ELECTRONIC INDUSTRIES
& TELE-TECH

1957 Directory
of
Microwave Manufacturers

n this issue:

nstrumentation for Hi-G . . .
Aedical Interference Control

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November • 1956
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ELECTRONIC INDUSTRIES

& TELE-TECH

Vol. 15, No. 11 — **November, 1956**

FRONT COVER: Microwave waveguide configurations herald our 4th annual round-up of microwave equipment manufacturers. In a little over four years this industry has skyrocketed from a research and development phase to an industry grossing more than $35 million annually. The role of microwaves in communication systems for military communication and for pipeline, railroad, telephone and TV services is well known and continue to expand. In this issue please turn to pages 50, 60 and 83 for the latest editorial features on microwaves.

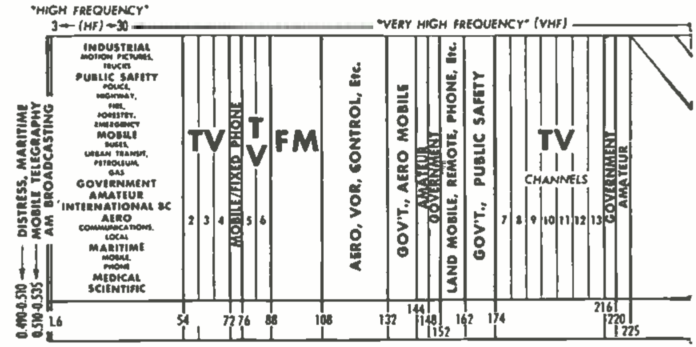
MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

BPA NBP

RADARSCOPE



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

AUTOMATION COSTS MORE! Set makers have found that automatic insertion of components on printed circuit boards sometimes costs more than hand insertion of components. Difficulty appears to be that conventional components have not been re-designed for handling by automatic machinery. Question is: Who will pay component manufacturers for necessary retooling? Thus far set makers need components for lowest costs to meet competition and component makers won't put up venture capital without guaranteed market.

PORTABLE TV sales during the first four months of this year accounted for 17% of total retail sales.

SOAP BUBBLE "ATOMS"

Dr. Wm. Mullins of Westinghouse Research Labs illustrates with soap bubbles how atoms group themselves into orderly "crystal structures." "Bubble" technique permits scientists to investigate on a vastly larger scale the patterns and defect structures formed by atoms in nature.

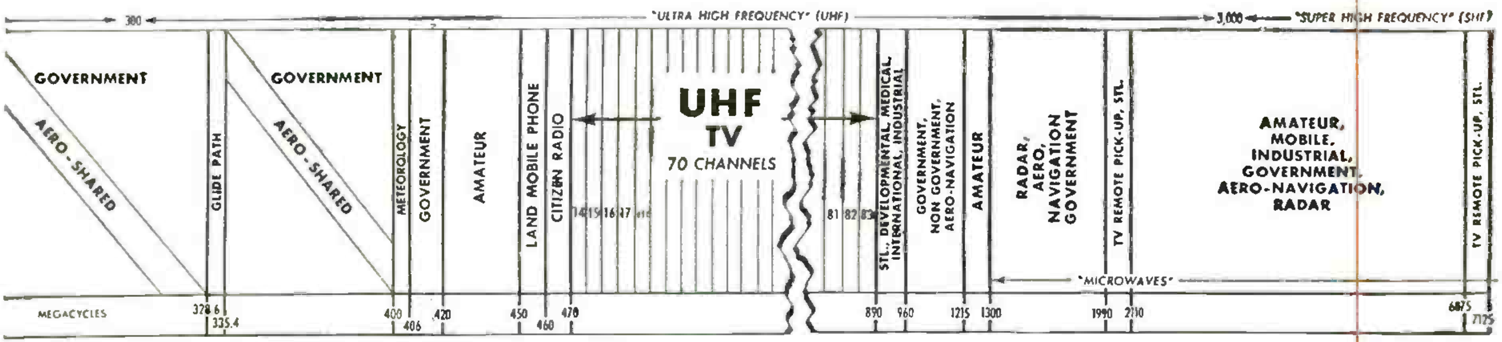
AIRLINER TELEPHONES. We have telephone service available from private automobiles and on railroad trains. But with the public becoming more and more airminded it's a wonder that we don't have a telephone service for passengers aboard airplanes. Many busy traveling business executives would certainly welcome such a service. Aside from being able to transact business enroute to distant cities, travelers would be able to inform home or office of changes on flying schedules, delays, and estimated arrival times. Telephones on airliners are a sorely needed service.

NEW PIEZOELECTRIC MATERIAL for high temperature applications is lead metaniobate. General Electric Co. is now in pilot production of this material which develops small voltages under pressure at temperatures up to 500°C. Missile accelerometers is one obvious application of this new material. Another possible application is in a safety device to detect and control excessive vibration which could damage jet engines.

TRANSISTORIZED TRANSDUCERS are beginning to appear. In these items a miniature battery operated transistor amplifier serves to increase the output signal level of microphones or the power output of loudspeakers. While these devices are momentarily confined to audio applications, the trend toward transistorization of other transducing devices will undoubtedly continue.

TEST EQUIPMENTS of foreign manufacture are becoming increasingly popular as products to sell in the U. S. market. European equipment designs are good and costs of overseas manufacture plus import and distribution costs still permit competitive pricing. At present two major U. S. electronic producers are involved in distribution of such high-quality test equipment and others are eyeing the situation with interest.

ELECTRONIC RAILROADS featuring push button control of a whole system from one headquarters plant, with complete television pictures of all vital operations are among future possibilities, it was reported to the Signal Section of the Assn. of American Railroads. At present one of the top priorities is for cab signals that "tell what to expect where we are going instead of what we have where we are."



PREFERRED TUBE TYPES program will provide greater standardization in TV receiving circuitry. RCA's new listing of preferred tubes includes application, e.g., r-f tuners, deflection oscillators damper circuits, and control circuits.

MINING OF TUNGSTEN, one of four strategic materials, has been temporarily rescued by a government appropriation of $21 million. This appropriation is to carry out a new stockpile program for the maintenance of production of asbestos, fluorspar, and columbium-tantalum, in addition to tungsten.

CANADIAN COLOR TV is marking time waiting for a positive statement from the Royal Commission on Broadcasting. What is needed is a target date for color telecasting so that set manufacturers can be encouraged to tool up.

ELECTRONIC CAMERA

Early reports indicate that a new electronic camera has been developed employing an image iconoscope principle that is capable of providing a good negative or positive print within 12 microseconds after exposure. Official announcements are not expected for about another three months. The camera is suitable for mass use.

AERONAUTICAL COMMUNICATIONS

The 2nd Annual Symposium of Aeronautical Communications held recently in Utica was singularly successful and it appears that this will be an annual event here to stay. Attendance this year was approximately 600 as compared to 400 previously. Some 26 exhibitors had displays in the lobby, mezzanine and ballroom floors of the Hotel Utica. Here are some items of interest that developed during the conference:

MLITARY COMMUNICATIONS . . . Future emphasis is on long distance reliable communication systems with minimum number of intermediate repeater points. Present facilities for traversing North Atlantic singled out as needing immediate improvement.

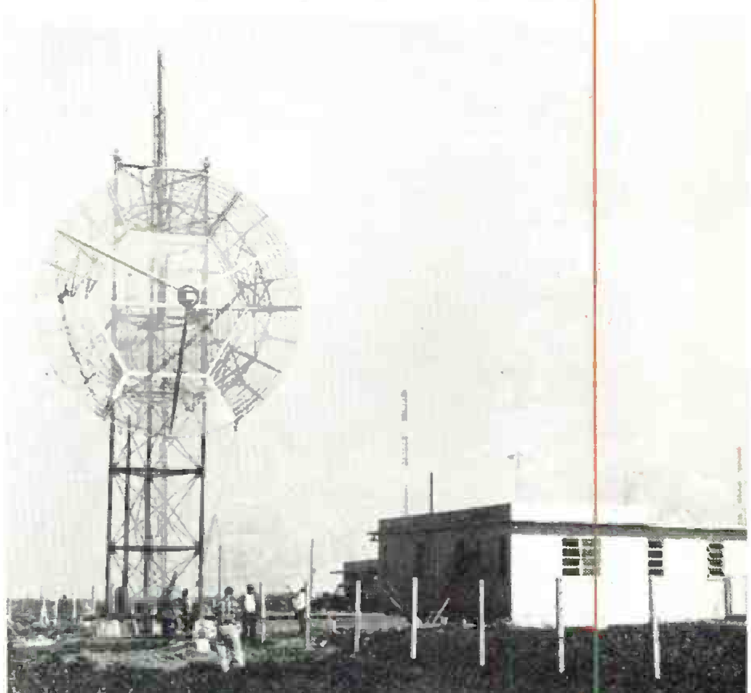
AIR SUPPORTED PARABOLIC ANTENNA for tropospheric scatter communications displayed by Westinghouse drew considerable attention. Unit is made from vinyl-coated fibreglass. Air-supported antenna sits on air-supported column inside-air-supported radome. Antenna has a vapor deposit of aluminum. Contemplated sizes are for a 50 ft. dish supported 50 ft. off the ground.

EXTRA-SENSORY PERCEPTION was subject of keynote address by Dr. J. B. Rhine. The review of activities to date indicate this to be a large new area of research and investigation. Modern electronic equipment such as electroencephalographs and computers have not been employed to fullest extent. Neither have drugs or stimulants. Such faculties in personnel could have important military advantages.

BIGGEST DISH YET. There is some indication that even larger sized parabolic antennas and reflectors than have been used in over the horizon transmissions will be built. A 120 ft. design is reportedly underway. At this rate communication antennas will be the skyscrapers of the future.

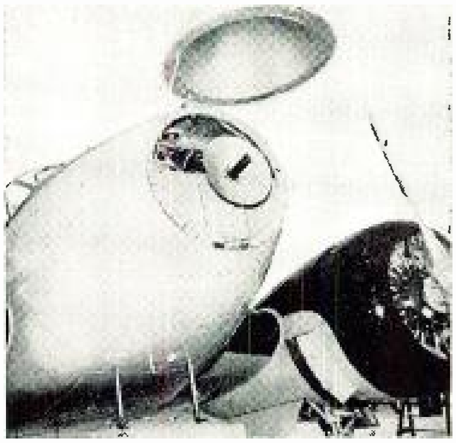
SYNCHRONOUS COMMUNICATIONS, a paper by GE's Dr. J. P. Costas, evoked considerable interest. Dr. Costas believes that present usage of AM does not permit realization of the inherent capabilities of the modulation process. His double sideband system, using coherent detection techniques (no i-fs), he claims is also superior to present single sideband transmissions. More details on this in a later issue.

CARIBBEAN MICROWAVE



This 28-ft. parabolic antenna at Dorado, Puerto Rico, is part of Federal Telecommunication Labs 238-mile "over-the-horizon" microwave link to the Dominican Republic. The link operates on a frequency of 891 MC with a power of 500 watts.

ANTI-STORM RADAR



Small, Light early-warning weather-avoidance radar has been developed by RCA Defense Electronic Products, Camden. This 50-lb. system enables pilots to "see" and avoid storms, turbulent areas up to 50 mis. ahead. For business and private aircraft, this AVQ-50 system meets "flyweight" requirements for such planes. Photo shows radar system's antenna installed in nose of twin-engine business aircraft. Picture of storm formations picked up by antenna is projected on a radarscope mounted in plane's cabin. Commercial production of this radar system planned for late 1956.

Radio Engineers' Jobs

Examinations for Radio Engineer for filling positions in Grades GS-5 and GS-7 with the FCC in Washington and throughout the U. S., its territories and possessions, has been announced by the U. S. Civil Service Commission. Appropriate education or experience, or both, are required.

Application forms may be obtained from Regional Civil Service Offices in key cities (Boston. New York, Philadelphia, Atlanta, Cincinnati, Chicago, Dallas, New Orleans, St. Louis, St. Paul, Denver, Seattle, San Francisco and Los Angeles), or direct from the U. S. Civil Service Commission, Washington 25. Applications accepted until further notice.

Satellite Transmitter

A tiny transmitter, "Minitrack," has been developed by Naval Research Lab. scientists for use in sending signals from the scientific earth satellite to radio tracking stations on the ground. Transmitter weighs 13 ounces, has a 10 milliwatt output, and operates on a fixed frequency of 108 megacycles. Western Electric Co. and Philco Corp. developed the transistors for use in the unit.

Easy-to-Launch, Cheap Missile in 1st Flight

Notable for its low cost and ease of launching, a new, cheap, easy-to-fire two-stage rocket was recently sent on its first flight to an altitude of 80 miles, the Defense Dept. has disclosed. This high altitude research missile is a Defense Dept. project by the University of Maryland; it is called Terrapin, after the University's mascot.

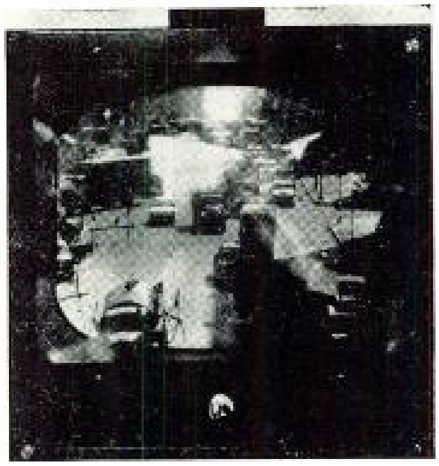
Missile is 15 ft. long, 6½ in. across at its widest point, and weighs 225 lbs. Designed and built by Republic Aviation Corp., Mineola, N. Y., the missile attained a speed of 3,800 mph in its initial test.

Terrapin was designed not as a substitute or competitor for the Vanguard space satellite, but to take atmospheric measurements of the kinds that Vanguard will be able to do.

Enlarge Microwave Lab

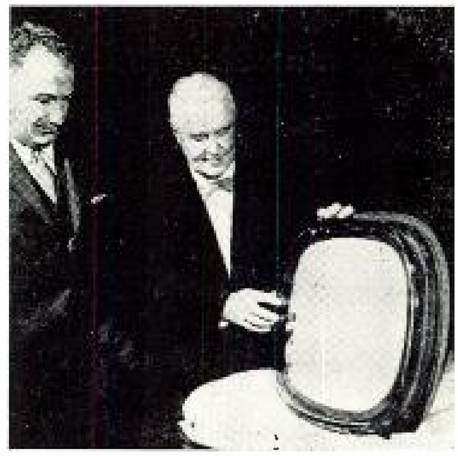
Construction of a second laboratory to be devoted to antenna engineering has been started by the Wheeler Laboratories, Inc., Great Neck, N. Y., a microwave development group. The new quarters will be located on a 12-acre plot at Smithtown, N. Y., and will be an air-conditioned building of 11,000 sq. ft. forming one terminal of a 1,000-ft. antenna range. New facility will be self-contained unit with labs, machine shop and offices.

TRAFFIC WEAPON



Traffic Control by TV is tested on New York's teeming 10th Avenue with this 17-in. monitor. Closed circuit TV test conducted jointly by the Port of N. Y. Authority and General Precision Laboratory.

COLOR TUBE DEAL



Top Officers Examine Tube—The 1,000 fine color lines on screen of the Chromatic single-gun color TV picture tube are pointed out by Paul Raibourn (right), the Chairman of Chromatic TV Labs, to David T. Schultz, President of Du Mont Labs, after they announced that Du Mont will undertake a program leading to commercial production of the simplified tube, and the manufacture of a less complex color television receiver which includes the Chromatic picture tube.

Du Mont to Produce Chromatic Color Tube

Production of the Chromatic single-gun color tube and the color television set using the Chromatron will be undertaken by Du Mont in an agreement reached recently by Allen B. Du Mont Labs and Chromatic TV Labs. It is expected that preparatory work leading to mass production of both the tube and the color receiver will be completed within a year.

Nobel Prize winner Dr. Ernest O. Lawrence, Univ. of California, developed the Chromatic tube, which has a single cathode-ray gun.

Helicopter Problems Given to Inventors

America's inventors are being asked to solve six problems tending to limit the effective operation of Army helicopters. The problems, now in the hands of the National Inventors Council, U. S. Dept. of Commerce, Washington, are: vibration level detector; rotor blade stall indicator; helicopter instrument flight; coating for skis, or ski-type, landing gear; electronic "stethoscope" for gear components in operation; and metal-to-metal bond inspection techniques.

More News on page 6

ELECTRONIC SHORTS

Nearly a half-million electronic tubes ordered at cost of $1,544,631 by Civil Aeronautics Administration for its airway facilities. Tubes, from 39 manufacturers, needed for 81,000 miles of Federal airways.

Radar installation to speed plane landings put into effect at LaGuardia Airport, New York. CAA expects radar to increase rate of instrument landings by over 30%.

IBM Corp., New York, took land options on 224 acres at Yorktown, N. Y., for new research and administrative center.

Topp Industries, Inc., Los Angeles electronics & mfg. firm is buying Heli-Coil Corp., Danbury, Conn., which makes a screw thread insert.

Smaller, lighter TV set development reported by Motorola, Inc., Chicago, and Centralab Div. of Globe-Union., Inc., Milwaukee. Chassis area on 17-in. model is 20 percent smaller, and 97 separate parts are in 17 packaged units to elimininate 90 percent of conventional wiring. Sets to retail at about $150 in Motorola's 1957 line.

Compass system with practically no drift, for precise navigation on long overwater and polar flights, announced by Sperry Gyroscope, Great Neck, N. Y. All-transistorized, equipment is called C-10 Gyrosyn Compass System; it was designed under Air Force standards for lightweight instrumentation providing drift rate of less than three degrees / hour.
Federal Telephone & Radio Corp., an affilitate of IT&T, plans to establish a selenium rectifier plant in Puerto Rico.

Photographic memory that can remember things permanently in three or four colors has been patented by Gilbert W. King, Pacific Palisades, Calif. This memory uses photographic film, and saves space by using same spot for several colors. Patent (No. 2,760,404) is owned by international Telemeter Corp., Los Angeles.

Four were killed and 12 permanently disabled during 1955 working on construction of the Distant Early Warning (DEW) Line in Canada.

An airborne Doppler navigator, that is entirely independent of ground station facilities, has been in production over two years, Marconi's Wireless Telegraph Co., Ltd., announced. Unit gives continuous flow of navigational info.; used with gyro-compass & suitable computer.

Inter-continental ballistic missiles computer, the UNIVAC Scientific 1103A, being used by Lockheed's Missile Systems Div., Van Nuys, Calif. Versatile, lightning-fast computer will be the "heart" of Lockheed's new Palo Alto computer center.

Electronic device to prevent mid-air aircraft collisions has been given top development priority by Collins Radio Co., Cedar Rapids, Ia. Preliminary detection device is expected to be available to airlines in 1958.

Closed circuit TV for RR crossings being tried out by the New York Central at Springfield, Ohio. A single watchman can scan sets and control crossing lights and signals with cameras set up on city streets.

Electronic trail-marking equipment has been successfully tested by the Army. Vehicles following storm-blanketed trails through the Arctic will have guide something like that used by planes following beam in sky.

Educational TV progresses: In Maryland, 6,000 children in Hagerstown's eight public schools officially began to learn by TV, and each pupil will get one hour of TV instruction daily on closed circuit sets; a Ford Foundation agency and RETMA are supporting the project. In New York State, a state-sponsored test in two Long Island high scools and two teachers' colleges began with Dage closed circuit TV equipment.

Coast-to-coast electronic airline reservations network will be installed with Teleregister Corp. equipment by TWA. Three magnetic drum centers, at N.Y., Chicago & L.A., will store space availability info.

Twenty fellowships and 33 scholarships to be awarded in 1956-57 academic year by RCA. Grants are going to over 30 colleges in 20 states and D. C.

Who's News: Dr. Emanuel R. Piore appointed Director of Research by IBM Corp., New York . . . **John F. Sculley** named Asst. Vice Pres.-Adminstration of Western Union's Engineering Dept. . . . **Herman B. Amster** named Manager of Industrial Engrg. for Federal Telephone & Radio Co.'s radio product line . . . **Air Vice Marshal John L. Plant,** RCAF (ret), appointed Executive Vice Pres. of Collins Radio Co. of Canada, Ltd., subsidiary of the U. S. Collins Radio Co. . . . **Frederick R. Kappel** becomes AT&T's ninth President, succeeding Cleo F. Craig.

Scatter Transmission System Studied for AF

Westinghouse's Electronics Div. in Baltimore is under contract to RDC's Rome Air Development Center in operating an over-the-horizon UHF tropospheric scatter transmission system between Verona, N. Y., and Baltimore. Study is in the bands of 900 mc and 2000 mc.

Data resulting from this study will make it possible to determine scatter transmission system performance in terms of signal attenuations, fading limits, and bandwidth capability, as well as practical antenna sizes for maximum gain and diversity considerations.

"Wartime" Factory Built in 29 Minutes

Standard components and unitized building block-type construction made it possible for a complete manufacturing operation to be set up in 29 minutes at the Alden Research Center, Westboro, Mass., in a recent demonstration for the Eastern Seaboard Defense Mobilization Council.

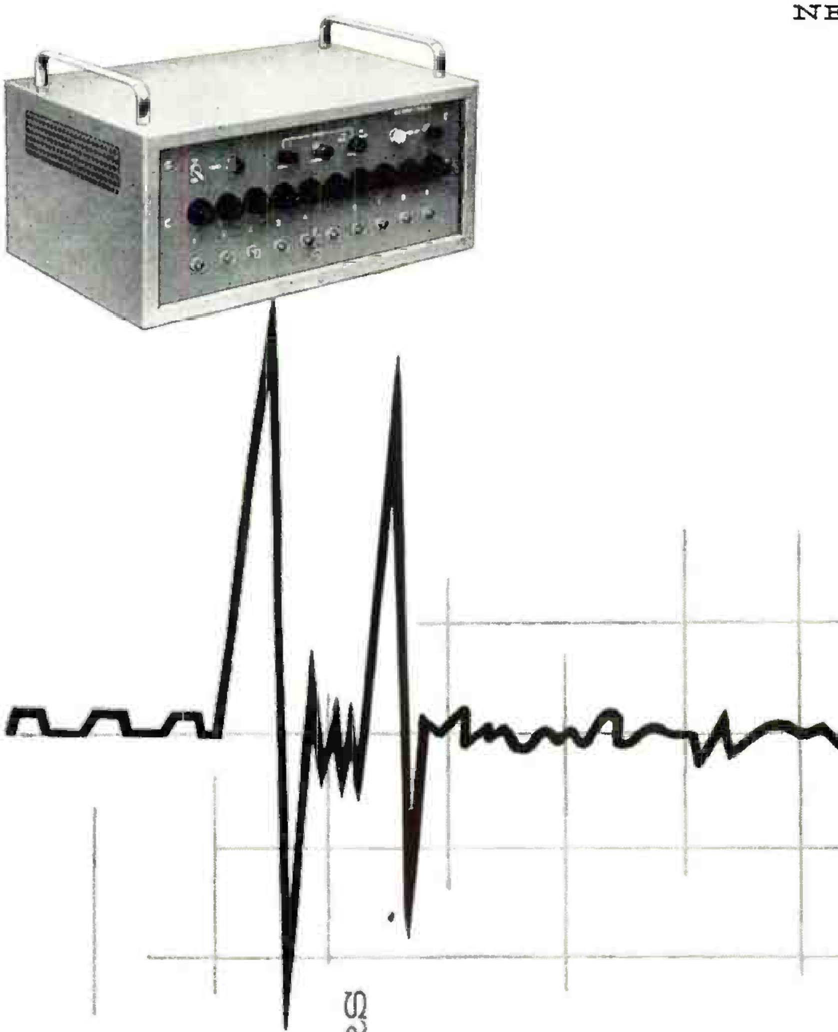
Objective was how to keep production rolling in time of war when industrial plants are bombed out; also, how skills can be stockpiled so that production lines can be kept operating all over the U. S. in time of emergency.

Demonstration started from a bare floor. Complete manufacturing operation, including lighting, power facilities and work positions, was set up. In 29 minutes, actual production from a 4-position operation was coming off the line. It was pointed out that entire factories can be stored in warehouses ready for instant use, and ready to be set up in short order whenever the necessity arises.

Alden Systems Co. and the Alden Electronic and Impulse Recording Equipment Co. put on the demonstration, which showed that a portable generator makes establishment of a factory possible even in a tent during emergencies.

More News on page 15

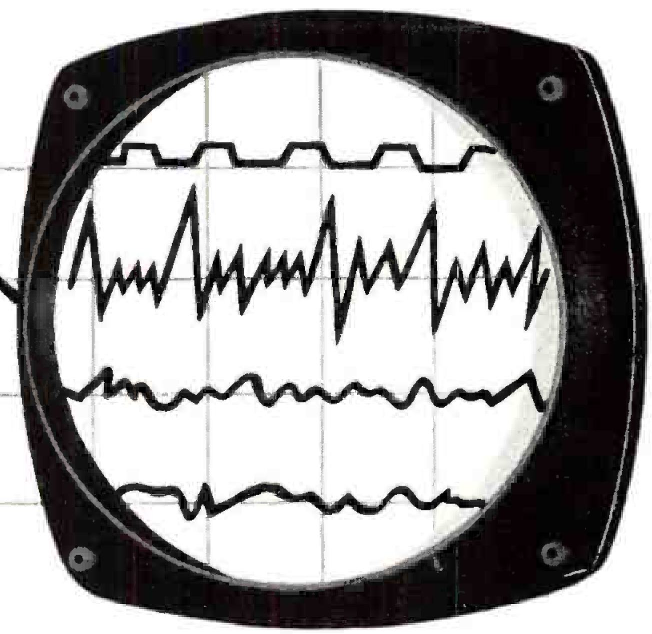
make your scope multi-channel



NEW BURROUGHS BEAMPLEXER

displays up to 10 separate signals on a single-channel scope simultaneously

Now you can have the advantages of multi-channel oscillography at a fraction of the cost of a multi-channel oscilloscope. Just hook Burroughs' new Beamplexer up to your present single channel scope, and you'll be able to observe up to ten separate channels of information simultaneously on the face of your present single-gun tube.



TOOLS FOR ENGINEERS

The Beamplexer is actually a fast electronic switch. Its heart is the Burroughs Beam Switching Tube which acts as a gate, picking the ten parallel input signals off in sequence, at adjustable speeds ranging from push button to 100 kc, and putting them out on one line. Each signal can be located on the scope as desired, and even superimposed on one another through individual positioning pedestal controls for each channel. Other controls include separate amplification for each channel.

Power consumption is 120 volts a-c, 60 cps, single phase, 0.73 amps, with the entire unit self-contained for cabinet or standard relay rack mounting.

Full details on how the Beamplexer can make your scope more useful . . . make your time more efficient . . . are given in Technical Bulletin 346 available for the asking. Write for your copy.

BURROUGHS CORP. • ELECTRONIC INSTRUMENTS DIVISION
Department D • 1209 Vine Street • Philadelphia 7, Penna.

For product information, use inquiry card on page 137

in waveguide...

Isolators Single, compact units combine best features previously exhibited only by very narrow band components. Designed for operation at very high power levels into severe load-impedance mismatches without deterioration in electrical characteristics.

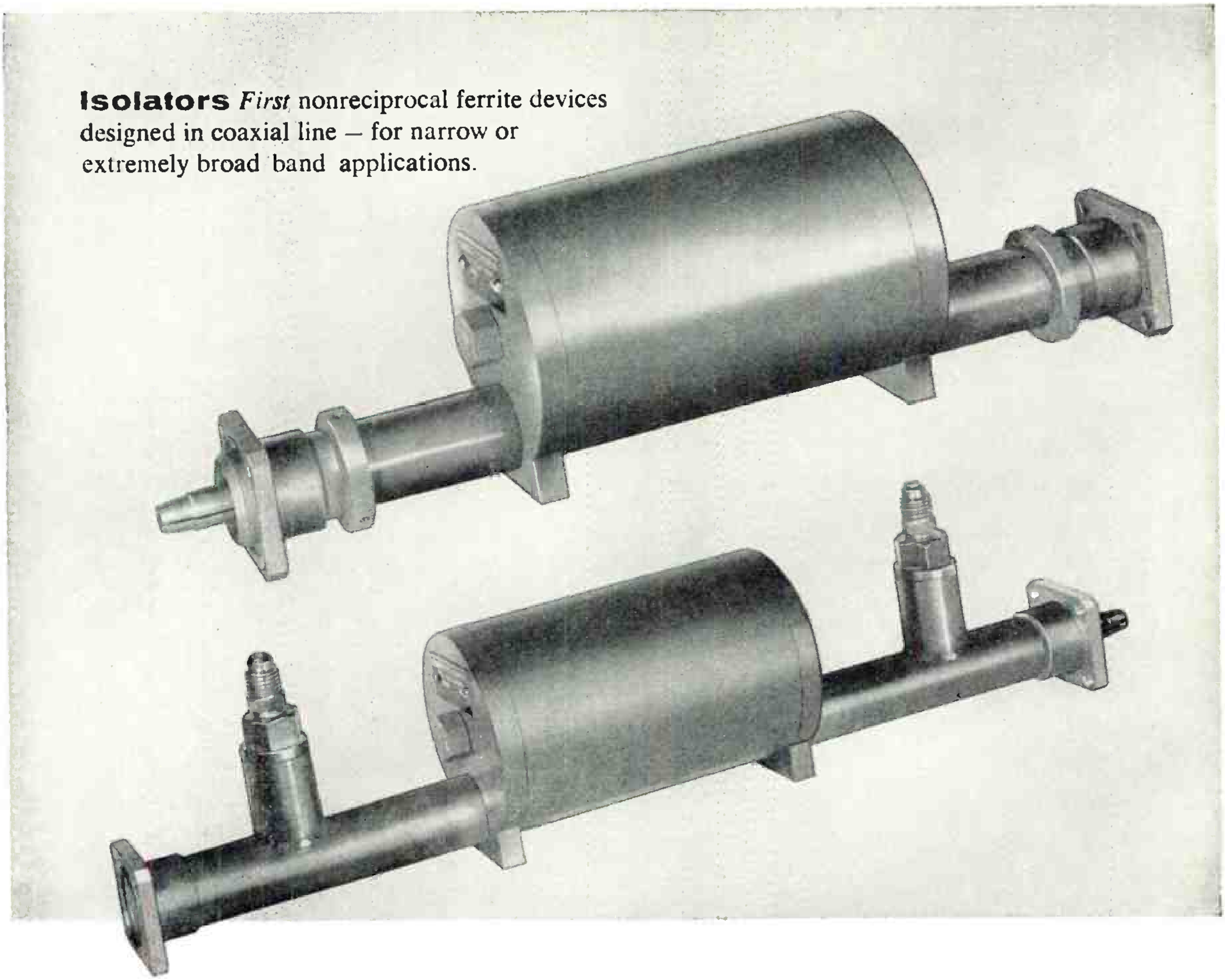
Attenuators Miniaturized designs produced for severe space, weight, and drive power limitations. Remotely actuated current varies attenuation without moving parts.

Introducing

New Microwave

Modulators Faraday rotation devices originally designed and produced to simulate a nutating radar beam. Ruggedized units satisfy MIL T-945A.

in coaxial line...



Isolators *First* nonreciprocal ferrite devices designed in coaxial line – for narrow or extremely broad band applications.

FERRITE Devices

Coaxial-Line Isolators and other ferrite units shown here represent new devices just introduced by Sperry's Microwave Electronics Division for advanced electronic systems in the 1 to 40 kmc range. These new components result from an intensive research and development program and have made possible important advances in many Sperry systems. Now Sperry has concentrated in its Microwave Electronics Division specialized engineering knowledge and facilities for production of a large variety of advanced ferrite devices.

You can see more of these devices in a new brochure which is yours for the asking. For assistance in applying these versatile devices, consult engineers of the Microwave Electronics Division. Telephone or write directly to this division in Great Neck, N.Y.

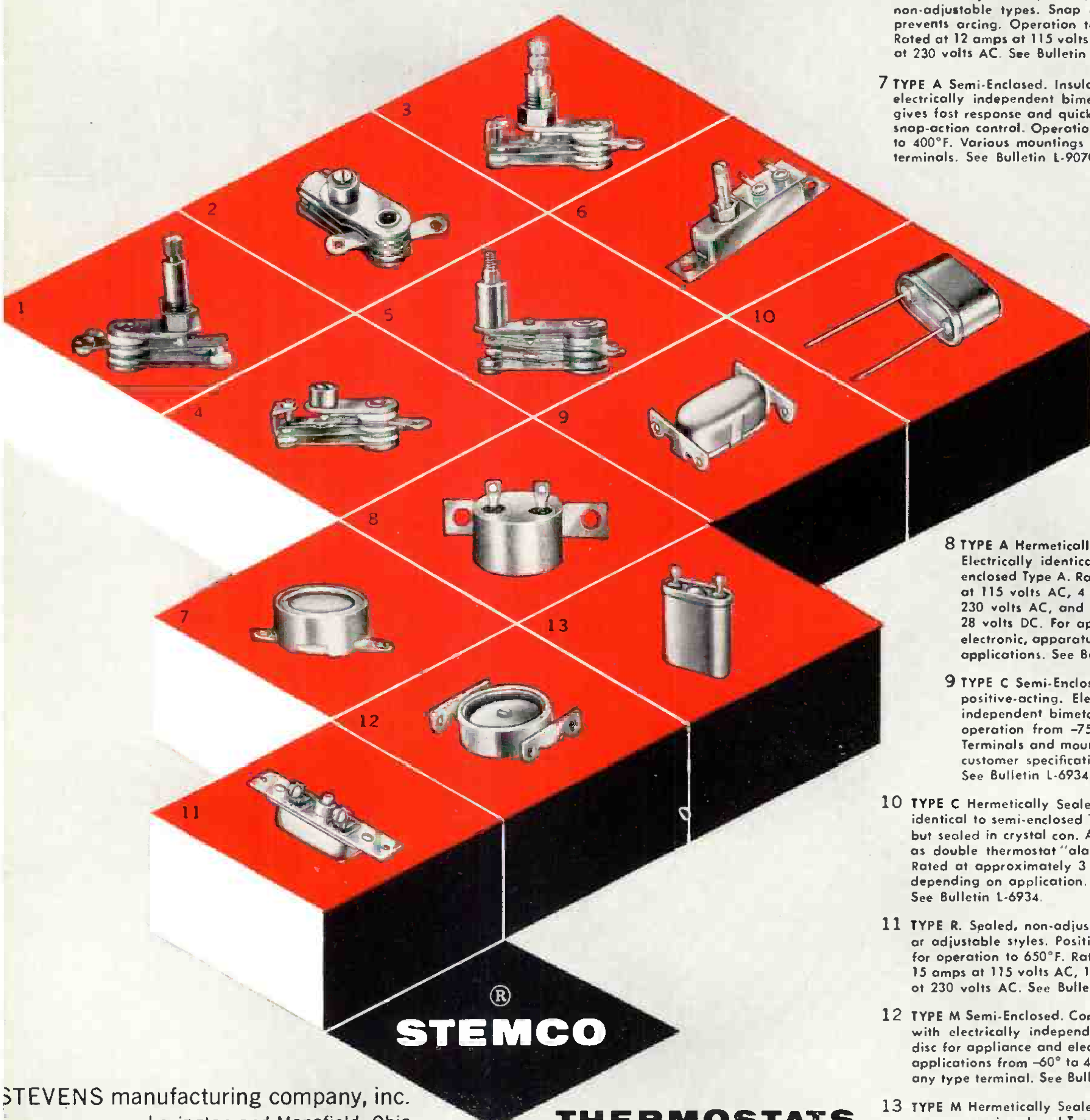
SPERRY **Microwave Electronics Division**
GYROSCOPE COMPANY
Great Neck, New York
DIVISION OF SPERRY RAND CORPORATION

For product information, use inquiry card on page 137.

look to Stemco Thermostats first

for precise, sensitive temperature control

If your product requires precise, sensitive temperature control . . . if it's scheduled for volume production—look to Stemco thermostats first. Since Stevens produces the broadest range of bimetal thermostats in the industry, chances are you can use a standard production-line unit to satisfy all your special requirements exactly. This saves design, development and tooling expense . . . cuts down on lead time . . . gives you a better, proven thermostat at lower cost—sooner.



