positive real remainder

(*Continued on page* 144)

KOVR ATOP MT. DIABLO

FCC has approved call letters KOVR for new Channel 13 station of Television Diablo, Inc., Stockton, Calif. Principal stockholder Les Hoffman reports programming to begin in Sept. Map shows how 12-bay antenna with 144 kw ERP will cover 40% of state's population from 4000-ft. Mt. Diablo. A. Joscelyn is gen. mgr.

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Network Analysis

(*Continued from page 142*)

$$Y_b - 1 = \frac{4s^2 + 17s + 20}{s^2 + 6s + 10},$$

Thus this conductance may be removed from the lattice arms to yield an equivalent resistance-terminated lattice. The remainder of the diagonal arm admittance has a zero real part curve whose closest point to the j axis occurs at $\sigma = -2$. Substituting the new variable $(s-2)$ for s in the remainder, we obtain

$$Y' = \frac{4s^2 + s + 2}{s^2 + 2s + 2}$$

which we now realize by the Bott-and-Duffin procedure[8] as the network shown in Fig. 6. This network is then corrected for the predistortion.

Now applying Thevenin's theorem to the input of the lattice thus obtained, we finally realize the lattice shown in Fig. 7.

Any realizable transfer voltage ratio, transfer admittance or transfer impedance may be realized by the method presented in this paper as a lattice terminated in resistance at both its input and output terminals. No mutual inductance is necessary and each inductance has an associated series resistance so that low-Q coils may be used in building the network. When the transfer function is a proper fraction, a shunt capacitance may also be obtained at both the input and output terminals.

This paper was presented at the 1954 I. R. E. Convention, New York City.

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8. For details on the realization of this driving-point function, see E. A. Guillemin, loc. cit., where the dual of the admittance is synthesized.

Palnut to United-Carr

Arthur W. Kimbell, President of United-Carr Fastener Corp., Cambridge, Mass., has announced the company's acquisition of the Palnut Co., Irvington, N.J.

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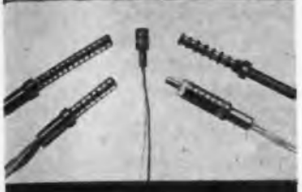

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Brain Mapping

(*Continued from page 68*)

cal experiment. On the left hand side is the sound proof room with the animal in place. The ear phones are connected to the ears and the wires are shown in contact with the brain. The recording equipment consists of the control unit at the top of the figure which generates the control pulses. Just below this is the 10-channel CRO which is connected to the animal, and on the right is the sound generation equipment consisting of two channels which follow the conventional audio design. The filters shown are of the ½ octave push-button type and are used to filter out harmonics and are also being used to generate the short pulses of sound. The output of these two audio channels can be mixed or sent independently to the earphones at the two ears.

The sound calibration system is located here and consists of a condenser transmitter connected to an automatic frequency response recorder. The condenser transmitter is a Western Electric 640AA originally calibrated by the reciprocity method. The ear phones form a closed system with the animal's ear and this closed system is calibrated with a coupler to the transmitter. The calibration is of the open circuit type. The intensity levels are represented as db above the standard reference level of 10—16 watts /sq. cm. The spectra of the audio signals we use were determined with a wave analyzer having a 4-cycle band pass. The frequency of the steady tones was read from the oscillator dials.

Pure Tone Effect

When our work was begun in 1942 we accidentally discovered that the rather abrupt onset of a pure tone caused an electrical response at one spot in the brain of the anesthetized dog. The position of this spot was found to depend systematically on the frequency of the tone. The electrical changes were not seen during the steady portion of the tone because of certain physiological effects of the anesthetic. This discovery that the sudden change in amplitude of a sound would produce a potential under anesthesia has served as a useful tool for determining the connections from the ear to the brain for different frequencies of sound. From the standpoint of communication, the onset of a pure tone was not a satisfactory signal because its spectral

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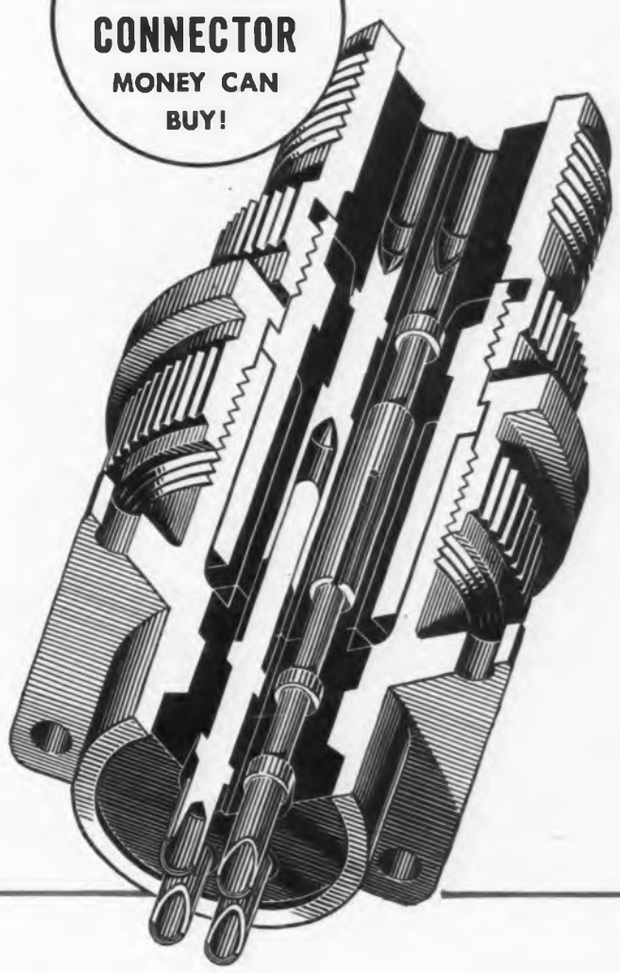

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Brain Mapping

(*Continued from page* 146)

and temporal characteristics were difficult to analyze, and complicated the picture because of the combination of transient and steady state signals.

To define the sending end of our communication channel more clearly, we have adopted for our auditory signal a new type of sound which is variously called the probability pulse, the logon, or the tone pip. Fig. 4 shows an oscillogram of the probability pulse and its spectral properties. This type of signal was studied by Gabor from the standpoint of communication theory and he has pointed out that contains one bit of information. In other words, it fits the requirements in communication theory where the product of bandwidth and duration is a constant. In the sense of Wiener, it also has something to do with the concept of ideal filtering. As a matter of fact, we generate this probability pulse by ringing or "ideally" filtering with a half-octave filter, a rectangular pulse whose duration is equal to one-half the period of the mid-frequency of the half-octave section. The rectangular pulse results in an envelope of sinusoidal waves as indicated with a normal or probability curve drawn on the face of the CRO to show the general fit of the probability pulse. The spectrum is a half octave wide, 3 db down, and one octave wide, 40 db down. As a matter of fact, this spectral curve represents the design curve of the filter. The spectrum of the pulse is actually log normal rather than normal because the filter was designed on a log normal basis. Because the ear is logarithmic frequency wise, this fact is probably of no importance. The intensity of these pulses we measure at the peak which is equal to the amplitude of a steady tone of the same frequency.

Time Relationships

We therefore are able to characterize the sound field or the sending end of our communication channel in terms of the following parameters: The spectral properties of the pulse are half octave at 3 db and one octave at 40 db. The number of cycles are the same but the duration of the pulse varies with frequency. This allows us to examine precisely the time relationships of the various cycles of the probability pulse with the received signal in the brain. Finally the intensity of the

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Brain Mapping

(*Continued from page* 148)

pulses are known. By setting up these precise signals in advance we can establish *a priori* the probability of the message that we send to the brain. We also use a steady pure tone, thermal noise and pulsed thermal noise with known bandwidths to produce a phenomenon known as masking, in which a signal due to the probability pulse is obliterated as a certain function of the frequency and intensity of the masking sound. Masking is very common in hearing and although we do not understand its function we can measure its effects very precisely. Having defined the sending end of our communication channel we can not look at the receiving end or the auditory cortex of the brain.

Fig. 9: 50-channel cathode ray oscilloscope

Fig. 1 shows the summary of our results in receiving end of the dog brain concerning the mapping of frequency and intensity. There are four regions from which electrical responses are obtained to sounds and these are indicated on the photograph. In three of these regions there appears to be a space-wise representation of frequencies. Ordinarily this representation of frequencies can be shown by placing electrodes on the surface and stimulating the ear with a sound of a given frequency. This results in electrical responses at the points indicated by the frequencies marked in the photograph. Thus, a 100-cycle sound produces responses across this strip, 1.0 KC at this strip, and

so on. This is somewhat similar to a reed frequency analyzer in which the position of the vibrating reed indicates the frequency of the impressed sound. In this case the position of the electrical response indicates the frequency of the impressed sound. Thus, the frequency of the sound appears to be represented by the position of the nerve cells that respond.

The distribution of these positions, is on a logarthmic basis. Because the brain is a volume conductor the electrical response does not allow precise measurements of these positions. To improve our measurements of these positions we have used a rather artificial device which works beautifully here to increase the signal-to-noise ratio and thus eliminates misinterpretations due to electrical fields. As shown in Fig. 6, we simply put a piece of paper 1 sq. mm. in size, soaked in strychnine on the surface. The strychnine by some uncanny means causes a potential 10 to 20 times the usual magnitude to appear if a nerve impulse enters the region where the strychnine is located. It acts somewhat like a bandpass filter in that it indicates only those impulses which enter the 1 mm segment. By measuring the frequency and intensity of the sounds which discharge this enormous potential one gets a bandpass curve to represent the spectra of the nerve fibers activated. The high frequency slope of this bandpass curve may be as much as 90 db per one-fourth octave.

Connection Measurement

If the piece of paper is moved in the frequency axis of the area, the bandpass curve shifts by an amount dependent upon the displacement. If we move it 2 mm, the bandpass curve shifts one octave: 4 mm, it moves two octaves; 1 mm, it moves one-half octave. By moving this paper it has been possible to detect a $\frac{1}{10}$ octave displacement of the curve when the paper was moved 0.2 mm. Thus, there are apparently different frequencies represented in increments of 200 microns which represent $\frac{1}{10}$ octave. This is an enormously high degree of precision in measurements of connections, particularly if the finer connections are somewhat random in their arrangement. Some of the nerve cells, as a matter of fact, have processes extending 100 to 300 microns.

Assuming that there are about 7 octaves in the area and that the smallest interval is 0.2 mm then

Brain Mapping

(*Continued from page* 151)

there would be seventy 1/10 octave intervals in 1.4 cm of cortex. Further assuming that each one of these intervals is a binary digital device it would allow for two to the 70th or ten to the 24th power different sounds to be represented. An enormous capacity for such a small structure. It is becoming apparent, however that this is not entirely a digital device but rather an analog device, and therefore the amount of information is dependent on the signals impressed on the ear in the form of probability pulses. Undoubtedly this part of the cortex will have to be represented as a continuous distribution of nerve connections representing different frequencies rather than a purely digital series of units. However, the precision of 1/10 octave allows us to define the distribution functions more clearly.

Frequency Positions

The other two areas in the brain do not show the same precision of representation of frequencies. At least they appear to be more complex and we have not worked on them as intensely as in this area. You will notice on this line an intensity scale. We have found that the frequency positions are actively represented by strips of cortex rather than points. The entire strip responds to one frequency at one intensity level for the ear on the opposite side of the brain but for the ear on the same side a different intensity is required to excite different parts of the strip. This is apparently a sort of intensity representation of sound. It is very crude at best and its significance is not known at the present time.

We have thus shown how the frequency characteristics of sound are represented in the brain by the positions of the nerve cells. A communication channel really is concerned with the information transmitted during an interval of time. Thus far we have not mentioned the temporal character of the signals that we receive in the brain. There is no evidence that the frequency of a sound is represented in any way temporally in the brain. This makes it necessary to consider what information we get from the auditory cortex temporally.

As seen in Fig. 7 the potentials that we record oscillographically from the surface of the brain show

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Brain Mapping

(Continued from page 152)

considerable variation from one location to another, but in general have an initial positive deflection beginning about 12 msecs from the onset of a sound. This represents the conduction time from the ear to the brain. Duration of the positive potential is about 10 msecs and this is followed by a negative one lasting perhaps about 30 millisecs.

Pattern Variations

There are numerous variations of this pattern present over the cortex, and their origins have not been defined. These potential characteristics are important, and a knowledge of their distribution as a function of place, frequency, intensity, and ear are important for our problem. Another aspect that we will investigate is the fact that when a potential appears in a given group of nerve cells, these nerve cells are incapable of complete response for about 10 msecs, and are capable of incomplete response for about 250 msecs. This is what we call a refractory or unresponsive period characteristic of nerve tissue which represents the recovery of excitability in the cells. The temporal characteristics of the refractory period must be determined for the function of place, frequency, intensity, ear, etc. The refractory period may be significant for two reasons: one, that it limits the amount of information transmitted in time; and two, it may represent a delay or memory by which information is temporarily stored for analysis purpose. Incidentally, the potential itself is a form of short memory because its duration outlasts the duration of the P pulse, particularly at high frequencies. Because of the long duration of the P pulse we sometimes see as many as three potentials from the cortex for very low frequency sounds since the duration of the refractory period is shorter than the period of the frequency of the P pulse. We consider the temporal aspects of the signals so important that we are installing a 50-channel cathode-ray oscilloscope in order to observe simultaneously activity from as many different points.

Thus far we have considered conditions from the anesthetized animals, but soon we will start recording from the unanesthetized animal in which case the amount of information in time is increased considerably as Fig. 8 indicates. Here we

find the problem of medium term memories lasting for one to two seconds and activity that occurs during the steady portions of tones. These potentials have no resemblance to the potentials that we have considered thus far, and their time course is independent of the events of the previous potentials. Under these considerations the spontaneous electrical activity of the nervous system is greater and represents noise as far as this communication channel is concerned.

At this point our mapping problem begins to look like a real universe. When we consider that we shall have 60 channels with perhaps as many as 100 measurements per channel, each record taken with 14 frequencies for each ear and each frequency taken at about 10 intensity levels, a little arithmetic will show the extent of the measurements necessary for a given experiment.

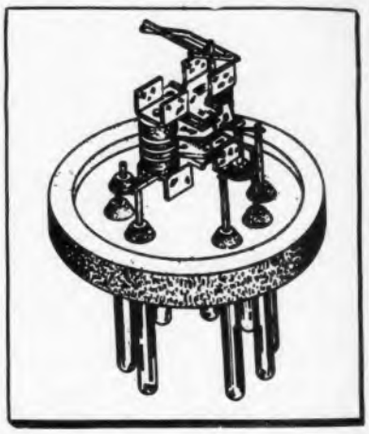
We are already up to our necks in measurements with the 10-channel instrument, but we still are not getting the maps of the parameters of the brain that are necessary for interpretation of the findings from a communication standpoint. Thus, we are turning more and more toward electronic devices for help in automatic measurements and data reduction. We are considering such devices as the Oscar as an interim device for exploratory purposes and we have already begun thinking about such electrical analyzers as auto-correlation devices and probability analyzers, since the probability of events is likely the only means of getting to the ultimate capacity of the nervous system. Even our present results involving a function of place, frequency, intensity, ear and time and amplitude of the potential would require some high power statistical analysis. Thus, we are conscious of the need of high speed computations on our data as it stands today.

WIRELESS MICROPHONE

Close-up view of wireless microphone worn by Joan Diener as shown on page 63. Note location and size of transistor circuitry and power supply battery.

"Stacked Tubes"

(*Continued from page 69*)



Difference in design between "stacked tube" (bottom) and conventional tube is indicated by illustration of stem and mount of each

Viewing test of new tube which functions normally at over 1000°F are (l to r) H. Ward Zimmer, Sylvania President; Don G. Mitchell, Sylvania Board Chairman; Vice Admiral Jack Gingrich, Chief of Naval Material; and Capt. Rawson Bennet of Navy Bureau of Ships

The ceramic envelope is much stronger than the glass envelope, and the tube can be handled and shipped without breakage. The ceramic envelope is also extremely rugged under widely fluctuating temperature conditions. It has been

Parts of new tube are stacked and riveted together in single operation on mounting jig shown, permitting automatic mass production

removed from liquid nitrogen at −195° C. and immersed in boiling water at 100° C. without fracture. Tubes have also been thermally cycled from room temperature up to 450° C. without damage.

Expand Radio Line

The radio communications division of Bendix Aviation Corp. is expected to double its car radio production in order to meet output levels required for 1955 models, it was announced recently.

Production Transferred

Effective July 15, 1954, all high production manufacturing done by Lennox Engineering Assoc., 6007 Euclid Ave., Cleveland, Ohio, was transferred to Park Products Co., 6900 Wade Park Ave., Cleveland.

Division Changes Name

Radio Receptor Co., Inc., N.Y.C., has announced the change in the name of its Seletron & Germanium Div. to "Semi-Conductor Division."

West Coast Purchase

Century Electronics, division of Century Metalcraft, has been purchased by the Kearfott Co., Inc. and will now be known as Kearfott Co., Inc., Western Manufacturing Division, 14844 Oxnard St., Van Nuys, Calif.

THE YEARS AHEAD

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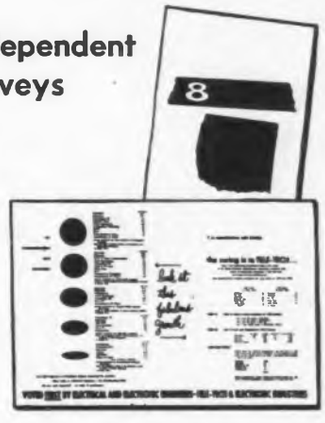

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PERSONAL

Dr. Augustus B. Kinzel is the new director of research at Union Carbide and Carbon Corp., 30 E. 42nd St., N.Y. 17. Dr. Kinzel has been with Union Carbide since 1926 when he joined the company as a research metallurgist.

B. Ballou

W. McAulay

Byron Ballou and **William McAulay** have recently been added to the field engineering staff at the San Bruno, Calif. plant of Eitel-McCullough Inc., manufacturers of electron power tubes. Ballou has been with the Eimac research labs for the past ten years. McAulay was formerly a station engineer and transmitting engineer at NBC.

E. B. Jones has been appointed chief engineer in charge of estimating and engineering in the newly formed "Field-Erected Equipment Div." of the Lindbergh Engineering Co., 2450 W. Hubbard St., Chicago. Until recently Mr. Jones had been with Continental Industrial Engineers, Inc.

E. B. Jones

R. M. Soria

Dr. Rodolfo M. Soria has been appointed director of engineering at the American Phenolic Cpro., succeeding **Richard M. Purinton,** who now represents the company in the New England area.

Erwin M. Weiss has been named chief engineer in charge of instrumentation, and **Michael G. Seidl,** chief engineer in charge of the commercial music division, at Magnecord, Inc., Chicago.