1 **TYPE S** Adjustable. Positive-acting, with electrically independent bimetal. Adjusting stem and terminals to customer specification. See Bulletin F-2006.

2 **TYPE S** Non-Adjustable. Electrically identical to adjustable Type S. Single-stud mounting. Operates to 650°F. Rating: 15 amps at 115 volts AC, 10 amps at 230 volts AC. See Bulletin F-2006.

3 **TYPE SA** Adjustable. Snap-acting with electrically independent bimetal. Also single-pole, double-throw. Adjusting stem and terminals to customer order. See Bulletin L-6397-A.

4 **TYPE SA** Non-Adjustable. Is electrically identical to adjustable Type SA. Non-inductive-load rating 15 amps at 115 volts AC, 10 amps at 230 volts AC. See Bulletin L-6397-A.

5 **TYPE SM** Manual Reset. Mechanically and electrically same as adjustable and non-adjustable Type SA except for manual reset feature. See Bulletin L-6397-A.

6 **TYPE W.** Adjustable *(shown)* or non-adjustable types. Snap action prevents arcing. Operation to 350°F. Rated at 12 amps at 115 volts AC, 8 amps at 230 volts AC. See Bulletin L-6395.

7 **TYPE A** Semi-Enclosed. Insulated, electrically independent bimetal disc gives fast response and quick, snap-action control. Operation from -40° to 400°F. Various mountings and terminals. See Bulletin L-9070.

8 **TYPE A** Hermetically Sealed. Electrically identical to semi-enclosed Type A. Rated at 8 amps at 115 volts AC, 4 amps at 230 volts AC, and 4 amps at 28 volts DC. For appliance, electronic, apparatus applications. See Bulletin L-9070.

9 **TYPE C** Semi-Enclosed. Small, positive-acting. Electrically independent bimetal strip for operation from -75° to 300°F. Terminals and mountings to customer specifications. See Bulletin L-6934.

10 **TYPE C** Hermetically Sealed. Electrically identical to semi-enclosed Type C but sealed in crystal can. Also supplied as double thermostat "alarm" type. Rated at approximately 3 amps, depending on application. See Bulletin L-6934.

11 **TYPE R.** Sealed, non-adjustable *(shown)* or adjustable styles. Positive acting for operation to 650°F. Rated at 15 amps at 115 volts AC, 10 amps at 230 volts AC. See Bulletin F-2003.

12 **TYPE M** Semi-Enclosed. Compact unit with electrically independent bimetal disc for appliance and electronic applications from -60° to 400°F. Virtually any type terminal. See Bulletin F-2009.

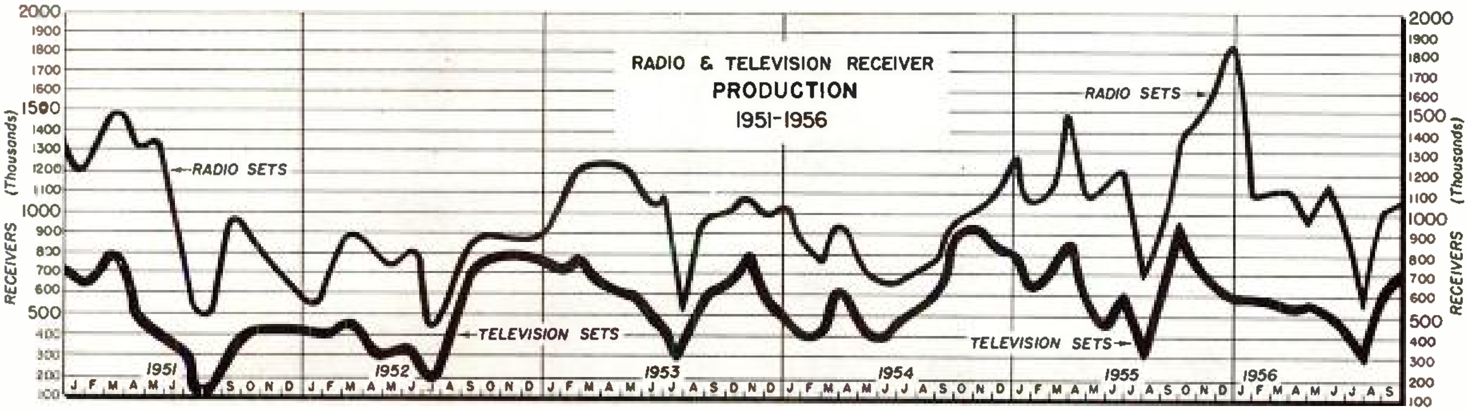
13 **TYPE M** Hermetically Sealed. Electrically same as semi-enclosed Type M. Rating: 8 amps at 115 volts AC, 4 amps at 230 volts AC, 4 amps at 28 volts DC. See Bulletin F-2009.

THERMOSTATS

STEVENS manufacturing company, inc.
Lexington and Mansfield, Ohio

AA-2338

TOTALS



TOP MILITARY CONTRACTORS

The following companies received the bulk of Government funds ($15.286 billion) allocated for Fiscal Year 1956.

Place	Company	Amt. Rec'd (millions)	% of Total
1	Boeing Airplane	797	5.2
2	North American Aviation	791	5.2
3	General Dynamics Corp.	788	5.1
4	United Aircraft Corp.	592	3.8
5	General Electric Co.	590	3.8
6	American Telephone & Telegraph	515	3.3
7	Ford Motor Co.	485	3.1
8	Lockheed Aircraft Corp.	420	2.7
9	Curtiss-Wright Corp.	358	2.3
10	Douglas Aircraft Co.	296	1.9

VALUE OF FACTORY SALES OF PICTURE AND RECEIVING TUBES—1956.

	Picture Tubes		Receiving Tubes	
	Units	Value	Units	Value
Jan.	892,385	$ 17,016,391	40,141,000	$ 31,314,000
Feb.	898,063	17,136,695	37,754,000	30,756,000
March	848,055	15,714,365	42,525,000	34,849,000
April	830,902	15,141,461	35,184,000	28,616,000
May	906,732	16,123,625	33,015,000	27,145,000
June	776,601	13,663,408	39,037,000	32,176,000
July	585,380	10,861,634	31,400,000	24,781,000
TOTAL	5,738,123	$105,657,579	259,056,000	$209,637,000

(From statistics supplied by RETMA)

MILITARY-TYPE INSTRUMENT PRODUCTION

By Types of Instruments and by Years (000,000 added)

	1951	1952	1953	1954	1955	Early 1956	Totals
Voltage & Current Measuring Inst.	$ .3	$ 1.0	$ 2.5	$ .1	$ .3	$ .1	$ 4.3
Frequency & Time Interval Meas. Inst.	$10.8	$ 8.0	$ 1.0	$ 8.3	$ 1.4	$ 1.7	$ 31.2
Impedance & Standing Wave Ratio Meas. Inst.	$ .2	$ .1	$ .1	$ .6	$ .4	$ .1	$ 1.5
Power & Electromagnetic Field Meas. Inst.	$ 2.3	$ 4.9	$ 1.1	$ .4	$ 1.7	$ .2	$ 10.6
Waveform Meas. and/or Analyzing Inst.	$ 7.2	$ 4.3	$ 1.8	$ .1	$ 1.3	$ .3	$ 15.0
Signal Generating Instruments	$14.7	$14.8	$ 4.2	$ 4.4	$ 4.8	$ .9	$ 43.8
Active Network Type Instruments	$ .1	$ 1.5	$ 1.3	$ .9	$ .1	$ —	$ 3.9
Passive Network Type Instruments	$ .2	$ .1	$ .3	$ .4	$ .1	$ —	$ 1.1
TOTALS	$35.8	$34.7	$12.3	$15.2	$10.1	$ 3.3	$111.4

Average Rate: $21,000,000 per year. Average Rate—Last Three Years: $12,500,000 per year.
—From "The General Purpose Electronics Test Instrument Industry"—U. S. Dept. of Commerce

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by Government procurement agencies in September 1956.

Amplifiers	756,284	Radar Equip.	1,725,343
Amplifiers, Audio	63,280	Radiac Equip.	167,206
Analyzers	78,645	Radio Beacon Sets	367,885
Antennas	4,233,392	Radio Direction Finders	139,115
Batteries, Dry	51,035	Radio Receivers	218,603
Batteries, Mercury	44,562	Radio Receivers-Transmitters	1,871,058
Batteries, Storage	657,295	Radio Sets	1,194,878
Cable Assemblies	55,470	Radiosonde	615,785
Circuit Breakers	50,025	Radio Transmitters	294,342
Computers	142,444	Recorders, Tape	101,373
Connectors	70,759	Relays	36,300
Fire Control Equip.	7,308,053	Relays, Solenoid	36,730
Generators, Power	1,430,040	Resolvers	29,194
Handsets	29,103	Switches	25,735
Kits, Radar Modification	389,375	Telemetering Equip	1,881,019
Meters, Frequency	486,400	Teletype Equip.	115,218
Meters, Watt	57,990	Transformers	76,680
Oscilloscopes	56,358	Tubes, Electron	1,233,958
Potentiometers	72,284	Wire & Cable	684,714
Radar Components & Spares	72,168		

EMPLOYMENT

250,000 Scientists in the U.S.
60% of Scientists in industry.
Remainder divided equally in education and government.

700,000 Engineers in the Nation.
75% of Engineers in industry.
2% in education and 23% in government.

- Dr. A. T. Waterman, Director, National Science Foundation

ELECTRIC POWER

Gross amount of money received

Year	From All Users in Thousands of Dollars	% From Residential
1955	8,020,439	39.7
1954	7,277,267	40.1
1953	6,793,660	39.1
1952	6,137,272	39.1
1951	5,647,672	38.3

—Edison Electric Institute, Bulletin #23

AIRCRAFT

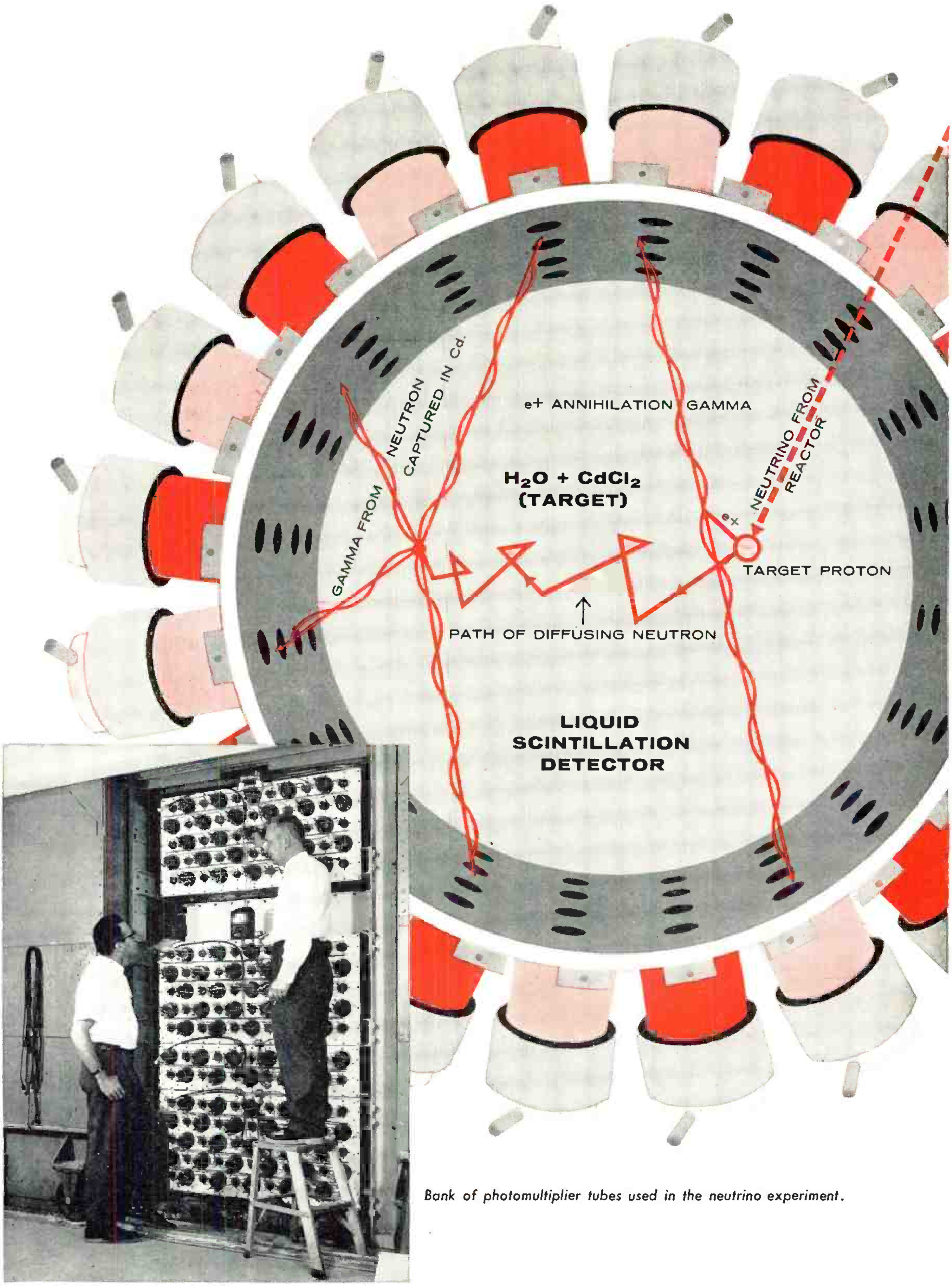
Today's Bomber contains over 1,500 electronic tubes.

Today's Medium Bomber requires over 40 miles of wiring as compared to 10 miles in W. W. II.

Today's Jet Fighter requires 5,500 wires totaling approx. 23,000 ft. as compared to W. W. II propeller driven plane which had 515 wires totaling 1,545 ft.

$80,000 is the approx. cost of radar, fire control and navigational equipment on All-Weather Fighters.

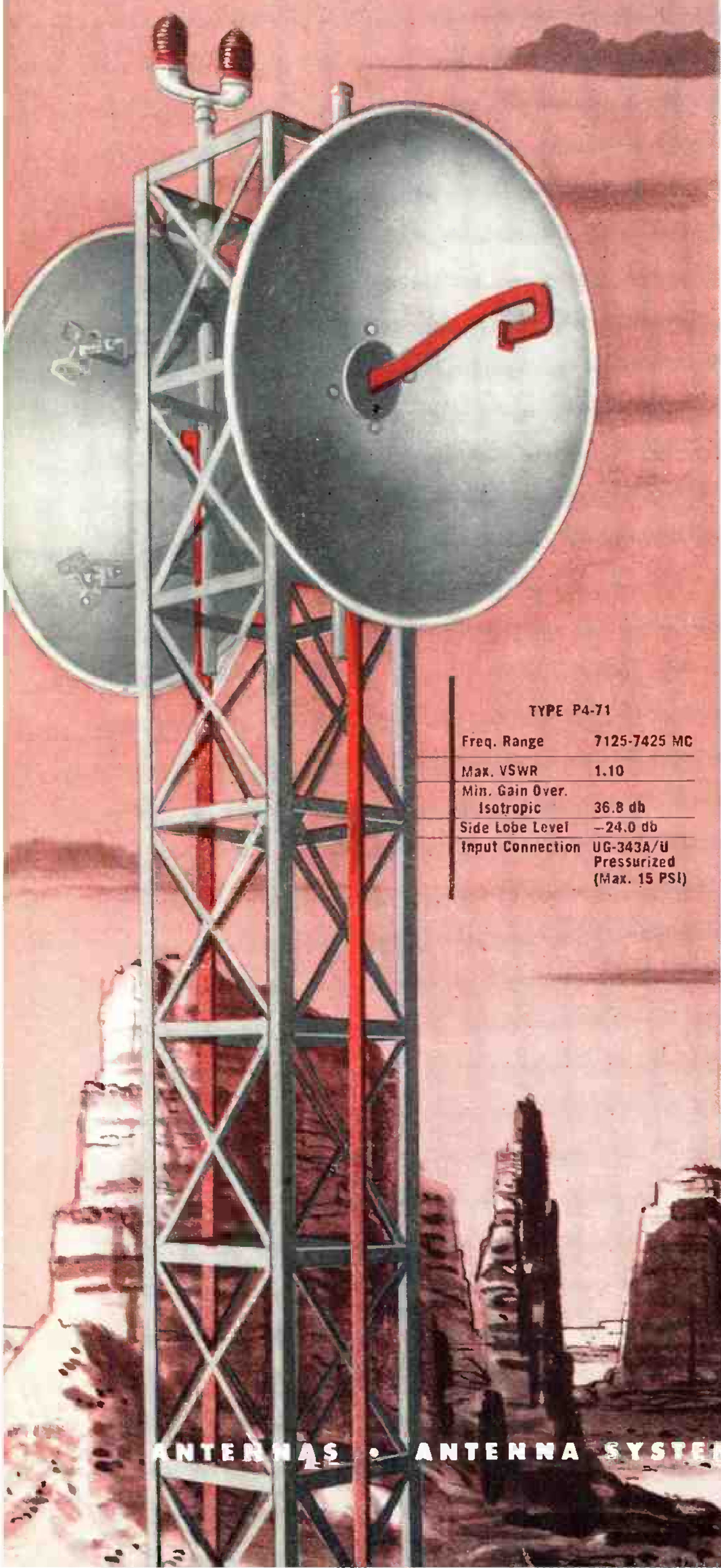
—Aircraft Industries Association of America



Bank of photomultiplier tubes used in the neutrino experiment.

For product information, use inquiry card on page 137.

Reliability



TYPE P4-71

Freq. Range	7125-7425 MC
Max. VSWR	1.10
Min. Gain Over. Isotropic	36.8 db
Side Lobe Level	−24.0 db
Input Connection	UG-343A/U Pressurized (Max. 15 PSI)

ANDREW

Isolated microwave relay installations must be reliable and require the extra performance factors of mechanical and electrical design found only in ANDREW Parabolic Antennas. Thousands of installations serving over a million channel miles of microwave have proven their superiority.

ANDREW offers a complete range of sizes and frequencies. Specify ANDREW Antennas for your microwave system. Here is a representative selection of stock antennas.

TYPE NUMBERS OF STOCK PARABOLIC ANTENNAS

Frequency Range (MC)	ANDREW Type Number 4 ft. dia.	6 ft. dia.	8 ft. dia.	10 ft. dia.
890 - 920	1004A-1	1006A-1		1010A-1
920 - 960	1004A-2	1006A-2		1010A-2
1700 - 1850	2004A-1	2006A-1	2008A-1	2010A-1
1850 - 1990	2004A-2	2006A-2	2008A-3	2010A-3
1990 - 2110	2004A-3	2006A-3	2008A-3	2010A-3
2450 - 2700		P6-24		P10-24
3750 - 4200			PS8-37	
5925 - 6425	P4-59	P6-59	P8-59	P10-59
6575 - 7125	P4-65	P6-65	P8-65	P10-65
7125 - 7425	P4-71	P6-71	P8-71	P10-71

Specifications of these and other stock antennas and special design antennas are available by consulting the ANDREW Sales Engineer in your area or by writing to:

Andrew CORPORATION
363 EAST 75th STREET · CHICAGO 19

Offices: New York • Boston • Los Angeles • Toronto

ANTENNAS • ANTENNA SYSTEMS • TRANSMISSION LINES

New RETMA Standards

Five new recommended RETMA Standards have been announced by RETMA's Engineering Dept., New York: RS-161 — Unit Standards for Ceramic Based Printed Circuits; RS-162—Test Standards for Ceramic Based Printed Circuits; RS-163 — RF Radiation Label; RS-164—Fixed Paper Dielectric Capacitors in Tubular Non-Metallic Cases; and RS-165 —Ceramic Dielectric Capacitors. Classes 1 and 2, 1,000 through 7,500 Volt Rating.

Portable Microwave Phone Unit Developed

Capable of carrying on seven conversations simultaneously for distances up to 30 miles, a self-contained portable radiotelephone microwave unit has been announced by Federal Telecommunication Labs. Unit incorporates transmitter, receiver, antenna and other components into a single package; power requirements, says FTL, are the same as "those of an electric toaster."

Useful in flood-stricken areas and for police and Civil Defense, the radiotelephone weighs 125 lbs., operates in the 9,000-11,000 megacycle frequency band, and uses 115-volt, 50/60 cycle current. Unit uses printed circuitry and cross-polarization; printed circuit cards are used for multiplexing the seven telephone channels.

F. I. Medal Winners

Five research mathematicians were awarded the Louis E. Levy Medal of The Franklin Institute, Philadelphia, at annual Medal Day ceremonies on Oct. 17. They were: Dr. Arthur W. Burks, Carl H. Pollmar, Don W. Warren, and Dr. Jesse B. Wright, all of the University of Michigan; and Dr. Robert McNaughton, Stanford University.

The five men were honored for their paper, "The Folded Tree," which appeared in F. I.'s Journal last year and dealt with a computing machine project sponsored by Burroughs Corp.

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period November to April, 1957, that are of special interest to electronic engineers

Nov. 1, 8 and 13: Creative Engineering Symposium, last three of six lectures, jointly sponsored by Philadelphia Sections of AIEE and IRE; at Univ. Museum, U. of Pa., Philadelphia.

Nov. 2-3: Sixth Annual Tool Engineering Conference, sponsored by IIT and Northwestern and Illinois Universities in cooperation with Illinois chapters of the American Society of Tool Engineers; on the Illinois Tech campus, Chicago.

Nov. 7-9: Conf. on Elec. Tech. in Medicine & Biology, sponsored by the PGME, AIEE and the ISA; at the Gov. Clinton Hotel, New York.

Nov. 8-9: Ann. Tech. Conf., Kansas City, Kans., IRE Section; at Town House Hotel, Kansas City, Kans.

Nov. 12-16: Natl. Electrical Mfrs. Assn. Annual Convention; at Traymore Hotel, Atlantic City.

Nov. 14-16: Symp. on Applications on Optical Principles to Microwaves, sponsored by the PGAP and Geo. Wash. Univ.; at Geo. Wash. Univ., Washington.

Nov. 15-16: New England Radio Engineering Meeting, sponsored by Region 1, IRE, at Boston.

Nov. 26-30: International Automation Exposition, at the Trade Show Bldg., 500 Eighth Ave., New York.

Nov. 26-30: Human Engineering Conf., co-sponsored by Manhattan College, New York, in conjunction with 3rd International Automation Exposition, in New York.

Nov. 29-30: PGVC Annual Mtg., sponsored by the PGVC; at the Fort Shelby Hotel, Detroit.

Dec. 5-7: 2nd IRE Instrumentation Conf. & Exhibit, PGI, Atlanta Section; at the Biltmore Hotel, Atlanta.

Dec. 10-12: Eastern Joint Computer Conference, sponsored by the PGEC, AIEE and the ACM; at the Hotel New Yorker, New York.

Jan. 14-15, 1957: Symp. on Reliability & Quality Control in Elec., sponsored by the PGRQC, ASQC and RETMA; at the Statler Hotel, Washington.

Jan. 23-25, 1957: Very-Low Frequency Symposium, sponsored by Denver-Boulder chapter of PGAP and the Boulder Lab., Nat'l Bureau of Standards; at the NBS Boulder Labs., Boulder.

Jan. 28-31, 1957: Plant Maintenance & Engrg. Show and Plant Maint. & Engrg. Conference; at Public Auditorium, Cleveland.

Jan. 30, 1957: Electronics in Aviation Day, sponsored by the PGANE, IAS and RTCA; at New York.

Feb. 1957: Conf. on Transistor Circuits, sponsored by PGCT, Phila. Sec, and the AIEE, at Philadelphia.

Feb. 26-28: Western Joint Computer Conf., sponsored by PGEC, AIEE and the ACM; at Los Angeles.

March 11-15, 1957: The 1957 Nuclear Congress, incl. International Atomic Exposition; sponsored by AICE and four other engineering societies — AIMMPE, ASME, ASCE and AIEE; 2nd Nuclear Engrg. & Science Congress, sponsored by Engineers Joint Council; 5th Atomic Energy in Industry Conf., sponsored by NICB; and Hot Labs Committee's 5th Hot Labs & Equipment Conf.; all events in Convention Hall, Philadelphia.

March 18-21: IRE National Convention, sponsored by all P.G.'s; at the Waldorf-Astoria Hotel, New York.

April 7-11, 1957: Annual Convention of NARTB; at Conrad Hilton Hotel, Chicago.

Abbreviations:

- **AICE:** American Inst. of Chemical Engrs.
- **AIEE:** American Inst. of Electrical Engrs.
- **AIMMPE:** American Inst. of Mining, Metallurgical & Petroleum Engineers
- **ASCE:** American Society of Civil Engineers
- **ASME:** American Soc. of Mechanical Engrs.
- **ASTE:** American Society of Tool Engineers
- **ASTM:** American Society for Testing Materials
- **IAS:** Inst. of Aeronautical Sciences
- **IMS:** Industrial Management Society
- **IRE:** Institute of Radio Engineers
- **ISA:** Instrument Society of America
- **NARTB:** National Assn. of Radio & TV Broadcasters
- **NICB:** National Industrial Conference Board
- **RETMA:** Radio-Electronic-TV Mfrs. Assn.
- **WCEMA:** West Coast Electronic Mfrs. Assn.

Electronic Industries News Briefs

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

EAST

GENERAL ELECTRIC CO. changes: Manufacture and sales of electrical insulating matetrials now handled by a new Special Insulating Materials Section with headquarters at Schenectady and managed by Louis E. Newman. GE's Microwave Lab at Stanford Univ. was transferred from Defense Electronics Div. to Power Tube Dept.; no change of location or personnel planned. The GE Trumbull Components Dept., Plainville, Conn., renamed the Circuit Protective Devices Dept.

INTERNATIONAL RESISTANCE CO., Philadelphia, has announced move of its subsidiary, Circuit Instruments, Inc., to a new 12,500 sq. ft. plant at 2801 Anvil St., North, St. Petersburg, Fla.

SYLVANIA ELECTRIC PRODUCTS, INC., New York, made these sales changes: A District Office has been opened in Alexandria, Va., for TV, radio and hi-fi sales to dealers in the Washington area; Arthur Moyer is Manager. District sales group of Parts Div. moved from Union City, N. J., to 1000 Huyler St., Teterboro, N. J.

ALLEN B. DU MONT LABS, INC., Clifton, N. J., established a New England branch sales office at 272 Centre St., Newton, Mass., for cathode-ray oscillographs and associated electronic instruments.

BETA ELECTRIC CORP., New York, has merged with SORENSEN & CO., Stamford, Conn., RMC Associates, New York, reps for both firms, has announced.

TELE-DYNAMICS, INC., Philadelphia (formerly Raymond Rosen Engrg. Prods.), plans to move from 32nd & Walnut sts., Philadelphia 4, to larger quarters at 51st & Parkside Ave., Philadelphia 31, in 1957. Firm has a Western Regional Office in Sherman Oaks, Calif.

DEPT. OF DEFENSE established a center for monitoring electronic test equipment at New York University's College of Engineering, New York. A team of NYU research engineers will serve as the staff.

ACME ELECTRIC CORP., Cuba, N. Y., reported a 21% sales increase in last quarter of fiscal 1956, plus substantial backlog. Color TV development is expected to improve sales of Acme's color TV transformer business.

KARP, LESSER & CO., INC., 60 E. 42nd St., New York 17, formed as engineering and management consultants to sheet metal fabrication field and allied industries.

AMERICAN BRASS CO., New York, announced change of name for its Waterbury Brass Goods Div., Waterbury, Conn., to the Fabricated Metal Goods Div. American Brass is a subsidiary of Anaconda Co.

FISCHER & PORTER CO., in suburban Philadelphia at Hatboro, named Robert F. Lane, Asst. to President, to the board. . . .

ELECTRIC STORAGE BATTERY CO., Philadelphia, appointed E. Albert Wagner Administrative Asst. to Director of Engineering.

SPERRY RAIL SERVICE, Danbury, Conn., will manufacture, market, and service Westinghouse Electric's Type FE-1 railroad communication radio.

STERLING ENGINEERING DIV., AMERICAN MACHINE & FOUNDRY CO., Laconia, N. H., has been made a subsidiary of Potter & Brumfield Inc.

U. S. TESTING CO.'S main laboratories at Hoboken, N. J., have added a new reliability evaluation department to supply government and industry with advanced design and performance information on the reliability of components.

UNITRONICS CORP. is the new corporate name of Olympic Radio & Television Inc. and its affiliated companies, which now include David Bogen Co. and Presto Recording Co., Paramus, N. J.

RAYTHEON MANUFACTURING CO. has purchased a 15 acre site in Goleta, Calif., for a new engineering laboratory.

ROBERTSHAW-FULTON CONTROLS CO. has moved its Cleveland office into new quarters at 6116 St. Clair Ave.

PIONEER-CENTRAL DIVISION, BENDIX AVIATION CORP. has developed two large ultrasonic cleaning units for the U. S. Navy. Two of the units are to be installed at each of nine Navy aviation overhaul and maintenance bases in the U. S.

RADIO RECEPTOR CO., INC. has moved its Semiconductor Sales Department to 240 Wythe Avenue, Brooklyn.

MID-WEST

GENERAL TAPE CORP., St. Paul, has announced a new kind of strong transparent pressure-sensitive tape for business and industrial uses. Top surface of tape is resistant to acids and alkalis, and impermeable to greases, oils and powders; comes in ½-in wide rolls, 2,592 in. in length.

NATIONAL BOARD OF I. R. E. will meet at 1957 Southwestern IRE Conference and Electronics Show at the Shamrock Hotel, Houston, to be held April 11-13, 1957.

AMPHENOL ELECTRONICS CORP., Chicago, purchased assets of Exact Metal Specialties Co., screw machine firm in Chicago. Exact is operating as separate division and designated Plant No. 6.

PLASTIC CAPACITORS, INC., Chicago, has moved to new and larger quarters at 2620 No. Clybourn Ave., Chicago.

CURTISS-WRIGHT CORP., Wood-Ridge, N. J., opened branch sales office at 208 So. LaSalle, Chicago. Sales reps from the Electronics Div., Carlstadt, N. J., are included in new office.

AUTOMATIC ELECTRIC CO., Chicago, increasing size of new headquarters plant by 200,000 sq. ft. to 1,500,000 sq. ft. Scheduled for completion in suburban Northlake by mid-1957, building will include both manufacturing and research facilities.

MOTOROLA, INC., Communications & Electronics Div., Chicago, has been certified by the Signal Corps to participate in the Corps' Reduced Inspection Quality Assurance Plan (RIQAP).

LAB-TRONICS, INC., Chicago, has moved to a new and larger plant at 3656 N. Lincoln Ave., Chicago 13.

GENERAL ELECTRIC opened Microwave Sales Office in Kansas City, Mo., headed by Wayne E. Evans.

KEIL ENGINEERING PRODUCTS purchased a building at 6833 Manchester, St. Louis, for its plant and research lab.

AFFTON INDUSTRIES, St. Louis, adding two new plants, representing 52,000 sq ft., to its facilities.

WEST

NEELY ENTERPRISES, Los Angeles electronic mfrs' reps, expect to complete building program this Fall with two new structures in San Francisco and San Diego.

SNYDER MFG. CO., Philadelphia, appointed Milton Schindler Director of West Coast Sales. He was Asst. to President.

HELIPOT DIV., Beckman Instruments, Inc., completed move from South Pasadena to temporary quarters in Costa Mesa, Calif., preparatory to occupying new $2,000,000 Newport Beach, Calif., plant early next year.

NATIONAL ELECTRONICS CORP., Los Angeles, opened a third plant and moved corporate offices into the new building at 11815 Vose St., No. Hollywood. Firm was recently formed as consolidation of Morand Electronics, Los Angeles, and El Ray Motor Co., No. Hollywood.

LYNCH CARRIER SYSTEMS, INC., San Francisco, placing its stock on market for public sale. Former President Frank W. Lynch is selling his 40,000 shares of stock in the electronics firm; D. E. Campbell is now President.

RETMA President Dr. W. R. G. Baker recently predicted that the expected 30% increase in electronics industry's annual volume to $15,000,000,000 by 1960 is "only the first plateau." GE Vice President warned that future growth must be "more orderly" to keep the industry on a sound financial basis.

FOREIGN

HUPP CORP., Cleveland, has acquired controlling interest in Apparatenbow Nedalo NV, of Hengelo, The Netherlands. Dutch firm gives Hupp its first manufacturing facility in Europe.

HIGH VOLTAGE ENGINEERING CORP., Cambridge, Mass., has named the Leybold organization, in Koln-Bayental, Germany, as its German sales rep, the eighth foreign rep to be named by High Voltage.

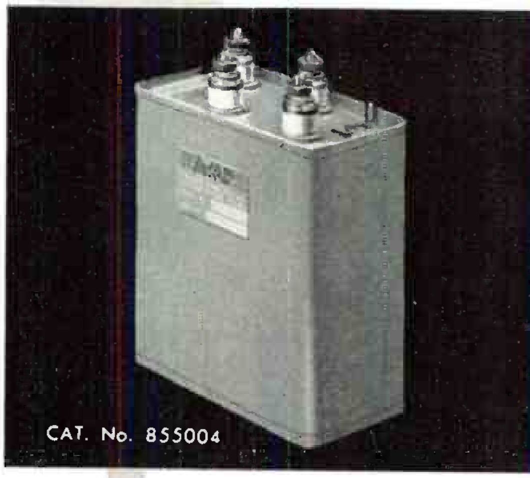
MARCONI'S WIRELESS TELEGRAPH CO., LTD., Chelmsford, Essex, England, supplied the transmitting equipment for South African Broadcasting Corp.'s biggest broadcasting station, recently opened at Paradys, in the Orange Free State. High-power short wave broadcasting has thus begun in South Africa; four transmitters, of planned total of nine, are in use.

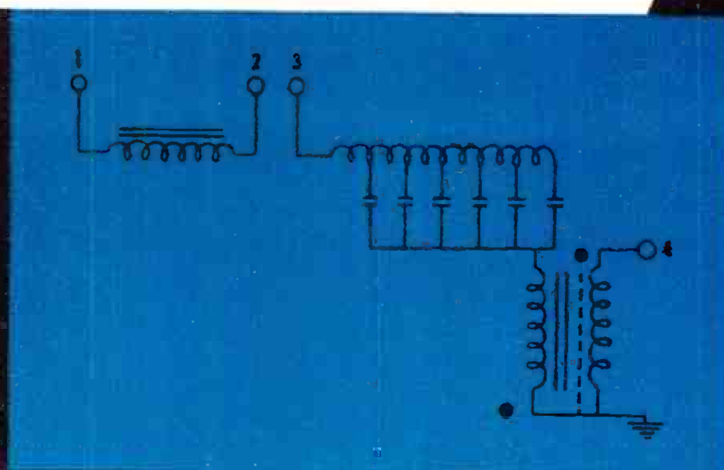
A-MP Pulse System Package Solves Trigger Problem for High Power Thyratrons

3-IN-1 UNIT CONTAINS:

1. Resonant charging choke
2. Pulse forming network
3. Pulse Transformer

Specifically designed to drive grid of JAN 5948/1754 Thyratron





Cuts procurement, stocking, testing, assembly problem by 2/3. Saves time, design work, size, and weight. Gives better performance, greater reliability.

Special designs available to meet individual requirements. Similar standard designs available on the shelf for other thyratron trigger applications.

ask about

Amp's Creative Approach

TO NETWORK AND PULSE SYSTEM PROBLEMS

CHARACTERISTICS:

Input: 1200 Volts d-c; Max. 50 Milliamperes Max.

Output Pulse: 2.2 Microsecond Min. at 70% amplitude. 1200 Volts, Max. Positive

Pulse Voltage: .35 Microsecond maximum rise time, 20 to 85% amplitude

Output Impedance: 70 OHMS nominal

Repetition Rate: 0-1400 Pulses per second, higher repetition rates can be obtained at lower power supply voltages

Network Impedance: 75 OHMS nominal

Pulse Transformer Ratio: — 1: +1

Operating Temperatures: — 55°C to 80°C ambient

Altitude: 10,000 Feet

Shock & Vibration: MIL-E-5400

A-MP®

AIRCRAFT-MARINE PRODUCTS, INC.

Chemicals and Dielectrics Division

155 Park Street, Elizabethtown, Pennsylvania

A-MP of Canada, Ltd., Toronto, Canada • Societe A-MP de France, Courbevoie, Seine, France
A-MP—Holland N.V., 's-Hertogenbosch, Holland • Aircraft-Marine Products (G.B.) Ltd., London, England

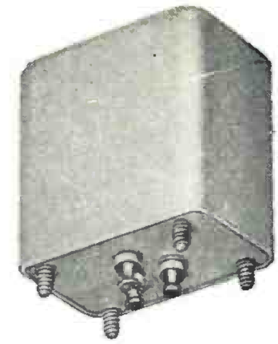
For product information, use inquiry card on page 137.

ƆUR 10 MILLIONTH MILITARY UNIT SHIPPED THIS YEAR

Military Components

FOR EVERY APPLICATION

ᴧ HUNDRED STOCK UNITS in our catalog B... 30,000 special designs

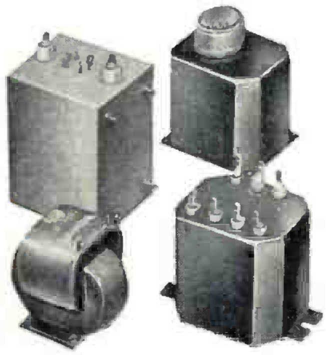


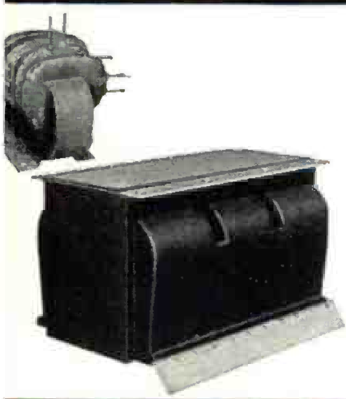
FILTERS

UTC filters, equalizers and discrim nators are produced in designs fro .1 cycles to 400 mc. Carrier, aircraf and telemetering types available i standard designs.

ᴘOWER ƆOMPONENTS

he scope of military power com ɒnents produced at UTC ranges from 00 lb. plate transformers to min iturized 2 oz. units... hermetically ealed and encapsulated... molded pes.





ENCAPSULATED UNITS

8 years of encapsulation experience assure maximum reliability in this class of UTC material.

MOLDED UNITS

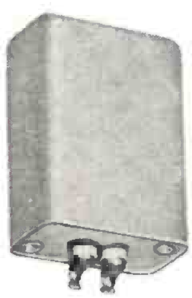
UTC molded units range from ⅓ oz. miniatures to the 100 lb. 3 phase unit illustrated.

PULSE TRANSFORMERS

UTC pulse transformers cover the range from molded structures weighing a fraction of an ounce to high power modulator applications.

ᴧUDIO ƆOMPONENTS

TC military audio units range from ounce subminiatures to high power ıodulation transformers. Standard, igh fidelity, sub-audio, and super ɔnic types.



HIGH Q COILS

Unequalled stability is effected in UTC high Q coils thru special processes and materials. Toroid, mu-core, and variable inductors are available to military standards.

MINIATURIZED COMPONENTS

UTC H-30 series audios are the smallest hermetic types made. Class A, B, and H power components of maximum miniaturization are regular production at UTC.

MAGNETIC AMPLIFIERS

In addition to a stock line of serv motor magnetic amplifiers, UTC manufactures a wide variety to custome specifications. Saturable reactors ar supplied for frequencies from cycle to 40 mc.

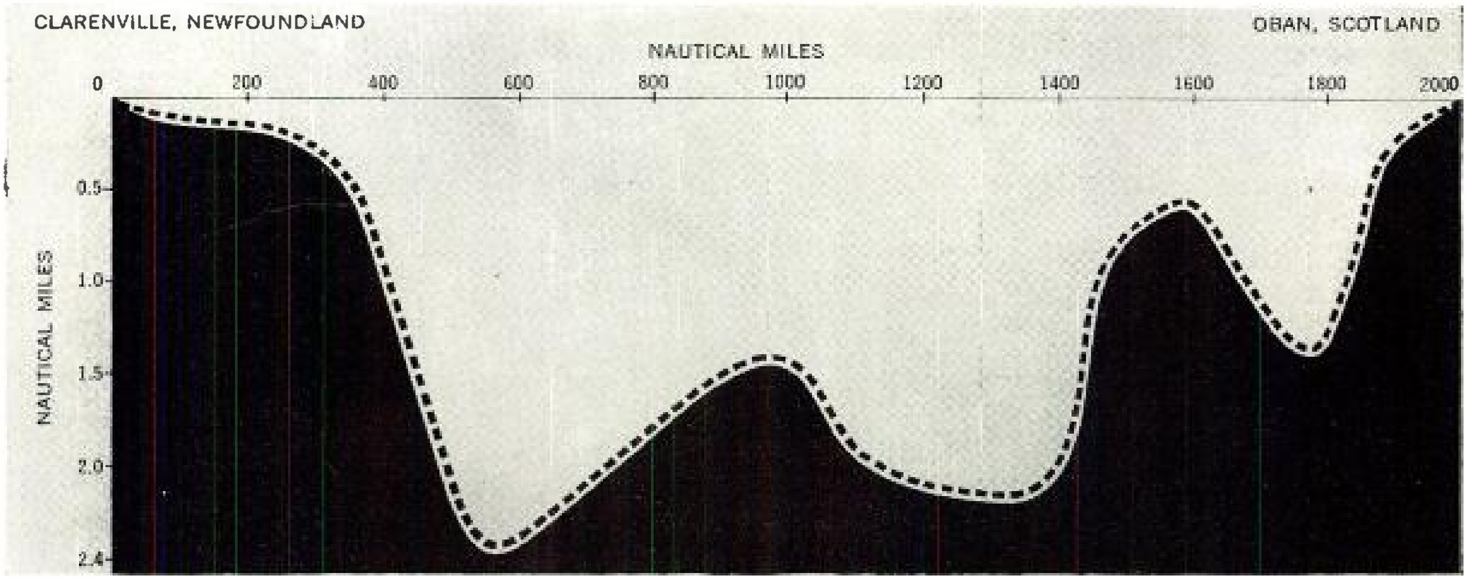
ʏRITE FOR UTC CATALOG B

... includes complete line of her etic audios, reactors, magnetic am ifiers, filters, high Q coils, pulse

UNITED TRANSFORMER CO.

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

A TRIUMPH OF TELEPHONE TECHNOLOGY



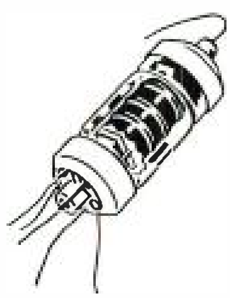
Contour of ocean bed where cable swiftly and clearly carries 36 conversations simultaneously. This is deep-sea part of system – a joint enterprise of the American Telephone and Telegraph Company, British Post Office and Canadian Overseas Telecommunications Corporation.

A great new telephone cable now links North America and Europe—the first transoceanic cable to carry voices.

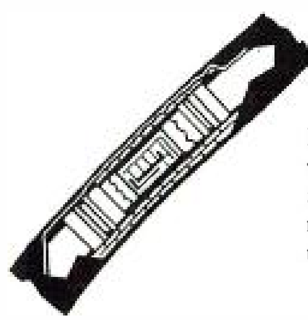
To make possible this historic forward step in world communications, Bell Laboratories scientists and engineers had to solve formidable new problems never encountered with previous cables, which carry only telegraph signals.

To transmit voices clearly demanded a much wider frequency band and efficient ways of overcoming huge attenuation losses over its more than 2000-mile span. The complex electronic apparatus must withstand the tremendous pressures and stresses encountered on the ocean floor, far beyond adjustment or servicing for years to come.

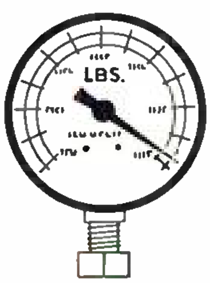
Here are a few of the key developments that made this unique achievement possible:



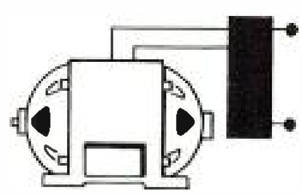
More than 300 electron tubes of unrivaled endurance operate continuously, energized by current sent from land.



Precisely designed equalizing networks and amplifiers compensate for the loss in the cable every 40 miles and produce a communication highway 144 kc. wide.



A unique triple watertight seal protects the amplifiers from pressures as high as 6500 pounds per square inch.



Power supplies of exceptional reliability send precisely regulated current along the same coaxial that carries your voice to energize the amplifying units.

BELL TELEPHONE LABORATORIES

World center of communications research and development

For product information, use inquiry card on page 137.

At long

150A High Frequency Oscilloscope

130A Low Frequency Oscilloscope

***-hp-* 130A Low Frequency Oscilloscope** is a versatile, accurate tool for laboratory and design work, yet its high gain, balanced input, simple operation and rugged construction make it a practical production instrument. The instrument also serves as a millivoltmeter or voltmeter.

Horizontal and vertical amplifiers are similar. Sensitivity is 1 mv/cm or 10 mv full scale deflection. Amplifiers have wide pass bands from dc to 300 KC. Input circuits are balanced on the five most sensitive ranges. Single ended input is also available, either ac or dc coupled. Both amplifiers are highly stable, and their gain may be standardized by an internal 1,000 cycle square wave source. These features, together with the instrument's precision input attenuator, permit use of the oscilloscope as a millivoltmeter or voltmeter accurate within 5%.

21 sweep times may be set and read directly. Horizontal sweeps are calibrated from 1 μsec/cm to 5 sec/cm. Accuracy is within 5%, and sweeps are highly linear.

In most cases, *-hp-* 130A will accept signals direct from a standard transducer without preamplification, presenting findings as a brilliant, high resolution trace visible under

BRIEF SPECIFICATIONS

-hp- 130A Low Frequency Oscilloscope

Sweep Range: 1 μsec/cm to 15 sec/cm.
Calibration: 21 sweeps: 1-2-5-10 sequence, 1 μsec/cm to 5 sec/cm. 5% accuracy.
Triggering: Internal, line voltage or external 2 v or more. Pos. or neg. slope, +30 to —30 v trigger range.
Preset Trigger: Optimum setting for automatic stable triggering.
Input Amplifiers: (Similar Vert. or Horiz. Amps). Sensitivity 1 mv/cm to 50 v/cm; 14 ranges plus continuous vernier. Pass band dc to 300 KC.
Amplitude Calibration: 1 KC square wave. 5% accuracy.
Price: $450.00.

-hp- 150A High Frequency Oscilloscope

Sweep Range: 0.02 μsec/cm to 15 sec/cm.
Calibration: 24 sweeps: 1-2-5-10 sequence, 0.1 μsec/cm to 5 sec/cm. 3% accuracy.
Triggering: Internal, line voltage or external 0.5 v or more. Pos. or neg. slope, +30 to —30 v trigger range.
Preset Trigger: Optimum setting for automatic stable triggering.
Horizontal Amplifier: Magnification 5, 10, 50, 100 times. Vernier selects any 10 cm part of sweep. Pass band dc to over 500 KC. Sensitivity 200 mv/cm to 25 v/cm.

Now, more than ever, *(hp)* means "Complete

last!

Real Dependability day after day!

-hp- OSCILLOSCOPES

Revolutionary Convenience
Broadest Possible Usefulness

any light. A special feature of the instrument is the "universal" automatic triggering system — one preset condition which provides optimum triggering with almost any input signal.

-hp- 150A High Frequency Oscilloscope employs plug-in vertical preamplifiers. These include *-hp- 151A*, a high gain unit with 5 mv/cm sensitivity and frequency response from dc to 10 MC; and *-hp- 152A*, a dual amplifier permitting two phenomena to be presented on the CRT simultaneously.

Model 150A's vertical amplifier has good transient response and less than 0.035 μsec rise time, pass band dc to 10 MC. A 0.25 μsec delay line permits viewing the leading edge of the signal triggering the sweep.

A direct reading panel control selects any of 24 calibrated sweeps. The instrument includes the "universal" triggering adjustment providing optimum triggering for almost all conditions. Model 150A also features a single-shot sweep circuit which, after "firing", remains locked out until rearmed.

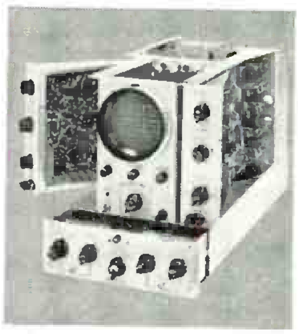
The instrument's horizontal amplifier provides sweep magnification of 5, 10, 50 and 100 times. "Reminder" lamps indicate when the circuit is in use, or the combination of sweep time and magnification exceeds the maximum calibrated sweep time. The amplifier's sensitivity is 50 mv/cm to 25 v/cm, pass band dc to 500 KC.

Vertical Amplifier: Pass band dc to 10 MC. Optimum transient response and rise time less than 0.035 μsec. Signal delay of 0.25 μsec permits leading edge of triggering signal to be viewed.

Amplitude Calibration: 18 calib. voltages, 2-5-10 sequence, 0.2 mv to 100 v peak-to-peak. Accuracy 3%. Approx. 1 KC square wave, rise and decay approx. 1.0 μsec.

Prices: *-hp-* 150A High Frequency Oscilloscope, $1,000.00.
-hp- 151A High Gain Amplifier, $100.00.
-hp- 152A Dual Channel Amplifier, $200.00.

Data subject to change without notice. Prices f.o.b. factory.



Unitized construction. Basic circuit elements assembled as separate units. Translucent mounting boards, hinged sub-chassis for maximum accessibility.

15° turn removes bezel for filter replacement, or quick CRT interchange. Bezel provides solid camera base. Top access door permits direct CRT connections.

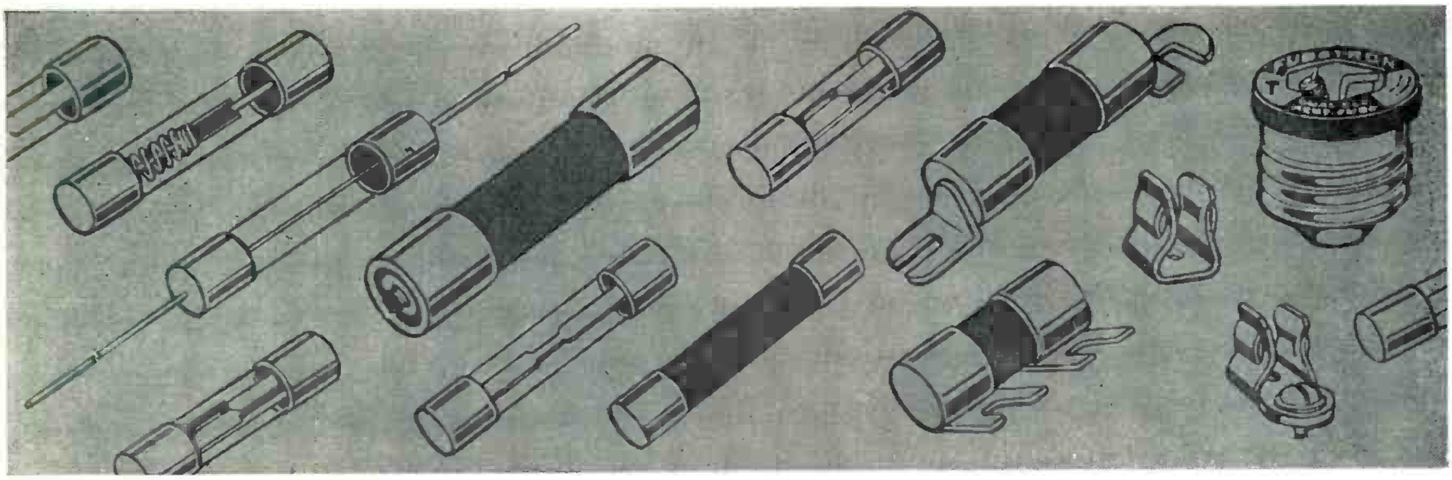
Voltage divider probe. New 10 μμf capacitance probe has exclusive clip-on nose; 10 megohm input impedance.

GET THE COMPLETE STORY! SEE YOUR -hp- REPRESENTATIVE OR WRITE DIRECT!

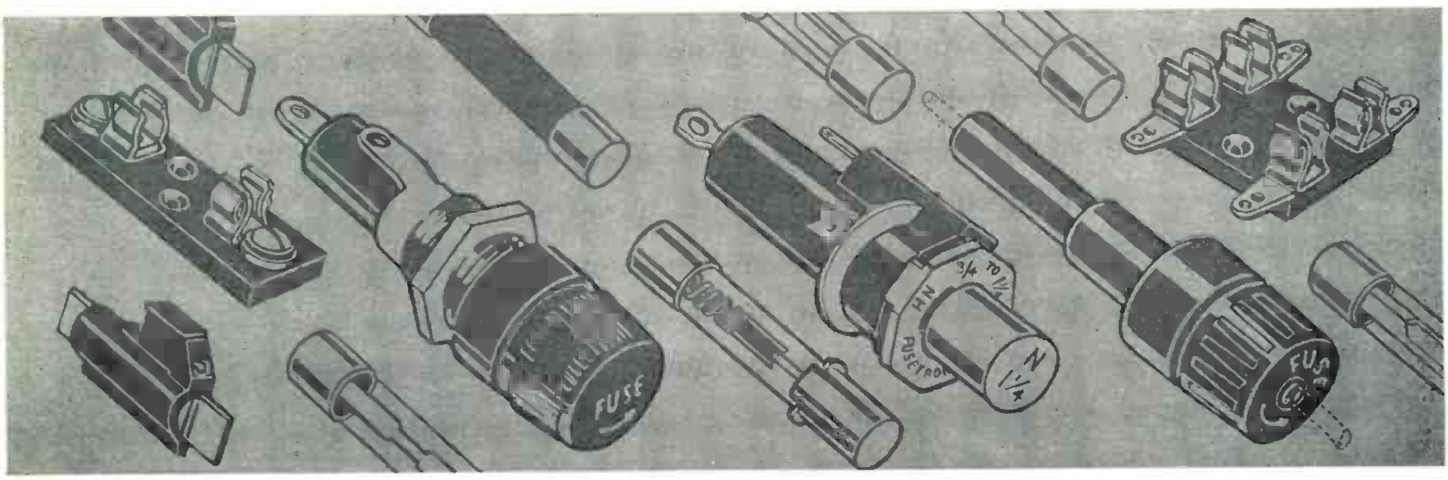
HEWLETT-PACKARD COMPANY
3636T PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
Field engineers in all principal areas
Cable "HEWPACK" • DAVENPORT 5-4451

Coverage" in electronic test instruments!

For product information, use inquiry card on page 137.



Whenever you need fuses...



you'll save time and trouble by turning <u>FIRST</u> to BUSS!

By relying on BUSS as your source for fuses, you can quickly and easily find the type and size fuse you need. The complete BUSS line of fuses includes: Standard types, dual-element (slow blowing), renewable and one-time types . . . in sizes from 1/500 amp. up—plus a companion line of fuse clips, blocks and holders.

BUSS fuses are made to protect— not to blow needlessly

When you specify BUSS fuses—users of your equipment receive maximum protection against damage due to electrical faults. And just as important, users are safeguarded against irritating, useless shutdowns caused by faulty fuses blowing needlessly.

A component part that operates as intended helps to maintain the reputation of your equipment for quality and service. That's why it pays to rely on dependable BUSS fuses.

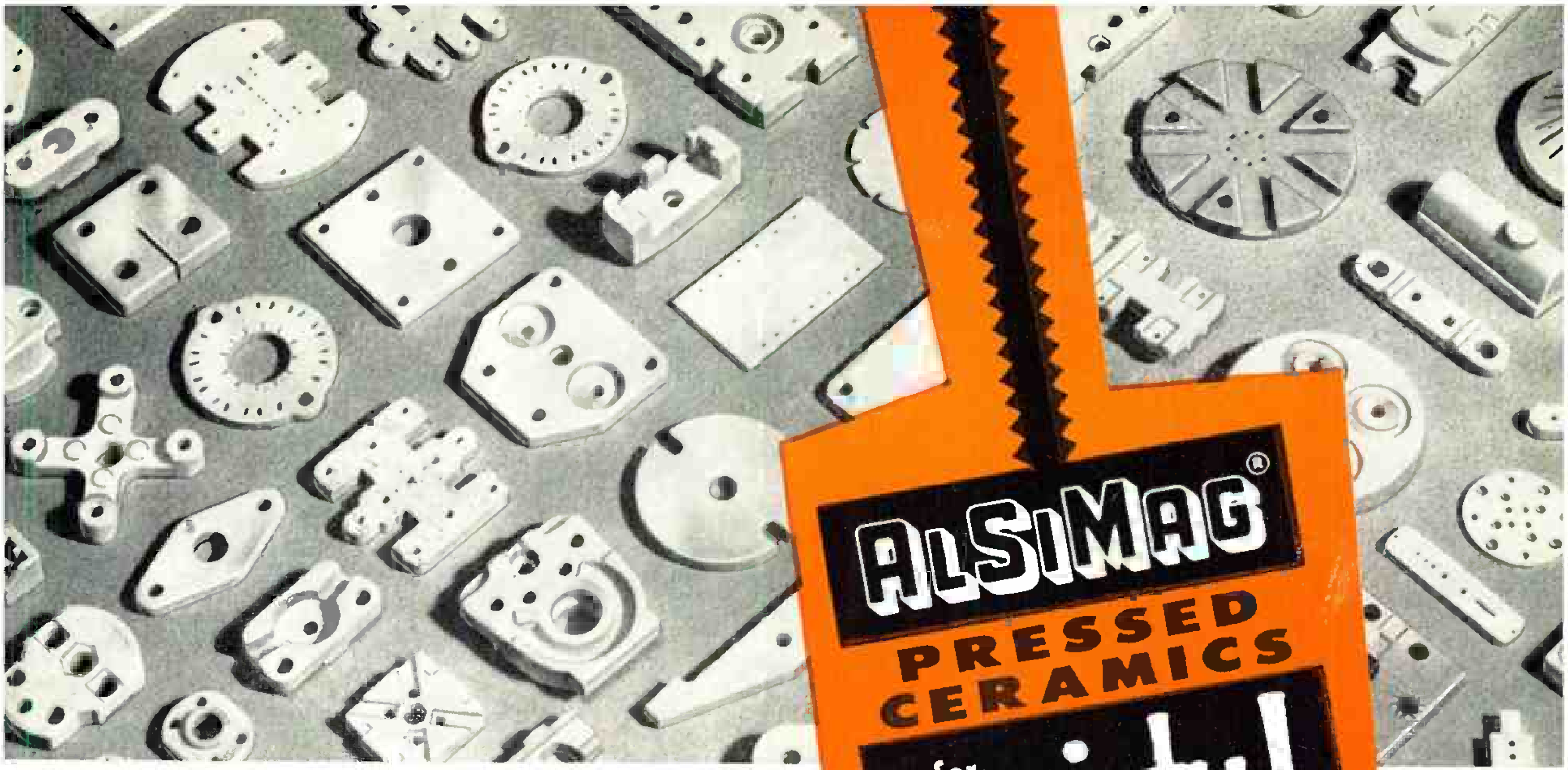
If you should have a special problem in electrical protection . . . the world's largest fuse research laboratory and its staff of engineers are at your service—backed by over 42 years of experience. Whenever possible, the fuse selected will be available in local wholesalers' stocks, so that your device can be easily serviced.

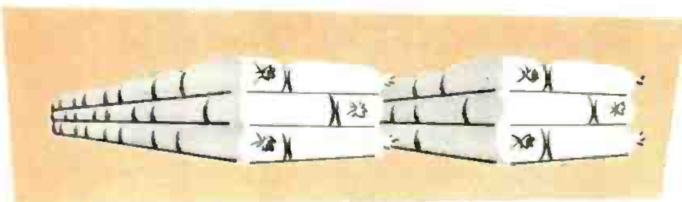
For more information on BUSS and Fusetron small dimension fuses and fuseholders...Write for bulletin TT.

Makers of a complete line of fuses for home, farm, commercial, electronic, automotive and industrial use.

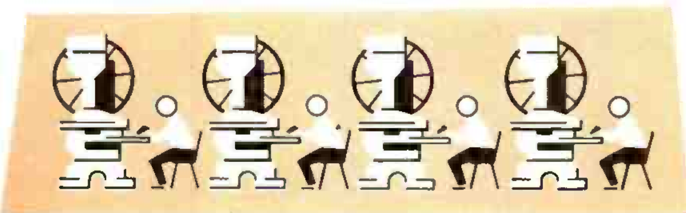
BUSSMANN MFG. CO. (*Division of McGraw Electric Co.*)
UNIVERSITY AT JEFFERSON ST. LOUIS 7, MO.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

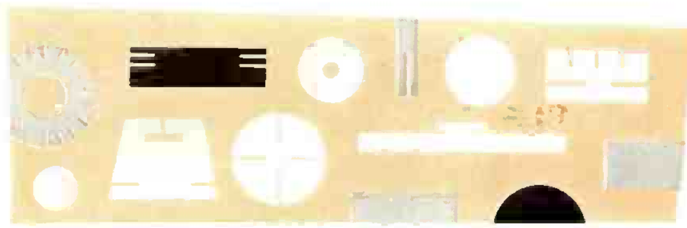




More Materials. Alumina, Cordierite, Forsterite, Magnesium Silicate, Steatite, Titanium Dioxide, Zircon, Zirconium Oxide . . . to name a few! Custom formulations of special-characteristic materials to meet special needs.



More Production Facilities. The right combination of equipment for efficient and economical production in any quantity, large or small! **FAST DELIVERIES!** Greatest lineup of high-speed automatic presses in the industry: Small tablet varieties, multi-impression rotaries, huge hydraulics. Tooling from our own die shops. Vast kiln space — including controlled atmosphere, continuous firing.



More Latitude in Design. Simplest to most complex. Broad tolerance shapes supplied at prices below those of almost any other material. Precision tolerances on intricate shapes. Over half a century of specialized experience in producing "impossibles." Free redesign service for lower production costs, easier assembly, improved performance. AlSiMag Extras: High temperature metalizing, metal-ceramic combinations.

Why not see what AlSiMag can do in your application? Blueprint or sketch plus outline of operating procedure will bring you complete details.

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AMERICAN LAVA CORPORATION

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55TH YEAR OF CERAMIC LEADERSHIP

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TELE-TIPS

PIRATING ENGINEERS can be a risky business, when the other firm is a customer. One large West Coast company has had to adopt a firm policy of refusing to consider engineers presently employed by their customers. The possible effect on sales just does not make the risk worth while.

EXPANDABLE DISH, a 16-footer, that can be enlarged to diameters suitable for scatter transmission has been developed by General Electric.

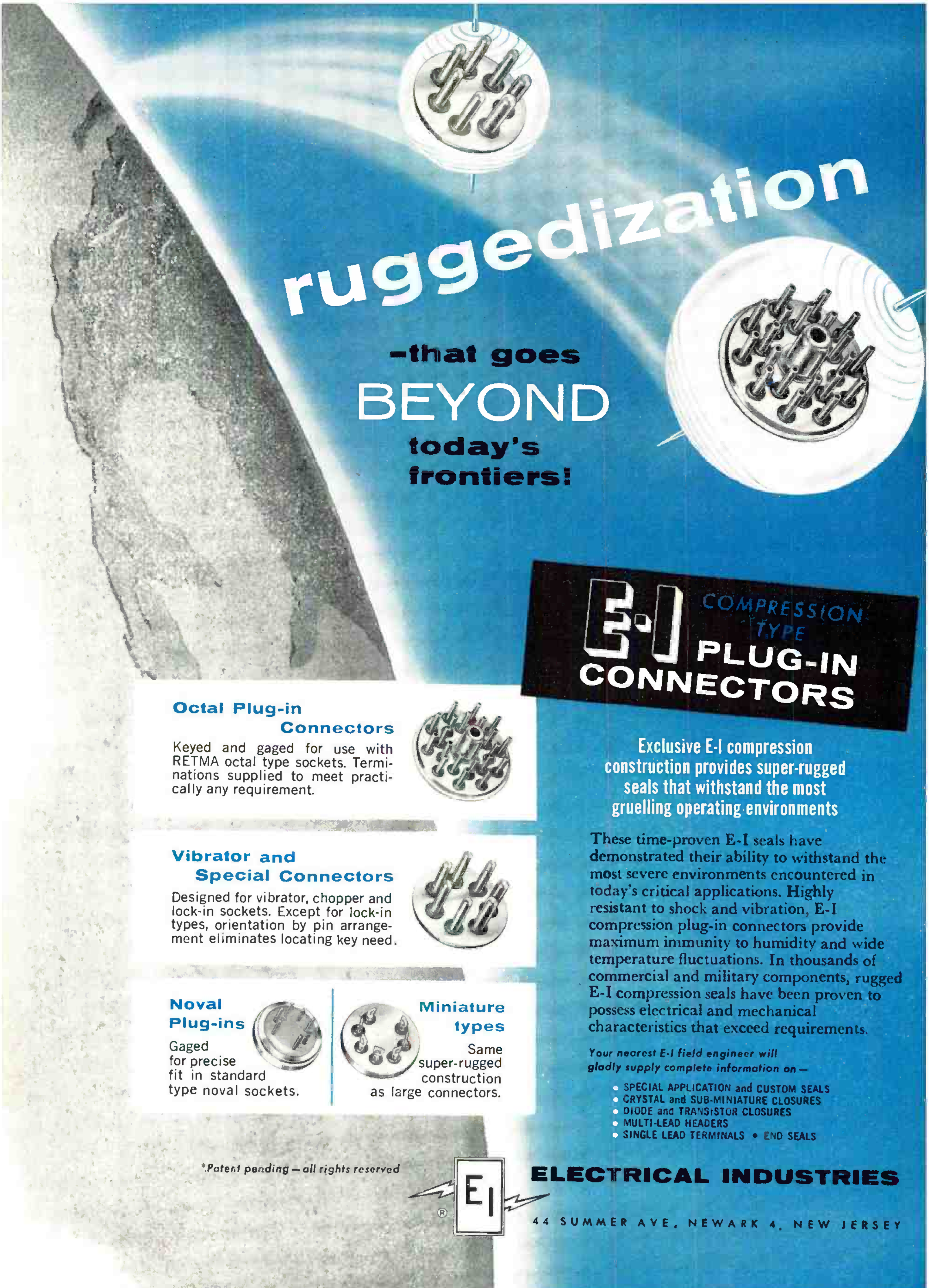
THE NEW PRODUCT is a 5-to-1 gamble, reports D. R. Hull, vice-pres. of Raytheon Mfg. Co. Hull blames the four-out-of-five failures on insufficient planning and lack of adequate preparation in design.

LATEST CLOSED CIRCUIT application: To link the hospital ward with the lobby so that the kids can see Mom or Dad upstairs in bed.