Capacitor Leakage

(*Continued from page 91*)

The relationship was found to be:

$$E_o = E_\beta \frac{R_2C_1}{\alpha^{1/2}}\left[e^{-\frac{\beta-\alpha^{1/2}}{2\gamma}t} - e^{-\frac{\beta+\alpha^{1/2}}{2\gamma}t}\right]$$

where

$$\alpha = [R_1C_1+R_2(C_1+C_2)]^2 - 4R_1R_2C_1C_2$$

$$\beta = R_1R_2+R_2(C_1+C_2)$$

$$\gamma = R_1R_2C_1C_2$$

to normalize

let $C_1 = nC_2$

$R_1 = pR_2$

also let $C_2 = 1$

$R_2 = 1$

$$\text{then } E_o = E_\beta \frac{n}{\alpha^{1/2}}\left[e^{-\frac{\beta-\alpha^{1/2}}{2\gamma}} - e^{-\frac{\beta+\alpha^{1/2}}{2\gamma}t}\right]$$

Where $\alpha = (np+n+1)^2 - 4np$

$\beta = p+n+1$

$\gamma = np$

To simulate a case close to the observed results, let

$n = .2$

$p = .05$

$E_\beta = 1.0$

then $E_o = E_\beta\, 0.168\ [e^{-3t} - e^{-122t}]$

Fig. 7 shows the plot of this result, and also the two functions of which it is the sum.

While the picture here shows close resemblance to the experimental data it would be hazardous to extrapolate the experimental information to extract accurate values for the system components.

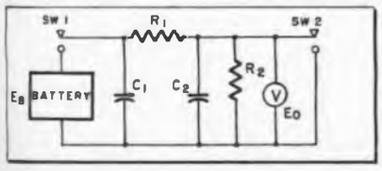

Fig. 8: Equivalent circuit for evaluating data. C_2 is working capacity; R_2 is leakage resistance; C_1 and R_1 are "soak" components

Conclusion

The method described may be an important tool for the evaluation of capacitors components, both for the user and manufacturer of such components. It may also be useful in the evaluation of dielectric materials, cable performance and be helpful by furnishing criteria of importance concerning waxes and oils. It is doubtful that fundamental measurements can be made in this manner unless the systems involved are relatively simple. The instrumentation can be relatively simple, inexpensive, and can be operated by inexperienced personnel.

Barrier Transistor

(*Continued from page* 80)

megacycle region is well known. Surface-barrier transistors have been used in bandpass amplifiers from 5 to 55 MC. The common-base connection proves to be the most practical in this application since a high cutoff frequency is required. It is desirable to minimize interaction between stages of cascaded bandpass amplifiers to facilitate tuning and increase over-all amplifier stability. This is accomplished by using bridge neutralization.

Input Impedance

Fig. 9 shows the input impedance vs. frequency for a tuned amplifier, both neutralized and unneutralized. For the unneutralized case, a slight detuning of the output tank (or an equivalent signal-frequency shift) can cause Z_{11} to go to zero or even negative (Fig. 9B) and produce oscillations. The input impedance of the neutralized amplifier, however, is independent of frequency and output tank resonance (Fig. 9C) since $Z_{12} = 0$.

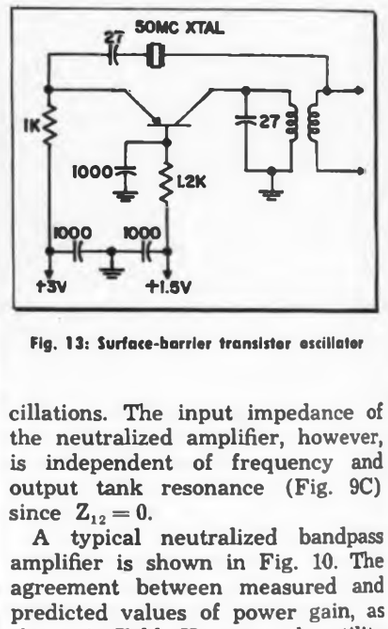

Fig. 13: Surface-barrier transistor oscillator

A typical neutralized bandpass amplifier is shown in Fig. 10. The agreement between measured and predicted values of power gain, as shown in Table II, proves the utility of the π equivalent circuit.

SBT wide-band low-pass amplifiers have gains of 14 db per stage and over-all bandwidths as high as 9 MC. The common-emitter connection has proven to be the most useful configuration in directly cascading many of these stages. Each stage, having a load impedance equal to its input impedance, has a voltage gain equal to its current gain, $+\alpha_o/1 - \alpha_o$, and a cutoff frequency closely equal to

$$f_{\alpha\alpha}(1 - \alpha_o).$$

Therefore, the voltage-gain band-

width product equals

$$\alpha_o f_{\alpha o}.$$

This is a realistic figure of merit since optimum match is not required for this application. A typical two-stage video amplifier operating between equal source and load impedances is shown in Fig. 11. With the coils short-circuited, the bandwidth was 3.2 MC and the gain was 28 db. Even though

$f_{\alpha o}$ was 50 MC,

the stage gain-bandwidth product was only 25 MC. This discrepancy was due to losses in the interstage coupling resistances. When the effect of these losses was compensated for

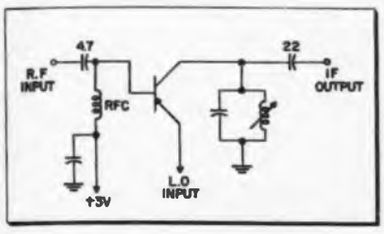

Fig. 14: Surface-barrier transistor mixer

by adding the two coils, the bandwidth doubled, giving good agreement between the theoretical and measured gain-bandwidth product.

A method of trading gain for bandwidth and vice versa would prove valuable in circuit design. Conceivably, a feedback amplifier with proper phase relationships should achieve this result. A typical two-stage feedback amplifier utilizing resistive feedback from the collector of the second stage to the emitter of the first stage is shown in Fig. 12.

TABLE II

Typical SBT Performance in Bandpass Amplifiers

Frequency (mc)	Measured Power Gain (db)	Calculated Power Gain (db)
5	20.6	23.0
28	19.0	18.3
55	12.2	13.0

Surface-barrier transistors have been operated in both LC and crystal-controlled oscillators. A 50-MC crystal-controlled oscillator delivering 400 microwatts at 25% efficiency is shown in Fig. 13. A standard LC oscillator with even better efficiency is obtained by shorting the crystal. The parameters limiting the maximum frequency of oscillation are basically the same ones governing power gain. The maximum oscillat-

Barrier Transistor

(*Continued from page 163*)

ing frequency on the basis of unity power gain, is

$$f_{max} = \sqrt{\frac{\alpha_o f_{\alpha o}}{25 r'_b C_c}}$$

Predicted values of f_{max} are within 10% of experimental values. Maximum oscillating frequencies well in excess of 100 Mc can be obtained using surface-barrier transistors.

A vital component in the transistorization of a VHF receiver is a transistor mixer. The surface-barrier transistor performs very well in this application (Fig. 14) and has a typical measured conversion gain, from 55 Mc to 5 Mc, of 8.6 db. The transistor performs a two-fold function. Mixing action occurs at the base-to-emitter diode, and the detected signal at the base is amplified by transistor action; thus, an amplified i-f output is developed across the collector tank circuit.

In computer applications, quick

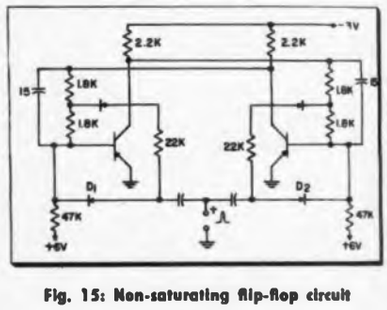

Fig. 15: Non-saturating flip-flop circuit

response is of prime importance. SBT flip-flops, requiring only a 3-v collector supply, have rise times of 0.07 μsec and fall times of 0.15μsec. One of the basic computer circuits is that of a collector-coupled flip-flop employing common-emitter connected transistors. To achieve the fast rise and fall times noted above, the transistor must have a high cut-off frequency and a reasonable current gain, and the circuit must be designed to eliminate the effects of hole storage on fall time.

Flip-Flop Circuit

Embodiment of the above features in a non-saturating flip-flop circuit[3] is shown in Fig. 15. Circuit performance is independent of wide variations in current gain. This is desirable and relaxes the transistor specifications. The non-saturating features of this flip-flop are obtained by the use of diodes and dividing resistors which prevent the "on" transistor from saturating. When the

collector voltage of the "on" transistor drops to approximately $-\frac{1}{2}$ v, the diode conducts and a continued rise in base current is prevented. This reduces the adverse effects of hole storage since there are less holes to be removed from the base region when the "on" transistor is triggered "off." The use of steering diodes (D_1 and D_2) allows the trigger to be a pulse or a square wave, relaxing specifications on pulse width, and provides isolation between the two sections of the flip-flop. The non-criticalness of this circuit aids the designer and should be welcomed by the manufacturer of transistors.

References

1. "The Surface-Barrier Transistor," *Proc. I.R.E.*, vol 41, pp. 1702-1720; Dec., 1953.
2. J. B. Angell and F. P. Keiper, "Circuit Applications of Surfaace-Barrier Transitors," *Proc. I.R.E.*, vol 41, pp 1709-1712; Dec., 1953.
3. J. Warnock, "Junction Transistor Switching Circuits," Paper given at IRE Transitor Symposium, Philadelphia, Pa., February, 1954.
4. "Philco Develops 'Surface-Barrier' Transistor," *Tele-Tech & Electronic Industries*, p. 87, Jan. 1954.

Polarized Antennas

(*Continued from page 72*)

frequency range from 2200 MC to the desired 2600 MC. This is accomplished by a modification of the cavity plunger, which is motor driven, sweeping the frequency from 1000 MC to 2600 MC in only 30 seconds' time. To insure that operation be conducted within only one mode throughout this frequency range, a wider range of reflector tracking voltage is required, in this instance approximately 500. Excellent tracking is obtained by mechanical cam variation of a resistance network which varies the reference voltage of a differential regulator power supply. Bias for the bolometers used for sampling incident and reflected power is reduced at the band's upper limit. This is done because the klystron's power output varies over a greater range than is acceptable by the ratio amplifier's input, even though the amplifier operates satisfactorily with as much as 15 db. input variation. In addition, an increase in output power becomes magnified by the one-hole couplers' characteristics, since their coupling factor decreases 6 db per octave.

Function Switch

The function switch shown in Fig. 5 controls the pre-set frequency cams. For VSWR measurements, these cams are rendered inoperative, and the oscillator sweeps continu-

Polarized Antennas

(*Continued from page 165*)

ously from 1000 to 2600 MC. The sweep may be stopped at any frequency within this range by means of a manual switch. For pattern measurements, the cams halt the sweep at predetermined frequencies at which radiation measurements are required.

Electrical details of the VSWR plotter are shown in Fig. 7, a block diagram of the system. The incident wave passes in series through two modified Sierra Electronics Model 138A coaxial directional couplers. Information supplied to the ratio amplifier could be obtained from one coupler only; however, directivity depends upon how well the arms of coupler secondary line are matched. The bolometer mounts present a VSWR of as high as 1.25:1, thus separate couplers are employed for sampling incident and reflected waves. The unused arms are dry-load terminated.

Identical Coupling

For maximum accuracy the couplers must have identical coupling characteristic and constant coupling with frequency. A small error is introduced due to variation of coupling with frequency, since the ratio amplifier is calibrated at one coupling only. This error becomes negligible if the coupling is greater than 20 db; the couplers employed have a minimum coupling of 22 db.

It is important that the coupler nearest the generator sample the incident wave, otherwise a portion of the reflected wave will appear in the incident arm. Unmatched coupling characteristics of the individual couplers leads to a direct measurement error which is a function of the coupling difference and the VSWR being measured. In this equipment, the coupling tracks to within 0.2 db, corresponding to an error of ± 0.003 in VSWR when measuring 1.10 and ± 0.07 when measuring 2:50 VSWR. Directivity of the couplers is better than 26.5 db, enabling accurate VSWR measurements to as low as 1.10.

A sample of the incident and reflected waves is detected and fed to the terminals of the ratio amplifier. The reflected component, E_r, is passed through a 5-KC bandpass filter for identification by means of frequency content. The filtered components then feed to a balanced modulator-amplifier stage. The incident component then passes

through a high gain voltage delay loop, providing AGC potential to the modulator, this voltage being proportional to $1/E_i$. The modulator-amplifier output is then proportional to E_r/E_i. Note that the ratio amplifier provides visual panel meter indication of VSWR, while a range switch enables accurate reading of VSWR from 1 to 1.3 and from 1.2 to 2.5.

Labor Shortage

(*Continued from page 72*)

the company's industrial relations formula.

Group term life insurance and accidental death and dismemberment insurance valued at $2,000 is automatically provided without cost to the employee, after 90 days of employment. Similar insurance with maximum values to $20,000 is available to employees on a contributory basis. Costs in excess of employee contributions are paid by the company. A third life-accidental death plan permits personnel with two years of service to purchase from $2,000 to $25,000 worth of insurance with paid-up values at low group rates.

Voluntary Insurance Plan

Outstanding is an insurance plan offered to employees on a voluntary and contributory basis which provides hospital coverage for as long as three months, maximum surgical benefits of $300, and special accident expense up to an additional $300. Most important, it also pays for major medical expenses resulting from either severe non-occupational accidents or prolonged illness to a maximum of $5,000.

To show appreciation of the contributions of employees to the progress of the company and at the same time to provide a means to help them build estates for retirement, Consolidated launched an Employee Profit Sharing and Retirement program in Dec. 1952, following study of more than 200 such plans operated by other industrial and commercial organizations. Consolidated, and its subsidiaries, contribute 12% of each year's combined net profits before taxes, but not more than 15% of that year's total payroll, for all participating employees. An employee participating in the plan must contribute a minimum of 4% of his gross salary or wage with the option of increasing the amount up to a maximum

Labor Shortage

(*Continued from page* 167)

of 10%. Contributions are made through payroll deductions. Eligibility for plan membership is established when the employee completes a year's service and has reached the age of 21. To date, almost 88% of employees eligible joined the plan.

In the short history of the plan, company contributions of $280,000 and employee contributions of approximately $294,000 have been pooled in an investment trust. Returns on the investments have averaged more than 8% a year.

Consolidated believes the aesthetic side of the picture is important too. It has invested a great deal of money to provide one of the most attractively landscaped industrial settings in the country.

Consolidated is proud of the high regard with which it is held by its people. Its management is fully aware that "man lives not by bread alone"—that research, development and sound financing, vital as they are to continuing success in the highly competitive electronic industry, spell only part of a successful business operation. Much more is required to convert ideas to products. The answer lies with a company's people and how they feel about their company.

Timing System

(*Continued from page* 89)

telemetering system and recorded on charts, graphs, film, or magnetic tape. When a missile flight of even a few minutes has ended, a mountain of data results. In order to evaluate the operation of the missile, a scientist must evaluate this data. He must know, for instance, what happened 1 min. and 27 sec. after the launching. He must know what photographs were taken at that instant; which foot of magnetic tape contains information transmitted by devices inside of the missile via radio to the ground stations. He must know which position of certain graphs and charts covered the 1 min. and 27 sec. of the missile's flight. All this—plus the correct time of launching—is provided by signals from the dual timing Signal System control console.

One half of this system could provide all of the required signals necessary for correct operation.

However, in order to reinforce the reliability, two systems were built to give dual operation. Either of the two systems may be operated separately, but without dual reliability, to provide signals for a double launching. But, the paramount reason for a dual system is to provide as successful a launching and recording of flight data as possible. The dual system reduces the possibility of losing missile flight data because of power failure, tube failure, or even a system failure. For example, one system is connected with the local power mains at Cape Canaveral, while the other system receives its power from a public utility source. Each of the systems is synchronized with the other, to retain the highest degree of accuracy when a system switchover is necessary. The importance of such reliability is immediately evident since the cost of one missile can exceed the cost of the timing system.

Design Data

The dual timing Signal System consists of two identical electronic time base generators which are coupled together by means of the control console. Four racks of terminal equipment are located directly behind the operator to provide the signals necessary for the operation of instrumentation equipment which is located in the vicinity of the master control at Cape Canaveral. These four racks of terminal timing equipment are similar to those which are located at the downrange stations. These equipments give the operator an indication of how the output signals of the systems are functioning at the receiving end. The four racks contain terminal timing equipment for telemetering, raydist, radar, and tracking telescope systems, plus a special pulse shaper.

The basic signal of the time base generator originates from 128 KC temperature controlled crystal oscillator with a basic accuracy of one part in 10^7. A pulse rate divider consisting of chains of flip-flops divides the basic 128 KC signal time into the pulse rates which are used by the A. F. Missile Test Center timing system. This system consists of central equipment located at island stations along the 1,000 mi. range and of terminal equipment located in or adjacent to range instrumentation equipment. The 30 output signals of the dual timing system are generated with a pulse width of 300 μ sec. with an amplitude of approximately 1 v. These signals are distributed over 250-ohm balanced lines. The outgo-

Timing System

(*Continued from page* 169)

ing signals are distributed directly from the console which has controls to permit individual signal selection from the outputs of either time base generator.

The sine wave and pulse signals are available from the dual timing system in graduated steps from 1 pulse per minute to 64 KC.

The following binary "presence-absence" code signals are available:
10-digit, 20 pps readout, binary code
10-digit, 100 pps readout, binary code
10-digit, 500 pps readout, binary code
9-digit, 1 pps readout, binary code

Additional output lines are provided in the dual system in order to accommodate any special signals which may be required at the A. F. Missile Test Center.

Tube Reliability

(*Continued from page* 85)

kind, either on the anode or on the envelope. This is something new in the art of electron tubes at that power level and is made possible because the envelope sections and seals can take the temperature. During operation at 450 watts anode dissipation, the anode seals run 400° C. and the ceramic itself runs 350° C. Such temperatures are well below the capabilities of both the seals and the ceramic bodies.

Also incorporated in this tube is an improved ruggedized thoriated tungsten filament developed under a Navy sponsored contract. Under shock tests this filament will withstand 380 G. compared to 125 G. for a standard thoriated tungsten filament of similar construction—an improvement of about 200%.

Fig. 6 illustrates a 20KW ceramic tetrode involving a metal anode and ceramic-to-metal seals. This shows the stem and anode structures separated prior to making the final seal, which is a heli-arc weld between metal flanges.

Klystrons

As is fairly well known, we have also incorporated ceramics as R.F. windows in an improved design of klystron amplifier tube. Fig. 8 shows a series of three power klystrons covering the UHF TV frequencies. The purpose here was to provide an externally tunable klystron, while keeping the tube itself as simple as possible. The resulting simplicity

eliminates structural problems and permits outgassing and exhaust by good high vacuum techniques.

All of the above ceramic tube work has been sponsored by Eimac. Certain of this is already in factory production. Some very important work is also being carried on under the sponsorship of the Air Force. These company and government sponsored programs are thoroughly integrated so that each project gets the benefit of results accomplished under the other. The military work particularly benefits from the concurrent Eimac production experience.

Fig. 7 illustrates a ceramic version of the 2C39A, the new tube being called the 2C39B. The simplicity of the envelope in its ceramic form is noteworthy.

A very important government sponsored program at Eimac is concentrating on tube reliability in the smaller tube category. This is a long range program, and the approach to the problem constitutes a radical de-

Fig. 9: Exploded view of ceramic twin triode. When assembled, all parts are brazed solidly

parture from previous designs. Fig. 9 shows a new experimental twin-triode comparable with the 6SN7. From appearance it would be difficult to tell that it was a vacuum tube. It is of all-ceramic construction and is of flat cylindrical shape resembling a pill box. Flexible leads are provided because the inherent reliability is expected to permit soldering the tube permanently into a circuit, as one would a resistor or condenser. No socketing which invites removal is expected. Ceramic end disks comprise the anodes. Grids and cathode are separated by ceramic spacer rings, all assembled in stacked relationship in a confining ceramic envelope cylinder. The grids are made by a photographic electroforming process for accurate high speed production. The cathode button contains a packaged heater which is a structurally integral part of the unit. Since the heater is integrally formed, it cannot move or vibrate. All of the

Tube Reliability

(*Continued from page* 171)

parts, including the electrode supports, are brazed solidly in position. Spot welds have been eliminated.

The stacked construction was selected because it permits assembly without requiring skilled operators. It is also ideal for automatic machine assembly operations, that also being one of the objectives of our program. The stacked construction illustrated is a basic design, adaptable for a variety of tube types. Thus by eliminating the grids, one has a twin-diode. By inserting more grids we make a twin-tetrode. While a twin structure has been illustrated, it is understood that this stacked structure is adaptable for the commoner single unit tubes, such as diodes, triodes, and the like. We have laid out designs in which the disk at one end of the tube supports the cathode and the disk at the other end forms the anode, thus providing a simple diode. This basic diode may then be expanded into a triode, tetrode or pentode simply by stacking in the requisite number of grids. Certain tube parts, not unlike building blocks, are therefore common to a variety of tube types, depending upon the particular combination desired.

Exhaust

The proposed method of pumping these tubes is of interest. There is no exhaust tubulation on the tube. All parts are assembled and brazed together except one of the end wall disks. The exhaust then takes place in a vacuum chamber, while the end disk is held separated from the main body of the tube, thus providing a wide opening for withdrawal of gas. Exhaust problems associated with restricted pumping tubulations are thus avoided. As a final step, the end disk is lowered and brazed in place while the tube is still in the vacuum chamber. Many tubes can be exhausted simultaneously in this manner.

Bakeout and exhaust at high temperatures of, say, 650° C is permitted because of the absence of glass and other low melting point materials. Flash getters are eliminated. In high vacuum work one knows that such active getters are employed as a crutch for inadequate pumping procedure. Some gettering action is planned for the tube, but it is of a stable, high temperature kind earlier developed by Eimac in its power tube work.

This paper was presented at the National Conference on Airborne Electronics.

Direct Recording

(*Continued from page 94*)

inaudible. It appears that flutter effects will be below audibility if the RMS value of flutter components in the range from 0 to 200 CPS, as measured on an unweighted basis, total less than 0.15%, provided these components are of random distribution with respect to frequency, and provided that the level of variations in the 0 to 7 CPS rate area is very low compared to this total.

While the ultimate limit on signal-to-noise is imposed by tape velocity, tape characteristics, and equalization, the highest limit which may be reached at conventional audio tape speeds and current equalization practices, is from 60 to 65 db, and is imposed by the nature of the tape itself. If the uppermost frequency of the transmission is extended by increasing the velocity of the tape, and if, simultaneously, equalization practices were optimized, we would reach a point at which the tape and electronic playback noise would contribute equally to the fundamental noise level, at which point the level of hum would become the lower limit of noise in the system. Other low frequency noises, such as cathode flicker, would also be significant contributors under these circumstances.

The electronic requirements of apparatus designed to reach the limit of attainable performance in a direct magnetic recorder are severe. Appropriate equalization practices must be employed, and every conventional technique for reducing the level of hum and hiss must be used in the playback equipment. The output from the magnetic playback head, under optimum circumstances, is such that electronic circuits possessing a signal-to-noise ratio of about 65 db will be needed, the corresponding effective input noise level being about —130 dbm, which is about the limit to which noise in the electronic circuitry can be reduced at the current state of the art. The application of such expedients as dc heater supply, ceramic film resistors, and low currents through low level stages, are appropriate.

PRD Opens Chicago Office

Polytechnic Research and Development Co., Brooklyn, N. Y., has opened a new office at 1 South Northwest Highway, Park Ridge, Ill., under the direction of K. W. Meyers.

Pulse Width

(*Continued from page 94*)

netic track. 2) Economy of tape medium is high, by reason of the efficiency of information storage already mentioned. 3) High accuracy is easily attainable, since automatic calibration of the system can readily be applied at frequent intervals, commonly resulting in accuracies of the order of 0.5% of full scale. 4) Recordings of this type are inherently insensitive to speed variations in the transport mechanism, since recalibration occurs at approximately a 30 cps rate in the usual systems of this kind. 5) The record equipment is relatively compact and efficient, permitting portable installations. 6) The signal-to-noise is relatively high, compared to FM systems, primarily because the band width for each channel is narrow.

The pulse width modulation technique is limited to narrow frequency range data, and hence limited to applications in which such frequency ranges are useful. Playback circuits for this type of recording are more complex than those for direct-recording playback.

The equipment, both mechanical and electrical, for pulse width modulation recording, may meet specifications which are comparatively loose on speed stability. The primary requirement for pulse width modulation techniques are, as for any recorder, those of compactness and reliability. The characteristics of the electronic apparatus used with this technique will determine performance specifications with regard to signal-to-noise frequency range, distortion, and accuracy. As in the FM system, precision is gained by care in design, taking advantage of those electronic techniques which result in low drift with temperature and line-voltage variations.

HIGH-SPEED PHOTOS

New framing camera, Model 222, made by Beckman & Whitley, 915 San Carlos Ave., San Carlos, Calif., produces photos at rate of 2.4 million per second. Controls include EPUT meter and variable time delay generator

Direct Pulse

(*Continued from page* 95)

tremely simple record circuitry is involved. 7) Comparatively simple playback circuitry is needed.

Among the disadvantages of this technique are the comparative inefficiency of information storage, especially when extremely high accuracies are required. In contrast to some non-magnetic storage techniques, the accuracy of the system may be almost indefinitely extended by extensions in the use of the recording medium, with consequent reduction in storage efficiency. Occasional errors will occur because of the nature of the tape medium (dropouts), which can in certain cases be serious. Reduction of these errors involves the use of checking apparatus, with increased complication of circuitry, and increased use of medium.

Severe Requirements

The requirements of the recorder for this method are usually severe, although if recording is to be accomplished on a continuous basis, at constant speed, the mechanical requirements are looser. In the majority of applications a special type of mechanism is required. When the apparatus is to operate on a discontinuous basis, its mechanical components must be able to handle the tape, which is usually wide, with great gentleness. Furthermore, the apparatus must start and stop this wide tape smoothly, quickly, and with a minimum of stresses. Typical of the numerous special application requirements could be a start time, from 0 to 95% of full speed, of 10 msec; tape velocities up to 100 ips have to be reached; and stopping time usually must be similar to starting time. The flutter and wow characteristics of the mechanism are of secondary importance. The electronic apparatus associated with recording digital information is comparatively simple in design, but must be made just as reliable as must the rest of the system, in relation to the application. This may involve the use of highly redundant electronic circuits, with components of great reliability and consequent high cost.

TIC in California

Technology Instrument Corp. has opened a new office at 731 N. La-Brea Ave., Hollywood 31, Calif. Joseph Looney is engineer in charge.

FM Recording

(*Continued from page 95*)

through" does not occur. The wave lengths recorded routinely with the FM technique are comparable to the thickness of the tape itself, effectively eliminating the occurence of "print-through." Moreover, FM systems are highly selective to higher amplitude signals, further reducing the effectiveness of such "print-through," even if it should occur; 6) FM systems are characterized by the absence of "modulation noise" or "noise behind the signal." This effect is produced in direct recorders by AM components which are the result of flutter, and variations in tape roughness.

High Costs

The disadvantageous aspects of FM recording are almost entirely associated with cost. The circuitry, both record and playback, is somewhat more complex than that for direct magnetic recording. The signal-to-noise ratio of any FM magnetic recorder is limited by the motional stability of the tape transport, since wow and flutter are equivalent to FM so far as the carrier is concerned, and therefore constitute modulation, producing output in the form of noise. Thus flutter and wow in the tape transport mechanism are represented directly as noise in recorders of this type. In comparison with direct recording, tape economy is poor when compared on an information basis, since the upper frequency limit of FM systems is approximately 20% of that possible with direct recording at similar velocities. This is because the upper frequency recorded on the tape as information may ordinarily not exceed 20% of the carrier frequency. However, since recording is possible essentially down to 0 cycles, the number of octaves of information which may be recorded on FM systems approaches infinity.

The requirements imposed upon the mechanical and electronic components of the system in order to exploit the advantages of this type of recording include the reduction of speed variations in the transport mechanism to very low limits. For example, it is necessary to limit flutter and wow to approximately 0.2% rms throughout the entire pass band of the recorder in order to reach a signal-to-noise ratio of 46 db. This is, of course, a much more severe limitation than that which is imposed upon the direct recorder

of audio material. With a single saturated carrier the above requirements must be met. With multiple carriers on one track, however, the flutter requirements become still more stringent since a much narrower peak frequency deviation is permissible. Using R.D.B. standards the usual deviation is 7½% of the carrier frequency. Under such conditions the effect of the flutter is about seven times greater than with, for example, a 50% deviation standard. Under such conditions, to get an overall accuracy through a channel of the system of 1%, the speed variations due to the recorder transport mechanism would have to be limited to approximately 0.1% peak-to-peak. If we assume that the flutter is sinusoidal, this would correspond to 0.035% on the usual RMS flutter-measuring standard. Such accuracies can be obtained when the tape is handled with the greatest precision.

With a machine which embodies the mechanical characteristics necessary to reach this degree of performance, the possibility is open to use FM systems for audio recordings whose ultimate signal-to-noise capability might be as high as 80 db, and whose frequency range would be restricted only by the design of the associated amplification. Additional improvement, even beyond this, is conceivable with multiple track systems, whose multiplicity permits flutter compensation and record track redundancy to eliminate pops from "dropouts," and further to reduce the background noise due to flutter.

The electronic apparatus for any of the various FM forms of magnetic recording must have excellent ac and dc drift characteristics. This requires feedback type ac amplifiers, drift-compensated dc amplifiers, stabilized dc supplies, regulated filament supplies, and components with small temperature coefficients.

RETMA AWARDS

Leslie F. Muter (l), RETMA treasurer, presents Certificate of Award to A. V. Loughren, who accepted for all members of NTSC, for Committee's work in developing color TV standards. Similar awards were made to Dr. O. H. Caldwell and Dr. A. F. Murray of the editorial staff of TELE-TECH & ELECTRONICS INDUSTRIES.

Antenna Coupler

(*Continued from page* 88)

the unit and contains all components in the coupling circuit, including the following major items: (See Fig. 5.)

(1) a section of the main coaxial transmission line, cut away lengthwise so as to expose the inner conductor;

(2) a coupling element or stub, adjustable to a quarter wavelength at any frequency in the operating band;

(3) a movable platform which supports the stub and carries it parallel to the cutaway section of line;

(4) a contact spring and an apron extension of the cutaway outer conductor to provide a sliding contact between the platform and the main line;

(5) a coaxial transmitter-receiver feed line consisting of two telescoping sections to permit motion of the platform; and

(6) part of the drive mechanism and a counter-balancing spring assembly.

The ends of the cutaway section of main line are provided with elbow fittings so as to bring the line out through the sides of the unit. At the lower left side of unit No. 1, (numbering from left to right) in the coupler system, the elbow is fitted with a shorting bar which short-circuits the main transmission line. All the other main-line elbows in the system have alternating plug and receptacle-type fittings which plug together when the units are arranged into a group so that the line is continuous from the short circuit to the antenna (see Fig. 3).

Coupling Stub

The quarter-wave coupling stub consists of two telescoping sections of tubing with the outer member secured to the platform by a short post. A "finger" spring located at one end of the stationary part provides electrical contact between the two sections. The mounting post projects at right angles to the coupler, and thus serves not only to secure the coupler to the platform but also to space the coupler the proper distance above the platform and to hold the coupler parallel to the main line. Furthermore, this post provides an r-f ground for the coupler and a point of attachment for the feed-line inner conductor. The movable portion of the coupler is driven by a lead screw which in turn is driven by a train of bevel gears and

shafts passing down through the ground post and the platform to a pinion gear. The latter is driven by a pinion rod which extends over the length of the platform travel, thus providing a means for driving the coupler regardless of the position of the platform in the r-f coupling section.

The platform is supported by four rollers which engage with a pair of guide rails. It is capable of moving 20 in., or approximately 0.4 wavelength at 230 Mc. Thus the coupler or coupling point in any unit in the system can be shifted by this amount with respect to the short circuit on the main line. The platform serves as a ground for r-f in the coupling circuit and hence must make positive electrical contact with the outer conductor of the cutaway line. The motion of the platform requires this to be a sliding contact, which is provided by a spring secured to the platform and bearing against an apron extension of the main-line outer conductor. The spring is specially designed to produce sufficient contact pressure on the apron to give a low-resistance contact but not overload the automatic drive mechanism.

Platform-Drive

The platform-drive mechanism consists of a system of bevel gears, shafts, sprockets, and a chain. The platform and stub main-drive shafts are coupled to the tuning section mechanism by means of multi-jaw couplings so that the drive assembly can be readily disengaged from the r-f coupling section assembly.

Since one end of the feedline is attached to the movable platform, the length of this line must be variable. This line is therefore made up of two telescoping sections of coaxial line having a characteristic impedance of approximately 50 ohms to match the other lines in the system. The inner conductor of the feed line attaches to the supporting post on the stub at a point $\frac{9}{32}$-in. above the platform. This feed-point dimension which was arrived at experimentally presents a resistive load of 50 ohms at the input terminal of the feed line when the coupler is properly tuned to an operation frequency.

The counterbalancing spring is added to assist the tuning section in lifting the mass of the platform against the gravitational force and against friction in the sliding contacts. It is of the flat spiral type which is wound up for energy storage when the platform descends in the r-f coupling section. The energy so stored is used during the first

Antenna Coupler

(*Continued from page* 179)

half of a tuning cycle when the platform travels to the upper end or "home" position in the r-f coupling section. Also it adds support to the platform when at rest either in the automatic or manual coupler.

Reflectometer

A schematic diagram of the reflectometer is shown in Fig. 6. This device, located in the feedline between the input terminal and the telescoping section, is a detector or directional coupler which, when properly oriented in its mounting, will pick up and rectify the wave reflected from the coupling circuit back toward the transmitter, the rectified dc being shown on a microammeter. When the coupler is energized at some operating frequency and the reflectometer output meter reads zero, then there is no reflected wave and the coupler is properly tuned and presents a 50-ohm resistive load to the transmitter.

The pickup loop couples to the inner conductor of the feed line. The plane of this U-shaped loop is normally parallel to the axis of the feed line, one end being connected to ground through resistor R703 while the other connects to crystal detector CR701 and thence through current-limiting resistor R704 to dc microammeter M701 and to ground. Capacitor C702 is an r-f by-pass for meter M701. Capacitor C701 is a small capacitance which adds to the capacitance between inductance L701 and the inner conductor of the transmission line to provide the correct amount of capacitive coupling.

The voltage applied to the detector is the vector sum of the components due to inductive and to capacitive coupling. R703 controls the relative magnitudes of these two components. As the angle which the loop makes with the axis of the line changes, the amplitude of the inductive component varies from zero to a maximum while the capacitive component remains constant. The phase of the inductive component is reversed by rotating the loop through 180°. Therefore, at some orientation of the loop the currents due to the two components will cancel, provided that resistor R703 is the correct value. Cancellation occurs when there is no reflected wave on the line if the following conditions are satisfied:

(1) The capacitive coupling be

very small,

(2) The inductance of the loop be negligible compared with resistance R703,

(3) Resistance R703 be noninductive.

Under these conditions cancellation is independent of frequency. Thus, when the loop is oriented to pick up the reflected wave on the line and when the coupling-circuit impedance in the coupler is adjusted to match the 50-ohm feed line, then there is no reflected wave and the meter M701 will read zero.

Automatic Tuning Section

The drive mechanism for the (CU-255/UR) automatic coupler, which permits either manual or automatic tuning of the two variable elements (coupler and line tuning), is an electrically-controlled mechanical-drive system designed to work primarily in conjunction with the Model TDZ transmitting equipment. Automatic tuning of the coupler to ten preset channels is obtained merely by dialing the desired channel number on the TDZ transmitter. In this drive system the same type of autotune mechanisms and electrical components and the same circuit arrangement are used as in the master automatic-tuning-control system in the TDZ transmiter and many other common communications equipments. Hence the same power-supply and control voltages are required (115 volts ac and 48 volts dc). Both of these voltages are available in the transmitter and thus no auxiliary power is needed.

The drive mechanism for the CU-332A/UR coupler provides two hand cranks for coupler and line tuning and must be reset manually each time the operating frequency is changed.

Signal Generator

(*Continued from page* 93)

pacity of the input to the first filter section appears as a low impedance at the higher frequencies of the desired mode, so that the terminating characteristics of the plunger are not significantly affected in this region. As a result of this arrangement, the resonator appears to the tube as a terminated transmission line at frequencies below 6,500 MC and as a shorted, tunable, high-Q transmission line resonator at frequencies above 6,500 MC.

Peripheral resonances, if they occur in or near the frequency range of the resonator and are not sup-

Signal Generator

(*Continued from page* 181)

pressed, will absorb power from the resonator and will usually damp the oscillations completely. Such resonances can occur with a non-contacting type plunger because the periphery of the plunger acts with the surface of the resonator to form a type of strip transmission line which is circled back on itself.

To suppress a peripheral resonance that occurred in the gap between the plunger and the center conductor, the gap has been dielectrically loaded by means of a plastic sheath. This has the effect of lowering the frequency of the resonance to a frequency below the frequency range of the generator where it is ineffective.

Output Attenuator

A feature which is unusual for a wide-band generator in this frequency range is that the output attenuator is direct-reading and does not require correction for frequency effects. The attenuator used in the generator is a waveguide-beyond-cutoff type, a type which is unexcelled for signal generator use because of its high accuracy.

In designing such an attenuator for use over wide frequency and attenuation ranges, it is desirable that the cutoff frequency of the attenuator be approximately 10 times the highest frequency at which the attenuator is to be used. In this case, where the highest frequency used is 11 KMC, this requirement would mean that the cutoff frequency of the attenuator would have to be in excess of 100 KMC, or in physical terms about 1.6 mm in diameter. The attenuator plunger and pickup loop would thus have to be constructed to clear this small diameter. At best this would be a painstaking and consequently expensive assembly operation.