BIG EI BOUQUET to the Bell System for enlightened management. To assure stable, well-balanced leadership in the field they are underwriting a liberal arts education for selected technically competent employees. Fortunate employees are relocated, with their families, to top rank universities and given one year's concentrated study in the humanities. Unofficial estimates set the cost to the Bell System at $20,000 per man per year.

XMAS SPIRITS will be rare this year. National Premium Research Institute reports that American business execs are dropping some 120,000 customers and friends from their business gift lists this year at an estimated saving of $9,000,000.

(Continued on page 28)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-that goes
BEYOND
today's
frontiers!
E-I
COMPRESSION TYPE
PLUG-IN
CONNECTORS
Octal Plug-in Connectors
Keyed and gaged for use with RETMA octal type sockets. Terminations supplied to meet practically any requirement.
Vibrator and Special Connectors
Designed for vibrator, chopper and lock-in sockets. Except for lock-in types, orientation by pin arrangement eliminates locating key need.
Noval Plug-ins
Gaged for precise fit in standard type noval sockets.
Miniature types
Same super-rugged construction as large connectors.
Exclusive E-I compression construction provides super-rugged seals that withstand the most gruelling operating environments
These time-proven E-I seals have demonstrated their ability to withstand the most severe environments encountered in today's critical applications. Highly resistant to shock and vibration, E-I compression plug-in connectors provide maximum immunity to humidity and wide temperature fluctuations. In thousands of commercial and military components, rugged E-I compression seals have been proven to possess electrical and mechanical characteristics that exceed requirements.
Your nearest E-I field engineer will gladly supply complete information on —
• SPECIAL APPLICATION and CUSTOM SEALS
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EI
ELECTRICAL INDUSTRIES
44 SUMMER AVE., NEWARK 4, NEW JERSEY

What Does VACUUM Do For a Relay?

RE4
SPDT

RD1
N/O

RD2
N/C

RE2
SPDT

RE3
SPDT

JGF-RE2
SPDT

RM4
4PDT

RM2
2PDT

1 **A high vacuum positively insures clean contacts that stay clean. The high temperature processing required to achieve an insulating vacuum drives off all vapors that might contaminate the contacts. The permanent vacuum then keeps the contacts clean during their storage and service life since all sources of contamination (such as organic matter, metallic oxides, etc.) are excluded from the evacuated contact enclosure. Contact resistance actually tends to improve with use.**

2 **A high vacuum permits antennas, pulse forming networks, and dc circuits to be switched "hot" if necessary without the danger of sticking or welding. The arc time is less than in any other interrupting medium. Since there is nothing to burn or to ionize, arcing ceases as soon as the contacts are parted enough so that field emission is no longer possible.**

3 **A high vacuum is excellent high voltage insulation permitting the construction of small, efficient contact actuating mechanisms that resist vibration and shock forces.**

In Jennings' Transfer Relays this high vacuum is combined with an efficient magnetic circuit that has no air gap losses except those of the armature itself. Sufficient contact pressure is provided by the small 5 to 10 watt coil to permit rf current ratings of 10 to 15 amperes and contact resistances of less than .01 to .02 ohms.

Two new transfer relays have recently been developed by Jennings. The type JGF-RE2 relay is a 10 kv, 10 ampere RE2 vacuum relay enclosed in a rugged gas-filled container so that it can be mounted in exposed locations. The Type RE4 relay is for higher operating voltages up to 25 kv. It has a 5 watt actuating coil and like all Jennings transfer relays it has a simple flange mount so that the high voltage terminals can be sealed into a pressurized or oil filled container with the low voltage terminals and the coil accessible from the outside.

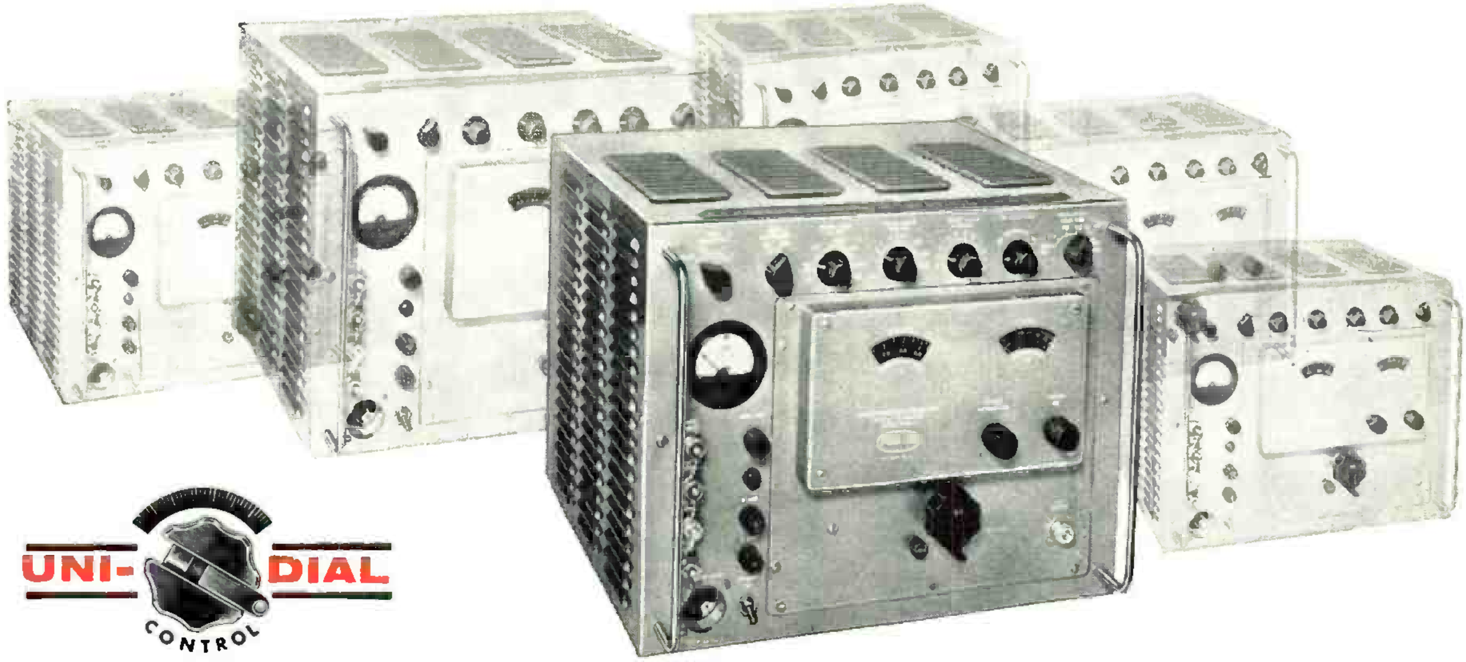
If you have difficult switching requirements that cannot be easily met by conventional relay types, we would like the opportunity of suggesting a suitable vacuum relay. Literature mailed upon request.

Jennings RADIO ®
VACUUM ELECTRONIC COMPONENTS

JENNINGS RADIO MANUFACTURING CORPORATION • 970 McLAUGHLIN AVE. P.O. BOX 1278 • SAN JOSE 8, CALIFORNIA

MICROWAVE SIGNAL GENERATORS

950 to 11,500 mc



UNI-DIAL CONTROL

JUST ONE POLARAD MICROWAVE SIGNAL GENERATOR CAN MAKE ALL THESE MEASUREMENTS . . . . .

- Receiver sensitivity
- Noise figure
- Signal to noise ratio
- Image rejection
- Beacon sensitivity
- Bandwidth
- Standing wave ratio
- Antenna gain and pattern
- Conversion gain or loss
- Attenuation
- Filter characteristics
- Multi-pulsed systems, such as Beacons, DME, Tacan, etc.

Each Polarad Microwave Signal Generator (4 models cover 950-11,500 mc) is equipped with the unusually simple UNI-DIAL control that tracks reflector voltages automatically while tuning continuously. Frequency, accurate to ±1%, is read directly on the single frequency dial. There are no mode charts, no slide rule interpolations necessary.

But, most significant are the built-in features that enable use of these rugged instruments for so many applications: internal modulation, pulse and FM; internal square wave modulation; synchronization outputs, delayed and undelayed; provision for multi-pulse modulation input; provision for external modulation and synchronization; variable attenuator calibrated directly in - dbm; engineered ventilation to insure specification performance over long operating periods.

Contact your local Polarad representative or write directly to the factory for the latest detailed specifications.

SPECIFICATIONS (all models unless indicated)

Model #	Frequency Range
MSG-1	950 - 2400 mc
MSG-2	2150 - 4600 mc
MSG-3	4450 - 8000 mc
MSG-4	6950 - 10,800 mc
MSG-4A	6950 - 11,500 mc

Frequency accuracy: ±1%

Power output:
MSG-1 & 2: 1 mw
MSG-3, 4 & 4A: 0.2 mw

Attenuator range: 120 db

Attenuator Accuracy: ± 2 db

Output impedance: 50 ohms nominal

Internal pulse modulation:
Pulse width: 0.5 to 10 microseconds
Delay: 3 to 300 microseconds
Rate: 40 to 4000 pps
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:
MSG-1 & 2: ±2.5 mcs
MSG-3, 4 & 4A: ±6 mcs

Internal square wave modulation:
40 to 4000 pps

External pulse modulation:
Polarity: Positive or negative
Rate: 40 to 4000 pps
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
Rise time: Less than 1 microsecond

Price:
MSG-1, 2 ....$1,720.00
MSG-3, 4 ....$2,190.00
MSG-4A $2,450.00

AVAILABLE ON EQUIPMENT LEASE PLAN

FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

Prices subject to change without notice.

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

REPRESENTATIVES: Albuquerque, Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dayton, Denver, Fort Worth, Kansas City, Los Angeles, New York, Philadelphia, Portland, St. Louis, San Francisco, Schenectady, Syracuse, Washington, D. C., Winston-Salem, Canada; Arnprior, Ontario. Resident Representatives in Principal Foreign Cities

For product information, use inquiry card on page 137.

TELE-TIPS

(Continued from page 24)

NEWLY ISSUED RETMA STANDARDS include: RS-161 Unit Standards for Ceramic Based Printed Circuits, $0.70; RS-162 Test Standard for Ceramic Based Printed Circuits, $0.30; RS-163 RF Radiation Label, $0.25; RS-164 Fixed Paper Dielectric Capacitors in Tubular Non-Metallic Cases, $0.50; RS-165 Ceramic Dielectric Capacitors 1000-7500 v., $0.80. Available from RETMA Engineering Dept., 11 W. 42 St., N. Y. 36, N. Y.

ELECTROSTATIC SPEAKER that covers the full audio range—25 to 25,000 cps—has been developed by Pickering.

NARTB has launched an informal contest among the staff personnel for the purpose of "Seeking appropriate audible and visual symbols or trademarks" to be used by radio stations that subscribe and adhere to the NARTB Radio Standards of Practice.

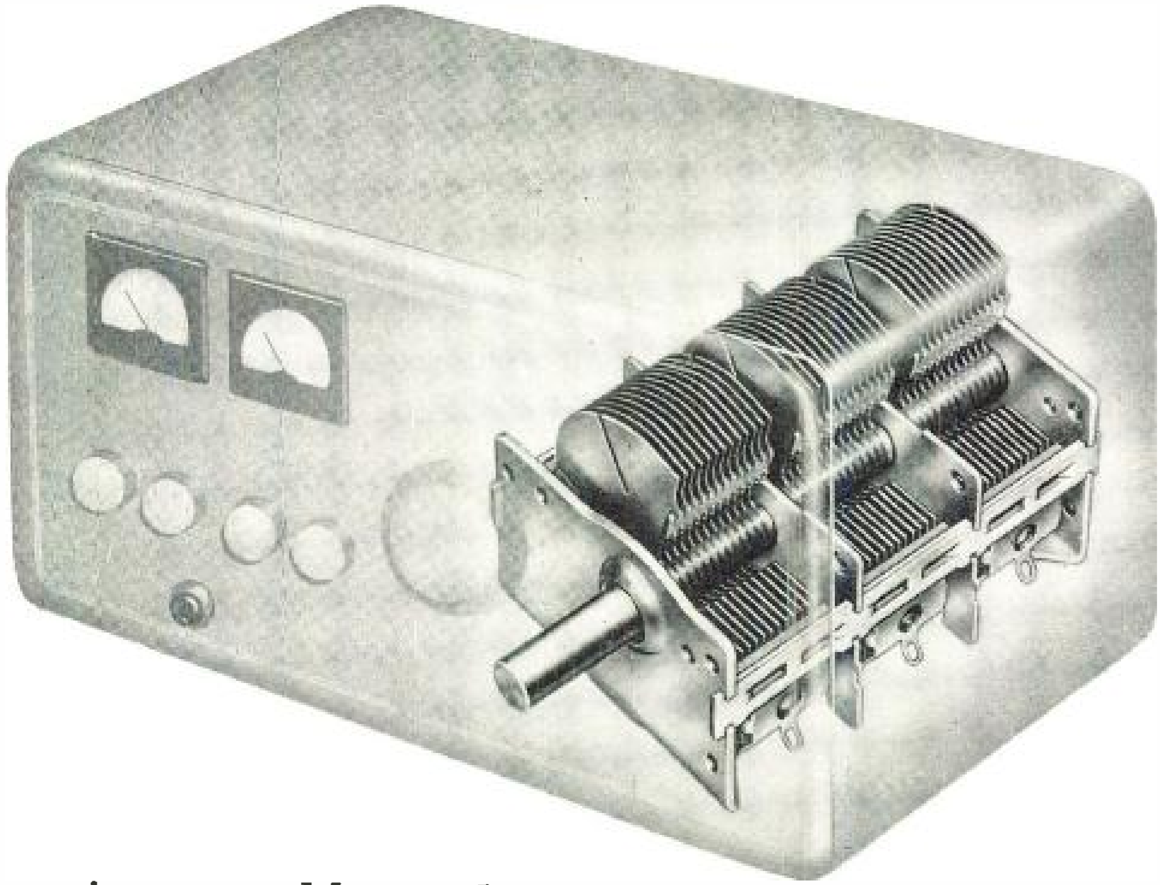
CLOSED-CIRCUIT COLOR TV is now being used to observe ballistic missiles in the Army Missile Test Center, Cape Canaveral, Florida. Color TV makes it possible to observe the first few seconds of missile launching which was formerly next to impossible, because of personnel safety precautions and the extreme variations of brightness.

NO ESCAPE—Travelers on the N. Y.-Phila. route of the Pennsy RR are opening their timetable to read—"Electronic engineers, Does your timetable for the future provide early arrival at a sound career in electronic research and development?"

LAYMAN'S VIEW of electronics is parodied in a cartoon in last month's Saturday Evening Post. A sweet young thing is murmuring soulfully to her escort, "I don't exactly understand what you do as an electronics engineer. Could you explain it in dollars and cents?"

For product information, use inquiry card on page 137.

variable capacitors for electronic Instruments



save time, trouble, and expense, when made by R/C

Whether you manufacture frequency meters, grid dip meters, or "Q" meters—sweep generators or communications kits—if it includes a variable capacitor, chances are Radio Condenser can help you.

As a major supplier of tuning devices for thirty-four years, R/C has long manufactured a complete line of standard, special, and custom variable capacitors especially for instrument use. Characterized by quality consistent with the particular end product, these variable capacitors are well suited to rapid, low-cost, quantity production.

Let us know what your requirements are and we'll be happy to send you complete information on the variable capacitors you need. Or, a call to the Radio Condenser Engineering office nearest you will bring a variable capacitor specialist right to your desk.

RADIO CONDENSER CO.

East Coast: Davis & Copewood Streets, Camden 3, New Jersey, EMerson 5-5500
Middle West: 4335 West Armitage Ave., Chicago 39, Ill., SPaulding 2-4411.
West Coast: 1102 Southwestern Avenue, Los Angeles 6, Calif., REpublic 2-8103
Export: International Div., 15 Moore St., N.Y. 4, N.Y., CABLE: MINTHORNE
Canada: Radio Condenser Co. Ltd., 6 Bermondsey Rd., Toronto, Ontario

For product information, use inquiry card on page 137.

KEEPS 'EM ROLLING!

KESTER "44" Resin, Plastic Rosin and "Resin-Five" Flux-Core Solders keep the production lines moving by providing the exactly right solder for every application. Only virgin metals are used in Kester . . . further assurance of the constant solder alloy control combined with consistent flux formulae . . . all part of Kester Flux-Core Solder quality that'll "keep 'em rolling" for you!

• • •

BE SURE YOU GET KESTER'S new 78-page informative textbook "SOLDER . . . Its Fundamentals and Usage."

KESTER SOLDER

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

For product information, use inquiry card on page 137.

MICROWAVE COMMUNICATIONS:

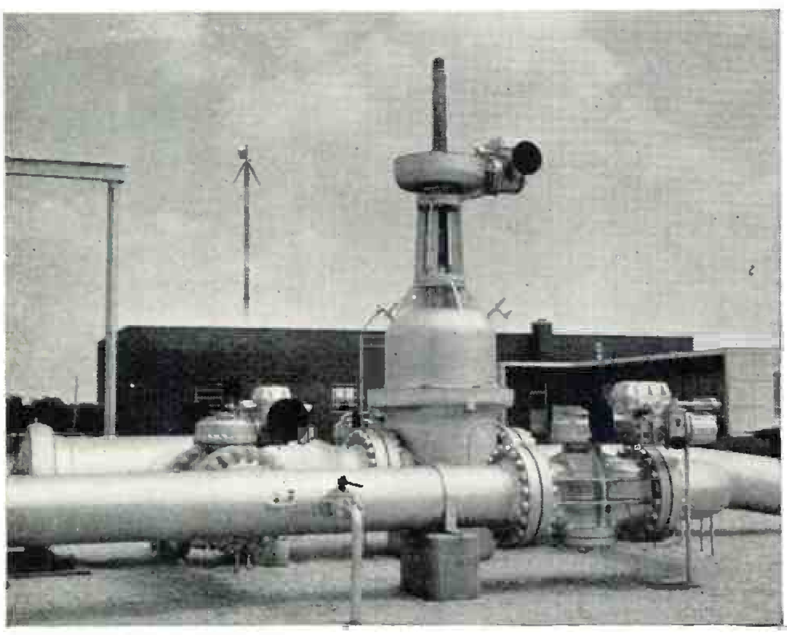
Public Service Company of Indiana, Inc.

Microwave radio aids in controlling supply of electricity for the state of Indiana. Four branches of a G-E Microwave system—combining voice and telemetering channels—originate at utility headquarters in Plainfield. From this hub regional demands are controlled according to local needs. Load control information obtained by remote control telemetering is analyzed, then transmitted to generating stations in necessary areas. Entire electrical power system is linked solidly by microwave radio.

Busy Tower

Antenna receives, transmits, or relays voice or telemetering signals. Antennas like these link headquarters with generating plants and sub-stations over a wide area.

P.S.I.'s microwave network provides utmost dependability because of standby equipment, fail safe feature, and because equipment can be concentrated at specific locations where it can be fully protected and easily maintained.



Sinclair Pipe Line Company

Microwave radio helps Sinclair coordinate flow of crude oil and oil products over many states—even turns pumps on and off. 7 voice, 4 telemetering channels link Cushing, Oklahoma and East Chicago, Indiana. Another channel permits remote control of 16 VHF radio base stations along the line which provide communication between over 100 radio-equipped vehicles and any company office in the microwave system. System is capable of providing up to 12 additional channels as needed.

Are microwave circuits your answer, too?

It depends.

What kind of service do you provide, how do you do it?

Let's assume that instant control and coordination of many functions, over long distances, are vital to your needs. Then you *should* investigate microwave because it is dependable, economical, and inexpensive to add additional circuits.

The services shown here *need* dependable voice and signal circuits. One controls the flow of crude oil and oil products over many states. The other uses microwave to link electric power facilities throughout one state.

Both use G-E Microwave Equipment for efficiency and economy. For additional microwave information, write: *General Electric Co., Microwave Equipment, Sect. X48116, Electronics Park, Syracuse, N.Y.*

Progress Is Our Most Important Product

GENERAL ELECTRIC

To meet the increasing demand for miniaturization, Fairchild's line of sine-cosine potentiometers has been expanded and now includes 3", 2" and 1⅛" diameter sizes. Development of these sizes resulted from Fairchild's continuous and extensive research to provide users with the practical balance between size and functional conformity to best meet their individual needs. As an example, an entirely new winding technique has been developed by Fairchild which assures greater accuracy and reliability with longer life.

SINE-COSINE POTENTIOMETERS

What size do you need?

These new all-metal-case sine-cosine potentiometers are easily gangable and available in three sizes.

The 3" diameter (Type 753) has a resistance range up to 45K ohms per quadrant and a functional conformity of ±0.35% measured peak-to-peak. The 2" unit (Type 754) has a resistance range of 300 to 25K ohms and ±0.65% functional conformity. The miniature 1⅛" diameter (Type 741) has a resistance range up to 12K ohms per quadrant and a functional conformity of ±1%. Conformity values as low as 0.25%, 0.50% and 0.75% are available under special conditions in Types 753, 754 and 741 respectively.

The exclusive new winding technique, eliminating wire changes and tapping or shunting, provides longer life and greater accuracies than previously obtainable.

No matter what factors govern your choice of precision potentiometers, you'll find the answer in Fairchild's complete line. Write Dept. 140-71E, Fairchild Controls Corporation, Components Division, 225 Park Avenue, Hicksville, Long Island, New York.

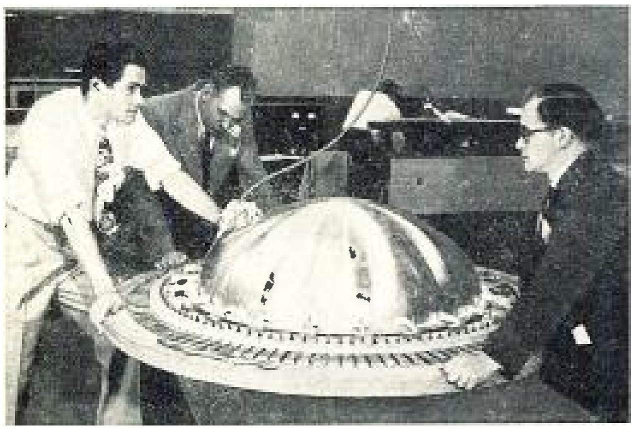
EAST COAST
225 Park Avenue
Hicksville, L. I., N. Y.

WEST COAST
6111 E. Washington Blvd.
Los Angeles, Cal.

FAIRCHILD
PRECISION POTENTIOMETERS and COMPONENTS

For product information, use inquiry card on page 137.

In which of these 3 activities does **YOUR FUTURE** *lie?*



RESEARCH AND DEVELOPMENT.
Projects of the engineers and scientists in this area at Hughes encompass practically every known field of electronics—and often border on the unknown. It is this team which is responsible for the Falcon air-to-air guided missile and the Automatic Armament Control System. Some of the projects include Microwave Tubes and Antennas, Digital and Analog Computers, Ground and Airborne Radar systems, long-range highly miniaturized communications equipment, and missile systems.

FIELD SERVICE AND SUPPORT.
Engineers in the Field Service and Support activity are responsible for the maximum field performance of Hughes-produced military equipment. Theirs is essentially liaison work with the company, airframe manufacturers, and the armed forces. Their recommendations are often the basis for important modifications. Openings exist for Engineers assigned to airbases and airframe manufacturers, Engineering Writers, Laboratory and Classroom Instructors, and Equipment Modification Engineers.

MANUFACTURING AND PRODUCTION.
In this area at Hughes technical experts are responsible for the development of production techniques for the manufacture of advanced electronic equipment from the Research and Development Laboratories. Some of the open areas include Engineers for Test Equipment Design; Quality Control; and Manufacturing Processes for semiconductors, automatic controls and miniaturized electronic systems.

You will find Hughes to be unsurpassed as a firm in which to begin a successful career. Last year, in fact, 327 June and February graduates joined the Hughes staff. Since then they have been working directly with the nation's finest scientists and engineers.

Hughes is the West's leading center for advanced electronics. The company's interest in electronics spans both the military and commercial fields. Whether you choose Research and Development, Field Service and Support, or Manufacturing and Production, you will be rewarded with a top salary, a challenging future, and the ideal climate of Southern California.

If you are interested in the long-range opportunities available at Hughes, contact your college or university placement office or mail a resume to us today.

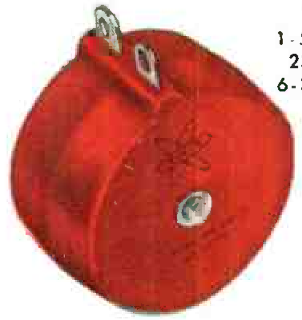
Scientific Staff Relations

HUGHES

Research and Development Laboratories
HUGHES AIRCRAFT COMPANY
Culver City, California

SIZE
1-1/16 OD
1/2 H
6-32 MTG.

TYPES	Q max.	Freq.
MP206	140	14 KC
MP848	185	35 KC
MP608	170	60 KC
MP073	265	250 KC



SIZE
1-5/16 OD
23/32 H
6-32 MTG.

TYPES	Q max.	Freq.
MP930	160	8 KC
MP395	225	25 KC

SIZE
2 OD
1 H
8-32 MTG.

TYPE	Q max.	Freq.
MP254	210	6 KC

C-A-C ®

C-100

TOROIDS—PLASTIC MOLDED

Now Less Cost Than Bare Unprotected Equivalents

MP (Molded Plastic) units are the result of a long development program. CAC MP toroids have repeatedly passed all tests for MIL-T-27, Grade 1, Class A without exception. Most compact design—may be stacked—mounted by center bushing—absorbs mounting pressures—sturdy plated terminals—standard inductance values listed below shipped from stock—complete Q versus frequency data at your request.

MOLDED AND CASED TOROIDS CARRIED IN STOCK

(Order by Part Number)

Types also available in subminiature sizes . . . catalog on request.

MP206		MP848		MP930		MP395		MP254	
IND.	PART. No.	IND.	PART. No.	IND.	PART. No.	IND.	PART. No.	IND.	PART No.
5.0 MH	MP-206-1 —	2.0 MH	MP-848-1 —	5.0 MH	MP-930-1 —	5.0 MH	MP-395-1 —	20 MH	MP-254-1 —
6.0 MH	MP-206-2 —	2.4 MH	MP-848-2 —	6.0 MH	MP-930-2 —	6.0 MH	MP-395-2 —	24 MH	MP-254-2 —
7.2 MH	MP-206-3 —	3.0 MH	MP-848-3 —	7.2 MH	MP-930-3 —	7.2 MH	MP-395-3 —	30 MH	MP-254-3 —
8.6 MH	MP-206-4 —	3.6 MH	MP-848-4 —	8.6 MH	MP-930-4 —	8.6 MH	MP-395-4 —	36 MH	MP-254-4 —
10 MH	MP-206-5 —	4.3 MH	MP-848-5 —	10 MH	MP-930-5 —	10 MH	MP-395-5 —	43 MH	MP-254-5 —
12 MH	MP-206-6 —	5.0 MH	MP-848-6 —	12 MH	MP-930-6 —	12 MH	MP-395-6 —	50 MH	MP-254-6 —
15 MH	MP-206-7 —	6.0 MH	MP-848-7 —	15 MH	MP-930-7 —	15 MH	MP-395-7 —	60 MH	MP-254-7 —
17.5 MH	MP-206-8 —	7.2 MH	MP-848-8 —	17.5 MH	MP-930-8 —	17.5 MH	MP-395-8 —	72 MH	MP-254-8 —
20 MH	MP-206-9 —	8.6 MH	MP-848-9 —	20 MH	MP-930-9 —	20 MH	MP-395-9 —	86 MH	MP-254-9 —
24 MH	MP-206-10 —	10 MH	MP-848-10 —	24 MH	MP-930-10 —	24 MH	MP-395-10 —	100 MH	MP-254-10 —
30 MH	MP-206-11 —	12 MH	MP-848-11 —	30 MH	MP-930-11 —	30 MH	MP-395-11 —	120 MH	MP-254-11 —
36 MH	MP-206-12 —	15 MH	MP-848-12 —	36 MH	MP-930-12 —	36 MH	MP-395-12 —	150 MH	MP-254-12 —
43 MH	MP-206-13 —	17.5 MH	MP-848-13 —	43 MH	MP-930-13 —	43 MH	MP-395-13 —	175 MH	MP-254-13 —
50 MH	MP-206-14 —	20 MH	MP-848-14 —	50 MH	MP-930-14 —	50 MH	MP-395-14 —	200 MH	MP-254-14 —
60 MH	MP-206-15 —	24 MH	MP-848-15 —	60 MH	MP-930-15 —	60 MH	MP-395-15 —	240 MH	MP-254-15 —
72 MH	MP-206-16 —	30 MH	MP-848-16 —	72 MH	MP-930-16 —	72 MH	MP-395-16 —	300 MH	MP-254-16 —
86 MH	MP-206-17 —	36 MH	MP-848-17 —	86 MH	MP-930-17 —	86 MH	MP-395-17 —	360 MH	MP-254-17 —
100 MH	MP-206-18 —	43 MH	MP-848-18 —	100 MH	MP-930-18 —	100 MH	MP-395-18 —	430 MH	MP-254-18 —
120 MH	MP-206-19 —	50 MH	MP-848-19 —	120 MH	MP-930-19 —	120 MH	MP-395-19 —	500 MH	MP-254-19 —
150 MH	MP-206-20 —	60 MH	MP-848-20 —	150 MH	MP-930-20 —	150 MH	MP-395-20 —	600 MH	MP-254-20 —
175 MH	MP-206-21 —	72 MH	MP-848-21 —	175 MH	MP-930-21 —	175 MH	MP-395-21 —	720 MH	MP-254-21 —
200 MH	MP-206-22 —	86 MH	MP-848-22 —	200 MH	MP-930-22 —	200 MH	MP-395-22 —	860 MH	MP-254-22 —
240 MH	MP-206-23 —	100 MH	MP-848-23 —	240 MH	MP-930-23 —	240 MH	MP-395-23 —	1.00 HY	MP-254-23 —
300 MH	MP-206-24 —	120 MH	MP-848-24 —	300 MH	MP-930-24 —	300 MH	MP-395-24 —	1.20 HY	MP-254-24 —
360 MH	MP-206-25 —	150 MH	MP-848-25 —	360 MH	MP-930-25 —	360 MH	MP-395-25 —	1.50 HY	MP-254-25 —
430 MH	MP-206-26 —	175 MH	MP-848-26 —	430 MH	MP-930-26 —	430 MH	MP-395-26 —	1.75 HY	MP-254-26 —
500 MH	MP-206-27 —	200 MH	MP-848-27 —	500 MH	MP-930-27 —	500 MH	MP-395-27 —	2.00 HY	MP-254-27 —
600 MH	MP-206-28 —	240 MH	MP-848-28 —	600 MH	MP-930-28 —			2.40 HY	MP-254-28 —
720 MH	MP-206-29 —	300 MH	MP-848-29 —	720 MH	MP-930-29 —			3.00 HY	MP-254-29 —
860 MH	MP-206-30 —	360 MH	MP-848-30 —	860 MH	MP-930-30 —			3.60 HY	MP-254-30 —
1.00 HY	MP-206-31 —	430 MH	MP-848-31 —	1.00 HY	MP-930-31 —			4.30 HY	MP-254-31 —
1.20 HY	MP-206-32 —	500 MH	MP-848-32 —	1.20 HY	MP-930-32 —			5.00 HY	MP-254-32 —
1.50 HY	MP-206-33 —			1.50 HY	MP-930-33 —			6.00 HY	MP-254-33 —
1.75 HY	MP-206-34 —			1.75 HY	MP-930-34 —			7.20 HY	MP-254-34 —
2.00 HY	MP-206-35 —			2.00 HY	MP-930-35 —			8.60 HY	MP-254-35 —
2.40 HY	MP-206-36 —			2.40 HY	MP-930-36 —			10.0 HY	MP-254-36 —
3.00 HY	MP-206-37 —			3.00 HY	MP-930-37 —			12.0 HY	MP-254-37 —
				3.60 HY	MP-930-38 —			15.0 HY	MP-254-38 —
				4.30 HY	MP-930-39 —			17.5 HY	MP-254-39 —
				5.00 HY	MP-930-40 —			20.0 HY	MP-254-40 —
				6.00 HY	MP-930-41 —			24.0 HY	MP-254-41 —
				7.20 HY	MP-930-42 —			30.0 HY	MP-254-42 —
				8.6 HY	MP-930-43 —			36.0 HY	MP-254-43 —
				10.0 HY	MP-930-44 —				
				12.0 HY	MP-930-45 —				
				15.0 HY	MP-930-46 —				
				17.5 HY	MP-930-47 —				

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For product information, use inquiry card on page 137.

BOOKS

Circuit Theory and Design

By John L. Stewart. Published 1956 by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16. 494 pages. Price $9.50.

Avoiding abstract mathemtics, this important new work applies modern network theory to the understanding of vacuum tubes and feedback systems. In doing so it assembles a great deal of information which has previously been scattered throughout the literature in relatively incomplete form.

Pole-zero design methods, founded on an easily grasped pictorial representation, are employed extensively. The presentation of feedback amplifiers, oscillators, and servomechanisms is unique. Also, many topics which are especially useful adjuncts to circuit design are given attention, e.g., function design, normalization, and the use of the ideal transformer.

Precision Electrical Masurements

Published 1956 by Philosophical Library, Inc., 15 East 40th St., New York 16. Price $12.00.

The proceedings of an international symposium on the techniques of precision electrical measurement are divided into 5 parts dealing successively with techniques applicable to electric fields and dielectrics, magnetic fields and associated materials, electrotechnical measurements, standard techniques for high-voltage measurements and for impulse-testing.

The papers are unabridged. Summarized discussions appear at the end of each part. The text is generously illustrated with half-tones and line drawings.

Electronic Tubes, Circuits, and Devices

By Lewis G. Bevins. Published 1956 by Universal Scientific Co., Inc., 1102 Shelby St., Vincennes, Ind. 620 pages, paper bound. Price $4.50.

This book is a combination textbook and manual covering the field of fundamental electronic principles and their practical application. The third in a series of 3 volumes, this book covers radio transmitting and receiving principles, radar, and TV principles and fundamentals of industrial electronic controls.

The book is profusely illustrated with photographs, schematics, and graphs. All exercises can be performed and comprehended without a knowledge of mathematics being required.

(*Continued on Page* 38)

Joseph B. Haigh, Chief Engineer, KFJZ, Fort Worth, Texas, *SAYS:*

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"We particularly like the low image retention of G-E camera tubes. Some days our cameras must preview commercials for hours at a time. They are required to focus on a stationary object like a trademark, and then image burn-in becomes a problem.