To avoid this situation, an arrangement has been used whereby the diameter of the attenuator waveguide has been increased to more practical dimensions. However, the frequency effect that is incurred by increasing the attenuator dimensions has been held to a quite acceptable value by distributing the total effect over the frequency and attenuation range of the generator.

It should be emphasized that the accuracy of the output level from the generator has a wider tolerance than 0.5 db in order to accommodate impedance mismatches arising from

connector reflections and an imperfect source impedance for the generator.

Because of the small dimensions of these waveguides as described above, the pick-up loops have been designed with a new approach. Instead of forming the pick-up loops from pieces of small wire, the construction shown in Fig. 5 has been used. The leads for the pick-up loops are attached to small glass beads located in the ends of the attenuator and monitor waveguide plungers. A recess is provided in each bead to make this connection mechanically secure. Across the radius of the bead is a raised surface of approximately the same width as the diameter of the lead secured to the bead. This raised surface is coated with a special mixture of platinum so as to have a resistance of approximately 50 ohms. The end result is that the pick-up loop has low inductance and at the same time has a resistive value of approximately the correct value to represent the 50-ohm source impedance desired for the generator. The internal VSWR of the attenuator is better than 2:1 as measured through the panel connector.

Power Monitoring System

The direct-reading power output feature is obtained by providing a reference point for the operation of the output attenuator. This reference point is obtained by sampling the power level in the resonator with a built-in power meter.

The power sample applied to the power meter and the power absorbed by the output attenuator are received by identical pick-up loops that operate in identical waveguides opening into the resonator.

The output attenuator and the power monitor attenuator are each operated by identical gear trains coupled to separate drive shafts on the front panel. The shaft from the output attenuator is coupled to a calibrated dial, while the power monitor is coupled to a concentric shaft operating a fiducial index on the periphery of the calibrated dial.

Since both attenuators are identical and since both are operated by identical gear trains, any change in the field level within the resonator will be reflected in a change in the power monitor meter. When such a change is compensated by adjusting the monitor attenuator, so as to keep a constant meter reading, the fiducial for the attenuator dial will be automatically rotated the proper amount to correct the reading of the attenuator.

(*Continued on page* 184)

Signal Generator

(*Continued from page* 183)

The power meter consists of a coaxial thermistor mount and d-c Wheatstone bridge of which one arm is the r-f thermistor. As the power monitor attenuator is adjusted, the amount of r-f received changes thereby changing the resistance of the thermistor and causing a deflection on the bridge circuit.

R-F Leakage

Leakage from the resonator itself is kept 90 db below 1 milliwatt as measured with a waveguide horn held next to the resonator. R-f leakage is held to a minimum by use of waveguide-beyond-cutoff techniques and polyiron loaded plastics in the resonator housing. New techniques involving in-place casting of an epoxy resin and polyiron mixture were used to obtain this low value of leakage. The aluminum cabinet adds another 20 or 30 db of protection over and above the 90 dbm leakage.

Forced air cooling is used to keep parts from operating beyond design limits. A blower is located in the lower part of the equipment and forces part of the cool air directly onto the glass seals of the klystron. Comparative tests show glass-to-metal seal temperature near 300° C. without cooling as compared to 140° C. with cooling. Maximum recommended temperatures for seals are 160° C. The remainder of the cool air is circulated around the resonator, power transformer and tubes. A renewable air filter element is mounted at the air airtake.

New Industrial Film

"Stampings for Electronics," a new full color and sound motion picture filmed for John Volkert Metal Stampings Inc. at their plant in Queens Village, N. Y., shows the many processes which go into the production of electron gum elements, tube lugs, shields, and similar metal products.

Each department—design engineering, through the final shipping—is shown making its specific contribution. The film concerns itself particularly with pointing out how precision in the tooling stages, and the designing of accurate progressive dies, can lower production costs.

The 16 mm film will be available for free showings to industrial management, technical societies and other groups.

Carrier System

(*Continued from page 76*)

pass and bandpass filters. The low-pass filter selects voice frequencies up to 3100 or 3400 CPS depending on whether or not out-of-band signaling is used. The bandpass filter picks off signaling frequencies only (3400 and 3550 CPS).

Signaling frequencies are fed to an additional amplifier which drives the discriminator and relay circuitry. Signaling frequencies are also used to control the channel unit flat gain regulator which is located between the receiving bandpass filter and the demodulator.

Operation of this regulator is briefly as follows: Because signaling is on a carrier shift basis, one of the signaling tones is always present in the output of the signaling amplifier. A portion of the signaling tone is rectified and the dc obtained is used to vary the plate current of the amplifier tube. Because the plate current of the amplifier tube flows through a thermistor located in the regulator bridge, variations in plate current cause the gain in the receiving branch of the channel unit to vary.

Transmission characteristics of the channel terminal unit meet requirements for links in the nationwide toll network. Voice frequency bandwidth is essentially flat from 250 to either 3100 or 3400 CPS, at the option of the user. When the unit is connected for four-wire operation, the transmitting branch will operate from speech levels as low as −16 db (referred to the toll switchboard). Output level of the receive branch is +7 db. The flat gain regulator in the channel unit will correct for deviations in received level of approximately ±7 db to within ±1 db. The out-of-band signaling system will reproduce dial pulses at speeds of 7 to 20 CPS with negligible distortion. Ringdown signaling can also be used.

System Regulator

An essential part of any carrier system used for open wire line applications is the equipment providing for maintaining received levels constant over a wide range of line attentuation. In the 45A system this function is accomplished by a completely electronic slope and flat gain regulating device. It corrects for changes in line attenuation, both as it affects the flat gain and the frequency response of the system.

Plug-in subassemblies adapt the

Carrier System

(*Continued from page* 185)

regulator for either the 40 to 88 KC frequency range used in the West-East direction or the 100 to 150 KC frequency range used in the East-West direction. A typical regulator unit is shown in Fig. 5.

The chart in Fig. 6 indicates loss and slope conditions for various typical telephone lines. A 170-mi. line in wet weather has a loss of approximately 48 db at 100 KC and 60 db at 150 KC. Net slope is 12 db. This same line when dry has an attenuation of approximately 38 db at 100 KC and 46 db at 150 KC. The system regulator will automatically correct for loss and slope of this line for either condition with an accuracy of about 1½ db. An even more extreme condition is the case of a 33-mile telephone line in sleet country. This line when dry has a loss of approximately 7 db at 100 KC and about 9 db at 150 KC. During sleet weather with ¼ in. ice on the line, the loss rises to approximately 34 db at 100 KC and to about 60 db at 150 KC. For this extreme the regulator must make up for a maximum attenuation change of approximately 51 db and simultaneously correct for a change in slope of about 24 db. This the regulator does with an error not exceeding approximately 1½ db.

Regulator Operation

Operation of the regulator is controlled by two continuously transmitted pilot tones. These tones are located approximately at opposite ends of the frequency spectrum. In the high frequency direction, for example, the pilot which operates the flat gain corrector is at 99 KC. The pilot which operates the slope correction device is at 150 KC. The regulator samples these two pilots and from them determines the amount of attenuation and slope in the telephone line. It then compensates for this attenuation and slope so that all frequencies between the range of 99 and 150 KC passing through the regulator receive the proper amount of gain and slope correction to make them appear at equal level and at the proper system level at the output of the regulator.

A block diagram showing regulators for both directions of transmission is shown in Fig. 8. The regulator might be considered as an electronic servo-mechanism. In the West-East direction (low frequency group), all frequencies first pass through a line filter equalizer and

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then through a fixed line equalizer which applies a fixed compromise slope correction. Signals then pass through an attenuator network and a feedback controlled amplifier. From there signals pass through a pair of amplifiers whose frequency characteristics can be altered by means of slope networks in their feedback paths. The circuitry up to this point could be considered the mu path of a servo system. At the output of this mu path, an amplifier with highly selective crystal pick-off filters separates the two pilot frequencies from the message frequencies, combines them, and amplifies them. Then they are again separated

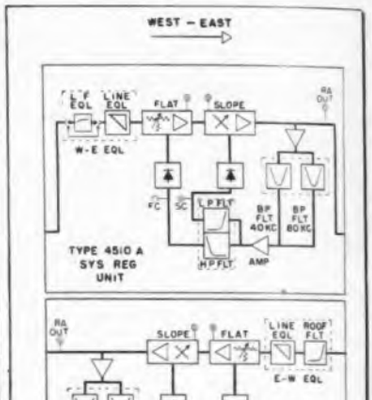

Fig. 7: Regulators for both directions of transmission operate as servos to correct for changes in frequency response and attenuation

by a pair of filters and converted to direct current. This direct current or voltage is compared to a fixed reference voltage and the differential voltage obtained is used to operate a pair of dc control tubes. In the case of the flat gain pilot, the dc control tube operates a group of thermistors in such a way as to cause the gain of the mu path to vary but without respect to frequency. The control tube operated by the slope pilot controls a pair of thermistors which are part of frequency sensitive networks placed in the feedback paths of the slope amplifiers. Variations in control current through these thermistors will cause variation in frequency characteristic of the slope amplifier and these characteristics are so arranged that the flat and

slope pilots always appear at the output of the mu path amplifiers at equal levels or approximately equal levels. Operation of the slope correcting networks is a linear function. Therefore, if the servo action of the regulator causes the slope and flat pilots to appear at equal level at its output, the mu path of the regulator has automatically assumed a slope that is the reciprocal of the slope of the telephone line. This corrects for changes in the frequency response and attenuation of the transmission line.

Frequency Generation System

The carrier frequency supply for the 45A system is contained in three interconnecting units indicated in the block diagram of Fig. 7. Two oven regulated, crystal controlled oscillators are included in one unit. Overall frequency stability of the two oscilators is in the order of magnitude of one part in 10^9. Because all carrier frequencies used in the system are derived from these exceptionally stable oscillators, synchronization of carriers is never required.

One of the master oscillators supplies carrier voltage to the system base group modulator. A choice of four crystals is used to provide a frequency between 187 and 190 KC depending upon the allocation at which the system is to be operated.

The other master oscillator provides a 96 KC signal to one pregroup modulator and to the first frequency divider network. This network divides the 96 KC down to 16, and multiplies it back up again to 64 and 80 KC, the carrier frequency used in the pregroup modulators. The 16-KC output is fed through appropriate filters both directly to one channel carrier supply and to the next frequency divider network. This network divides the 16 KC down to 4 KC, and multiplies it up again to obtain 8, 12, 20 and 24 KC, all of which are channel carrier frequencies. The dividers used are of the regenerative type and require no synchronization. Outputs of the frequency generators are extremely level and stable, and they are free from unwanted harmonics or interfering frequencies.

Conclusions

The three units described briefly here are representative of all equipment deveoped for 45-class carrier systems. Soundness of the development program has been demonstrated by the performance record

Carrier System

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of dozens of 45A and 45BX carrier systems installed during the past year. In all cases, performance has met design objectives in a highly satisfactory manner. A continuing development program is underway to complete the 45-class equipment line and to further improve the utility of various electrical and mechanical equipment features.

Plant Noise

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2. The range of levels remote from the plant shall be 40-90 db.
3. The near or plant range shall be 80-150 db.
4. Community and plant sound level readings shall be recorded at the central control point.
5. The overall frequency response of the system shall be 20-8000 cps.
6. The microphones shall be suitable for continuous operation in all types of weather.
7. The equipment shall be installed to be capable of quick repair and replacement.

Microphone Pickup Equipment

An Altec 21BR type microphone and its associated 157A base is used. This unit, comprising the microphone and its cathode follower tube, is mounted on a pole, approximately 20 ft. high. A sharp spike is provided over this equipment to prevent birds perching on it. At the base of the pole, a weatherproof box is used to enclose the microphone power supply, line amplifier, its power supply, and the leased wire circuit termination. A supply source of 110 volts ac at 3 amperes is required.

Leased Wire Facilities

Between the remote field pickup point and the control center, leased wire circuits are used. These are 600 ohm balanced telephone lines.

Usually the largest portion of the circuit is composed of #19 gage pairs having an attenuation of 1 db per circuit mile at 1000 cycles. Small portions of the total length use smaller gage cable but this added attenuation is negligible compared to the total amount. The 1000 cycle equalized equivalent attenuation varies with the square root of the

Plant Noise

(*Continued from page* 190)

frequency range. The total loss or attenuation is approximately 4 db per circuit mile for an equalized circuit up to 8,000 cps.

The maximum level on the circuit before cross talk appears in adjacent circuits is plus 10 db above the 1 milliwatt reference and the input to the line should be maintained below this value.

The signal-to-noise ratio on a balanced telephone line by the selection of pairs can be as high as 75 db on cable lengths of two to three miles and not less than 50 db.

Central Plant Equipment

The output of the leased wire is terminated in jacks. Each circuit is then supplied with a line amplifier to compensate for the wire loss and provide sufficient output for the recorder, warning lamp, etc.

Selector switches are provided to:

1. Switch any microphone on monitor amplifier.
2. Switch any microphone on recorder.
3. Switch any microphone on analyzer.

In addition the warning light relay is permanently connected across each channel.

A typical installation of this system has been in operation for a period of several months and the observed drift is less than 2 db per month.

A calibration system may be provided with the use of an acoustic calibrator. This unit is placed in close proximity to the microphone and a standardized voltage applied to the unit. This gives an overall sensitivity at 400 cycles for the complete acoustical and electrical equipment.

Factors Influencing Noise

While the emphasis is on gas turbine noise, the power output of propeller driven aircraft has increased during the past several years by a factor of 50%. When the turbo prop operates above Mach No. 1, the noise adds 10-15 db at the blade frequencies and their harmonics.

Many factors are involved in the variation of the sound from aircraft and aircraft engine testing on the ground. Ingard has shown that the short range sound propagation attenuation by wind irregularities (gustiness) often is of major importance in comparison with humidity, fog and rain. The attenuation is a function of the height of the source and the receiver off the ground.

Plant noise

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Normally the wind increases with height above the ground. The presence of wind gradients will reduce shadow formation caused by temperature gradients and the noise reduction due to temperature is available only in the direction against the wind. Therefore, over distances of less than 1 mile gustiness seems to be of major importance in changing attenuation of the sound as it is propagated out from the source into the surrounding community.

Continuous monitoring of the sound is considered necessary because of the many variations encountered. During the day the temperature generally decreases upward and the sound rays will be refracted upward and for some distance the observer will be in a sound shadow. At night there is a general inversion of the temperature gradient and the sound rays will be bent downward. Often the audibility during the night is reported to be greater than during the day.

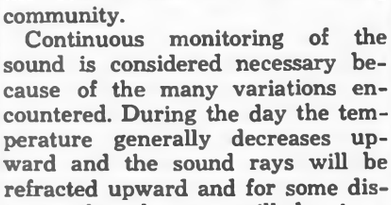

Fig. 3: Maximum daytime sound level permitted in a community before complaints originate

The maximum daytime sound level permissible in a community before complaints originate has been derived, and general agreement has been reached on data as shown in Fig. 3. It is anticipated that nighttime complaints may occur unless the level is held 3 db lower than the curve.

It is on this basis that the warning lights are operated:

Fig. 2 (after Parrack), indicates the various threshold sound levels for the human ear, for sounds throughout the wide range of pressures which could be encountered at aircraft engine plants, as well as by operating personnel working around jet aircraft on the ground.

The sensitivities of the 21BR type microphones are in several ranges and microphones are selected on the basis of the maximum level to be expected in each location.

BULLETINS

Waveguides

Bulletin T-2200 describes a line of microwave duplexers and related equipment manufactured by Airtron Inc, Linden, N.J.

Toroids

Information on a line of adjustable toroidal coils is contained in Bulletin PR available from Hycor Co., Inc., 11423 Vanowen St., N. Hollywood, Calif.

Capacitors

Information on three new additions to the Elmenco line of capacitors is contained in a new release from Arco Electronics Inc., 103 Lafayette St., N.Y. 13, N.Y.

Transformers

A line of new transformers specifically designed for use in voltage regulated power supplies, cathode ray tube suuplies, preamplifiers and vacuum tube voltmeters, are shown in the new Triad Catalog TR-54. Write to Triad Transformer Corp., 4055 Redwood Ave., Venice, Calif.

Tape Splicer

A method for quick and simple editing of magnetic recording tape is described in a catalog describing the MT-1 Presto-Splicer. Available from Prestoseal Mfg. Co. 37-27 33rd St., L.I.C., N.Y.

Potentiometers

Titled "New Potentiometer Developments," a release from Bourns Laboratories, 6135 Magnolia Ave., Riverside, Calif., describes six new models in their line of sub-miniature and precision potentiometers.

Printed Circuits

Six standard pre-fabricated printed circuits designed to save time in assembling "breadboard" circuits and troubleshooting of the finishing equipment are described in a folder available from Tri-Dex Electronics, P.O. Box 1207, Lindsay, Calif.

Ultra-Violet Techniques

A descriptive folder from Ultra-Violet Products Inc., 145 Pasadena Ave., S. Pasadena, Calif. shows uses to which ultra-violet techniques have been applied by industrial organizations.

Test Instruments

The Model 110A X-Band VSWR Indicator and the Supertester are described in two brochures released by Color Television Inc., 973 East San Carlos Ave., San Carlos, Calif.

Metal Powders

A three-page release from Chemalloy-Electronics Inc., Gillespie Airport, Santee, Calif. covers their line of anti-friction metals, metal powders for electrification of liquids, and soldering and welding rods.

Klystrons

A 1-page release from Varian Associates, Palo Alto, Calif. describes their new VA-220 relay klystron designed for the 6-8 KMC band. First showing of this tube will be at the WESCON show.

Pulse Equipment

A line of pulse forming and timing equipment is described in a release from Rutherford Electronics Co., 3707 S. Robertson Blvd., Culver City, Calif.

Components

A bulletin from the Wm. Porter Co., 1007 S. Santa Fe. Los Angeles, Calif. gives technical data on their line of Fibreglass products, which includes coil bobbins, and tubular parts.

Locked Oscillators

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only of a transient nature and the average frequency remains exactly the same as the synchronizing input.

Locking Systems

The simplest system for locking an oscillator might be termed a "brute force" system. The synchronizing signal is injected directly into some portion of the oscillator circuit. Synchronization occurs because of non-linearity in the oscillating circuit. This produces cross modulation between the synchronizing signal and the oscillator signal. The net result of this cross modulation is that the oscillator frequency is shifted towards the synchronizing frequency. The cross modulation is evidenced by the presence of numerous side bands in the output of the oscillator. If the free running frequency of the oscillator is close enough to the synchronizing frequency, the oscillator

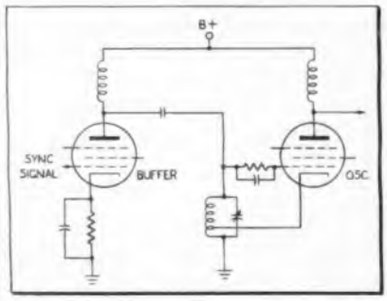

Fig. 5: Frequency meter uses "brute force"

will lock to the synchronizing frequency. The range of turning over which an oscillator will lock depends on several factors among which are the following:

1. In order for lock to occur, there must be some non-linearity in the circuit so that cross modulation can occur.
2. The oscillator must have relatively poor frequency stability in order to lock over a wide range. This is due to the fact that the oscillator can shift only $\pm\pi/2$ radians in phase with respect to the synchronizing signal, referred to the same frequency, before it jumps out of lock. Therefore, a rapid rate of change of phase, with respect to frequency, in the feedback elements of the oscillator will tend to produce a narrow synchronizing range. A rapid rate of change of phase is also a criterion of good fre-

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quency stability in an oscillator, therefore, good frequency stability automatically means a narrow "lock-in" range.