"With General Electric camera tubes, we've found that the risk of burn-in is reduced. Also, the tubes have good image resolution, and pick up fine detail. Black-white contrast is sharp.

"Furthermore, G-E tube packaging is the best we've seen. It protects spare image orthicons from dirt and damage, and makes it easy to store them compactly, so that they take up minimum space.

"From package to performance, General Electric camera tubes have proved themselves here at KFJZ. They help us provide crisp and clear pictures that mean pleasant viewing in Fort Worth homes."

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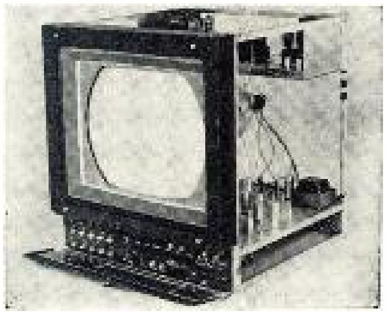


(*Continued from Page* 36)

Amplitude Modulation (Electronic Tech. Ser.)

By Alexander Schure, Ph.D., Ed.D. Published 1956 by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 64 pages, paper bound. Price $1.25.

This book explains the fundamentals of the modulated signal, modulation amplitude considerations, power in the modulated wave, improper modulation, asymmetrical modulation, basic design consideration, and frequency stability and linearity. The explanations are essentially non-mathematical.

Blocking Oscillators (Electronic Tech. Ser.)

By Alexander Schure, Ph.D., Ed.D. Published 1956 by John F. Rider Publisher, Inc., 480 Canal St., New York 13, N. Y. 72 pages, paper bound. Price $1.25.

This text has been written to give a non-mathematical but extremely comprehensive explanation of the operating features, pertinent design factors, and the more important applications of blocking oscillator theory.

How to Make Good Tape Recordings

By C. J. LeBel. Published 1956 by Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y. 151 pages, price: cloth-bound $2.50, paper-bound $1.50.

Contains up-to-the-minute information on tape recording. Included are chapters on microphone recording, tape editing, and use of sound effects.

Automation and Remote Control in English Translation (Jan., 1956)

Published 1956 by Consultants Bureau, Inc., 227 W. 17th St., New York 11, N. Y. 98 pages, paper bound, price $30.00 single issue, $185.00 annual subscription.

The first issue of the English translation of the Soviet monthly journal *Avtomatika i Telemekhanika* includes all diagrams, photographs, and tabular material integral with the text. Individual articles may be purchased for $12.50.

Books Received

ASTM Spec. Tech. Pub. No. 172—Evaluation of Insulating Oils—European Developments

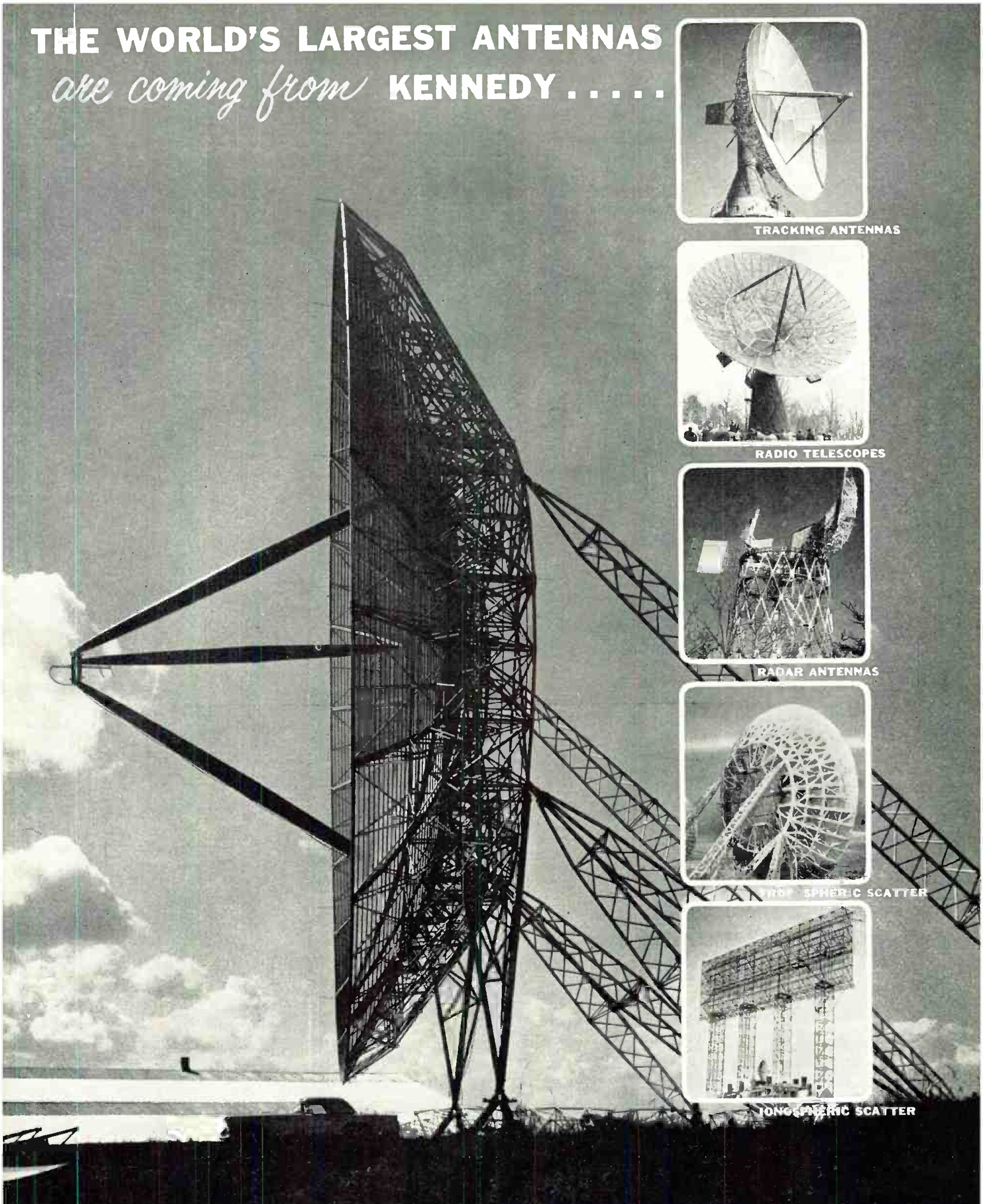
Published 1956 by American Society for Testing Materials, 1916 Race St., Phila. 3, Pa. 80 pages, paper bound.

RCA Transmitting Tubes

Published 1956 by Tube Division, RCA, Harrison, N. J. 256 pages, paper bound. Price $1.00.

Television Factbook, Semi-Annual Edition No. 23, 1956 Fall-Winter

Published 1956 by Television Digest, Wyatt Bldg., Wash. 5, D. C.
The Factbook includes among its features an international TV directory which lists stations, receivers, technical standards, etc. for all nations.



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INDUSTRY NEWS

Rear Adm. Thomas P. Wynkoop, Jr., USN (Ret), elected Vice President, Commercial Marine Distribution, RCA.

Dudley A. Hansen appointed Technical Advisor and Special Asst. to President by Phaostron Instrument & Electronic Co., South Pasadena.

Dr. Richard C. Raymond appointed Manager; **Peter J. Schenck** named Manager, Products Section; and **Russel L. Krapf** named Manager, Finance and Administration Section. in General Electric's new Technical Military Planning Operation, Syracuse. **Charles D. Brown** appointed Manager of Marketing, GE's Light Military Electronic Equipment Dept., Utica.

Henry F. DeLong named General Manager, Cathode Ray Tube Dept., of GE, with headquarters in Syracuse. **U. Clarke S. Dilks** named Manager, Research Div., Burroughs Corp. Research Center, Paoli, Pa.

Cyrus H. Warshaw named General Sales Manager, and **George L. Geiss** named Operations Manager, at Lansdale Tube Co., Div. of Philco Corp., Philadelphia.

Chester C. Pond appointed Manager-Product Planning of Philco's Govt. and Industrial Div.

W. H. (Hank) Evans has been elected President of Minneapolis-Honeywell Regulator Co., Ltd., Canada.

Dr. Richard K. Cook elected President, Acoustical Society of America, for 1957-58. He is Chief, Sound Section, NBS, Washington.

J. G. Leitch, WCAU, Philadelphia, has been named Chairman, Broadcast Engrg. Conference Committee, NARTB, for 1956-57 fiscal year.

Kenneth C. Kleidon named to new post of National Color TV Manager, and **Eugene V. Di Sciullo** made Eastern District Sales Mgr., with offices in Plainfield, N. J., by Hycon Electronics, Inc., Pasadena.

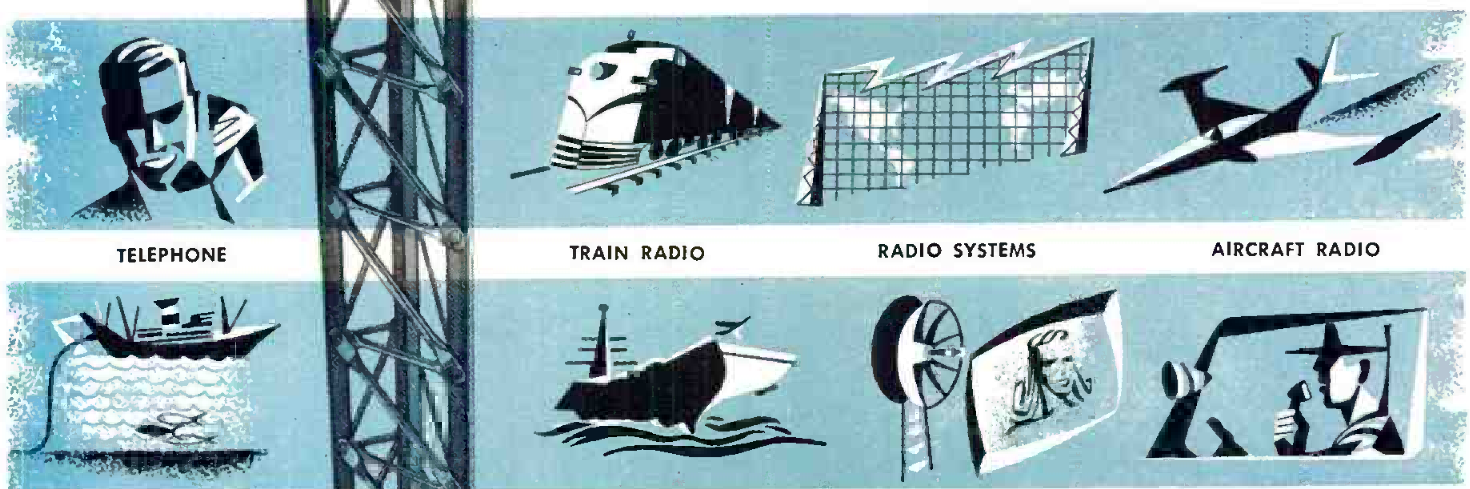
J. A. Goetz, Jr., is Manager of the new Component Engrg. & Tech. Svces. Div., IBM Engrg. Labs, San Jose, Calif.

Charles E. Balz is now Vice President-Sales of Burgess Battery Co., Freeport, Ill.

(*Continued on Page* 44)

Behind *Federal* MICROWAVE

—the world's most comprehensive communications experience



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No other microwave system is backed by communications experience so broad and diversified as that of Federal's parent company . . . the world-wide International Telephone and Telegraph Corporation.

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For product information, use inquiry card on page 137.

New Phelps Dodge Development

Foamflex coaxial cable—a companion of Styroflex and Spirafil coaxial cables—is the latest addition by Phelps Dodge to its unique line of semi-flexible, aluminum sheathed, communication cables.

This new low-loss, radiation-free cable is particularly adapted to use in community antenna systems, signal circuits and aviation communications, including both airborne and ground installations.

Foamflex coaxial cable has a number of outstanding advantages. These include *lighter weight*, longer cable life and improved operating characteristics over solid dielectric (RG) types of cables, with good frequency response over wide temperature variations.

★ ★ ★

Foamflex is available in 50 ohm and 70 ohm impedances. When intended for underground duct or direct burial installations and submarine applications, a Habirlene (polyethylene) jacket is supplied for corrosion protection.

A special bulletin describing Foamflex coaxial cable will be supplied upon request. Write Dept. HF1.

PHELPS DODGE COPPER PRODUCTS CORPORATION

300 PARK AVENUE, NEW YORK 22, N. Y.

Ideal Generator

for Audio and Ultrasonic Frequencies

Direct Reading 20 cycles to 40 kilocycles

Audio Spectrum 20 c to 20 kc in one sweep of dial

The versatile G-R Type 1304-B Beat-Frequency Audio Generator is the best test-signal generator for use at both audio and ultrasonic frequencies.

Type 1304-B Beat-Frequency Audio Generator: $575.00
(Available in either bench or relay rack models)

G-R offers several types of simple motor dial drives to convert the Type 1304-B generator and other manually-operated instruments to automatic sweep drives.

The Type 908-P1 is intended primarily for use with a graphic recorder since its synchronous motor provides convenient time base. Type 908-P2 has higher speed which is particularly suitable for limited sweep applications with oscilloscopes.

Both drives can be attached simply to the main frequency control in place of the knob. The motors are self-reversing; adjustable stops are provided for the dial to reverse the motor at any dial-position desired.

When used on the Type 1304-B Generator the sweep times are:

Type 908-P1 Synchronous Dial Drive: 50 sec/frequency decade or 15 sec/octave. Price: **$27.50**

Type 908-P2 Synchronous Dial Drive: 6⅔ sec/frequency decade or 2 sec/octave. Price: **$27.50**

Essentially Constant Output Voltage — continuously variable from less than 5 millivolts to 50 volts — between 20 and 20,000 cycles varies less than ±0.25 db

Logarithmic Frequency Scale — scale length approximately 12 inches — frequency calibration accurate within ±(1%+0.5 cycle)

Extremely Low Distortion — total harmonic content less than 0.25% from 100 to 10,000 cycles

High Frequency Stability — drift from cold start less than 7 cycles in first hour; essentially complete in 2 hours

Very Low Hum — less than 0.1% of output voltages above 10% of full scale

Accurate Output Voltmeter calibrated in open circuit output voltage and in dbm — used as zero beat indicator and also as frequency calibrator in terms of line frequency

Dial Can Be Motor Driven with several combinations of G-R Dial Drives to plot frequency characteristics automatically with graphic recorders

Frequency-Increment Dial calibrated +50 to −50 cycles with accuracy of ±1 cycle

Balanced Or Unbalanced Output Connections

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8055 13th St., Silver Spring, Md. **WASHINGTON, D. C.** 1000 N. Seward St. **LOS ANGELES 38**

(*Continued from Page 40*)

Robert K. Johnson has assumed the post of Sales Manager, for electronic components, Borg Equipment Div. of George W. Borg Corp., Janesville, Wis.

G. M. Miller will head all sales and advertising activities for the Antenna Div., Medal Mfg. Co., Sharon, Pa.

Herbert L. Weiss is supervising national field service and installation of the tubeless and transistorless autopilot for Federal Telephone & Radio Co., Clifton, N. J.

Robert H. Thompson has been promoted to Sales Manager, Packard-Bell Co., Los Angeles.

Maynard H. Patterson has been named Vice President and General Manager in the international operations of Minnesota Mining & Mfg. Co., St. Paul, and **Kenneth J. Shea** has been promoted to Vice President and General Manager of 3M's Canadian subsidiary. Mr. Patterson is responsible for over-all operations outside the U. S.

John R. Mazza has been promoted to Manager of Manufacturing at Bart-Messing Corp., Belleville, N. J.

Dave Gerstein named Vice President-Sales, Govt. & Industrial Products, by Olympic Radio & TV, Long Island City, N. Y.

Donald G. Fink, Director of Research, Philco Corp., Philadelphia, won the 1956 Journal Award of the Society of Motion Picture & TV Engineers.

Joseph B. Elliott was elected Executive Vice President of Raymond Rosen & Co., Philadelphia distributors.


J. B. Elliott


R. H. Frye

Raul H. Frye appointed General Manager Electronics Div., Fairchild Camera & Instrument Corp., Syosset, N. Y.

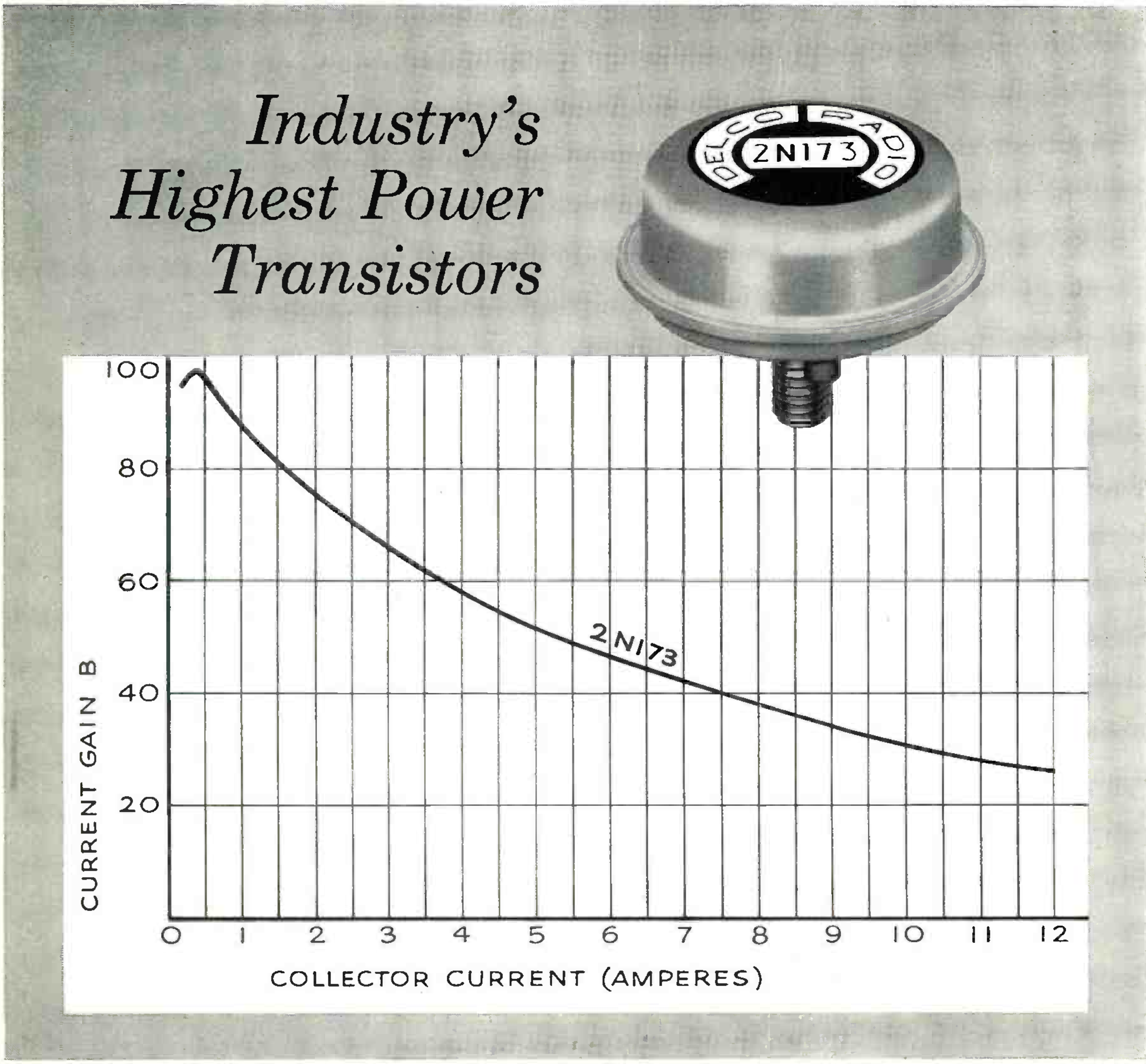
Eugene E. Crowther named Base Manager of Lockheed Missile Systems Div. flight test base at Holloman Air Force Base, Alamogordo, N. M.

Charles B. Appleman and **Joseph W. Steel** have been named sales engineers for General Electric's Light Military Electronic Equipment Dept., Utica, N. Y.

Elbert H. Godfrey has been appointed Government Contracts Mgr. of Narda Corp., Mineola, N. Y.

Norman Warren, Director of Advertising and Public Relations of Lear, Inc., Santa Monica, Calif., has been elected a Vice President of the firm.

John N. McCaul has been named Supervisor of Sales Service Engineering for electronic products of Sylvania Electric Products, Inc., New York, with headquarters in Teterboro, N. J. **Samuel J. McDonald** has been made Eastern Regional Manager, Distributor Sales, of the Electronic Products Sales Dept. of Sylvania, and is located in New York. **John Pomeroy** has been appointed Southern California District Manager of Sylvania's Electronic Products Distributor Sales, with headquarters in Los Angeles; and **Jerry P. Driscoll** is now Mid-Eastern District Manager, Sylvania Electronic Products Distributor Sales, with headquarters in Pittsburgh, Pa.



Delco Radio "High-Power" Transistors set a new industry standard of performance—

Produced by the thousands each day!

Delco Radio alloy junction germanium PNP power transistors 2N173 and 2N174, now in volume production, are characterized by high output power, high gain and low distortion. Stabilizing processes eliminate the effect of time on performance characteristics.

The high power handling ability does not exclude applications for low and medium power levels. Performance at low levels exceeds that of many low power transistors and will provide a higher degree of safety and stability to equipment design.

TYPICAL CHARACTERISTICS

	2N173	2N174	
Properties (25°C)	12 Volts	28 Volts	
Maximum current	12	12	amps
Maximum collector voltage	60	80	volts
Saturation voltage (12 amp.)	0.7	0.7	volts
Power gain (Class A, 10 watts)	38	38	db
Alpha cutoff frequency	0.4	0.4	Mc
Power dissipation	55	55	watts
Thermal gradient from junction to mounting base	1.2°	1.2°	°C/watt
Distortion (Class A, 8 watts)	5%	5%	

DELCO RADIO DIVISION OF GENERAL MOTORS KOKOMO, INDIANA

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build reliability into your product with OHMITE® COMPONENTS

close-control RHEOSTATS

All-ceramic and metal, close-control rheostats for unsurpassed dependability and smoothness of operation. Ten stock sizes, 25 to 1,000 watts.

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A wide range of dependable, fixed, adjustable, tapped, and noninductive power wire-wound resistors. Also a wide range of precision resistors.

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65 Types in four stock models. Good delivery on made-to-order relays. Contact current ratings up to 25 amps, AC or DC. Wide variety of contact arrangements. Hermetically sealed or dust-protective enclosures available.

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Five compact models, up to 100 amperes, AC, up to 12 taps. All-ceramic and metal construction. Silver-to-silver contacts, with self-cleaning rotor contact.

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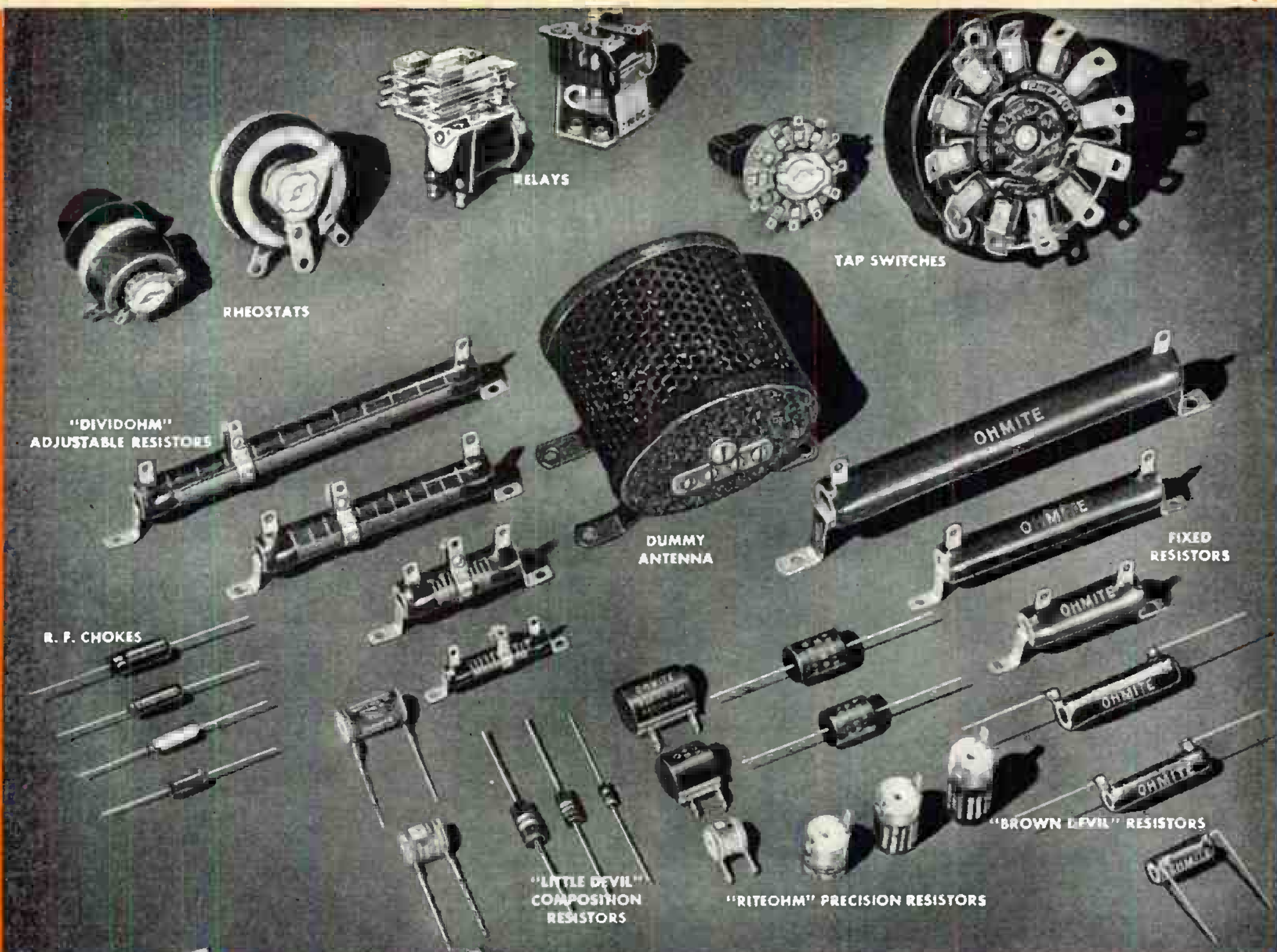
Single layer R.F. plate chokes and power line chokes on steatite or plastic cores. Protected by a special moisture-resistant coating.



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OHMITE MANUFACTURING COMPANY • 3662 Howard Street, Skokie, Illinois

ACTUAL SIZE

a new complete line of

subminiature pulse transformers

Take maximum advantage of available space on crowded wiring boards and in crammed chassis with Sprague's truly miniaturized line of reliable pulse transformers.

Designed to meet the environmental requirements of specification MIL-T-27A, these new Sprague designs offer dependability without sacrifice in electrical performance of their larger counterparts. The hermetically-sealed tubular metal cases are available with pin terminals on one end for mounting on printed wiring boards or with the conventional wire leads on opposite ends. The complete set of standard ratings shown below will take care of most circuit requirements.

• • •

Complete data on Sprague's new type 5Z pulse transformers are shown in Engineering Bulletin 503, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Mass.

TYPICAL SPECIFICATIONS

Cat. No.*	Turns Ratio	Lp (mH)	LL (μH)	Cd (μμF)	Source Impedance 100 Ω			Source Impedance 500 Ω			Source Impedance 1000 Ω		
					Load (Ohms)	Pulse Width** (μsec)	Rise Time (μsec)	Load (Ohms)	Pulse Width** (μsec)	Rise Time (μsec)	Load (Ohms)	Pulse Width** (μsec)	Rise Time (μsec)
5Z1 and 5Z2	1:1	0.5	1.0	6.0	50 100 200	1.8 1.2 0.8	0.01 0.01 0.01	250 500 1000	0.40 0.28 0.22	0.01 0.01 0.01	500 1000 2000	0.24 0.20 0.15	0.01 0.01 0.01
5Z3 and 5Z4	3:1	0.5	2.0	6.0	5 11 22	1.8 1.2 0.8	0.02 0.02 0.02	27 55 110	0.40 0.28 0.22	0.02 0.02 0.02	55 110 220	0.24 0.20 0.15	0.02 0.02 0.02
5Z5 and 5Z6	5:1	0.5	2.5	6.0	4 8	1.2 0.8	0.02 0.02	10 20 40	0.40 0.28 0.22	0.02 0.02 0.02	20 40 80	0.24 0.20 0.15	0.02 0.02 0.02
5Z7 and 5Z8	1:1:1	0.5	2.0	12.0	50 100 200	1.8 1.2 0.8	0.025 0.025 0.025	250 500 1000	0.40 0.28 0.22	0.02 0.02 0.02	500 1000 2000	0.24 0.20 0.15	0.02 0.02 0.02
5Z9 and 5Z10	1:1	1.0	1.5	6.0	50 100 200	3.4 2.2 1.6	0.015 0.015 0.015	250 500 1000	0.70 0.54 0.40	0.015 0.015 0.015	500 1000 2000	0.38 0.28 0.25	0.015 0.015 0.015
5Z11 and 5Z12	3:1	1.0	2.5	6.0	5 11 22	3.4 2.2 1.6	0.02 0.02 0.02	27 55 110	0.70 0.54 0.40	0.02 0.02 0.02	55 110 220	0.38 0.28 0.25	0.02 0.02 0.02
5Z13 and 5Z14	5:1	1.0	4.0	6.0	4 8	2.2 1.6	0.02 0.02	10 20 40	0.70 0.54 0.40	0.02 0.02 0.02	20 40 80	0.38 0.28 0.25	0.02 0.02 0.02
5Z15 and 5Z16	1:1:1	1.0	2.5	12.0	50 100 200	3.4 2.2 1.6	0.025 0.025 0.025	250 500 1000	0.70 0.54 0.40	0.025 0.025 0.025	500 1000 2000	0.38 0.28 0.25	0.025 0.025 0.025
5Z17 and 5Z18	1:1	2.5	3.0	6.0	50 100 200	8.7 5.4 3.6	0.02 0.02 0.02	250 500 1000	1.9 1.2 0.8	0.02 0.02 0.02	500 1000 2000	0.94 0.66 0.45	0.02 0.02 0.02
5Z19 and 5Z20	3:1	2.5	3.5	6.0	5 11 22	8.7 5.4 3.6	0.025 0.025 0.025	27 55 110	1.9 1.2 0.8	0.025 0.025 0.025	55 110 220	0.94 0.66 0.45	0.025 0.025 0.025
5Z21 and 5Z22	5:1	2.5	5.0	6.0	4 8	5.4 3.6	0.025 0.025	10 20 40	1.9 1.2 0.8	0.025 0.025 0.025	20 40 80	0.94 0.66 0.45	0.025 0.025 0.025
5Z23 and 5Z24	1:1:1	2.5	6.5	12.0	50 100 200	8.7 5.4 3.6	0.04 0.04 0.04	250 500 1000	1.9 1.2 0.8	0.04 0.04 0.04	500 1000 2000	0.94 0.66 0.45	0.04 0.04 0.04
5Z25 and 5Z26	1:1	6.0	6.0	6.0	50 100 200	21.0 13.0 8.4	0.03 0.03 0.03	250 500 1000	4.0 2.6 1.8	0.03 0.03 0.03	500 1000 2000	1.8 1.4 1.0	0.03 0.03 0.03
5Z27 and 5Z28	3:1	6.0	11.0	6.0	5 11 22	21.0 13.0 8.4	0.04 0.04 0.04	27 55 110	4.0 2.6 1.8	0.04 0.04 0.04	55 110 220	1.8 1.4 1.0	0.04 0.04 0.04
5Z29 and 5Z30	5:1	6.0	14.0	6.0	4 8	13.0 8.4	0.04 0.04	10 20 40	4.0 2.6 1.8	0.04 0.04 0.04	20 40 80	1.8 1.4 1.0	0.04 0.04 0.04
5Z31 and 5Z32	1:1:1	6.0	17.0	12.0	50 100 200	21.0 13.0 8.4	0.07 0.07 0.07	250 500 1000	4.0 2.6 1.8	0.07 0.07 0.07	500 1000 2000	1.8 1.4 1.0	0.07 0.07 0.07

*First cat. no. is for 2-ended style, second is for single-ended plug-in style.
NOTE: Two winding transformers can be furnished with tapped windings to customer specifications.

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ELECTRONIC INDUSTRIES

& TELE-TECH

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Wanted . . . Commercial-Industrial Distributors

The continued expansion of the electronic industries is making the problem of distributing its end products more and more difficult. In the past, radio and television or appliance distributors in strategic geographical locations, and the radio-electronic parts houses provided an effective means for the national distribution of manufacturers' products. Now, however, with an increase in the number of manufacturers, with products that are much more involved technologically, and with the growing need for "continual" customer contact many manufacturers have found existing distributing channels inadequate and are looking for a new type distributor who will specialize in commercial and industrial electronic sales.

Such commercial-industrial distributors would handle communication systems such as closed circuit TV, large audio intercommunication and music installations, antenna signal distributing systems, etc. They would provide equipment and parts for mobile radio systems, microwave installations, computer centers, electronic office machinery, etc. They would be a clearing house for test instruments and equipment for electronic and non-electronic industries.

The organization of such commercial-industrial distributors would differ considerably from the appliance type distributor. The staff would necessarily be highly technical. Sales engineers would be the contact with manufacturers in all industries to promote the industrial use of electronic equipment. A highly competent field engineering and maintenance staff would be required to assure equipment operation, which, incidentally, could be installed on a "sell" or "lease" basis.

To date, some of the larger radio parts houses are attempting to fill this distribution gap, but for the most part their operations and facilities fall far short of the requirements. Some manufacturers are now relying on "Rep" organizations to provide this service but again this too falls short of the goal because of the limited financial support that any individual representative can provide. The role of commercial-industrial electronic distributor is a big one involving big money in a big and continually growing sphere of opportunity. We hope it won't be too long before such distributors will be available to supply the nation's growing electronic needs.

Radar and the Andrea Doria

The recent sinking of the Andrea Doria came as quite a shock to everyone. In a sense it can be considered as the "Titanic" disaster of today because had the vessels been farther out to sea, help would have been farther away and the loss of life could have been even more staggering.

The most significant element about the disaster that we noted from the newspaper, television and radio reports was that each of the vessels was radar equipped; that the radars on both vessels were apparently working; that a radar "fix" had been obtained by at least one crew on the other vessel involved. We must wait for the official hearings to determine why some corrective steps via radio or otherwise were not taken sooner to avoid the collision. The important factor is that electronic radar provided the warning in advance even though the human element apparently failed to follow through.

Radar is one of the true miracles of our time and the electronic engineers engaged in this field have proven that they have done a superb job on equipment design. Unfortunately other industries have been slow to capitalize on the opportunities that electronic equipment offers them and/or they have been slow to accept the accuracy and reliability of the equipment they now have. In the case of the Andrea Doria, had the officers been obliged to follow standard operating procedure as the result of radarscope readings and had the radar been able to actuate an automatic collision warning system, the disaster might have been avoided.

The electronic industries, too, should make every effort to become aware of the problems of other industries and instead of delivering only the indicating, measuring, or communication equipment, they should instead be prepared to deliver a complete instrumentation package for the manufacturing processes or operations involved.

Simple economical plastic "H" elements with metallized outer surfaces serve as highly efficient waveguides into the millimeter region; attenuation decreases with increasing frequency. Less than .1% of the energy travels outside the guide.

H-Guide— A New Microwave Concept

By DR. FRIEDRICH J. TISCHER

The H-guide consists of two parallel conducting strips and a dielectric slab between them. In the cross-sectional view, the guide has the form of an H. The strips form the vertical legs and the dielectric its horizontal bar.

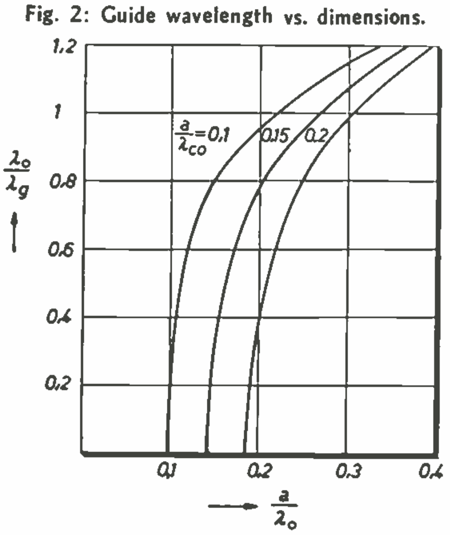
In contrast to commonly used waveguides, the guide is open at the top and bottom, but only a small part of the energy is transported outside the guide. The greatest part of the energy travels between the strips.

The new guide has some valuable properties:

1. Attenuation, which is lower than that of a rectangular guide, decreases continuously with increasing frequency.
2. Two sections of the guide can be joined without special connectors, since the energy flow is not affected by transverse gaps in the strips.
3. Complicated microwaves circuitry can be fabricated by simple production processes using H-guides.
4. Cross-sectional dimensions greater than those of a rectangular waveguide, and low losses make the guide suitable for frequency in the millimeter wave region.

DR. FRIEDRICH J. TISCHER, Research Laboratories, Ordnance Missile Laboratories, Redstone Arsenal, Huntsville, Ala.

Fig. 2: Guide wavelength vs. dimensions.



Propagation Theory

The propagation of electromagnetic waves along a homogeneous general waveguide in the X-direction can be mathematically described by

$$U = f(y,z) \cdot e^{-j\Gamma x} \quad (1)$$

where f(y, z) represents the distribution of the component of a vector potential in the X-direction in a cross-sectional plane and $\Gamma = -j\alpha + \beta$ is the wave propagation constant in the X-direction. It follows from Maxwell's equations that f must satisfy the relation

$$\frac{\partial^2 f}{\partial y^2} + \frac{\partial^2 f}{\partial z^2} = (\Gamma^2 - \omega^2\epsilon\mu) \cdot f \quad (2)$$

in which $\omega = 2\pi f$, the angular frequency ϵ,μ (for air: ϵ_o,μ_o) the material constants related to the space, where the wave propagation is to be described.

The conducting walls, as shown in Fig. 5 favor a wave propagation which is characterized by standing waves reflected between the walls. Therefore,

$$f = F_o \begin{matrix}\sin\\ \cos\end{matrix} \frac{\pi}{b} y \cdot e^{\pm kz} \quad (3)$$

represents a suitable solution of Eq. 2. Substitution in this equation yields

$$-\left(n\frac{\pi}{b}\right)^2 + k^2 = \Gamma^2 - \omega^2\epsilon\mu. \quad (4)$$

We transform Eq. 4 into a more convenient form

$$k^2 = \left(\frac{2\pi}{\lambda_g}\right)^2 - \left(\frac{2\pi}{\lambda_{go}}\right)^2 \quad (5)$$

where

$$\frac{2\pi}{\lambda_g} = \beta,$$

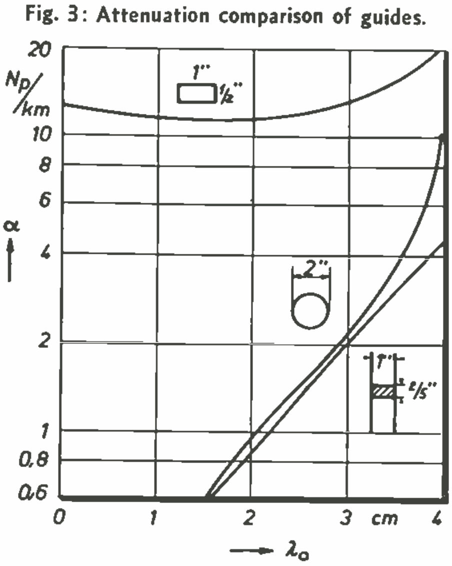
$$\left(\frac{2\pi}{\lambda_{go}}\right)^2 = \left(\frac{2\pi}{\lambda_o}\right)^2 - \left(\frac{2\pi}{\lambda_{co}}\right)^2$$

and

$$\frac{2\pi}{\lambda_o} = \omega\sqrt{\epsilon_o\mu_o}, \quad \frac{2\pi}{\lambda_{co}} = n\frac{\pi}{b}.$$

Eq. 5 interprets the field distribution in the Z-direction, which depends on λ_g and λ_{go}. λ_g is the actual guide wave length and λ_{go} a hypothetical guide wave length for the case that air or a homogeneous

Fig. 3: Attenuation comparison of guides.



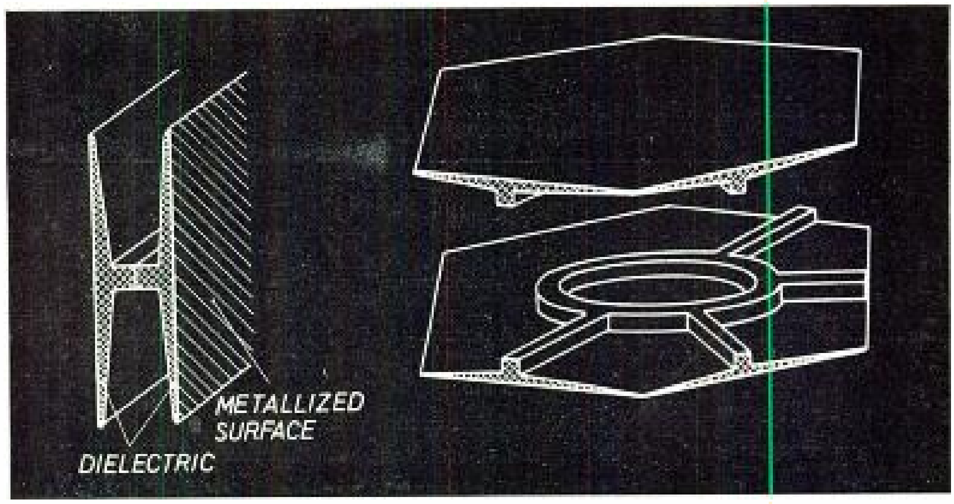


Fig. 1: Cross-sectional view of H-guide designed for simple fabrication (l.) and two parts of a ring type waveguide bridge which permits accurate, inexpensive, production. (r.)

material would fill the space between the walls. Both have different values if the cross-sectional structure is composed of different materials, as is the case in the H-guide. In this guide, the actual guide wave length is reduced by the influence of the dielectric slab. On the other hand, it is greater than it would be in a guide completely filled with the dielectric of the slab.

Field Strength

Application of these conditions to Eq. 5 shows that the field strength in the air space of the H-guide varies in transverse direction toward the openings exponentially. This follows from the positive value of k^2, since $\lambda_g < \lambda_{go}$. In the dielectric, where $\lambda_g > \lambda_{go}$ and k^2 is negative, wave propagation occurs which is described by $e^{\pm jkz}$. This propagation leads to standing waves in the slab of the guide.

In consequence, the cross-sectional field distribution can be represented by

$$f = F_o \begin{matrix}\sin\\ \cos\end{matrix}\, n \frac{\pi}{b} y \cdot e^{\pm k_a z} \qquad (6a)$$

in air, and

$$f = F_o \begin{matrix}\sin\\ \cos\end{matrix}\, n \frac{\pi}{b} y \cdot \begin{matrix}\sin\\ \cos\end{matrix}\, k_d z \qquad (6b)$$

in the dielectric slab.

Sum and difference of the exponential function in Eq. 6a can be occasionally expressed by hyperbolic functions.

Field Components

The functions in Eq. 6 permit description of the wave propagation characteristics of the H-guide in the form of the distribution of the field strength in the different directions. The distribution functions can be derived from the vector potential relation, Eq. 1. We introduce Eq. 6 in the general field strength relations for homogeneous waveguides under observation of the boundary conditions on the surface of the conducting strips. This yields separate equation systems for the components of the electric and magnetic field strength for TE-and TM-waves in air and in the dielectric. They are inter-related by the boundary conditions on the surfaces of the dielectric slab for $z = \pm a/2$ where

$$E_{y\ air} = E_{y\ diel},$$
$$\epsilon_o E_{z\ air} = \epsilon_o \epsilon_r E_{z\ diel},$$
$$H_{y\ air} = H_{y\ diel}.$$

with these relations, the field equation systems reduce to

$$E_x = E_o \cdot \cos \frac{\pi}{b} y \cdot e^{-k_a z} \quad (\sin k_d z)$$

$$E_y = -j \frac{\pi}{b} \frac{1}{\Gamma} E_o \cdot \sin \frac{\pi}{b} y \cdot e^{-k_a z} \quad (\sin k_d z)$$

$$E_z = -j \frac{k_a}{\Gamma} \left(1 + \frac{\omega^2 \epsilon \mu}{k_a^2}\right) E_o \cdot \cos \frac{\pi}{b} y \cdot e^{-k_a z} \quad (\cos k_d z)$$

$$H_x = -\frac{\omega \epsilon_o \frac{\pi}{b}}{\Gamma k_a} E_o \cdot \sin \frac{\pi}{b} y \cdot e^{-k_a z} \quad (\cos k_d z)$$

$$H_y = j \frac{\omega \epsilon_o}{k_a} E_o \cdot \cos \frac{\pi}{b} y \cdot e^{-k_a z} \quad (\cos k_d z)$$

$$H_z = 0 \qquad (7)$$

which represents the fundamental mode ($n = 1$) of combined TE-TM-waves in the air space of the guide. To obtain the distribution in the dielectric, the exponential functions have to be replaced by the trigonometric functions in the parentheses.

Eq. 7 shows as an interesting feature of the H-guide the non-existence of longitudinal currents ($H_z = 0$) on the walls. As a consequence, guide sections may be joined without special connectors and flanges.

Further relations can be derived from the above boundary conditions for the constants k_a and k_d and for the guide wave length. They show the dependence of these constants on the cross-sectional geometry of the guide. The ratio of guide wave length to free space wave length is plotted in Fig. 2 as a function of the relative values of the width of the guide and the height of the dielectric slab with $\epsilon_r = 2.53$.

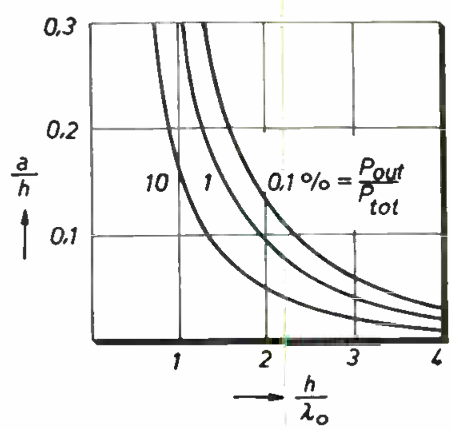


Fig. 4: Guide geometry for energy ratios.

Energy Transport

The derived relations are strictly valid only for guides with infinitely extended walls. However, they may be applied as an approximation for H-guides with finite

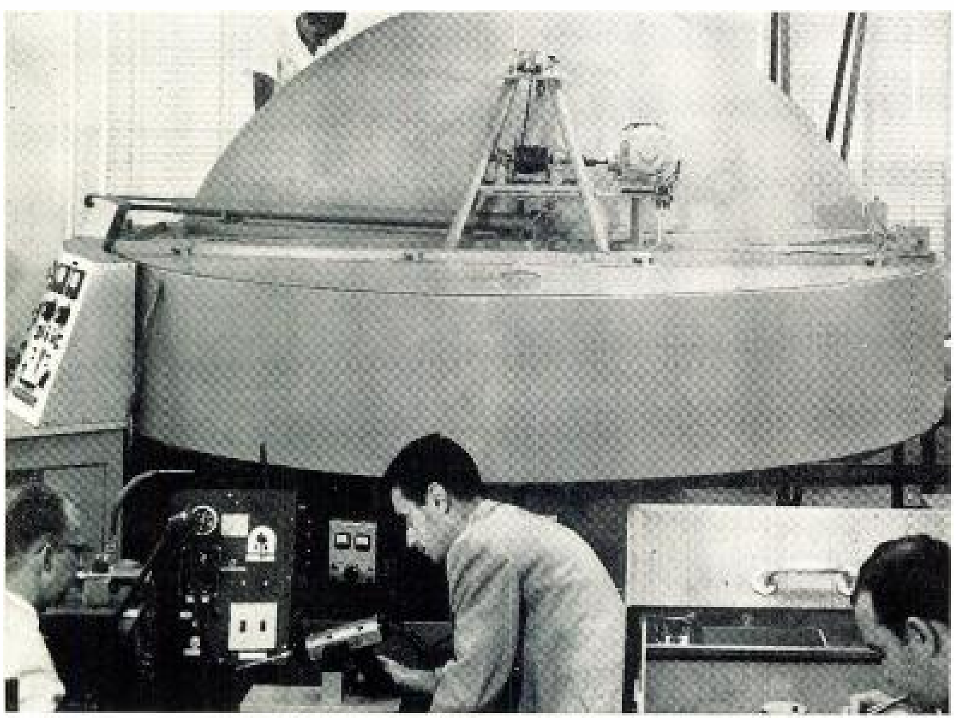
(*Continued on page* 130)

Describing the use of rotating transformers to sample the output of small components undergoing spin tests up to 300,000 g's. Data includes construction details and operational problems.

Instrumentation For High "G" Tests

By SAMUEL J. BOND

Fig. 1: A 12 ft. diameter centrifuge ordinarily used to develop up to 50 g's.



In the realm of a very increasing scope of application of relays, it inevitably becomes necessary to consider the application of the relay to many unusual environmental and use conditions. Ordinarily, most of us concern ourselves with the problems of determining relay function under acceleration conditions of 1, 10, or perhaps 50 g's. Occasionally much interest may go to relay application which involves consideration of as much as 1,000 or 2,000 g's. Usually in such high g applications, the design of the relay must be rather unique in order to function. So too, the design of the test apparatus must be somewhat unique in order to accurately predict compliance to specification or lack thereof by the relay under test.

Generally speaking for g tests in the order of 0 to 50 g's, a small centrifugal table is usually adequate. In this type of set-up, energy and information is conveyed to and from the component under test through the mechanism of slip rings. Certain basic conditions such as balance of the centrifuge table and proper support for the relay in its various held positions must be given due engineering consideration. Also, it is necessary to use a centrifuge table, Fig. 1, which is relatively large in relation to the relay size in order that the entire relay may be subjected to a relatively uniform gravitational field.

In situations where a very uniform field is to be obtained, it is necessary that the relay be extremely small in relation to the size of the centrifuge. In order to meet these requirements, sometimes it is necessary that very large centrifuges be used. An example of such a large centrifuge which has been applied to relay testing is shown in Fig. 1, also. This centrifuge is 12 ft. in diameter and although it is ordinarily used to deliver only 50 g's it provides a very constant field of acceleration to even large sized objects which are clamped thereon.

For the most part, most of these test techniques have been well established and are well understood by the workers in this field. What

SAMUEL J. BOND, Asst. Chief Engr., Bulova R&D Labs, Inc., Woodside, N. Y.

is involved, however, when we wish to test relays at 5,000, 20,000, 80,-000 or 300,000 g's? Unfortunately, the fundamental design of the ordinary centrifuge table is not one which can directly comply to these extreme g tests. Furthermore, it is a certainty that the ordinary concepts of standard electromagnetic relay design will not necessarily suffice for the construction of relays which will function at these extreme g's. It is safe to predict that something in the order of a transistor would be considered the working relay in this g range rather than the classic armature type electromagnetic relay. However, this article centers itself around test techniques in this range rather than relay design in this range of g's.

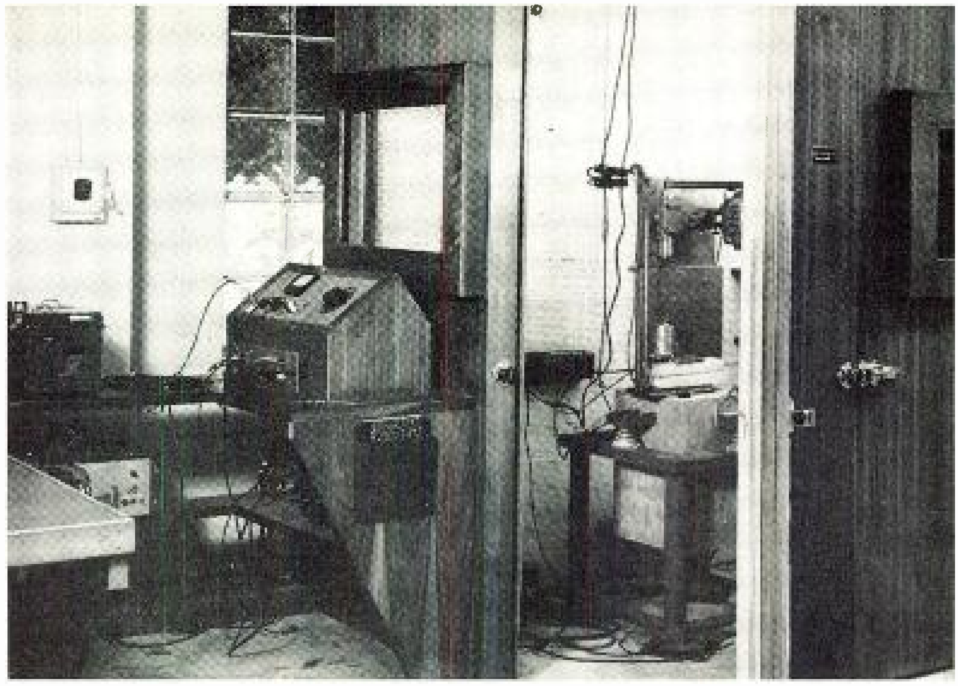


Fig. 2: Steel lined booth with bullet proof windows houses the 130,000 rpm spin rig.

High G Techniques

For reasons of space and material limitations, it is usually necessary to secure such very high g's via the process of very high spinning speeds. This work is ordinarily done in a machine called a spin rig which in the interest of safety is used in a steel lined booth with bullet proof observation windows. One such booth is shown in Fig 2. Spin rigs, Fig. 3, are capable of reaching speeds in excess of 130,000 rpm. These are speeds which are reached under load. Diameters spun at these speeds are in the vicinity of 2, 3 and 4 inches and yield accelerations of as much as 300,000 g's.

As might be expected, certain unusual problems present themselves in this type of work. For example, it is no longer possible to use slip rings to carry energy and information to and from the relay under test. At speeds above 20,000 rpm, it is virtually impossible to make and retain contact with any sort of commutator or slip ring. A solution to this problem has been developed in the form of a device called a rotating transformer. This device is capable of coupling energy and information into and out of the rotated body without any direct contact with the rotating system. In Fig. 4, we can see the rotating secondary and the stationary primary of this transformer. A transformer of this type, namely 2 in. in diameter and 4 in. in length, is capable of coupling 50 watts of energy.

In situations where it was desired to have DC for the rotating device, rectifiers and filters placed close to the center of rotation have adequately modified the AC energy. At times spin rigs have been designed with as many as 4 of these rotating transformers. All instrumentation is external and generally makes use of pen type recorders and oscilloscopes with camera recording attachment.

Many interesting techniques and problems are involved in the development of such high speed spinning apparatus. Problems of balance become extraordinarily acute at these rotational speeds. Furthermore, problems relating to mechanical resonances must be considered in their own right. Without due consideration to such problems it is not uncommon to find oneself picking balls, pulleys, motors, shafts, and bearings out of the sound proof walls of the spin booth.

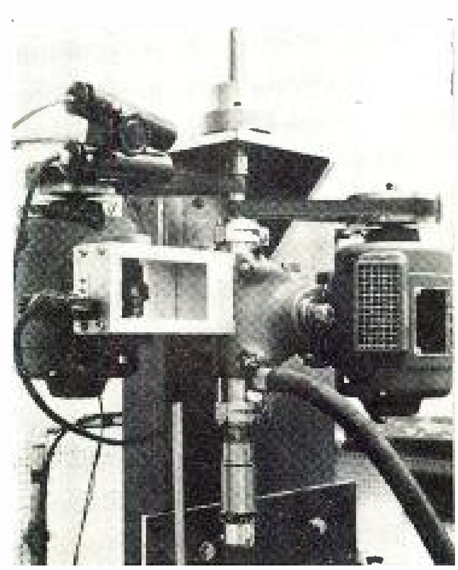
One of the most acute problems to be studied in this regard is the nature of deflections in the rotating system when passing through critical or mechanically resonant speeds. Generally speaking, these critical speeds must be traversed with a very substantial input of power. In the event that there is not sufficient power to "break through" the critical speed, the result will be a rapid and continuing build-up of deflection in the various parts of the rotating system until ultimately the high radial loads caused by the eccentric rotation of the deflected parts bring about bearing failure.

Frequently what happens is that the deflection at critical speeds progresses so rapidly, that, even though the bearings do not fail the shaft will tear itself apart under the degenerative action of its own centrifugal force. These failures, when they occur, are extremely rapid and seem to happen in a split second.

In order to minimize the influence of critical speeds, special precautions were taken to have the definite mechanical sections of the system resonate at widely separated frequencies. This prevented

(*Continued on page* 150)

Fig. 3: Close-up of a high "g" spin rig.



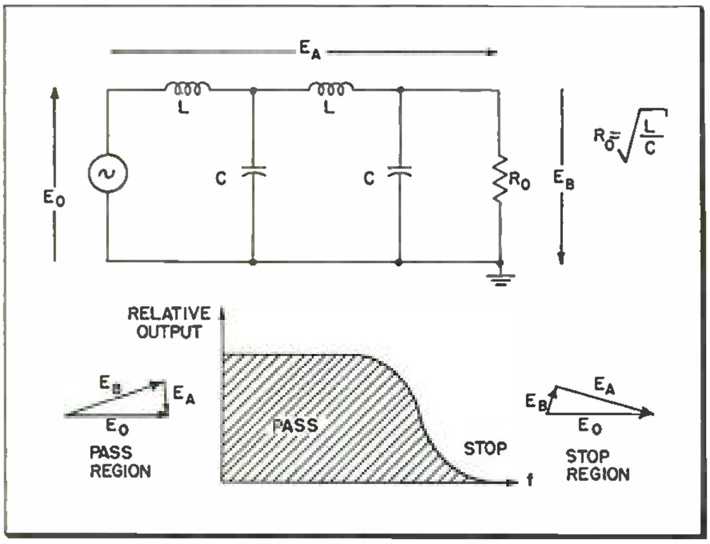


Fig. 1: Low-pass filter and output characteristic

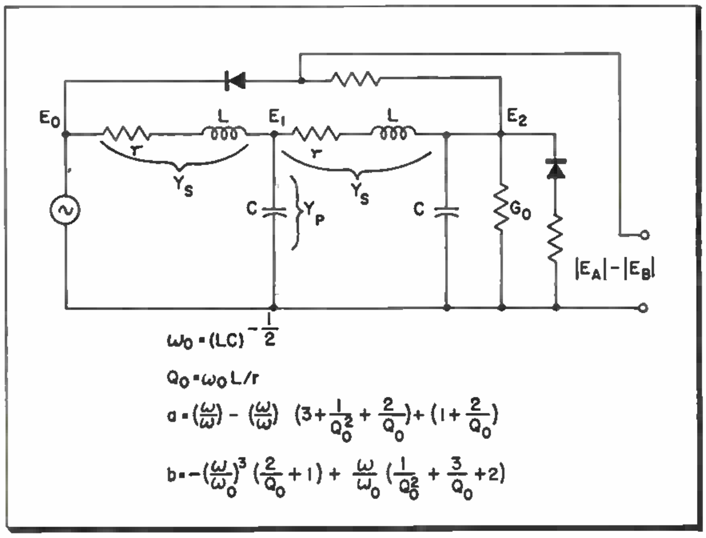
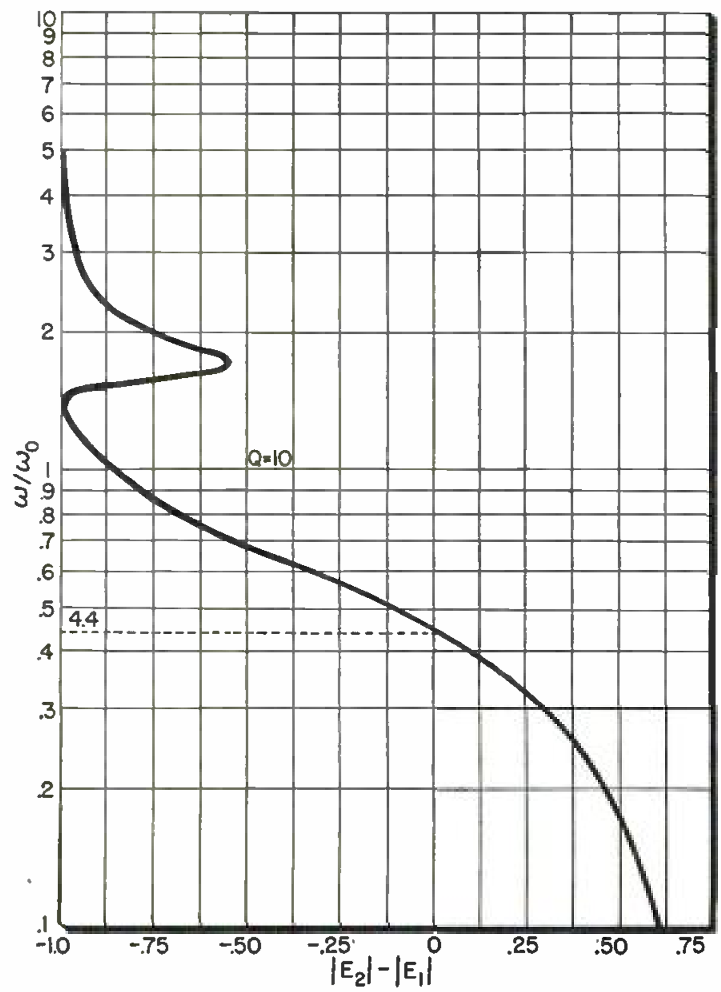


Fig. 2: Two-section single-ended balanced discriminator

Designing a Low Frequency Filter-Discriminator

Fig. 3: Output characteristic, Q = 10



By M. SANDERS

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IN many modern frequency-modulated or frequency-shifting systems, there is a requirement for a frequency discriminator in the audio and low r-f range. It is desirable, of course, to maintain the usual advantages of a balanced system: (1) no dc output at a particular frequency, f_o; (2) a change in polarity of the output current or voltage as the frequency is varied above and below f_o; (3) low impedance levels with good frequency discrimination sensitivity; (4) a common ground terminal at input and output.

Low impedance and sharp frequency characteristic at audio and low radio frequencies can be obtained with a filter-discriminator circuit that utilizes standard filter components

It is recognized that conventional balanced frequency discriminators utilize tuned coupled circuits, and that sharp frequency discrimination and low impedance levels are not compatible. At audio frequencies, the higher Q's required in coil components force the use of special core materials and expensive coil construction. However, the discriminator described in this article achieves a low impedance level with sharp frequency characteristic at audio- and low-radio frequencies.

The single-ended balanced discriminator uses a low-pass network as the basis of its operation. Such a circuit, together with an idealized frequency characteristic, is shown in Fig. 1. A conventional two-section filter terminates in R_o, the characteristic impedance. At any frequency, the vector sum of the voltages $\vec{E_O}$, $\vec{E_A}$, and $\vec{E_B}$ must vanish. In the pass region, since the voltage $\vec{E_B}$ is altered only slightly, the voltage $\vec{E_A}$ is smaller in magnitude and lies at some angle with respect to $\vec{E_B}$. In the stop band, the situation is reversed so that the magnitude of $\vec{E_A}$ is larger than the magnitude of $\vec{E_B}$. At some position between the pass and stop regions of the filter, these two magnitudes are equal. A slight change in frequency to one side or the other of this critical frequency will cause $|E_A|$ to be larger or smaller than $|E_B|$. The amount of this unbalance will be proportional to this frequency displacement until there is a shift into the full stop or full pass regions. If the unbalance can be determined in a manner to indicate whether $|E_A|$ or $|E_B|$ is larger, the device will be a frequency discriminator.

Two diode detectors, arranged as shown in Fig. 2, will accomplish the desired comparison. If diode rectifiers are high-impedance devices, the filter terminal conditions are essentially unchanged. The two diodes are in dc opposition so that the sign of $|E_A| - |E_B|$ is determined by the larger, and by the choice of diode arrangement.

One advantage of this filter-type discriminator is evidenced immediately by observing from filter theory that the steepness of the pass-stop transition can be increased by adding sections. The impedance level remains unchanged at image impedance R_o although the frequency discrimination becomes more sensitive.

A solution for a two-section filter discriminator, similar to that discussed above, is obtained by solving for the frequency dependence of $|E_A| - |E_B|$. The network equations can be obtained from Fig. 2 in the usual way. For convenience, dissipationless capacitors are assumed and E_O is taken as unity. The network equations are:

$$\begin{aligned} (Y_p + 2Y_s)\,E_1 - Y_s\,E_2 &= Y_s\,E_o \\ -Y_s\,E_1 + (Y_s + Y_p + G_o)\,E_2 &= 0. \end{aligned} \qquad (1)$$

The determinant of this set of equations is:

$$\Delta = \begin{vmatrix} Y + 2Y_s & -Y_s \\ -Y_s & Y_s + Y_p + G_o \end{vmatrix} \qquad (2)$$

and the solution for one voltage of interest, namely E_B, is

$$|E_B| = \left| \frac{Y_s^2}{\Delta} \right| \qquad (3)$$

The other voltage of interest $|E_A|$ is found by

$$|E_A| = |1 - E_B| \qquad (4)$$

Solution of the network equations yields the following answers:

$$|E_B| = \frac{1}{\sqrt{a^2 + b^2}} \qquad (5)$$

$$|E_A| = \frac{\sqrt{(a^2 - 1)^2 + b^2}}{\sqrt{a^2 + b^2}} \qquad (6)$$

so that

$$|E_B| - |E_A| = \frac{1 - \sqrt{(a - 1)^2 + b^2}}{\sqrt{a^2 + b^2}} \qquad (7)$$

where a and b are functions of the fixed constants r, L, and C and the variable ω/ω_o $(\omega_o) = (LC)^{-\frac{1}{2}}$.

A typical curve for a Q value of 10 in shown in Fig. 3 as a function of the variable ω/ω_o. Curves drawn for other values of Q are similar in shape with slightly different slopes at the balance point and different values of ω/ω_o at balance.

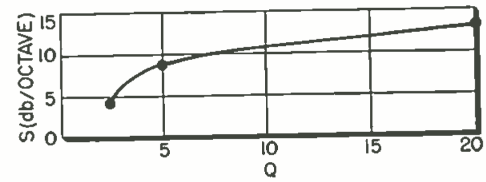

Fig. 4: Discriminator slope vs. Q

The slope of the discriminator characteristic at the balance point may be determined from Eq. 7 and is shown in Fig. 4 as a function of Q. The balanced points occur at values of ω/ω_o lower than unity. The value of ω/ω_o at balance, (ω/ω_o), is shown in Fig. 5 as a function of Q.

A two-section filter using power supply filter elements was constructed with an ω_o of $2\pi \times 900$.

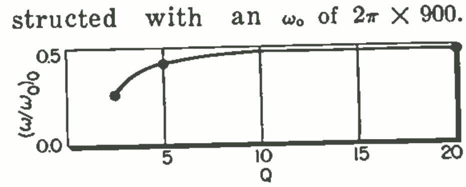

Fig. 5: Balance points vs. Q

The image impedance R_o was 2500 with 1.3µf capacitors and two heavy chokes. The coils had a Q of 7. The balance point was found to be at 403 CPS or $(\omega/\omega_o)_o = 44.6$. The slope at the balance was found to be 10 db per octave. All values are in substantial agreement with the computed curves.

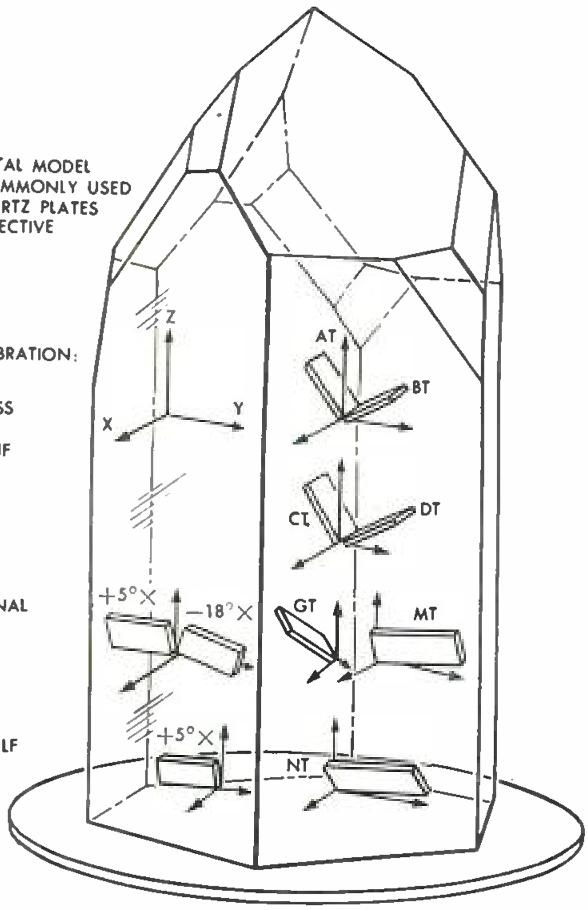

Fig. 1: Phantom view of a natural quartz crystal & cuts.