3. The larger the synchronizing signal, the wider will be the "lock-in" range.

Oscillator Injection

There are numerous methods of injecting the synchronizing signal. They can be injected in any place in the circuit where it can cause effective cross modulation. One method which has several advantages is shown in Fig. 5. Here the oscillator to be locked is a Hartley oscillator. The tuned circuit for the oscillator acts as a plate load to a pentode. Synchronizing signal is applied to the grid of the pentode. Since pentodes have a fairly high plate resistance, this arrangement produces a very little loading on the oscillator itself. If the oscillator is tuned to the synchronizing frequency, its tuned circuit presents a high impedence to

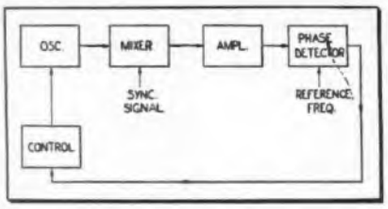

Fig. 6: 500-12,500 MC generator

the plate of the pentode and, therefore, a relatively large amplitude of synchronizing signal is built up across the tuned circuit of the oscillator. This method presents a high impedance to the synchronizing voltage source and produces a substantial amount of gain in the synchronizing voltage. Also this synchronizing source is very effectively isolated from the oscillator so that interactions between the two are greatly reduced. This system cannot be used at very high frequencies, however, because of the capacitive loading due to the pentode buffer. Some improvement may be obtained in this respect by tapping the pentode down on the tuned circuit at the expense of reduced gain for the synchronizing voltage.

Another method for locking an oscillator is the feedback system. Here the phase of the oscillator is compared against the phase of the synchronizing signal in a phase sensitive detector. The output of the

phase sensitive detector is fed back to a control on the oscillator. As the oscillator attempts to depart in phase from the synchronizing signal the control attempts to correct it, provided the feedback is in the proper direction. All the criteria of stability, band width, etc. associated with feedback amplifiers apply to this type of circuit. Since when the system is operating properly there can be only departures in phase, the frequency of the oscillator must be the same as the synchronizing signal. A block diagram of this type of system is shown in Fig. 1.

Frequency Control

Most types of electronic controls which can be applied to oscillators actually control the frequency of the oscillator. An example of this is the common reactance tube type of control. Since phase is the integral of frequency change, the phase output of such a controlled oscillator is proportional to the integral of the input voltage to the control circuit. This is equivalent to introducing a 90° lag into the circuit. Inasmuch as there are other inevitable lags around the feedback loop, it is almost certain that the loop will be unstable at some frequency unless precautions are taken such as the insertion of a correcting net work.

The feedback system offers many advantages. The lock may be made very wide, the only limitations being, (a) the gain around the loop, (b) the frequency response of the loop and (c) linearity of all the circuits. The pull-in range, that is, the maximum discrepancy which can exist between oscillator frequency and synchronizing frequency before the oscillator pulls into synchronization is determined by both the gain and bandwidth of the system. Phase jitter is inversely proportional to both gain and band width. Good frequency stability helps reduce phase jitter.

This type of control can be applied at very high frequencies and even offers a possibility of synchronizing Klystron oscillators whose frequency can be readily controlled by varying the repeller plate voltage. Circuits can be made which will allow synchronization with very weak synchronizing signals. Synchronization can also be made to occur at a frequency a fixed difference from the synchronizing frequency. The major disadvantage of these systems is their relative complexity.

The phase comparison need not be performed at the same frequency as the oscillator signal or the synchro-

Locked Oscillators

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nizing signal. They may be heterodyned down by means of a common local oscillator and compared at some lower frequency. In this system precautions must be taken to prevent the synchronizing signal from feeding down the oscillator channel and vice versa. Another system is shown in Fig. 2. Phase to amplitude conversion and also frequency conversion takes place in the double mixer system. The oscillator frequency is first mixed with the output from a fixed low frequency oscillator in a balanced mixer. The resulting side bands are then mixed with the synchronizing frequency in a second mixer. The resultant output, assuming equality between the oscillator frequency and the synchronizing frequency, is a frequency equal to that of the low frequency oscillator whose amplitude varies as a function of the

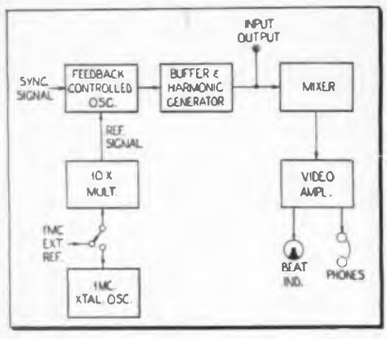

Fig. 7: Oscillator covers range of 500-1,000 MC

phase difference between the oscillator and the synchronizing signal. For certain values of phase difference the output of the mixer is zero and as it passes through zero the output changes its phase with respect to the fixed frequency oscillator. This furnishes a means of determining the sense of phase and, therefore, the loop can be completed by a phase detector which does not limit.

Another system is shown in Fig. 6. Here the oscillator is heterodyned against the synchronizing signal, a fixed frequency away from it. The difference frequency is fed through a filter and amplifier system to one input of a phase detector. The other input to the phase detector is a reference frequency which is equal to the difference frequency. Synchronization occurs when the oscillator frequency is equal to the synchronizing frequency plus or minus the

Locked Oscillators

(*Continued from page 200*)

reference frequency.

There are many other possible systems, however, this discussion will be limited to those outlined above.

An instrument using the "brute force" lock technique is shown in Fig. 3. This is a heterodyne frequency meter having a fundamental range of 20–40 MC. Frequencies are generated within the instrument by mixing harmonics of a 1-MC crystal with an oscillator covering the range of 1 to 2 MC. The difference frequency is used. It is fed to a pentode buffer and used to lock an oscillator as previously described. The output of the locked oscillator is fed to a diode type harmonic generator. The fundamental frequency and its harmonics are then fed either out of the instrument or to a mixer where they can be heterodyned against signals fed into the instrument for measuring purposes. The lock-in range of this particular locked oscillator is of the order of 0.1%.

Feedback Application

An instrument using the feedback type of locked oscillator is shown in Fig. 4. This instrument is used to measure or generate frequencies in the range of 500 to 12,500 MC. It requires for its operation a small synchronizing signal in the range of 500 to 1,000 MC. A block diagram of this instrument is shown in Fig. 7. The oscillator, which covers a range of 500 to 1,000 megacycles, is controlled by a circuit similar to that shown in Fig. 4. The reference frequency used in this case is 10 MC. This is derived either from the internal standard or from external sources. The controlled oscillator is followed by a buffer amplifier and diode type harmonic generator. The fundamental frequency and its harmonics are then fed out of the instrument and also to a mixer for measuring frequencies by comparison against a signal fed into the instrument. The reactance modulator used for control is a shunt type switched diode reactance modulator. The diode used is a germanium diode. The phase detector is a 6BN6 gated beam pantode which is ideal for this system since the reactance modulator requires a constant current source to drive it. Lock-in range varies considerably over the tuning range of the oscillator since the gain of the reactance modulator varies considerably with frequency. The range is of the order of 0.2 to 0.3%. Satisfactory synchro-

Locked Oscillators

(*Continued from page 203*)

nization can be obtained with inputs of the order of 100uv. Output of the instrument is of the order of 1 μwatt in X-band.

Reference

1. Leonard S. Cutler, "An Improved Direct-Reading VHF Frequency Meter," *Tele-Tech*, p. 72, Sept., 1952.

News of MANUFACTURERS' REPS

Richard R. Legg Co., 2118 S.E. Division St., Portland, Ore. has been appointed rep for the Clear Beam antenna line for the states of Washington, Oregon and Montana.

Frank A. Emmet Co., 2837 W. Pico St., Los Angeles, has been appointed to represent the G.E. Co. of England in southern Calif., Ariz., Nevada and N. M. Items for U.S. consumption include telephone relays and measuring instruments. The Emmet organization has also been appointed to represent the Geo. F. Wright Co., Worcester, Mass. manufacturers of steel guy wire and other products.

John B. Tubergen Co., 2232 W. 11th St., Los Angeles, now represents Wen Products, Chicago, makers of soldering guns and sanders, and Videocraft Mfg. Co., Chicago, manufacturers of deflection yokes and magnetic focalizers.

Robert E. McClendon, 3907 Central Ave., E., Albuquerque, N. M., has been named rep for the state of New Mexico by C. P. Clare & Co., Chicago relay manufacturers.

V. T. Rupp Co., 2230 W. 11th St., Los Angeles, Calif., has been appointed rep for Color Television Inc., San Carlos, Calif. for the southern California, Ariz., N.M., and El Paso area.

FATHER-SON TEAMS

Five father-and-son teams at the annual summer meet of the Los Angeles chapter of the Reps are (seated l to r) the dads: D. Wallace, C. Stressner, D. Marshank, J. Hill and C. Stone. Their offspring (standing l to r): W. Wallace, R. Strassner, E. Strassner, N. Marshank, J. T. Hill, J. J. Hill, D. Hill, C. Stone, Jr., and R. Hill. Chapter has membership of 57

TELE-TECH ADVERTISERS — AUGUST, 1954

INDUSTRY NEWS

Frank W. Edmonds has been named president of the recently formed Pacific Div. of Burnell and Co., designers and manufacturers of toroidal coils, audio and r-f filters and related networks. He will make his headquarters at the company's new plant, 720-726 Mission St., S. Pasadena, Calif.

F. W. Edmonds

J. R. Butler

James R. Butler has been appointed director of advertising and sales promotion for Magnecord Inc., manufacturers of magnetic tape equipment. Butler was formerly merchandising and eastern sales manager at Raytheon Mfg. Co.

William J. Gagnon has been appointed general sales manager at Bradley Laboratories Inc., New Haven, Conn., manufacturers of dry disc rectifiers and photoelectric cells. Gagnon was formerly national contract manager for Ultrasonic Corp.

Bennett Archambault has been elected president and a director of Stewart-Warner Corp., Chicago, Ill. He was formerly vice-pres. and general manager of the M. W. Kellogg Co.

B. Archambault

R. L. Weber

Ralph L. Weber, secretary of Gramer Transformer Corp., Chicago, has also been named executive vice-pres. Other promotions were **Burt Anderson,** to vice-pres. in charge of sales and **Fred R. Cooper,** to vice-pres. in charge of engineering.

In Two Sections • Section Two

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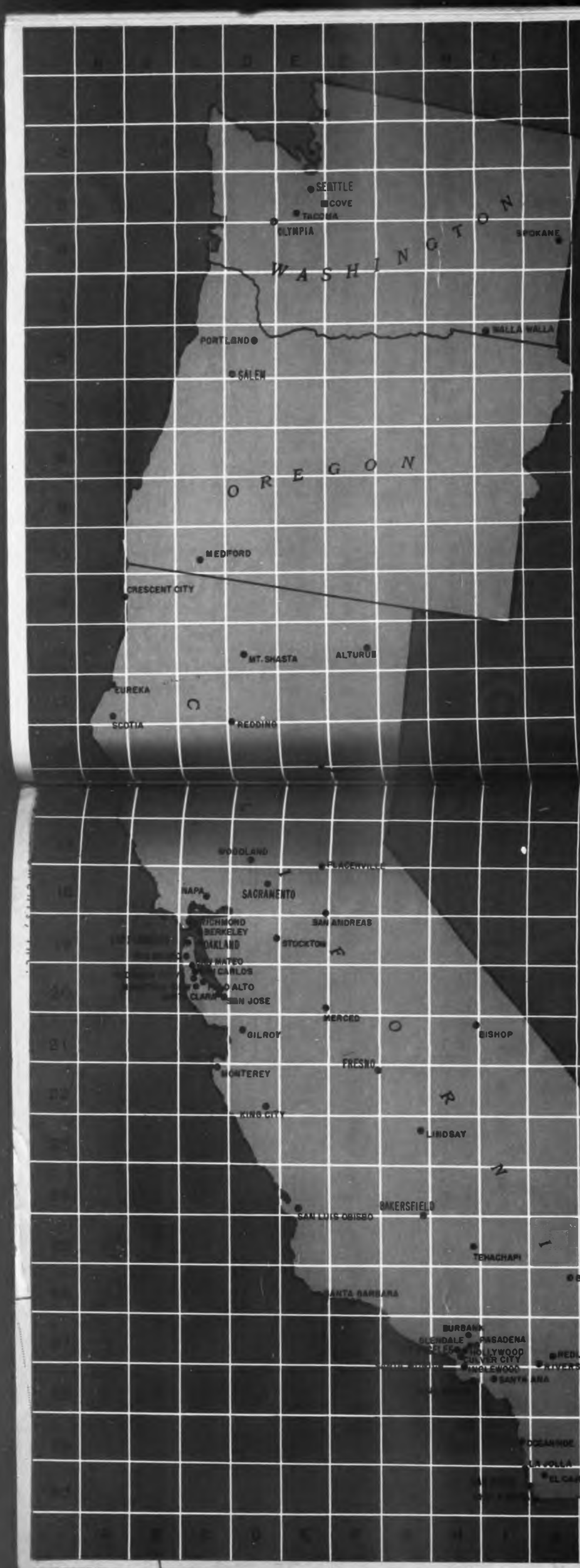
TELE-TECH
& Electronic Industries

CALDWELL-CLEMENTS, INC. 480 Lexington Avenue, New York 17, N. Y. ★ PLaza 9-7880



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WEST

Acme Camera 2704 W Olive Burbank J Kiel VI 9-3144 H-27
Acme Electric 1375 W Jefferson Los Angeles RE 4-3194 H-27
Acme Electronics 2724 Peck Monrovia R D Hallock DO 6-2135 I-27
Acousti-Craft 48 E San Jose Burbank TH 8-7682 H-27
Acra Instruments 168 Vista Pasadena R E Frazier RY 1-7646 H-27
Adel Div General Metals Burbank C A Kehle ST 7-2611 H-27
Advance Elec & Relay 2435 N Naomi Burbank G Wagner VI 9-1446 H-27
Aero-Coupling 3015 Winona Burbank VI 9-3101 H-27
Aero Instr 11423 Vanowen N Hollywood HP Studt ST 7-5433 H-27
Aerosonic Mfg 2015 Pontius Los Angeles L E Bissell AR 3-0634 H-27
Airborne Electronics Van Nuys L W Cannon ST 5-3867 H-27
Aircraft Armaments Pomona R G Hill LY 9-6414 I-27
AiResearch Mfg 9851 Sepulveda Ls Angls W Ramsaur OR 8-3942 H-27
Ajax Condenser 10905 Chandler N Hlyd H Kreinick ST 7-1385 H-27
Allied Elect 425 Brannan San Francisco E Crandall EX 2-0215 C-19
Allied Record 1041 N Las Palmas Hlywd S Salzman HO 9-5107 H-27
Allied Rsrch 1041 N Las Palmas Hollywood M Dike HO 2-1251 H-27
Alloy Die Casting 2211 Firestone Ls Angls C Scott LO 5-7411 H-27
Aloha Radio & TV 330 W Bdwy Long Beach H Putnam 7-4716 H-27
Alsar Mfg Redwood City C R Parmenter EM 8-4701 H-27
Altec Lansing 9356 S Monica Bvly Hls J Hilliard BR 2-6356 H-27
Amelco 2040 Colorado Santa Monica Glenn Carlson EX 3-7281 H-27
American Dia 11858 Miss Ls Angls F Christian AR 7-5627 H-27
American Elec Mtrs 4811 Telegraph Ls Angles J Serafin AN 9-7551 H-27
American Electroneering 2040 Colorado Santa Monica EX 3-7281 H-27
American Electronic 9503 W Jfrsn Culver City H Steele TE 0-5581 H-27
American Gyro 1509 Colorado Santa Monica R Benson EX 5-6755 H-27
American Helic 1800 Rosecranz Mnhtn Bch E Roberts OR 8-7631 H-27
American Microphone 370 S Fr Oks Pasadena J Brown RY 1-7444 I-27
American Vacuum 11779 S Monica W Ls Angles R Hulle AR 9-6212 H-27
Ampex Corp 934 Charter Redwood City Walter Selsted EM 8-1471 C-20
Ampex Ldspkr 6915 Farmdale N Hollywood J Rovenstine ST 7-6057 H-27
Anaheim Div Robertshaw-Fulton Anaheim T H Jeffers KE 5-8151 H-27
Angle Computer 1709 Standard Glendale R Wallace CH 5-2983 H-26
Annin Co 6570 Telegraph Los Angeles R D Randall RA 3-4547 H-27
Applied Elctrncs 1246 Folsom San Franc S Konigsberg MA 1-2634 C-19
Applied Physics 362 W Colorado Pasadena R Vaniman RY 1-7423 H-27
Applied Research Labs Box 1710 Glendale R Lindhurst CH 5-2688 H-26
Arkay Prods 4111 W Jefferson Los Angeles PI 3-2621 H-27
Audio Products 2265 Westwood Los Angeles D Kinsey BR 2-4266 H-27
Avery Adhesive Label 1616 S Calif Monrovia J Lochridge RY 1-5237 H-27
Aves Electric 2010 S Westgate Los Angeles F D Aves BR 2-2958 H-27
Avia Products 7266 Beverly Los Angeles A C Pearson YO 7295 H-27
Avionex Electronics 2838 N Naomi Brbnk L Davidson VI 9-3814 H-27

Babcock Radio 7942 Woodley Van Nuys B V Deltour ST 5-8648 H-27
Background Engrs 7313 Santa Monica Hlywd W Tillisch HO 5-4161 H-27
Bardwell & McAllister 2950 N Ontario Burbank J Bogue VI 9-2341 H-27
Baughman E J 350 S Central Los Angeles E C Baughman MA 9-1403 H-27
Beckman Instruments 820 Mission S Pasadena A Beckman PY 1-2141 H-27
Beckman & Whitley 985 San Carlos San Carlos E Whitley LY 3-7824 C-20
Bender Co 1011 Venice Los Angeles DU 7-6995 H-27
Bendix Av Pac Div 11600 Sherman N Hlywd W Leitch ST 7-2651 H-27
Bendix Comp Div 5630 A Vitae Los Angeles J Williams OR 8-2128 H-27
Bennett Labs 2700 Bay Rd Redwood City A E Bennett EM 6-6845 C-20
Bennett Products P O Box 1055 Palo Alto T Turner DA 2-2119 C-20
Benson-Lehner 2340 Sawtelle Los Angeles M J Bounds BR 2-4629 H-27
Berkly Div Beckman Instr 2200 Wright Richmond J Gordon LA 6-7730 C-20
Berkley Custom Elctrnx 2302 Nevil Berkeley J Klingr TH 3-4180 C-20
Berkley Div Beckman Instr 2200 Wright Richmond J Gordon LA 6-7730 C-20
Berkley Custom Elctrnx 2302 Nevil Berkeley J Klingr TH 3-4180 C-20
Bircher Corp 4371 Valley Los Angeles A G Babcock CA 2-9101 H-27
Bodde Screen 8829 Venice Los Angeles B M Bodde TE 0-3277 H-27
Boeing Airplane Seattle 14, Wash K C Gordon MO 3333 E-3
Bon-Air 711 S Victory Burbank H L Behlman VI 9-3001 H-27
Bono Eng'g 701 W Bdwy Glendale P E Alpine CH 5-2638 H-26
Booth Arthur E 265 S Alexandria Los Angeles W Stewart DU 9-4863 H-27
Bourns Labs 6135 Magnolia Riverside M E Harrison 7290 J-27
Browne Electronics 12450 W Washington Venice J E Browne 7-2156 H-27
Brubaker Mfg 9151 Exposition Los Angeles S F Arn TE 0-6441 H-27
Burnett Radio Lab 4818 Idaho San Diego W L Burnett AT 2-2740 I-30
Burton Mfg 11201 W Pico Los Angeles W B Warren RA 2-3445 H-27

Calhost Eng'g 828 N Highland Hollywood H Fremont HO 3-2119 H-27
Calif Chassis 5445 Century Lynwood NE 6-7777 H-27
Calif Computer Prods 3927 W Jefferson Los Angeles RE 8355 H-27
Califone Corp 1041 N Syeamore Hollywood R G Metzner HO 2-2353 H-27
Calif Electronics 21332 Ventura Woodland Hills DI 8-1558 D-18
Calif Magnetic Cntrl 7245 Atoll N Hlywd H Hornichel ST 7-5927 H-27
Calresin Corp 4543 Brazil Los Angeles W C Lockwood H-27
Caltech Elctrncs 8930 Lindblade Clvr City F Miller TE 0-5745 H-27
Cal-Tronics Corp 11307 Hindry Los Angeles Ray Floyd OR 1-7694 H-27
Caltron Products 1310 S Hobart Los Angeles L Klein RE 4-6144 H-27
Calvideo Tube 5232 W 104 Los Angeles Rindgo Shima OR 8-3979 H-27
Cannon Electric 3209 Humboldt Ls Angls Roger Bowen CA 5-1251 H-27
Canoga Corp 5955 Sepulveda Van Nuys G H Nibbe ST 5-8694 H-27
Capitol Records 5515 Melrose Hollywood E N Eneke HO 3-7114 H-27
Carad Corp 2850 Bay Rd Redwood City N Kovalevski EM 8-4846 C-20
Carruthers & Fernandez 1501 Cirdo S Monica F Fernandez EX 4-6768 H
Cascade Rsrch 53 Victory Ln Los Gatos D Caswell EL Gate 4-1305 D-20
Cntrl Elctrncs 4875 San Fernando W Los Angls F Fisher CH 5-3611 H-2
Century Electronics 14844 Oxnard Van Nuys A Pratt ST 7-1178 H-27
C & H Supply Boeing Field Seattle 8 Wash RA 8111 E-3

TELE-TECH's DIRECTORY of

ST COAST ELECTRONIC INDU

Chase Electronics Lab 2631 Woodlyn Pasadena N Chase SU 7-1441 H-27
Chattin Eng'g 1401 Middle Harbor Oakland C Chattin HI 4-4209 C-19
Chemo-Vac Electronic 760 Reed Santa Clara D Bellis CH 3-0111 C-20
Cherry Rivet 1224 E Delhi M C Ketchum Santa Ana EN 1-1063 I-28
Chromatic TV Labs 703 37th Ave Oakland D R Cone KE 2-6978 C-19
Cinema Engineering Div Aerovox Burbank Chas Bromeer VI 9-2381 H-27
Circon Component Co 17544 Raymer Northridge M J Ainsworth H-27
Clark Electronic Labs Box 165 Palm Springs D B Clark 8-3011 J-27
Clary Multiplier 408 Junipero San Gabriel R Boyden CU 3-2724 H-27
Clear Beam Antenna 100 Prospect Burbank W Maupin VI 9-2141 H-27
Coast Coil Co 5352 W Washington Los Angeles C H Adams WH 0442 H-27
Coast Electronics 130 N Beaudry Los Angeles MI 2848 H-27
Cole Instument 1320 S Grand Los Angeles G Edwards PR 2251 H-27
Coleman Eng'g 6040 W Jefferson Blvd Los Angeles TE 0-5871 H-27
*Collins Radio 2700 W Olive Burbank M L Doelz VI 9-3361 H-27
Color TV 973 E San Carlos J D Adkins LY 3-8466 C-20
Colortronics Inc 3116 Sunset Los Angeles M L Chan NO 3-3228 H-27
Computer Research Hawthorne H H Sarkissian OS 5-1171 H-27
Conrac Inc 19217 E Foothill Glendora J G Jones ED 5-1241 H-27
Conley's Electronics 11612 Ventura N Hlywd D Conley ST 7-1919 H-27
Consolidated Eng'g 300 N Sierra Madre Psdna R L Sink RY 1-8421 H-27
Consolidated Vultee Aircraft San Diego C F McCabe CY 6-6611 J-30
Convair Guided Missile Div Pomona Raymond Soward LO 7-1386 I-27
Cratex Mfg 81 Natoma San Francisco J C Craven GA 1-4845 C-19
Crawford Dimensitone 456 N Rodeo Bvly Hills F Nussbaum BR 2-3231 H-27
Creative Eng'g Corp 10816 Burbk N Hollywood R Blaine ST 7-4759 H-27
Crittenden Transformer 1220 Nadeau Ls Angls H Power KI 6173 H-27
Crosby Enterprises 9028 Sunset Los Angeles E S Kinney BR 2-2771 H-27
Crossley & Jeffries 6456 York Los Angeles W Jeffries CL 7-8271 H-27
Cryco Inc 1138 Mission S Pasadena E W Johnson PY 1-1174 H-27
Cable Corp 2841 Canon San Diego L G Dameson AC 3-8191 J-30
Culbertson Co 8471 Leroy San Gabriel G K Culbertson AT 7-3005 H-27
*Cutler-Hammer 1795 Pasadena Los Angeles W G Topping CA 2-8191 H-27
*Cutler-Hammer 2130 3rd San Francisco C W Ludrigsen HE 1-3835 C-19
Cyclotron Specialties Moraga D R Tibbetts OR 6-4712 C-19

Dallons Labs 5066 Santa Monica Los Angeles O Dallons OL 1951 H-27
Dalmotor Co 1375 Clay Santa Clara Karl Hummel AX 6-5958 C-20
Dalmo Victor 1414 El Camino Real San Carlos W Gates LY 3-3131 C-20
Davis Electronics 4002 Burbank Burbank R Anderson VI 9-1815 H-27
DeCoursey Eng'g Lab Box 2350 Ls Angls W DeCoursey AR 3-2530 H-27
Delta Electral Instr 2700 S Hill Los Angls W Richards PR 0053 H-27
Deltronic Corp 9010 Bellanca Los Angeles W Crawford OR 8-3814 H-27
DeMent Labs New Fliedner Bldg Portland 5 Ore Jack DeMent AT 4489 D-6
DeMornay-Bonardi 780 S Aroyo Psdna G Fonda Bonardi RY 1-7416 H-27
Detectron Corp 5420 Vineland N Hollymood P Swaine ST 7-5349 H-27
Detroit Controls 1650 Bdwy Redwood City H R Hulett EM 8-4107 C-20
Digital Prods 7643 Fay LaJolla G S MacDonnell GL 4-7216 I-29
Dilectron Inc 2661 S Myrtle Monrovia F T Reischel DO 6-2121 H-27
Dillon & Co W C 14620 Keswick Van Nuys R Dillon ST 5-3168 H-27
Dirigo Compass & Instr Box 37 Seattle 8 Wash H Wenger Jr LA 5940 E-30
Dondar Devices 321 E 6th Medford Ore D A Renyard ME 2-9824 C-10
Donner Scientific 2829 7th Berkeley V H Corey BE 7-3150 G-24
Douglas Arcrft 3000 Ocean Pk Santa Monica E F Burton EX 4-3241 H-27
D & R Ltd 402 E Gutierrez Santa Barbara G W Kingman 5-4511 F-26
Dressen-Barnes 250 N Vinedo Pasadena D D [illegible] SY 3-0691 H-27
Dunkle Coil 3257 W 6 St Los Angeles H-27
Dynamic Air Eng'g 7412 Main Ls Angeles [illegible] KI 3292 H-27

*Eastman Kodak 6706 Santa Monica Hollywood [illegible] HO 9-3101 H-27
[illegible] Pitzer RY 1-8357 H-27
Eitel-McCullough 798 San Mateo San [illegible]
Elcon Mfg 436 E Manchester Los Angeles [illegible]
Eldema Corp 5827 E Beverly Los Angeles [illegible]
Electrical Communic 763 Clementina San Franc E [illegible] AL 2-1947 C-19
Electrical Eng'g 4612 W Jefferson Ls Angls G Maurice RE 3-0151 H-27
Electrical Facilities 4224 Holden Oakland H [illegible] Muller OL 3-1661 C-19
Electrical Prods 950 30th Oakland E V Bacigalupi HU 3-9300 C-19
Electrical Svc 1271 Mission San Francisco F Pyce UN 1-2245 C-19
Electro Circuits 401 E Green Pasadena D C [illegible]man RY 1-6311 H-27
Electro Data Corp 717 N Lake Pasadena [illegible]
Electro Development 6006 washington Clvr City R Shuler H-27
Electro Eng'g 6021 College Oakland J J Halloran [illegible] Finch VE 8-0508 H-27
Electro Instr Box S Old San Diego Sta San Diego J Edwards [illegible] 3-1588 C-19 J-30
Electrofilm 7116 Laurel Canyon N Hollywood R E Cramp [illegible] 7-1324 H-27
Electromec Co 3200 N San Fernando Burbank W Howe VI 9-2248 H-27
Electro-Meas 4312 S E Stark Portland Ore M L Roberts FI 9235 D-6
Electro-Mech Snac 6819 Melrose Ls Angls J Goodman WE 3-5866 H-27
Electronic Cntrl 2138 Westwood Ls Angls A Brewer BR 2-6828 H-27
Electronic Devel 3418 W Pico Los Angeles W M Seeley RE 4-1221 H-27
Electronic Eng'g 180 S Alvarado Los Angeles R B Bonney DU 2-7353 H-27
Electronic Medical Fnd 1478 Sacramento Sn Franc H Saine GR 4-0056 C-19
Electronic Proc 1021 San Antonio Ls Alts C Blessing WH 8-2379 H-27
Electronic Prods 322 State Santa Barbara J W Overall F-26
Electronic Specialty 3456 Glendale Ls Angls W D Gibbs NO 2-2168 H-27
Electronic Windings 3001 Verdugo Ls Angls F Pierce CA 2-0138 H-27
Electro Parts Div Coyne Chem Glendale CA 1-2494 H-26
Electro-Pulse 11811 Major Culver City J E Niebuhr TE 0-8006 H-27
Electro Switch & Cntrls 5755 Camille Clvr Cty A Beals TE 0-4643 H-27
El Ray Motor 11747 Vese N Hollywood C H Adams ST 7-1686 H-27
Endevco Corp 180 E Calif Pasadena RY 1-8488 H-27
Engineered Instr 815 Soto Hayward D H Callow JE 7-1545 C-19
Erickson Specialized Tool Pico OX 9-3719
Esco-Lite 4217 W Jefferson Los Angeles RE 1-2263 H-27
Extraders Inc 3232 W El Segundo Hawthorne W Towne OR 8-4071 H-27

Faber Mfg 35 Stillman San Francisco M F Faber EX 2-7302 C-19
Feay Co Neal 427 Olive Santa Barbara D R Fitzgerald 2-0722 F-26
Federal Elec 6446 Santa Monica Ls Angls D Wilson HO 5-7013 H-27
Federal Equipment 38 Brady San Francisco R Randolph UN 3-3607 C-19
Felker Mfg 1128 Border Torrance NE 6-3535 H-28
Fischer & Co R A 525 Commercial Glendale R T DeVries CH 5-2404 H-26
Fisher Research Lab 1961 University Palo Alto G Fisher DA 2-4646 C-20
Fletcher Avia 190 W Colorado Pasadena W S Fletcher RY 1-6761 H-27
Flippen Mfg 132 S Main Orange Calif J A Flippen OR 1687 I-28
Fluke Mfg John 1111 W Nickerson Seattle Wash J Fluke AL 3322 E-3
F & M Sales Inc 1054 Cahuenga Hollywood G J Hider HO 3-1959 H-27
Ford Eng'g 129 E "A" St Upland A S Voak YU 322 H-27
Friden Calculating Mach San Leandro J L Moody SW 8-0700 C-19

Gaertner Radio 3614 Maple Los Angeles E C Ban AD 3-414 H-27
Galetronics Inc 2607 E Foothill Pasadena B F Grimm RY 1-7229 H-27
Gardner Elect 4227 Hollis Emeryville S M Gardner OL 2-7600 C-19
General Controls 801 Allen Glendale W A Ray RO 9-2181 H-26
Genisco Inc 2233 Federal Los Angeles RE Brown AR 9-8913 H-27
Gertsch Products 11846 Miss Los Angeles R Rorden BR 2-1795 H-27
Giannini & Co G M 914 E Green Pasadena C Sardon Jr SY 3-2103 H-27
Gilfillan Bros 1815 Venice Los Angeles H G Tasker DU 7-5131 H-27
Gilendon Electronics Rt 1 Bx 489 Cupertino F W Gillmeister E-20
Girard-Hopkins 1000 40th Oakland J Anderson KE 2-8477 C-19
Glasscraft Co 4755 Telegraph Los Angeles J Voorhees AN 9-7249 H-27
Glass-Engrg Labs 601 O'Neill Belmont H M Warden LY 3-8276 C-19
Glass Solder Eng'g 300 N Lake Pasadena R K Hassler RY 1-5111 H-27
Globe Elect 11019 Buford Inglewood R E Peterson OR 8-4273 H-27
G & M Equip 7315 Varna N Hollywood D J Raleigh PO 5-4185 H-27
Gonset Co 801 S Main Burbank W W Smith VI 9-2222 H-27
Good Inc Don 1014 Fair Oaks S Pasadena Don Good PY 1-1884 H-27
Goslin Electric 2921 W Olive Burbank A J Goslin VI 9-3025 H-27
Greenberg Electronic 1355 Market St San Francisco C-19
Gudeman Co 9200 Exposition Los Angeles D H Allen TE 0-7317 H-27
G W Assoc P O Box 2263 El Segundo G Underberger El Segundo 370 H-27

Hadley R M 5112 S Hoover Los Angeles A H Hadley AD 4-0131 H-27
Hallamore Mfg 2001 E Artesia Long Beach H Karsch 20-1428
Hallen Corp 3503 W Olive Burbank N Bartlett TH 8-6976 H-27
Hallett Mfg 1601 W Florence Inglewood V W Balzer OR 8-4751 H-27
Harder Co D C 3338 India San Diego D C Harder CY 8-2180 J-30
Harworth Mfg Menlo Park K Harworth DA 3-9965 C-20
Holl-Coll Corp 5470 Valley Blvd Los Angeles L K Rimer CA 2-0167 H-27

This directory contains the latest and most complete alphabetical listing of manufacturers in the We[st] Coast electronic industries, together with a quick reference geographical locator. Each line contains th[e] company name, address, name of key person to contact, telephone number, and geographical lette[r-] and-number code which refers to location on map at left. State locations are California unless state[d] otherwise. Companies preceded with an asterisk (*) are Eastern or Midwestern firms with manufacturing facilities on West Coast.

Helipot Corp 916 Meridian S Pasadena Frank Braugh PY 1-2164 H-27
Heller & Assoc H S 8414 W 3rd Los Angeles H S Heller WE 3-6371 H-27
Hercules Elec Mach'y 904 E 148th Compton K F Wharton AD 1-5121 H-27
Hewlett-Packard 395 Page Mill Palo Alto B Bauer DA 5-4451 C-20
H & H Prods Box 2333 Term Annex Ls Angls A Taylor OX 7-4516 H-27
Hiller Helicopters 1350 Willow Palo Alto Wayne Wiesner DA 5-3241 C-20
H M H Industries 746 N Pickering Whittier H M Holmes H-27
Hoffman Radio 3761 S Hill Los Angeles C Wasmansdorff RI 7-9661 H-27
Holl Audio 5020 N Encinita Temple City James Holl AT 7-2902 H-27
Hopkins Eng'g 2082 Lincoln Altadena C W Wieland SY 8-1185 H-27
Houston-Fearless 11801 W Olympic Ls Angls H Houston BR 2-4321 H-27
Howard Industries 2815 W Olive Burbank M L Pfening WE 8-2444 H-27
Hufford Machine 2201 Carmelina Ls Angls B J McComb AR 3771 H-27
Huggins Labs 711 Hamilton Menlo Park L A Roberts DA 2-6989 C-20
Hughes Arcrft Semi-Conductor Div 5305 W 102nd Ls Angls TE 0-7111 H-27
Hughes Research & Devel Culver City F A Hayes TE 0-7111 H-27
Hughey & Phillips 3300 N Sn Frndo Brbnk J Ganzenhuber RO 9-1104 H-27
Hycon Mfg 2961 E Colo Pasadena W McFadden SY 5-4241 H-27
Hycor Co 11423 Vanowen N Hollywood R E Scriegel St 7-5389 H-27
Hydro-Aire Sub Crane 3000 Winona Burbank D A Lichty TH 2-6121 H-27
Induflux Testing 1238 S Gerhart Los Angeles E M Irwin RA 3-7819 H-27
Indl Elctrnc 3973 Lankershim N Hylwd D Gumpertz SU 3-7303 H-27
Industrial Eng'g Pods 7416 Melrose Ls Angls R Benton YO 7167 H-27
Industrial Production 8969 Vernon Upland E A Rein PL 1-4124 H-27
Inet Div Leach Corp 4441 S Santa Fe Ls Angls J Smith LO 8-4771 H-27
Instr Components 1834 Franklin Santa Monica J M Berge EX 3-8239 H-27
Instr Lab 1836 W Florence Los Angeles L R Kettenring PI 2-4104 H-27
Insul-8 Corp 1285 Rollins Burlingame A C Howell DI 4-6871 C-19
*Int'l Business Mach 99 Notre Dame San Jose R Johnson CY 4-3560 E-20
Int'l Electronic Res 175 W Magnolia Burbank L Woods VI 9-2802 H-27
Int'l Rectifier 1521 E Grand El Segundo Eric Lidow OR 8-6281 H-27
Int'l Rsrch 2221 Warwick Santa Monica W Hornbostel TE 0-4415 H-27
Int'l Telemeter 2000 Stoner Los Angeles L N Ridenour AR 8-7751 H-27
Int'l Teletronics 215 Ellsworth San Mateo E M Smith DI 3-9103 C-20
Interstate Eng'g 2250 E Imperial Hwy El Sgndo W Theis OR 7-2128 H-27
Iq Industries 6110 Wilshire Los Angeles S Tongret WE 3-8203 H-27