As a guide to circuit designers, this article reviews the various cuts of crystals and their applications in electronic circuits. Testing procedures are described and operational problems are viewed from several highly practical viewpoints. The comparative ability of several crystal oscillator circuits is studied.

By HAROLD EDELSTEIN

Selection and Application

Quartz crystals may be broken down into categories with respect to:

(a) Type of cut (AT, BT, CT, DT, etc.).

(b) Type of Mounting (Plated, Pressure Mount, Lead Attached), and

(c) Mode of Operation (Fundamental, Overtone).

To illustrate type of cut, Fig. 1 shows a phantom view of a natural quartz crystal with some of the more widely used cuts drawn in. Each of the cuts has its special qualities and limitations. For exexample, the AT cut, which is the preferred cut for most applications in the frequency range 800 KC and higher, is characterized by an excellent temperature coefficient of frequency over a wide temperature range. Its frequency is dependent on thickness, and is approximately described by the formula $F_{kc} = \frac{66.2}{t}$. This works out to a thickness of .0827 in. at 800 KC to about .0035 in. at 20 MC. These extremes represent the practical production limits for this type of cut at the present time.

Since the thickness to diameter ratio should be kept as small as possible, a minimum of 1:20, and in no case smaller than 1:8 being considered a design objective, the 800 KC AT cut crystal becomes large enough to completely fill the conventional holders; using larger holders, we rapidly reach limitations in the size of natural quartz available. At the h-f end of the scale, breakage of the extremely thin quartz wafers during lapping and handling imposes a limitation.

At 20 MC we can consider going to the BT cut, whose frequency is determined by the formula $F_{kc} = \frac{100}{t}$. This makes the crystal ⅓ thicker for the same frequency, and enables us to grind to approximately 30 MC for the same thickness. However, as will be shown, the temperature coefficient of frequency for the BT cut is not as good as that of the AT.

Returning to the l-f end of the scale, it is possible to produce crystals economically in the range 200 KC to 800 KC by utilizing one of the face shear modes. These are illustrated in Fig. 1 by the CT, DT, and GT cuts. In these, the frequency is determined by the length or width of the plate and is described by the formula $F_{kc} = \frac{K}{L}$ where, K is 122 for a square CT cut and 81.9 for a square DT. (At 200 KC a DT cut crystal is 0.41 in. sq., and at 800 KC a CT is 0.153 in. sq.)

At still lower frequencies, down to approximately 16 KC as a practical lower limit, extensional or flexural modes of bars become the

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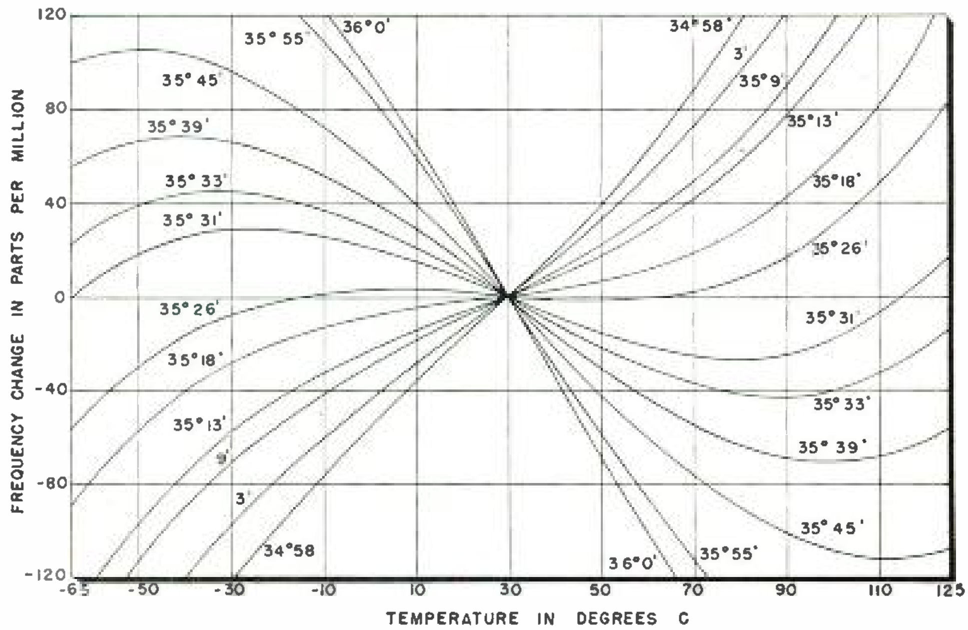


Fig. 2: Frequency-temperature characteristics of an AT cut resonator.

# of Quartz Crystals

cuts of choice. The frequency of a bar vibrating in an extensional mode is approximately given by the formula $F_{kc} = \frac{1}{2L}\sqrt{\frac{E}{\rho}}$ where, L is the length, E is the elastic modulus, and ρ is the density of the quartz. The quantity $\frac{E}{\rho}$ represents a velocity constant of sound in quartz. An X Bar at 100 KC is approximately $1\frac{1}{16}$ in. long and a 50 KC bar $2\frac{1}{8}$ in. long.

The frequency of a flexural mode such as an NT cut, is determined by the ratio $\frac{W}{L^2}$ multiplied by the velocity constant. In the case of an NT cut, this constant is of the order of 5000. Since this is a ratio crystal, there are many dimensions for a given frequency, but the flexural mode types can be made comparatively small at l-f.

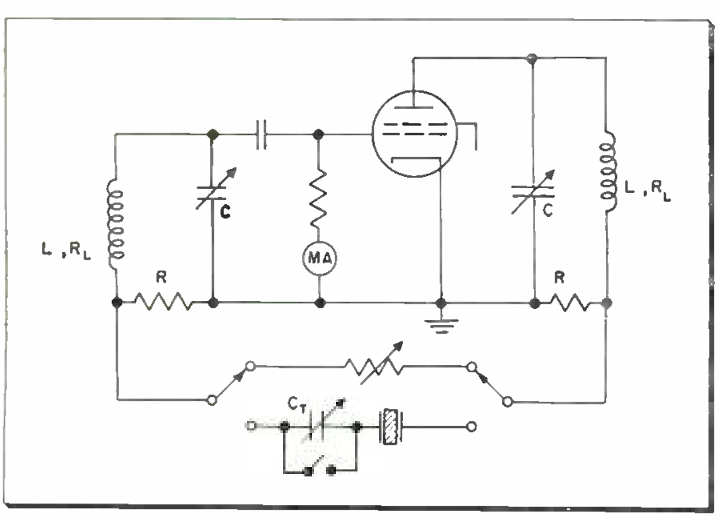


Fig. 3: Crystal impedance meter used by SCEL.

Temperature Coefficient

As has been mentioned, the temperature coefficient of frequency varies considerably with the type of cut. The AT cut will deviate less than ±.005% over the range —60° to +100°C. AT cut crystals can be made to deviate less than ±.0015% over this range. However, as will be shown, the cutting angle to produce crystals within this range must be rigidly held. The GT is a special type of cut, requiring three orientations, and is suitable only for a restricted frequency range, approximately 100 to 400 KC. Naturally, all of these cuts are amenable to temperature control, and, by setting the temperature at the turning point of the crystal, good performance, at least tempera-

Quartz Crystals (cont.)

ture-wise, can be obtained from all. Fig. 2 presents a family of curves for the AT cut crystal. The parameter which is varied is the Z-Z′

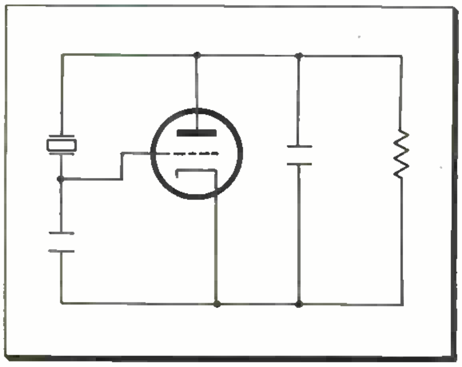


Fig. 4: Pierce Osc. for quality tests.

angle of orientation; this is the one which primarily determines the inclination of the TC curve. It happens that these particular curves are drawn for overtone crystals; these will be touched on later, but the characteristic shown applies to fundamental mode AT cut crystals as well as to overtones. It will be noted that for a change of 3′ in Z-Z′ orientation the frequency deviation over the temperature range is very appreciably altered, and the temperature of the turning point is changed. In quantity production of some crystals of this type, a tolerance of ±3′ is customarily maintained. The ideal Z-Z′ angle changes slightly with the frequency of the crystal, varying from 35° 00′ at 1 MC to 35° 26′ at 20 MC. This angle also changes slightly for overtones.

Cutting Factors

There are other factors which influence choice of cut. Among these are cost, ruggedness and longevity. In each of these factors, the choice is strongly in favor of the thickness shear modes. A crystal must be mounted and must have electrodes in order to function. A thickness shear plate is a low resistance osc. whose active area is restricted to the center of the plate, and the edges are almost stationary. It can, therefore, be clamped between electrodes, or the electrodes may be plated on and wires clipped to the edges, and it will still make a fine osc. The face shear modes and bars may not be so clamped, otherwise they will not oscillate.

The usual method of mounting these is to fire silver spots to the nodal points on the faces of the plates, and then solder the support wires to these. The silver spots, the solder, the wires, and the rest of the assembly all becomes part of the oscillating system. None of these materials is as stable, or has as high a "Q" as quartz, and the mechanical tolerances are extremely small. These factors tend to decrease the quality and increase the cost of these crystals.

The general conclusion here points to an overall preference for the thickness shear modes and these should be used if possible. It is often possible to substitute a higher frequency crystal of the thickness shear mode along with a divider

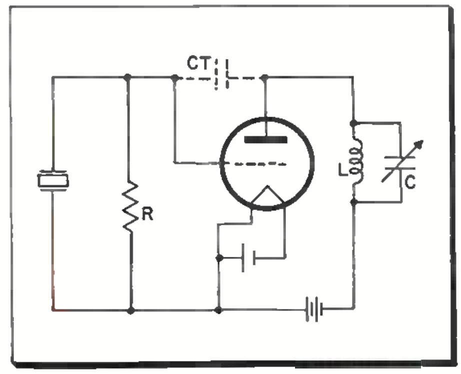


Fig. 5: Miller Osc. for 20 MC range.

stage or two for a l-f face shear crystal. To do so will usually improve performance, reliability, and longevity, and will not greatly increase weight and complexity. Of course, when the desired frequency is very low, and when power consumption and circuit complexity must be held to a min. it may not be possible to do this.

At frequencies above 20 MC, in order to increase the thickness to a workable value, the so-called overtone oscillators are used. These are crystals which are designed to be operated at other than the fundamental mode of oscillation. Thickness-shear and face-shear crystal plates, in general, will operate at odd-numbered mechanical overtones and will demonstrate quite low resistance at reasonably low-numbered overtones, such as the 3rd, 5th and 7th. The reason for operation at odd-numbered overtones only is readily seen, if the distribution of charges is considered. When stress is applied, one face develops a positive charge, and the other negative. At even over-

(*Continued on page* 152)

Fig. 6: Relative frequency stability merits of 4 oscillators

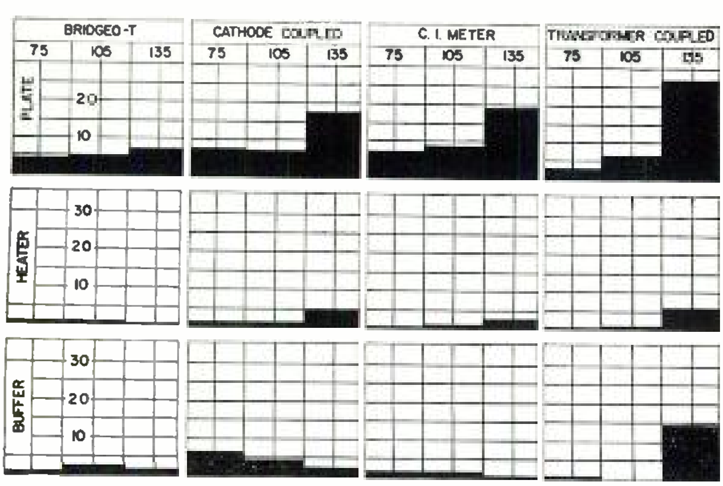
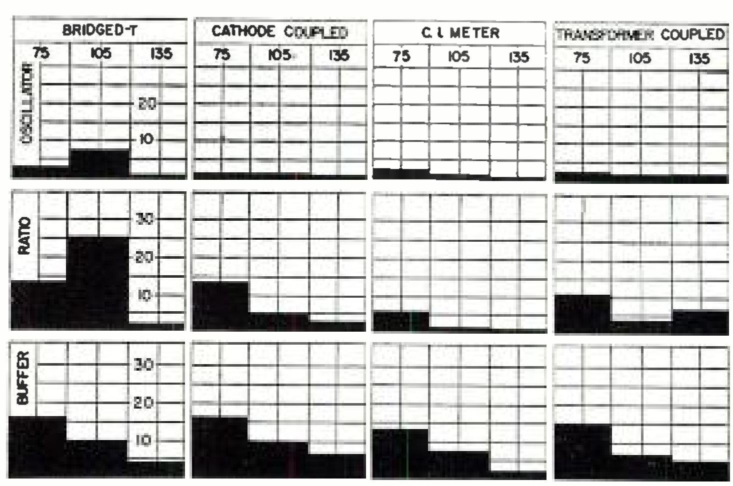


Fig. 7: Comparative ability to provide output power.



A finned power absorber, developed at Nihon University, Tokyo, eliminates spurious responses in cavity wavemeters, and gives greatly improved tuning characteristics.

by KORYU ISHII

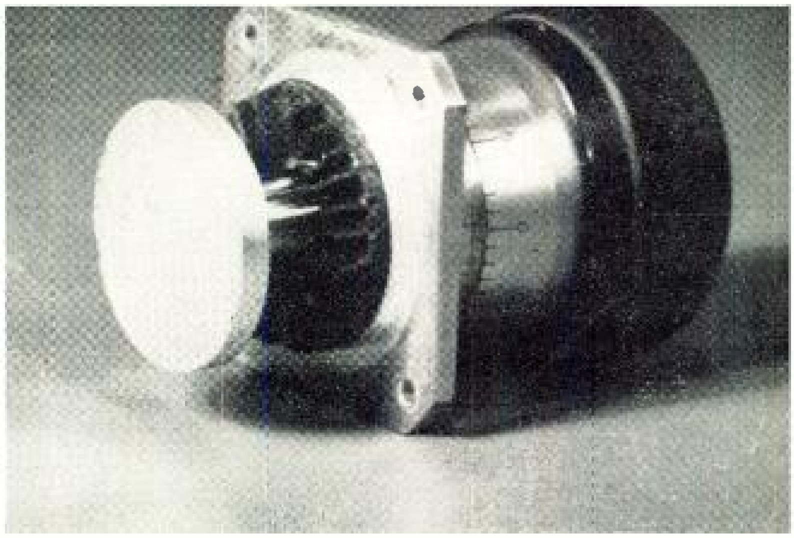


Fig. 1: Power absorber mounts on wavemeter cavity wall

K. Ishii

Resistive Fins Improve Wavemeter Tuning

In conventional cylindrical cavity wavemeters, a flat resistive power absorber plate is fixed to the chamber wall behind the movable piston. At this location, the magnetic field is maximum, but the electric field is minimum. Because of this, energy of the magnetic field is absorbed, but little electric field energy is absorbed.

In an attempt to give improved energy absorption from the electric field, resistive fins were mounted on a conventional flat power absorber in such a manner that they projected into the cavity and into a region of higher electric field intensity. It was believed that the finned projections would absorb power from the electric field and additional power from that portion of the magnetic field parallel to each fin film. The experimental absorber was fabricated of paste-board coated with a resistive film of carbon.

KORYU ISHII, The Laboratory of Microwave, Nihon University, Surugadai, Tokyo, Japan.

Experimental Results

Fig. 2 shows the tuning characteristics of the experimental cavity wavemeter with a conventional power absorber. Two tests were run; one with the power absorber mounted directly on the back of the tuning piston, and the other with the absorber mounted on the fixed wall behind the piston. Poor response of this conventional arrangement is evidenced by the twin-peaked curves of Fig. 2.

(*Continued on page* 128)

Fig. 2: Wavemeter tuning charactertistics with flat absorber

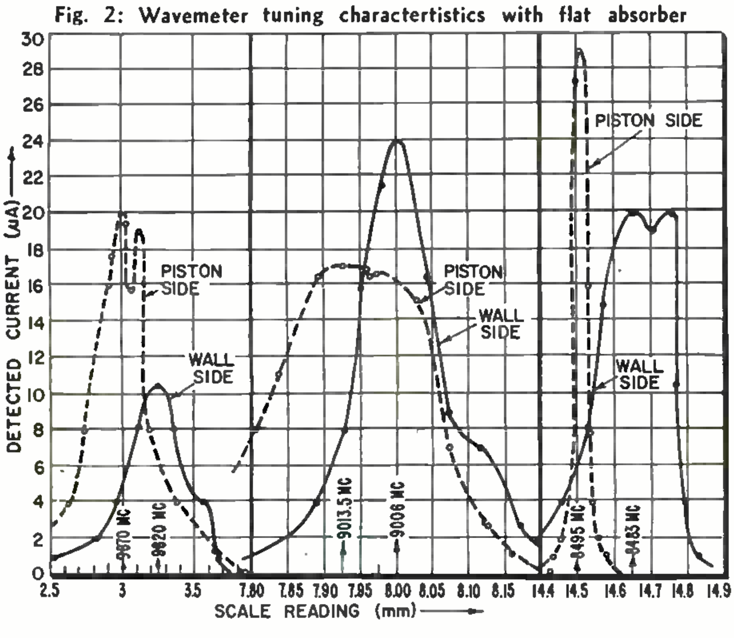
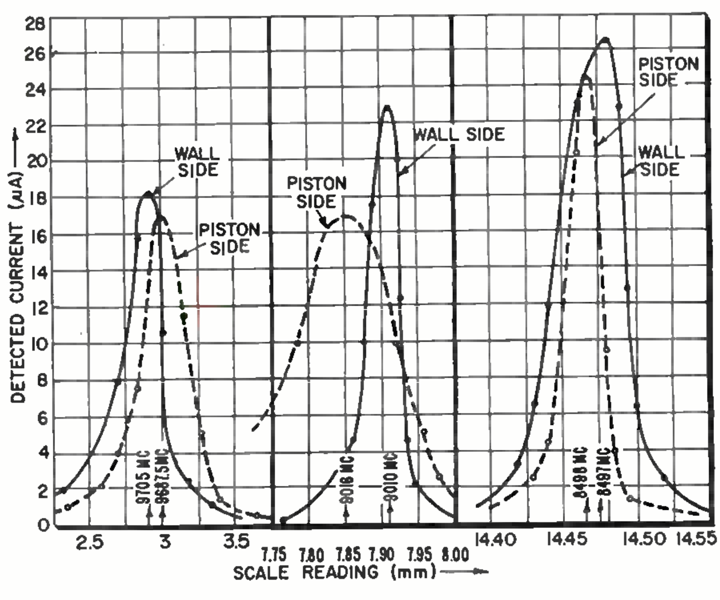


Fig. 3: Finned absorber gives improved tuning characteristics



Designing Open Grid Parabolic Antennas

Wind and ice loading of large microwave antennas is minimized by using fabricated grid parabolas. Boundary conditions for total reflection are developed

E. F. HARRIS

By E. F. HARRIS

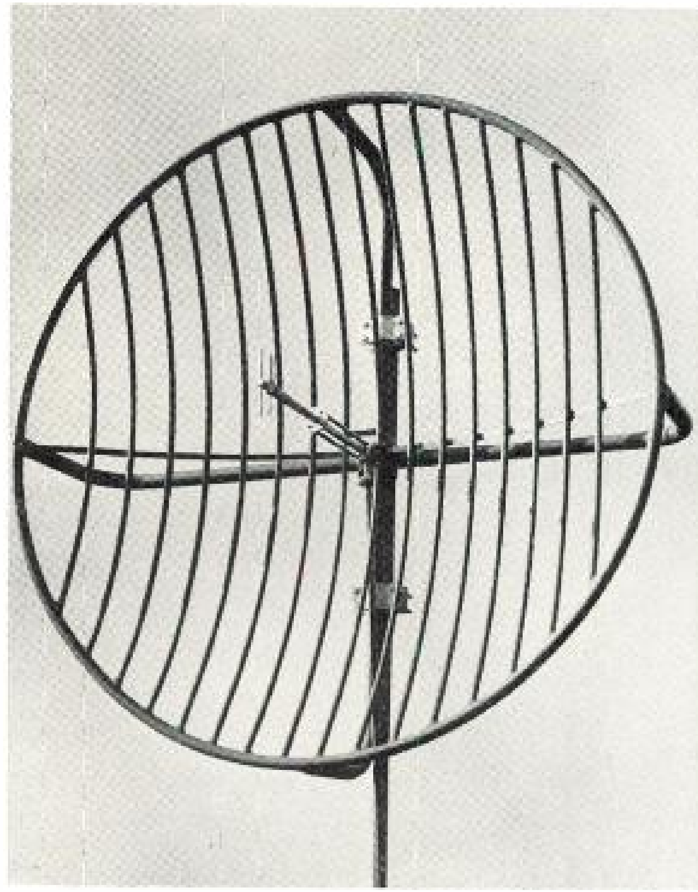


Fig. 1: 6 ft multielement parabolic antenna

The parabolic antenna design has had wide application in the microwave region as a single feed, large aperture radiator capable of high gains with relatively low minor lobe distribution. Because of radar applications and early developments at centimeter wavelengths the tendency has been to employ sheet reflectors consisting of aluminum spinnings in diameters up to ten feet.

There exists, however, a group of frequencies in the range from about 300 MC to somewhat over 1000 MC where the electrical design of a parabola still retains many desirable features as compared to arrays of fed elements. In this frequency range there is no need for a solid reflector, however, because of the magnitudes of the wavelengths involved.

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Construction

The multi-element grid parabola is constructed from a plurality of tubular elements set parallel in a framework; each tubular element having been formed into the shape of a section of the parabola at that line.[1] As shown in Fig. 1, the parabolic reflector is assembled from shaped elements which are "Heliarc" welded into a circular aluminum support frame. With this arrangement the illuminating primary feed must produce its E-vector (polarization) parallel to the lines of the elements.

From a practical standpoint this structure becomes useful only if it is possible to utilize tubing diameters and element spacing which will afford an appreciable saving in weight of material as well as materially reduce the effects of wind loading compared with solid reflectors or mesh type reflectors under conditions of icing.

Diameter Determination

It is apparent that as frequency increases, the element spacing must decrease so that at some frequency the required spacing becomes so small as to invalidate the design. Due to the many existing and proposed commercial applications in the 890-960 MC region it was decided to develop the first such units for optimum performance in this range. As will be seen, the resulting parabola is an exceptionally efficient electrical device and offers many desirable mechanical features unattainable with conventional parabolas.

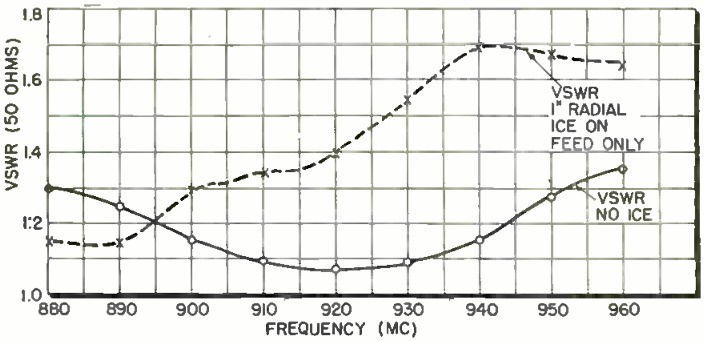

Fig. 2: (above) VSWR for normal operation and for operation with 1 inch ice load on the active element

Fig. 3: (right) H-plane pattern of grid parabola is nearly identical to that of a solid parabola

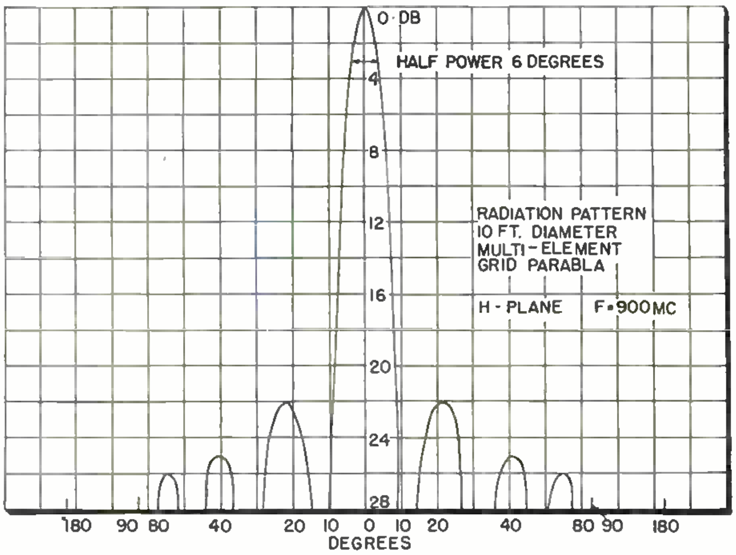

Fig. 4 is a set of curves which show the limits of operation for various diameter elements in terms of wavelength as related to the allowable spacing to produce a grid that operates essentially as a perfect reflector.[2] Consider a plane wave incident on an infinite grid of thin wires, parallel to the electric vector; the incident field will induce currents, in the parallel wires of the grating, of such a value that the net field is just zero at the surface of each wire. The resultant field on the far side of the grating will depend on the magnitude and phase of the induced current; these depend on the diameter of the wires and on the spacing between them. To simulate closely the effect of a continuous sheet the self inductance of the conductor in the grid must be made nearly equal and opposite to the mutual inductance. For a given grating of pitch g, this adjustment for equality can be brought about only by correct choice of the wire diameter. Provided the radius is chosen correctly, then the impedance of the wires is purely resistive and the induced current will be in phase with the inducing field E. In other words, the current per wire is equal, in magnitude and phase, to the current which would be induced in a width g of continuous sheet. In such circumstances the wave radiated by the grating will be equal in magnitude and opposite in phase to the incident field; this is the same as saying that the grid is a perfect screen. Although the grid is an open one, the result can be achieved by proper choice of element diameter and spacing.

Parabolic antennas utilizing the multi-element grid principle have been developed in diameters up to 15 ft and feeds are available for the 890-960 MC and 450-470 MC regions. An overall view of such a unit is shown in Fig. 1.

Table I shows performance data at 900 MC for a 6 ft and a 10 ft multi-grid type along with mechanical details; as well as a comparison with typical mechanical details of solid spun dishes.

Feed

A four-rod support system which ties rigidly to the cross casting of the parabola frame affords an exceptionally strong mount for the feed without presenting a large bulk. The entire feed assembly is pressure tight, the seal being accomplished by means of a single "O" ring and a Teflon radome covering the active element of the dipole. A typical VSWR curve is presented in Fig. 2 along with an added curve of VSWR taken under conditions of 1" of radial ice covering the Teflon radome and feed.

TABLE I

Comparison table of Multi-Element Grid parabolic antennas with similar parabolas of the solid spun reflector design.

MODEL of Parabola	6-Ft Multi-Grid	10-Ft Multi-Grid	6-Ft Spun Al.	10-Ft Spun Al.
Frequency, Mc.	900	900	900	900
Gain-Db over Dipole	20	25	20	25
Wind Thrust 100 MPH Vel.	250-Lbs.	700-Lbs	1100-Lbs	2250-Lbs
Net Weight	65-Lbs	100-Lbs	190-Lbs	625-Lbs

Ice Effects

The curves show graphically the low sensitivity of the feed to conditions of severe icing; the major effect has been to shift the match somewhat lower in frequency although the VSWR over the 890-960 MC band is still very good with the 1" of radial ice. The explanation seems to lie in the fact that the Teflon radome which covers the active element has a dielectric constant of the same order as ice.

In initial design the system is matched carefully by means of a quarter-wave slug of Teflon within the feed line near the fed element. Since the Teflon radome has already placed a certain amount of dielectric around the active element, and the effects of this dielectric have been accounted for in the matching network, the added ice loading on the radome has a secondary effect in changing impedance and is much less severe than would be the case if the active element of the feed were exposed.

Deicing

It is relatively simple to de-ice the feed by mounting an infra-red heat lamp behind the parabola grids and focusing the lamp on the feed.

(Continued on page 110)

A Tetrode Transistor

Design features and gain and bandwidth data on a new high frequency amplifier designed around a grown junction silicon transistor. Neutralized gain with conjugate source and load impedance is employed. Gain test sets are described for use at 5, 12 and 30 MC.

By ROGER R. WEBSTER

THE increased interest and activity in high frequency transistors generated several specific requirements for transistor amplifiers in the 5- to 30-MC region. Operating temperature requirements up to 100°C precluded the use of germanium, so that the development of a high frequency silicon transistor was undertaken. Using grown junction techniques, very narrow base regions are realizable, but only at the cost of high base resistance.

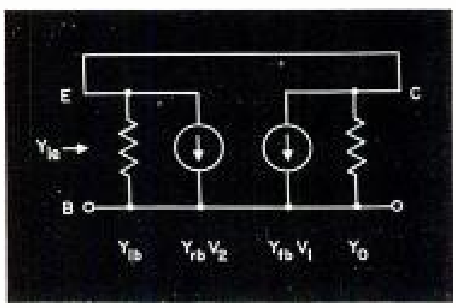

Fig: 1: Collector shorted to emitter for determination of fwd. transfer admittance

The tetrode transistor, therefore, is very attractive at these frequencies.

These transistors were to be used primarily in high frequency tuned amplifiers. Experience had shown the problems in working with high gain multistage amplifiers without neutralization, therefore the neutralized gain and complex impedances for conjugate match were required.

To aid in evaluation, gain test sets were constructed for use at 5, 12 and 30 MC.

The information gained from the tests was incomplete and limited to the specific frequencies mentioned.

There was no guarantee that the circuit configuration of the test sets was the optimum for all transistors, although considerable flexibility was built into them. A simple, yet accurate, method for computing gain from impedance measurements at any point in the frequency range was desired. The impedance measurements themselves, if of the proper kind, would supply most of the additional information required in the evaluation and application of the transistors.

Neutralized gain with conjugate source and load impedance simplified the problem considerably. If the losses in the neutralization networks are neglected, the justification for which will be shown later, the conjugate matched gain can be readily determined from impedance measurements. The most commonly used system of measurements are the h parameters, and it is not difficult to show for transistor power gain that:

$$A_p = \frac{h_f^2}{4 \text{ Re } h_i \text{ Re } h_o}$$

where h_f = short circuit forward current gain (hybrid)
h_i = short circuit input impedance (hybrid)
h_o = open circuit output admittance (hybrid)
Re = emitter resistance

Conditions:

(a) Conjugate generator and Load Impedance.

(b) Neutralized with lossless circuit.

(or) Reverse Signal Transfer = O.

In the frequency range of interest the grounded base Re h_o is sometimes positive, frequently negative, and zero at the crossover points. In addition, Re h_o was discovered to be extremely temperature sensitive near the upper frequency at which the transistor was useful as an amplifier.

Gains computed from the h parameters can be anything from — infinity to + infinity. These are related to h (or bridge) neutralized amplifier gain, and neutralized gains of 30 db and greater at 30 MC were obtained. The stability left a great deal to be desired. In the critical region small temperature changes resulted in fairly large gain variations.

Oscillations can be obtained in the h (or bridge) neutralized circuit if load conductance is less than the negative output conductance, the transistor simply acting as a two terminal negative resistance device. The neutralizing circuit itself adds but a small positive shunt conductance to the transistor output, and will frequently be of insufficient magnitude to alter Re h_o significantly.

Negative Re h_o is not peculiar to the silicon tetrode, but has been observed in high frequency transistors of various types. Negative output conductance in this frequency range will usually be caused by very small emitter-collector capacitance, and for this reason, it is very difficult to avoid.

Parasitic capacitances can be avoided if the short circuit admittances are measured. In this manner the regenerative paths due to parasitic capacitances are effectively shorted. For instance, the collector-emitter capacitance acts simply as a shunt reactance to ground. This choice will also give circuit design information if admittance neutralization is used.

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Amplifier for 5-40 MC

The gain formula is:

$$A_p = \frac{Y_f^2}{4 \, \mathrm{Re}\, Y_i \, \mathrm{Re}\, Y_o}$$

Y_f = short circuit forward transfer admittance

Y_i = short circuit input admittance

Y_o = short circuit output admittance

To determine Y_f in terms of admittance measurements, the common emitter input admittance is determined in terms of the common base admittances by shorting collector to emitter as shown in Fig. 1,

where Y_r = short circuit reverse transfer admittance, and the second subscript refers to common base or common emitter.

The common emitter input admittance can be written

(1) $Y_{ie} = Y_{ib} + Y_{rb} + Y_{fb} + Y_o$

(2) $Y_{fb} = Y_{ie} - Y_{ib} - Y_{rb} - Y_o$

and

$(Y_{ie} - Y_{ib}) >> -(Y_{rb} + Y_o)$

(3) $Y_{fe} = Y_{ib} - Y_{ie} - Y_{re} - Y_o$

and

$(Y_{ib} - Y_{ie}) >> -(Y_{re} + Y_o)$

The last two terms on the right side of equations 2 and 3 are ordinarily very small compared to the first two, so that it is possible to write with good accuracy:

(4) $Y_{fe} \cong -Y_{fb} \cong Y_{ib} - Y_{ie}$

and

$|Y_{fe}|^2 \cong |Y_{fb}|^2$

Calculations at 30 MC on a silicon tetrode with α_{co} of 17 MC show that the magnitude of the above approximation is about 2% small and that the phase angle is 1° small.