Jack Scientific Instr Box C-4 Solano Bch U Patchett SK 5-1551 J-30
JaMac Prods 4605 N E 188th Portland Ore D-6
Janco Corp 3111 Winona Burbank J M Norris VI 9-2107 H-27
Javex P O Box 646 Redlands C J Reimuller RE 4-5752 I-27
Jeffries Transformer 1710 E 57th Ls Angls R Persohn LO 8-3436 H-27
Jennings Radio P O Box 1278 San Jose J E Jennings CY 2-4025 I-29
Jobbins Electronic 500 Hamilton Menlo Park C Jobbins DA 2-7661 C-20
Johnson-Williams 2625 Park Palo Alto K W Johnson DA 2-1531 C-20
Jordan Electronic 119 E Union Pasadena J M Bell RY 1-8916 H-27

Kaar Eng'g 2995 Middlefield Palo Alto A B Simpkins DA 3-9001 C-20
Kahl Scientific Instr El Cajon G Walter H 4-5944 J-30
Kaiser Aluminum & Chem 1924 Bdwy Oklnd A deGrassi MA 6-4801 C-19
Karl-Douglas 3160 W El Segundo Hawthorne J Chrisman OR 8-0461 H-27
Kartron P O Box 772 Huntington Beach I-28
Kaye-Halbert 3623 Eastham Culver City R Tauber TE 0-4891 H-27
Kay-Lab Inc 1090 Morena San Diego R E Hangworthy CY 8-6181 J-30
*Kearfott Co 253 N Vinendo Pasadena J R Harkness SY 6-9139 H-27
Keese Eng'g 7356 Santa Monica Hollywood J R Alburger HO 7-5509 H-27
Kelnor Mfg 222 Kearney San Francisco Fred Miller DO 2-2996 C-19
*Ketay Mfg 12833 Simms Hawthorne H Loveman OR 8-6136 H-27
K-F Devel 2606 Spring Redwood City Paul Keeler EM 8-5670 C-20
Kinevox Inc 116 S Hollywoodway Burbank L H Roos VI 9-3291 H-27
Klein Leo 2404 S LaBrea Los Angeles L Klein WA 3119 H-27
Kwikheat Mfg 3732 San Fernando Glendale E E Wachter CH 5-2376 H-26

Lake Mfg 2323 Chestnut Oakland J Aletto TE 2-2498 C-19
La Morre C D 1325 San Julian Los Angeles L M C Givera RI 6378 H-27
Lane Electronics 7254 Atoll N Hollywood R Schollard ST 7-3267 H-27
Lansing Sound 2439 Fletcher Los Angeles W H Thomas NO 3-3218 H-27
Leach Relay 5915 Avalon Los Angeles E M Beale AD 8221 H-27
Lear Inc 11916 W Pico Los Angeles K M Miller AR 9-3751 H-27
Lee Electric & Mfg Box 69695 Ls Angls L Lanhead NO 3-1295 H-27
Lenkurt Electric 1105 County Rd San Carlos K E Appert LY 3-2161 C-20
Levinthal Elctrnc 2821 Fr Oks Rdwd Cty E Levinthal EM 8-2963 C-20
Lewis & Kaufman P O Box 337 Los Gatos N V Bramley EL 4-3540 C-19
Librascope Inc 1607 Flower Glendale D C Webster CI 4-3181 H-26
Lipps Eng'g Edwin A 5485 W Washington Ls Angls C Olson WA 4141 H-27
Litton Industries 336 N Foothill Bvly Hils H Boller CR 4-7344 H-27
Litton Ind 1025 Brittan San Carlos P Crapuchettes LY 3-3124 C-20
Lockheed Aircraft Burbank H L Hibbard ST 7-2711 H-27
Lockheed Missile Systems Div 7701 Woodley Van Nuys ST 7-5421 H-27
Loge Sound Engrs 2171 W Washington Ls Angls J Loge RI 4-9178 H-27
Logistics Rsrch 141 S Pacific Redondo Bch C Williams OR 8-7108 H-27
Luther Electronic 5728 W Washington Ls Angls C Johnson WY 5825 H-27
Lynch Carrier Systems 196 Jesse San Franc W Noller SU 1-1156 C-19
Lynn Electronic 9 W Magnolia Burbank C E Lynn VI 9-2864 H-27

Macson Co 3260 Motor Los Angeles T H MacDonald TE 0-3000 H-27
Mag-Electric Prods 12822 Yukon Hawthorne D H Ranson OR 8-6248 H-27
Magna Electronics 9810 Anza Inglewood D Hausmann OR 8-5675 H-27
Magnasyne Mfg 5517 Satsuma N Hollywood D J White SU 3-6413 H-27
*Magnavox Res Labs 2255 Carmelina Los Angeles I Rankin BR 2-1217 H-27
Magnetec Corp 11785 W Olympic W Los Angeles E J Rogers AR 9-2257 H-27
Magnetic Rcrdrs 7123 Mirs Ls Angls R Maitland-Rhenben WE 3-5545 H-27
Magnetic Rsrch 318 Kansas El Segundo H H Woordemann OR 8-5555 H-27
Manufacturers' Lab 10610 Keswick Sun Valley H P Stark H-27
Marchant Research 1475 Powell Oakland D F White PI 5-7435 C-19
Marco Industries 207 S Helena Anaheim F A Harrington KE 5-6037 I-28
Mars Eng'g 3000 N San Fernando Burbank F S Spiegel VI 9-2261 H-27
Masco Prods 2119 S Sepulveda Los Angeles R L Mathews BR 2-6629 H-27
Master Mobile Mounts 1306 Bond Los Angeles T Fowler RI 7-0638 H-27
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TELE-TECH's

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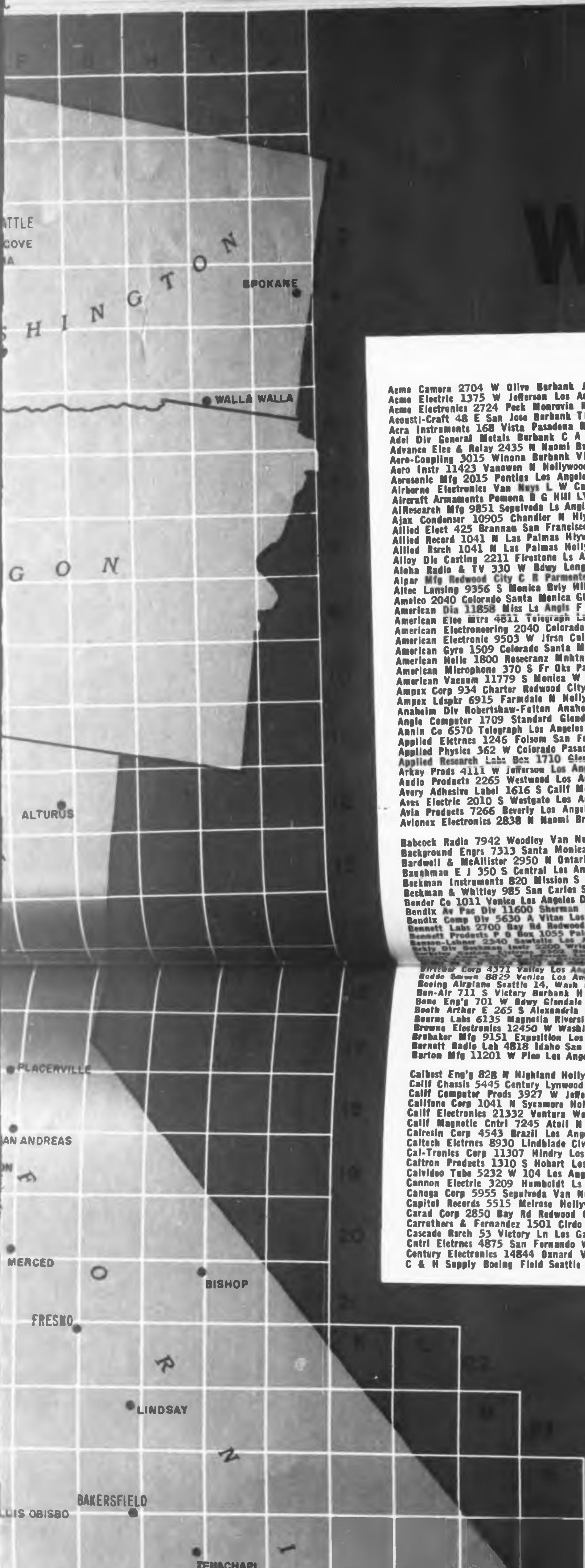

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DIRECTORY of the ELECTRONIC INDUSTRIES

directory contains the latest and most complete alphabetical listing of manufacturers in the West ast electronic industries, together with a quick reference geographical locator. Each line contains the mpany name, address, name of key person to contact, telephone number, and geographical letter--number code which refers to location on map at left. State locations are California unless stated erwise. Companies preceded with an asterisk (*) are Eastern or Midwestern firms with manufacturing ilities on West Coast.

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*Sylvania Electric Prods Mountain View R B Lang YO 7-6981 C-20
Symphony Radio & TV 925 S Western Ls Angls S Solat RE 4-1173 H-27

Tally Register 5300 14th N W Seattle 7 Wash M R Dilling DE 5500 E-3
Tartax Electronics 2979 N Ontario Burbank W T Holmes RO 9-2414 H-27
*Taylor Fibre LaVerne E G Howard MU 1088 H-27
T-Bar-V Productions 5919 Hollywood Hollywood D Fargo HO 3-1088 H-27
Technical Assoc 140 W Providencia Burbank H Grassford VI 9-1994 H-27
Technical Devel 4060 Inco Culver City H T Winchel TE 0-5461 H-27
Techno Instr 6666 Lexington Los Angeles R C Moody GL 3304 H-27
Tecnomatic Instr 2316 Pico Santa Monica H Wolcott EX 9-4872 H-27
Teksom Inc 11368 W Olympic Los Angeles H G Hoffer BR 2-4504 H-27
Tektronix 9450 S W Barnes Portland 7 Ore R L Reploguet CY 2-2611 D-6
Tele-Beam Industries 6th & Soscol Napa Calif R O Bykerk 4-0792 C-18
Telecomputing Corp 133 E Santa Anita Burbank P Simms TH 2-8161 H-27
Telefex Inc 5919 Hollywood Hollywood O Fargo HO 3-1088 H-27
Teletronic Labs 1835 W Rosecrans Gardena L Burkhardt PL 4-3151 H-27
Television Co of America Malibu A M Violante GL 6-2611 H-27
Television Craftsmen 451 N W L Angls E Schwartz HO 1-9911 H-27
Television Prods 1147 N McCadden Hlywd U Strampell HO 4-8253 H-27
Television Remte Cntrl 820 N Fairfax L Angls H Parker YO 1-8264 H-27
Tempo TV Mfg 100 Prospect Burbank W Maupin AX 3-8314 H-27
Tetrad Co 4054 Ocean Park Venice J McGarvey TE 0-5381 H-27
Thermador Elect 2000 S Camfield I Angls J Wardell RA 3-5189 H-27
Thermo Instr 1310 Old County Rd Belmont D M Comb LY 3-5139 C-19
Thomas Assoc 4607 Alger Los Angeles R T MacMillan CH 5-3744 H-27
Thompson Corp G S S Pasadena PL 1-2197 H-27
Thompson Co M I 1611 W Florence Inglewood J Warner OR 8-5621 H-27
Thor Transfmr 750 San Antonio Palo Alto C Carlton YO 7-9116 C-20
Tower Sales 6100 N EColumbia Portland 13 Ore C H Fisher TR 7303 D-6
*Tracerlab 2295 San Pablo Berkley TH 3-2527 G-24
Transco Prods 12210 Nebraska Los Angeles R G Kenway BR 2-5687 H-27
Transformer Engrs 161 E Calif Pasadena J P Whistler RY 1-6906 H-27
Trans-Tel Corp 736 N Highland Hollywood E Faigl HO 2-2463 H-27
Traber Radio Pasadena J King RY 1-6906 H-27
Triad Transformer 4055 Redwood Venice E M Kelliher TE 0-5381 H-27
Tri-Dex Co P O Box 1207 Lindsay K B Howard 2-4051 G-22
Triplett & Barton 831 N Lake Burbank T A Triplett VI 9-1291 H-27
Tropi-Sales 171 Minna San Francisco H Chan YU 2-4157 C-19
Trutone Electronics 812 N Highland L Angls N Cohen HO 4-1202 H-27
Tubing Seal Cap 808 W Santa Anita San Gabriel K Lytle CU 3-2791 I-27
Turbo Jet Prod 424 S San Gabriel San Gabriel R Preston CU 5-5191 I-27
Turner & Co W R 4831 W Jefferson L Angls W Turner RE 1-2279 H-27
T V Wire Prods 119 Prospect Burbank L Mann VI 9-3654 H-27

Ultra-Violet Prods 145 Pasadena S Pasadena I Pfister CL 6-2101 I-27
U M & F Mfg 10929 Van Owen N Hollywood J M Dill ST 7-5526 H-27
Ungar Electric Tools P O Box 312 Venice A R Knowles EX 8-5718 H-27
United Control 4540 Union Bay Seattle J Graybeal PL 9200 E-3
Unitek Corp 275 N Halstead Pasadena A DuFresne SY 5-2377 H-27
Universal Electronics 2012 S Sepulveda L Angls E Lacey OR 8-5229 H-27
Universal Microphone 424 Warren Inglewood J L Kaoo OR 8-4978 H-27
Universal Recorders 6757 Hollywood Hollywood HO 9-8282 H-27
Up-Right Inc 1013 Pardee Berkeley B E Fisher TH 3-0770 G-24
U S Elect Motors 200 E Slauson Los Angeles W M Evans AD 3-3131 H-27
U S Eng'g 521 Commercial Glendale K Robertson CH 5-5777 H-26
U S Relay 1744 Albion Los Angeles P Chamberlin CA 2-9146 H-27

Vacuum Tube Prods 506 S Cleveland Oceanside C L Giles OC 6567 I-29
Vanguard Electronics 3384 Motor L Angls S Colbert TE 0-7344 H-27
Vapor Recovery Systems 2820 N Alameda Compton G Denny NE 6-1211 H-27
Varian Assoc 611 Hansen Way Palo Alto S F Varian DA 5-5631 C-20
Vector Electronic 3352 San Fernando L Angls R Scoville CL 7-8237 H-27
V&H Radio & Electronics 2033 Venice L Angls R Sannett RE 0216 H-27
Vibrotec Corp 425 Bush San Francisco YO 2-5050 C-19
Victorlite Industries 4117 W Jefferson L Angls W Cole RE 2-4033 H-27
Viking Electric 1061 Ingraham Los Angeles H M Greene MI 9487 H-27
Vinson Co E B 1401 Middle Harbor Oakland E Vinson GL 1-2357 C-19

Walkirt Co 145 W Hazel Inglewood H W Beckwith OR 1-0212 H-27
Walsco Electronics 3602 Crenshaw L Angeles F Hurd OX 3-7201 H-27
Waterproof Electric 801 S Main Burbank W W Smith VI 9-2222 H-27
Weingarten Elctrnc 7556 Melrose L Agls B Weingarten WA 5405 H-27
Westberg Mfg 144 S Combs Napa V L Westberg NA 6-9218 C-18
West Coast Electrical 233 W 116 L Angls H Tobias PL 5-1138 H-27
West Coast Electriconics 5873 W Jefferson L Angls H Grove TE 0-7211 H-27
Western Coil Prods 2993 Middlefield Palo Alto F J Bella DA 5-2718 C-20
Wstrn Elctrnc Enstrp 3348 W Cmptn Blvd Gardena A Harris OR 8-4817 H-27
Western Gear P O Box 182 Lynwood Calif J Morris ME 6-2161 H-27
Western Gold & Platinum 589 Bryant Sn Fransco W Hack SU 1-2065 C-19
Western Instr 826 N Victory Burbank A K Edgerton VI 9-3013 H-27
Western Insulated Wire 2425 E 30th Los Angeles E Lewis JE 7103 H-27
Western Radiation 1107 W 24 Los Angeles G L Locher RI 7-8355 H-27
Westline Electronics 11656 W Olympic L Angls E Rogers AR 8-1847 H-27
Westline Prods 600 E 2nd Los Angeles M Kelsey TR 2641 H-27
Wilcox Res 11122 Agoa Vista B Hollywood J Wilcox ST 7-5102 H-27
Whittaker Co 915 N Citrus Los Angeles J W Gilbig HO 4-081 H-27
Wildberg Bros 742 Market San Francisco W T Haley DO 2-3505 C-19
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Wilson Eng'g 2989 Middlefield Palo Alto J C Wilson DA 5-3759 C-20
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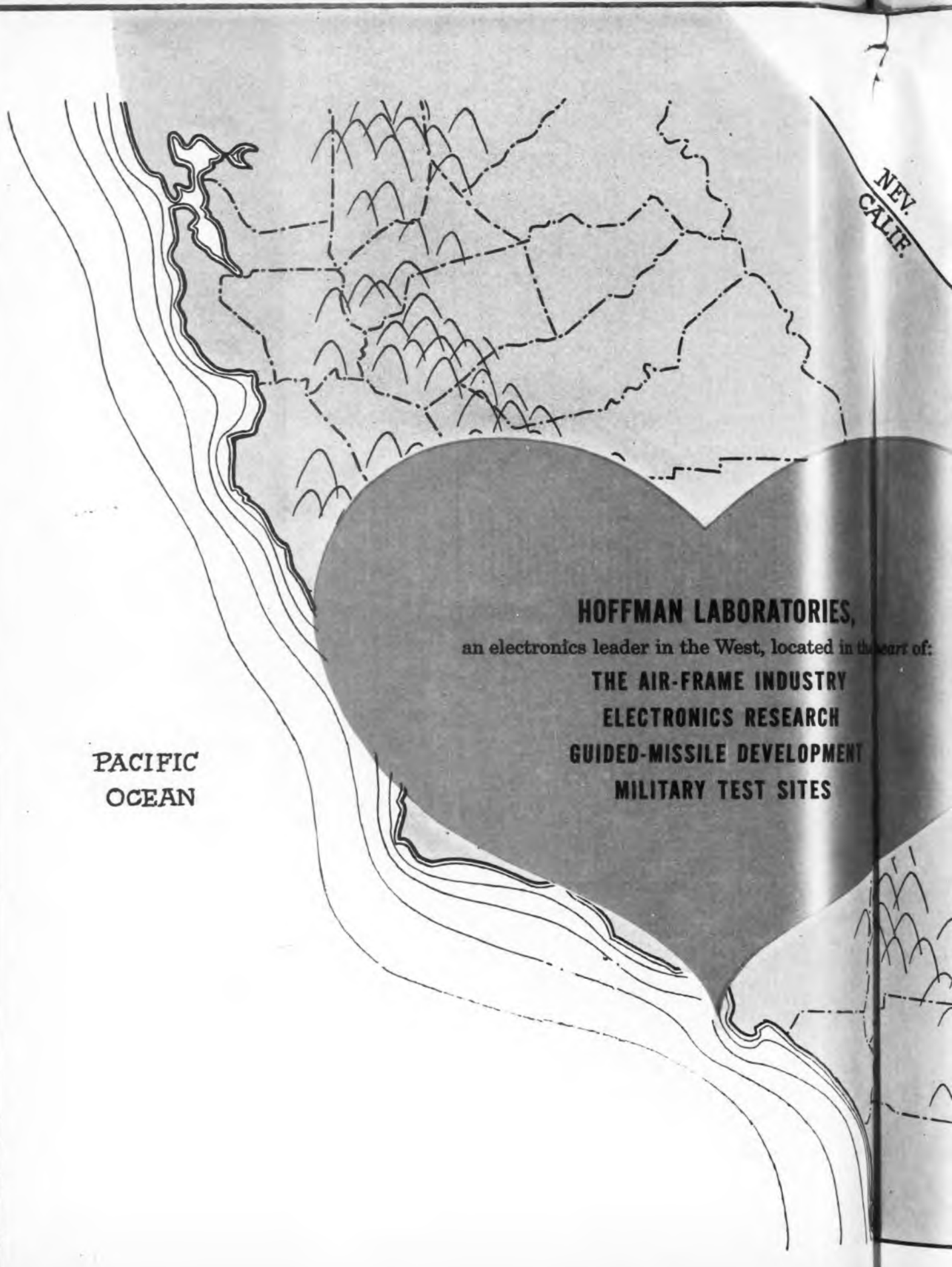
Zinsco Electrical Prods 729 Turner Los Angeles R Locher MA 5-7821 H-27



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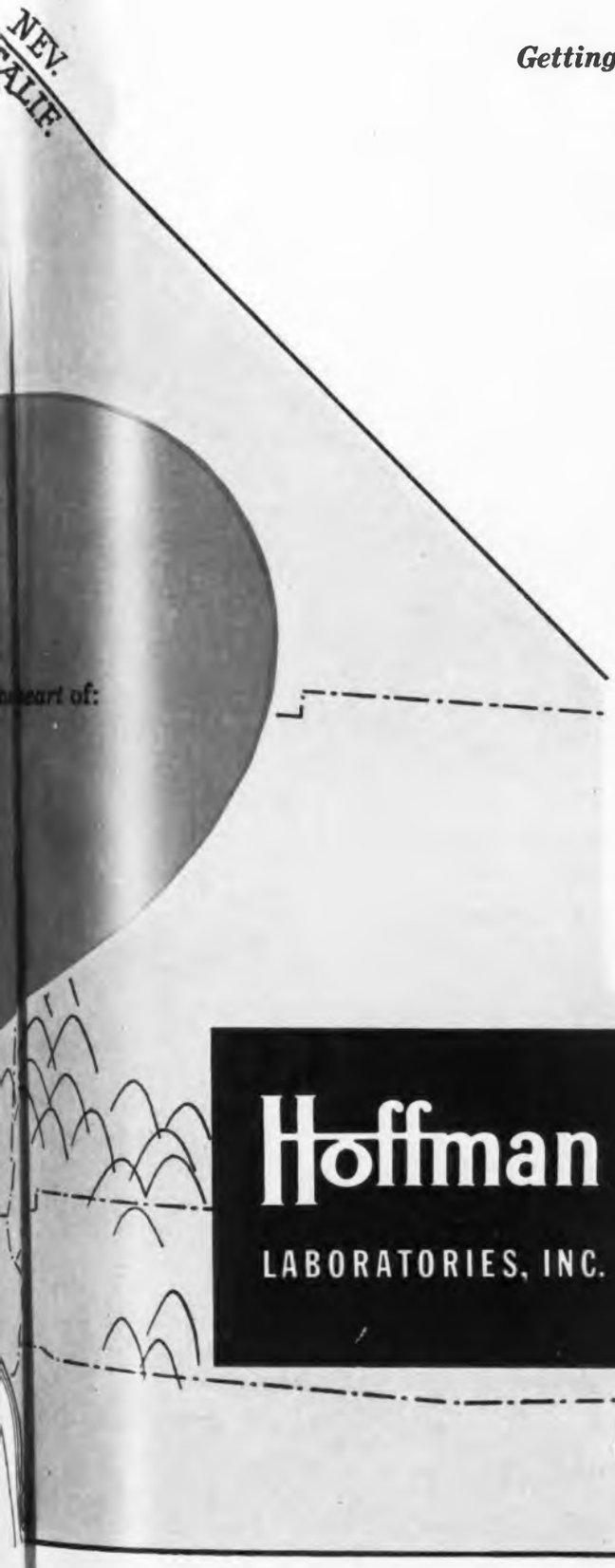

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Since early in World War II, Southern California has become a center of the electronics industry in the United States. Hoffman Laboratories, a western leader and pioneer in this vital field, has grown and expanded with the industry.

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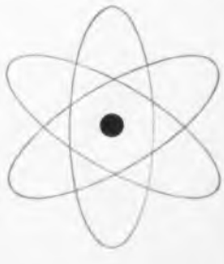

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LABORATORIES. IN

INDUSTRY NEWS

Frank W. Edmonds has been named president of the recently formed Pacific Div. of Burnell and Co., designers and manufacturers of toroidal coils, audio and r-f filters and related networks. He will make his headquarters at the company's new plant, 720-726 Mission St., S. Pasadena, Calif.

F. W. Edmonds

J. R. Butler

James R. Butler has been appointed director of advertising and sales promotion for Magnecord Inc., manufacturers of magnetic tape equipment. Butler was formerly merchandising and eastern sales manager at Raytheon Mfg. Co.

William J. Gagnon has been appointed general sales manager at Bradley Laboratories Inc., New Haven, Conn., manufacturers of dry disc rectifiers and photoelectric cells. Gagnon was formerly national contract manager for Ultrasonic Corp.

Bennett Archambault has been elected president and a director of Stewart-Warner Corp., Chicago, Ill. He was formerly vice-pres. and general manager of the M. W. Kellogg Co.

B. Archambault

R. L. Weber

Ralph L. Weber, secretary of Gramer Transformer Corp., Chicago, has also been named executive vice-pres. Other promotions were **Burt Anderson**, to vice-pres. in charge of sales and **Fred R. Cooper**, to vice-pres. in charge of engineering.

Do you want more information about PRODUCTS *advertised in*

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are using space in this issue to acquaint you with their products. Perhaps you want more information on some of them—on one or two, or possibly a score. You can cover all of your needs with the cards below. They are convenient and postfree.

Use the convenient postage-free cards below to get information quickly about products listed here—all advertised in this issue

101 Adams & Westlake Co.—Mercury relays
102 Advance Electric & Relay Co.—Relays
103 Aerovox Corp.—Metallized-paper capacitors
104 Air Associates, Inc.—Engineering
105 Aircraft Radio Corp.—Navigational equipment
106 Alden Products Co.—Plug-in components
107 American Electrical Heater Co.—Soldering irons
108 American Lava Corp.—Ceramics
109 American Phenolic Corp.—Cables & connectors
110 Ampex Corp.—Tape recorder
111 Andrew Corp.—Air dielectric cable
112 Arnold Engineering Co.—Magnetic materials
113 Assembly Products, Inc—Meter-relays
114 Astron Corp.—Capacitors
115 Audio Devices, Inc.—Magnetic tape
116 Audio Development Co.—Transformers & chokes
117 Avery Adhesive Label Corp.—Pressure-sensitive labels
118 Bardwell & McAlister, Inc.—TV spots
119 Bendix Aviation Corp., Scintilla Div.—Connectors
120 Berndt-Bach, Inc.—Kinescope recording camera
121 Bird Electronic Corp.—R-F wattmeter
122 Blaw-Knox Co.—Antenna towers
123 Bodnar Industries, Inc.—Plastic Lighting plates
124 Bomac Laboratories, Inc.—Reference cavities
125 Bourns Laboratories—Subminiature potentiometers
126 Bradley Laboratories, Inc.—Selenium rectifiers
127 Burnell & Co., Inc.—Filter networks, toroids
128 Burroughs Corp.—Pulse equipment
129 Bussman Manufacturing Co.—Fuses
130 Camera Equipment Co.—TV tripods, dollies
131 Cargo Packers, Inc.—Shock-proof packaging
132 Ceco Distributing Corp.—All-directional dolly
133 Chatham Electronics Corp.—Special-purpose tubes
134 Chicago Telephone Supply Corp.—Variable resistors
135 Cinch Manufacturing Corp.—Miniaturized connectors
136 Cinema Engineering Co.—Sound effects filter
137 Clark Crystal Co., Inc.—Crystals
138 Clarostat Mfg. Co., Inc—Miniaturized controls
139 Cleveland Container Co.—Phenolic tubing
140 Clippard Instrument Laboratory—Aids to automation
141 Coaxial Connector Co.—Coaxial Connectors
142 Collins Radio Co.—Broadcast equipment
143 Communication Accessories Co.—Engineering personnel
144 Continental Carbon, Inc.—Metal film resistors
145 Corning Glass Works—Capacitors, insulators
146 Crosby Enterprises, Bing—Tape recorder, distributor
147 Cubic Corp.—VSWR instrumentation system
148 Cunningham, Son & Co., Inc., James—Crossbar switch
149 Daga Electric Co., Inc.—Connectors
150 Dale Products, Inc.—Miniature power resistors
151 Dallons Laboratories, Inc.—Ultrasonic cleaning machine
152 Diamond Manufacturing Corp.—Connectors, test jacks
153 Diamond Microwave Corp.—Microwave products
154 Dumont Labs., Inc., Allen B.—Color TV picture tubes
155 Eitel-McCullough, Inc.—Reflex klystrons
156 Electrical Industries—Terminals & closures
157 Electro Development Co.—Slip ring & brush assemblies
158 Electro-Pulse, Inc—Pulse Generator
159 Electronic Fabricators, Inc.—Miniature film capacitors
160 Electronic Tube Corp.—Oscilloscopes
161 Equipto Div., Aurora Equipment Co.—Steel shelving
162 Eraser Co., Inc.—Wire stripper
163 Fairchild Camera & Instruments Corp.—Precision potentiometers
163A Fairchild Recording Equipment Co.—Phono. turntable
164 Federal Screw Products, Inc.—Hardware for electronics
165 Ford Instrument Corp.—Precision cams
166 Freed Transformer Co., Inc.—Test instruments
167 Gabriel Electronics Div., Gabriel Co.—Antennas
168 Garde Mfg. Co.—Barrier strips
169 General Electric Co.—Germanium diodes
170 General Electric Co.—TV slide scanner
171 General Precision Lab., Inc.—Color TV test equipment
172 General Radio Co.—Vacuum tube bridge
173 General Transformer Co.—Transformers
174 Gertsch Products, Inc.—Microwave frequency multiplier
175 Grant Pulley & Hardware Corp.—Industrial slides
176 Graphite Metallizing Corp.—Brushes contacts
177 Grayhill—Push button switch
178 Gudebrod Bros., Silk Co., Inc.—Nylon lacing tapes
179 Hart Manufacturing Co.—Hermatically sealed relays
180 Helipot Corp.—Free potentiometer manual
181 Hemingway & Bartlett Mfg. Co.—Lacing cords & Tapes
182 Heppner Manufacturing Co.—Magnetic focusing unit
183 Hermatic Seal Products Co.—Glass-to-metal seals
184 Hewlett-Packard Co.—Signal generators
185 Hoffman Radio Corp.—Engineering, Engineering personnel
186 Houston Fearless Corp.—TV film processor
187 Hubbell Inc., Harvey—Multimeters
188 Hughes Aircraft Co., Semiconductor Sales Div.—Germanium diodes
189 Hughes Research & Development Labs.—Engineering personnel
190 Hydro-Aire Inc.—Transistors

Listings continued on next page ▶▶▶

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Listings continued from preceding page

191 **Industrial Hardware Mfg. Co., Inc.**—Sockets, terminal strips, anode connectors
192 **Industrial Test Equipment Co.**—Power oscillator
193 **International Resistance Co.**—Wire wound resistors
194 **Jennings Radio Mfg. Corp.**—Vacuum capacitors
195 **Johnson Co., E. F.**—Pilot lights
196 **Johnson Co., E. F.**—Tip jacks
197 **Jones Div., H. B., Cinch Mfg. Corp.**—Plugs & Sockets
198 **Kahle Engineering Co.**—Manufacturing equipment
199 **Kay Electric Co.**—Test Instruments
200 **Kay-Lab., Inc.**—TV-telephone intercom
201 **Kellogg Switchboard & Supply Co.**—Magnetic impulse counter
202 **Kenyon Transformer Co.**—Transformers
203 **Kester Solder Co.**—Solder
204 **Keystone Products Co.**—Custom transformers
205 **Kierulff Electronics Inc.**—Electronic components & equipment
206 **Kings Electronics Co., Inc.**—Connectors
207 **Klein & Sons, Mathias**—Pliers for electronics
208 **Knights Co., James**—Crystals
209 **Langevin Manufacturing Corp.**—Transformers
210 **Lee Laboratories**—Glass R. F. components
211 **Leland Co., G. H.**—Rotary solenoids
212 **Librascope, Inc.**—X-Y plotter & recorder
213 **Mallory & Co., Inc., P. R.**—Capacitors
214 **May Engineering Co.**—Delay line
215 **Measurements Corp.**—Test equipment
216 **Melpar, Inc.**—Engineering personnel
217 **Microdot Div., Felta Corp.**—Coax connectors
212A **Midland Manufacturing Co.**—Crystals for color TV
213A **Miller Co., J. W.**—Miniature I.F. transformer
214A **Mitchell Industries**—Solder iron
215A **Moseley Co., F. L.**—Graphic recorder
216A **Mycalex Corp. of America**—Printed circuit tube sockets
217A **National Co.**—Popular dials & knobs
218 **National Vulcanized Fibre Co.**—Laminated plastic products
219 **Neeley Enterprises**—Engineering
220 **N.R.K. Mfg. & Engineering Co.**—Microwave assemblies
221 **Ohmite Manufacturing Co.**—Encapsulated resistors
222 **Onan & Sons, D. W.**—5KW engine-generator
223 **Panoramic Radio Products, Inc.**—Spectrum analysers
224 **Phalo Plastics Corp.**—Microphone cables, power supply cords
225 **Phaostron Co.**—Panel instruments
226 **Phelps Dodge Copper Products Corp.**—Coaxial cable
228 **Philco Corp.**—TV remote pickup equipment
229 **Radio Corporation of America**—TV broadcast manual
229 **Phillips Control Corp.**—Relays
230 **Polarad Electronics Corp.**—Microwave signal generators
231 **Polytechnic Research & Development Co.**—Microwave test components
232 **Ponder & Best**—TV lenses
233 **Precision Paper Tube Co.**—Coil bobbins
234 **Presto Recording Corp.**—Recording discs
235 **Prodelin Inc.**—Coaxial transmission lines, towers
236 **Pyramid Electric Co.**—MIL capacitors
237 **Radio Corporation of America**—UHF, color TV tubes
238 **Radio Corporation of America**—Deflection yokes, flybacks
239 **Radio Corporation of America**—TV broadcast manual
240 **Radio Materials Corp.**—Disc capacitors
241 **Raypar Inc.**—Transformers for printed circuits
242 **Raytheon Manufacturing Co.**—Microwave for color TV
243 **Reeves Hoffman Corp.**—Crystals
244 **Rust Industrial Co., Inc**—Remote control system
245 **Sampson Chemical & Pigment Corp.**—Free handbook of radioactive materials
246 **Sarkes Tarzian Inc.**—Selenium rectifiers
247 **Shallcross Manufacturing Co.**—Wheatstone bridges
248 **Shallcross Manufacturing Co.**—Encapsulated resistors
249 **Shure Brothers, Inc.**—Broadcast microphone
250 **Sigma Instruments, Inc**—Relays
251 **Solar Manufacturing Co.**—Capacitors
252 **Specific Products Co.**—Changeable chassis
253 **Sprague Electric Co.**—Precision resistors
254 **Sprague Electric Co.**—Ceramic capacitors
255 **Stainless, Inc.**—Broadcast towers
256 **Standard Piezo Co.**—Crystals
257 **Stoddart Aircraft Radio Co.**—R-F measuring equipment
258 **Stone Paper Tube Co.**—Paper tubing
259 **Stupakoff Ceramic & Manufacturing Co.**—Glass-to-metal seals
260 **Switchcraft, Inc.**—Switches, jacks
261 **Sylvania Electric Products, Inc.**—Planar triodes
262 **Sylvania Electric Products, Inc.**—Sockets
263 **Synthane Corp.**—Laminated plastics
264 **Technology Instrument Corp.**—Video phase meter
265 **Telechrome Inc.**—Video test equipment
266 **Tel-Rad Mfg. Co.**—Deflection yokes
267 **Tempel Manufacturing Co.**—Magnetic steel laminations
268 **Texas Instruments Inc.**—Semiconductors
268A **Thomson Engineering Service**—Sales engineering
269 **Tinnerman Products, Inc.**—Metal fastenings
270 **Transicoil Corp.**—Servo components
271 **Transradio Ltd.**—Coaxial cable
272 **Triad Transformer Corp.**—Transformers
273 **Truscon Steel Div., Republic Steel Corp.**—Antenna towers
274 **Tung-Sol Electric Inc.**—TV receiving tubes
275 **U. M. & F. Manufacturing Corp.**—Expandable chassis
276 **Ungar Electric Tools Inc.**—Soldering Irons
277 **Union Switch & Signal Div., Westinghouse Air Brake Co.**—Railroad signaling systems
278 **United-Carr Fastener Corp.**—Electrical assemblies
279 **U. S. Engineering Co.**—Printed circuits
280 **University Loudspeakers**—Loudspeaker
281 **Varflex Corp.**—Insulating tubing & sleeving
282 **Victoreen Instrument Co.**—VSWR instrumentation system
283 **Walkirt Co.**—Delay multivibrator
284 **Weckesser Co.**—Plastic cable clips
285 **Welch Mfg. Co., W. M.**—Vacuum pump
286A **White Dental Mfg. Co. S. S.**—Crystal manufacturing equipment
287 **Wiedemann Machine Co.**—Color TV chassis
288 **Zoomar Corp.**—Special purpose lenses for TV

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AVERAGE Q	2100
INSERTION LOSS	4.0 db — 6.0 db
TEMPERATURE COMPENSATION	
Room Temp. to 100°C	± 0.3 mc
Room Temp. to 0°C	± 0.3 mc
Room Temp. to −55°C	± 1.0 mc
ATMOSPHERIC PRESSURE	
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