Since $|Y_{fb}|^2 \cong |Y_{fe}|^2$ and $Y_{ob} \doteq Y_{oe}$, the ratio of common emitter to common base gain is shown

$$\frac{A_{pe}}{A_{pb}} \cong \frac{\mathrm{Re}\, Y_{ib}}{\mathrm{Re}\, Y_{ie}} \cong \frac{R_{ie}}{R_{ib}}$$

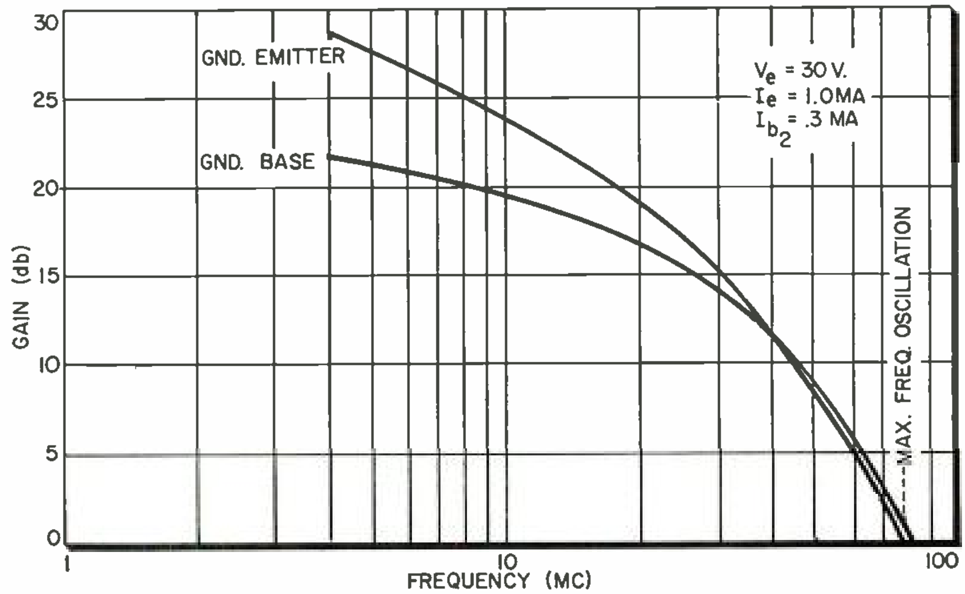


Fig. 2: Common emitter configuration is more advantageous for higher transistor gain

Fig. 3: A plot of R_N and C_N vs. Frequency for a typical silicon tetrode transistor

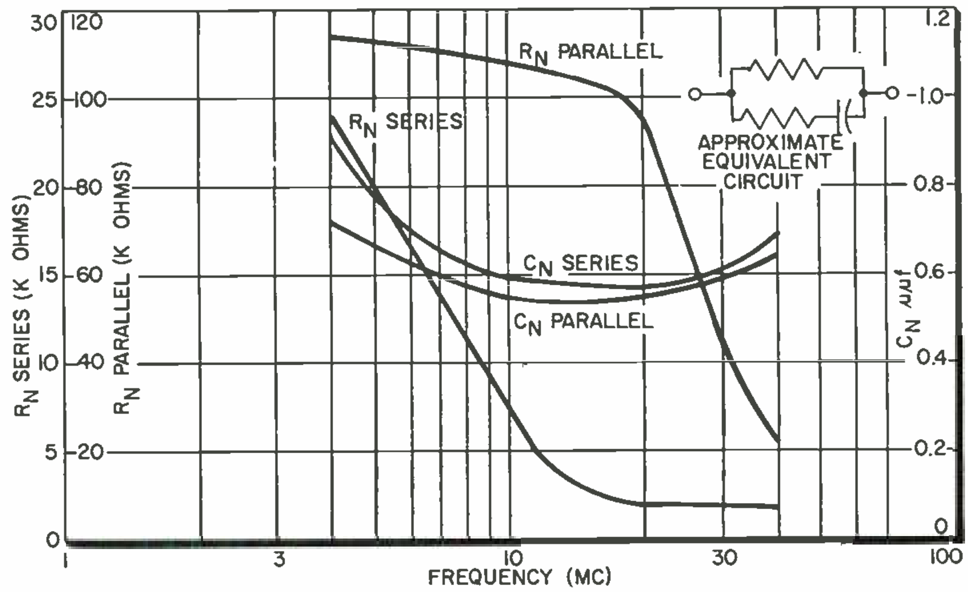
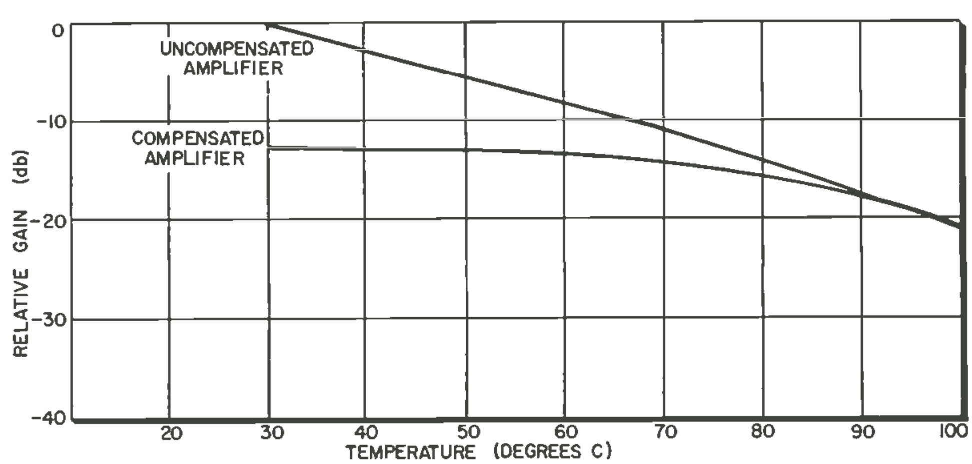


Fig. 4: Effects of temperature upon the relative gain of transistorized amplifiers



Transistor Amplifier (cont.)

where R_i = input impedance, resistive component

where the R's are the resistive component of the parallel input impedances with output short circuited.

This is an extremely important result since two simple impedance measurements tell immediately whether common emitter or common base operation will give more gain.

If the complete expression for power gain is developed in terms of R and C (such as measured on the Boonton R-X meter),

$$A_{pe} = \frac{R_o}{4 R_{ie}} \left[\left(1 - \frac{R_{ie}}{R_{ib}} \right)^2 + \omega^2 R_{ie}^2 (C_{ib} - C_{ie})^2 \right]$$

Thus, three simple measurements, the short circuit input impedance common emitter and common base, and the short circuit output impedance, are all that is required to accurately determine gain in either the common base or the common emitter configuration.

Comparisons between calculated and measured gains have shown the following results:

At 5 MC the calculated gain is within 0.5 db of measured

At 12.5 MC the calculated gain averages 0.7 db high

At 25 and 30 MC the calculated gain averages 1 db high

At 60 MC the calculated gain averages 1.5 db high

The differences are even less if the losses in the test set due to the neutralizing circuit, and impedance mismatch are considered.

Generally speaking, this formula will give accurate results down to about 10-db gain, with decreasing accuracy below 10 db. If good accuracy is required for gains of 2 or 3 db, and Y_f should be evaluated more precisely, although this is a rather lengthy process.

This method of evaluating transistors offers important advantages because of the simplicity of measurement and computation, the excellent agreement consistently obtained with measured gain, and the fact that these impedances are readily used in circuit design.

Evaluation of the transistors has shown that common emitter gain is greater than common base gain up to 35 or 40 MC. Fig. 2 shows a typical curve of gain vs. frequency. Generally speaking, the higher the transistor gain the more advantageous is the common emitter configuration.

Maximum gain obtained is 18 db at 30 MC. Average gain is 15 db.

While the above indicates the grounded emitter configuration is superior to grounded base, even at these frequencies, only a partial solution to the problem of neutralization has been indicated. Observations have shown that in the common emitter configuration, where negative Re h_o is not a factor, admittance (or feedback) neutralization has invariably given results superior to h (bridge) neutralization.

It is with the admittance neutralized amplifier operating with conjugate source and load impedances that results have consistently been obtained which agree closely with the computed gain.

One criticism of the admittance type neutralization is that it is exact at only one point, and not suitable for wide band applications. Although experiments with very wide band amplifiers indicated substantially complete neutralization was possible over wide bands, more positive evidence was needed. Therefore, the feedback admittance Y_r was computed, using the following formula:

$$y_{re} \cong \frac{Y_o - h_{oe}}{Y_{ib} - Y_{ie}} \times Y_{ie}$$

or

$$-R_n - jX_n \cong \frac{Y_{ib} - Y_{ie}}{(Y_o - h_{oe})(Y_{ie})}$$

Fig. 3 shows a plot of R_n and C_n for a typical silicon tetrode.

A simple series RC combination

(*Continued on page* 124)

TABLE I

SILICON TETRODE CHARACTERISTICS, GAIN AND BW AT 25MC

TETRODE CHARACTERISTICS	GAIN AND BANDWIDTH	Single Sync. Tuned BW	Single Sync. Tuned GAIN	Staggered Pairs BW	Staggered Pairs GAIN	Double Tuned Max. B.W.	
R_{ie} = 65 ohms							
C_{ie} = 120 μμfd							
R_o = 15 K ohms	Single Stage	5.8 MC	14.5 db	—	—	16.4 MC	13 db
C_o = 2 μμfd							
$C_{ext.}$ = 1.3 μμfd	Six Stages	2.05 MC	87 db	4.1 MC	69 db	9.6 MC	78 db
A_p = 15 db							

TABLE II

COMPARISON OF PREDICTED AND MEASURED PERFORMANCE OF 5-STAGE 25-MC AMPLIFIER

DESIGN DATA		PERFORMANCE CALCULATED	PERFORMANCE MEASURED
R_{ie} = 65 ohms	Single Stage BW	4.3 MC	—
C_{ie} = 120 μμf	5-Stage BW	1.67 MC	1.60 MC
R_o = 15 K ohms	Total Transistor Gain	77.5 db	—
C_o = 2 μμf	Transformer Loss (0.5 db per Transformer)	2.5 db	
C_{stray} = 1.1 μμf	Net Gain	75.0 db	75.5
C_{tune} = 1.8 μμf			
Circuit Q ≅ 5.8			
Coil Q ≅ 95			
Coil Loss ≅ 0.5 db			

CUES for BROADCASTERS

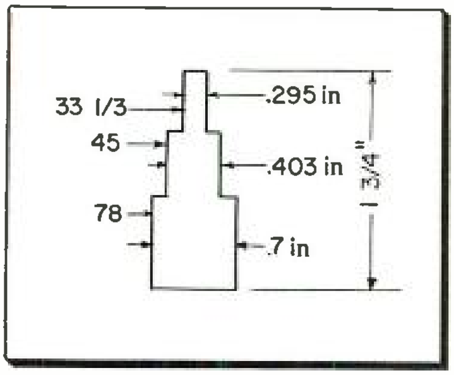
Practical ways of improving station operation and efficiency

3 Speed Operation

LEWIS M. OWENS, Ch. Eng.
WAIN, Columbia, Ky.

WITH the arrival of 45 RPM records, we tried converting our CB-11 turntables to 3 speed operation by the manufacturer's suggested method. It proved unsatisfactory for continuous use, so we decided upon the following method of converting from 33⅓ and 78 RPM to 33⅓ and 45 RPM.

A local machine shop made us an idler wheel shaft and cut the 78 RPM section down for 45 RPM use. The idler wheel spring needed adjusting to take up the additional space between the 78 RPM idler wheel and shaft. This method has operated satisfactorily for several months.



Idler shaft for 3 speed operation.

With most radio stations using 3 turntables, one can be a 3 speed, one converted to 33⅓ and 45 RPM and one for 78 and 33⅓ RPM, thus saving the price of a new 3 speed turntable.

Carrier Alarm Circuit

ED ROOS, Studio Supervisor
WEAT-TV, W. Palm Beach, Fla.

HERE is an alarm circuit that can be adapted to your transmitter, be it AM, FM, or TV. This alarm is connected in the control circuit so that a failure of the master relay, overload relay, or plate relay will actuate the alarm circuit. The "plate-on" pilot in most transmitters will receive its voltage only if the complete control circuit has gone through its cycle of operation. A loss of plate voltage, bias voltage, etc., would up-set the control circuit and, therefore, a loss of carrier would cause a loss of voltage supplied to the plate pilot.

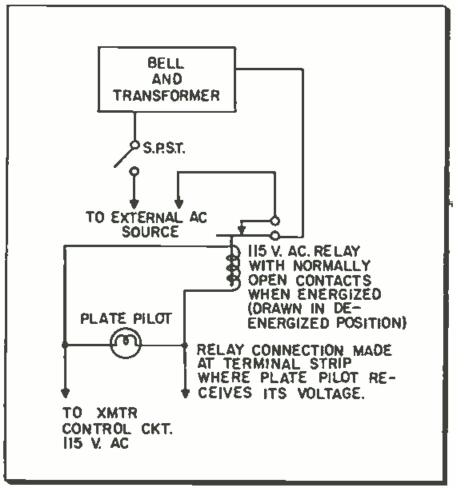


Diagram for carrier alarm circuit.

In the Gates BC-IF, to which this alarm is adapted, the plate pilot connection is brought out to a terminal strip. An ac normally open relay was connected across the plate pilot. Any voltage failure to the plate pilot will de-energize the relay, closing the relay contacts, and thereby energizing the alarm bell. An "on-off" switch was connected in the circuit to shut off the alarm circuit after loss of carrier is realized by the operator. The ac to the bell was connected to a separate circuit breaker than the transmitter so that if the latter breaker opens the alarm would still be heard.

Installing Ground Radials

JIM DE ROADLES, Ch. Engr.
CFGP, Grande Praire, Alberta

WE at CFGP installed a new 5 kw. directional transmitter on the site of the old one, which was non-directional.

To plow in the new ground radials, we had the use of a "John Deere" land breaker. To this land breaker we added a few things such as a windlass to run a wire off, and a pipe to feed it down to the back of the plowshares where we had installed a wheel. There is no damage done to the plow except for a few spot welds where the pipe was welded to the implement. This is very simple and inexpensive. In no time at all we did what we thought would be a difficult job.

Substitute Plate Transformer

EARL HODGES, Ch. Engr.
KFFA, Helena, Ark.

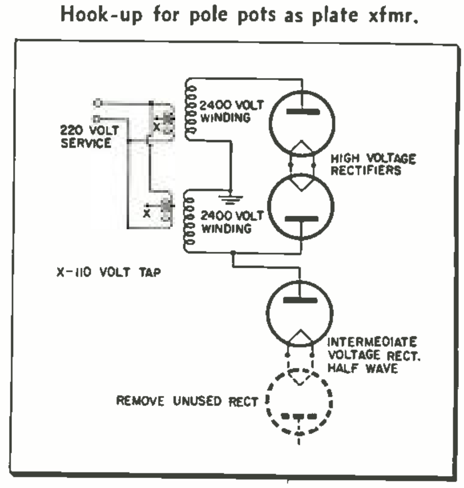
HERE is a very simple method of making temporary replacement of plate transformers in transmitters.

KFFA has a Gates 1-kw BC 1-E rig, and these seem to be subject to transformer failure. When this happens, we borrow 2 pole pots from the local power company, and connect them as shown in the diagram. The pots are ordinary 3 or 5 kva, with primaries of 2400 v., secondary 110-220 v. Primary and secondary is reversed for use in the transmitter, i.e., the 220 is fed from the transmitter service line, with the 2400 v. acting as high voltage secondary.

Be sure you have secondaries in proper phase relation or you won't get any power. I guarantee these pots to hold up until you can get a replacement. Another thing to remember; these pots will deliver only about 1700 VDC. In most kw. rigs, this will get about 500 w. And this half-wave intermediate supply will have no noticeable hum. Remove the unused intermediate rectifier. In our rig this is an 8008.

If you have a Gates rig of the -D, -E or -F type, I suggest you put your plate transformer on a couple of 2 x 4's. It is not necessary that the transformer be bolted down, nor the case grounded.

Hook-up for pole pots as plate xfmr.



New Technical Products

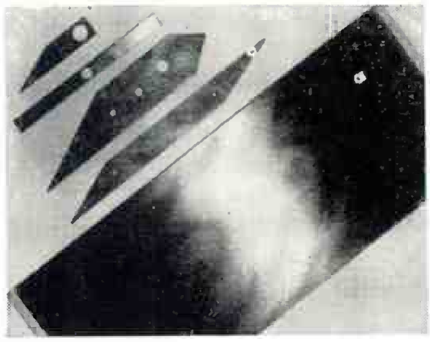
BROAD-BAND GENERATOR

A compact, precision unit featuring a direct reading frequency dial that offers "one-knob control" from 950 to 2000 and 1900 to 4000 MC is now being manufactured in

production quantities. The FXR Type No. S771A "all-in-one" Signal Sources combine a power supply, klystron, klystron cavity, and an automatic reflector voltage tracking system for efficient, versatile operation. Power is high enough for most measurements. **Electronics & X-Ray Div., F-R Machine Works, Inc., Woodside, N. Y. (Ref. No. 11-1).**

ATTENUATOR

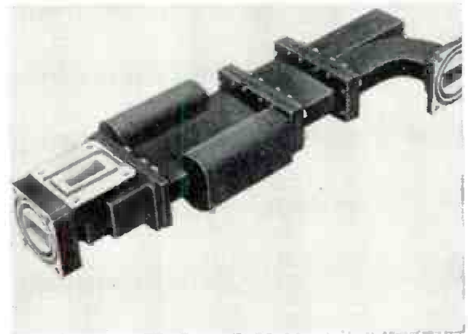
Metal film resistance cards are a new, highly stable, microwave attenuator material. The base is a fine weave glass cloth impregnated with high temperature ther-



mosetting resin. Resistance material is a thin film of pure metals, approx. 50 millionths of an inch thick, uniformly deposited on one surface of the plastic. A protective coating is provided over the metal film. No special machining techniques are required. Resistance range: 25 to 750 ohms/sq. Max. surface temperature should be limited to 130°C. **Filmohm Corp., N. Y. (Ref. No. 11-2).**

X-BAND DUPLEXER

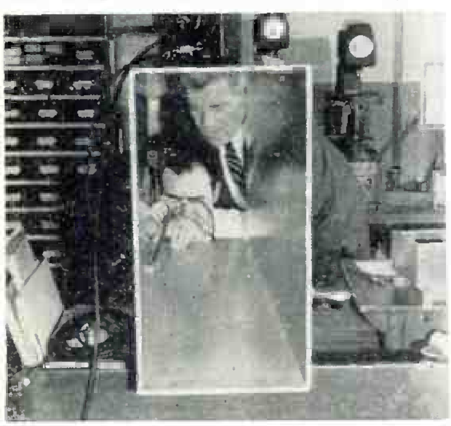
A ferrite phase differential duplexer incorporating both duplexer and load isolation action to insure optimum spectrum and power output with consequent



good AFC performance has been developed. Does not need an ATR tube or require use of a high power TR tube. Unit can operate at high power levels. Magnetron to load isolation is a built-in feature. Duplexer has a nominal 1 way insertion loss of 0.5 db over range of 8500-9600 MC. Unit has wide application in all high power radars. **Airtron, Inc., Linden, N. J. (Ref. No. 11-3).**

WAVEGUIDE

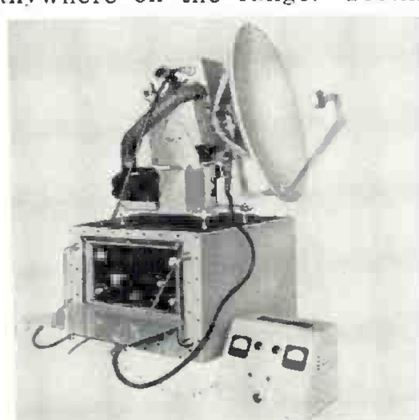
Large, precision fabricated. UHF waveguides for microwave and radar are now available. The new waveguide, made as large as 21 in. by 10½ in., has corner joints for which it is claimed that perfect r-f contact integrity is realizable. Manufacturing techniques have been devised so that this large fabricated guide may be



constructed with tolerances which could only be obtained previously by machining extrusions. New inspection methods have also been promulgated. **General Bronze Corp., Garden City, New York. (Ref. No. 11-4).**

X-BAND TRANSMITTER

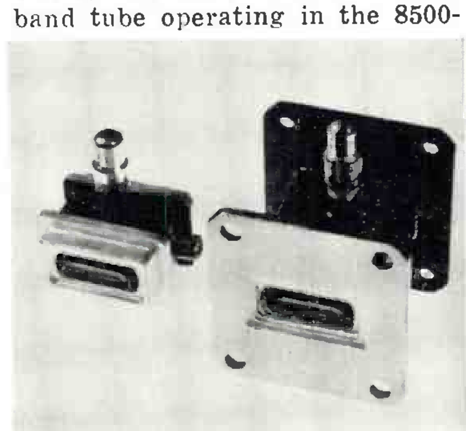
Providing a convenient r-f source for use on antenna testing ranges, this unit has a self-contained power supply and modulator and is tuneable from 8500 to 9000 MC. Changes in frequency, polarization, or antenna direction can be made from the main panel or the remote control unit, located anywhere on the range. Testing



is speeded by the provision of 2 azimuth positions. Modulation consists of a 1 μsec pulses at rep rate of 1000/sec. Specs: 24 in. parabola, 33 db gain, & 3.5° beam width. **Color Television, Inc., San Carlos, Calif. (Ref. No. 11-5).**

BANTAM TR TUBE

A new bantam TR tube, nearly 50% smaller than a comparable component has been announced. The new TR tube, designated as Tube Type 6795, was developed to meet requirements in commercial radar for a tube combining small size, ease of installation and removal, and low cost. A broadband tube operating in the 8500-

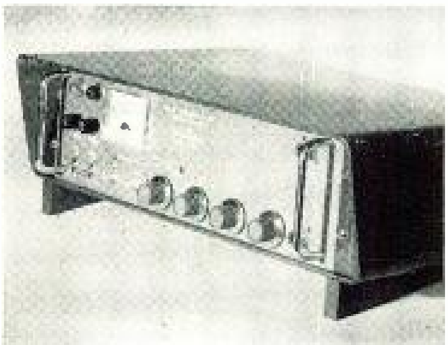


9600 MC range, the new device equals and in some cases excels all electrical characteristics of the 1B63A, a tube nearly twice its size used in the same applications. **Sylvania Electric Products, Inc., N. Y. (Ref. No. 11-6).**

For Microwave Applications

TW AMPLIFIER

Providing high, broad-band amplification in the SHF region between 2 and 4 KMC, this unit has a power output of 10 mw with a small signal gain of 25 to 35 db, a



noise figure of 20 db, and a VSWR (input & output) less than 2:1. Amplitude modulated by the TWT grid, the amplifier has these characteristics: bandwith, dc to approx. 100 MC; pulse rise-time, approx. 5 μsec at max. output; pulse delay, 15 μsec. Phase-modulated by the TWT helix, amplifier has bandwidth of 10 cps to 10 MC. **Wave/Particle Corp., Redwood City, Calif. (Ref. No. 11-7).**

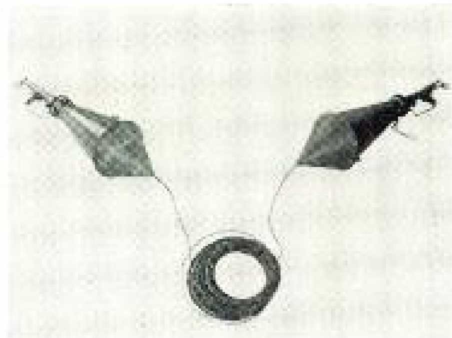
RELAY STATIONS

This shelter, weighing only 950 lbs., is strong enough to be picked up by helicopter and be transported to remote mountainous areas that would be inaccessible by road. In these locations, microwave reflectors are affixed directly to the roof, and thus the shelter provides its own antenna

mounting. Electronic equipment can be mounted in racks which are then shock mounted to the floor and walls. Construction utilizes aluminum skins bonded to a plastic foam core. **Craig Systems, Inc., Danvers, Mass. (Ref. No. 11-10).**

CO-AX REPLACEMENT

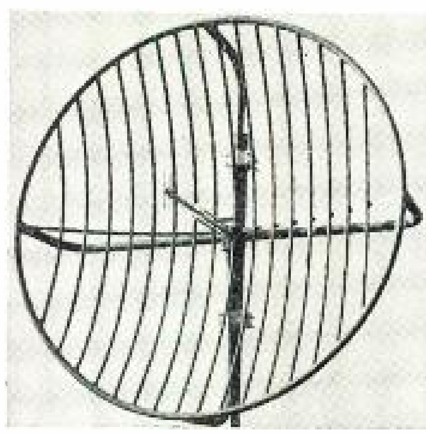
The G-Line, a new economical single wire surface wave transmission line assembly designed to eliminate coaxial transmission line and wave-guide in low power



microwave has been announced. Designed for high efficiency from 1700 to 2400 MC, the assembly consists of a modified copper wire, coupled at each end with identical r-f field transformers (launcher and collector). Power rating equals RETMA ⅞ in. 50 ohm air dielectric line. Operating wire loss is extremely low + 0.5 db per transformer. **Prodelin, Inc., Kearny, N. J. (Ref. No. 11-8).**

PARABOLA

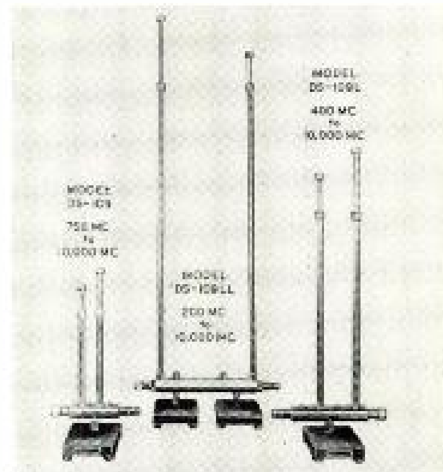
A new 15 ft. diameter parabola, based upon the recently developed multi-element grid principle, has been announced. The Model P-9180 covers the range 890-960 MC with a gain figure of 30 db over isotropic. Model P-4180 covers the 400-470 MC range. Gain is 25 db over isotropic. Both units are de-



signed so that they can be shipped in 3 separate sections. When assembled, the parabola weighs 330 lbs. and has a total wind load in 100 mph winds of 1200 lbs. **Mark Products Co., Morton Grove, Ill. (Ref. No. 11-11).**

DOUBLE STUB TUNERS

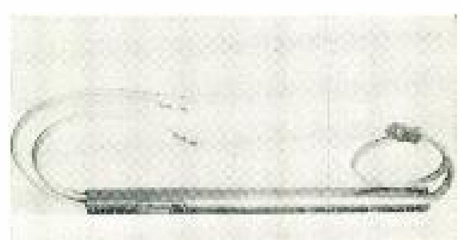
These 3 tuners cover the range 200 to 10,000 MC. The sliding contacts are placed outside the high current region and permit smooth low-noise adjustment. Col-



let locks have been added to each stub, permitting quick locking of the tuning position. The relative positions of the 2 stubs is readily adjustable to either of 3 positions, avoiding the impracticability of tuner use experienced when the relative position of both stubs is fixed. **Weinschel Engineering, Kensington, Md. (Ref. No. 11-9).**

TRAVELING WAVE TUBES

Two new traveling wave tubes feature broad-band medium noise figure, 10-20 db, operation across their bands, X-bands 8-12 KMC and L-band 1-2 KMC. Other important operating characteristics include at least 25-30 db gain and 5-10 mw output. The L-band unit is designated the HA-17 and the X-band unit is designated the HA-



15. The greatest application will be in fields where this improved noise figure is required in addition to their broad-band characteristics. **Huggins Laboratories, Inc., Menlo Park, Calif. (Ref. No. 11-12).**

 For product information, use inquiry card on page 137.

Suppressing Radiation From Medical Electronic Equipment

The problems of generation and susceptibility to interference signals are now being solved at their source. New type filters and enclosure shielding are the approaches that designers are taking. Data on these and other methods are presented.

By HERBERT M. SACHS and ARNOLD L. ALBIN

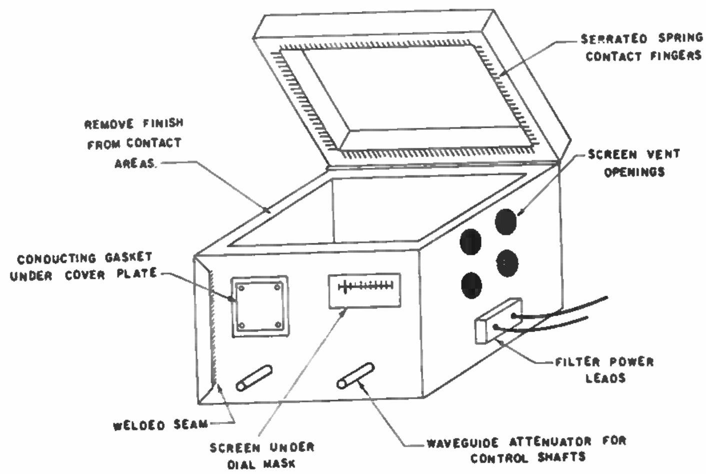


Fig. 1: Design features of effectively shielded enclosure.

During recent years the medical profession has been introduced to more and more specialized electrical and electronic equipment intended to facilitate pathology and diagnosis, and to aid in therapy. Along with the tremendous advantages of such units has come a problem common to many other devices in the electrical and electronics field—the generation of, and susceptibility to interfering signals whose energy distribution is concentrated at specific portions of the frequency spectrum. The term "radio interference" is usually applied to this phenomenon, although radio receivers and transmitters are far from the only equipments that produce or react to the interfering waveforms.

The increasing use of electromedical instrumentation has augmented the radio-interference problem, due to the greater possibility of interaction of equipments entirely unrelated in basic functions, and apparently differing in basic frequencies of operation. Considerable attention has been given to the means for reducing this interference, particularly by the Armed Services[1] and the FCC. While much is known of specific interference problems and reduction techniques, suppression of a particular piece of equipment to specified limits in many cases constitutes a major design problem.

HERBERT M. SACHS and ARNOLD L. ALBIN, Armour Research Foundation, Chicago, Ill.

Interference Types

Coupling between an electromedical device and a source or receiver of radio interference may occur by means of radiation, induction or conduction. The distinction between the first and second means of coupling is based on whether the near or far field about the source is being considered. Since so called "radiated" measurements are usually made in the induction field, it has become common practice to class both radiation and induction as radiated interference. Conducted interference, on the other hand, is caused by extraneous currents flowing along circuit conductors or ground paths.

The interfering signals can usually be grouped into one of two categories. Broadband interference is characterized by pulse waveshapes that are of short duration and have relatively fast rise and decay times—a Fourier integral representation of the signals is illustrated in Fig. 2 and indicates appreciable energy content over a wide frequency range. A high-current switching relay in an x-ray unit produces such a current-time waveform through its contact circuit. Continuous-wave interference is generated at discrete frequencies by essentially sinusoidal signals, such as diathermy machine harmonics. Its representative energy distribution is shown in Fig. 3.

Design

For effective application of radio-interference suppression, it is important to consider the problem early in the equipment design stage. While considerable intereference reduction can often be achieved by conservative design, it is frequently found that additional components must be incorporated to obtain the desired degree of suppression. Such possible difficulties can be antici-

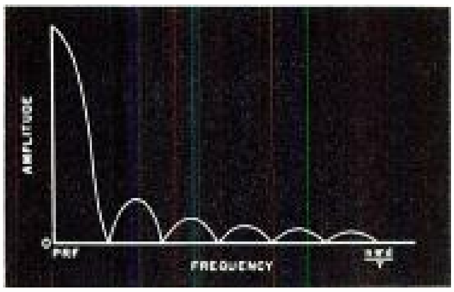
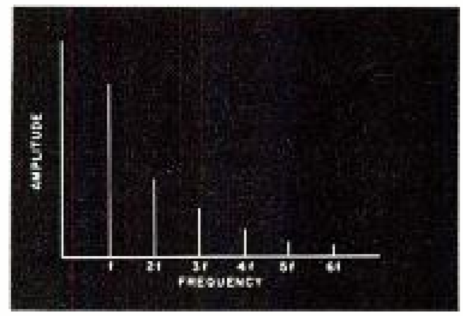


Fig. 2: (l) Fourier integral representation of rectangular pulse.

Fig. 3: (r) Harmonic components of a continuous-wave transmitter.



pated and room can be provided in the equipment for the extra parts. In addition, a careful choice of the system components can do much to reduce the overall suppression engineering. Conventional parts may often be replaced by others which have superior interference reduction properties at little or no extra cost. For example, extended-foil feed-through capacitors may be used to replace conventional lead-type bypass capacitors, and afford useful suppression to much higher frequencies.

Diathermy

When one thinks of interference from electro-medical units to other services, the first devices that usually come to mind are diathermy machines. The effects of diathermy interference on TV and radio reception are well known. The importance of suppressing this interference has been exemplified by the FCC's 1953 requirement for type-approval, certification or licensing of all commercial medical diathermy equipment.

The therapeutic effects of diathermy are due to the heat generated in body tissues by means of high-frequency signals. These signals are produced by an oscillator-amplifier combination, and are applied to the patient by means of either inductive or capacitive electrodes.

Harmonics

The power output of the equipment at its fundamental frequency is intended to provide the necessary heating effect. Permissible frequencies and maximum power output on the fundamental carrier are regulated by FCC. Because of non-linear circuits, unfiltered output systems, and other characteristics, harmonics of the fundamental may also be present. These harmonics can result in case radiation at the harmonic frequency as well as harmonic radiation from the diathermy electrodes and electrode cables, and may also be introduced onto the power line.

Suppression

Stable sinusoidal oscillators must be used for the source of radio frequency energy. Such units may be crystal controlled, although a decision of whether or not a crystal should be employed must also be based on warm-up time requirements, load requirements, use of a buffer amplifier, etc.. A well-filtered power supply is highly preferable from the interference standpoint, but, again, inclusion of such a unit instead of an unfiltered supply or no supply at all (reliance on the system self-rectifying properties) may be determined by other factors, particularly the added possibility of component failure when the equipment is needed.

Many other suppression techniques can be utilized in diathermy design. Balanced push-pull oscillator and power amplifier stages, conservative design of the output circuit, and reduction in final-amplifier grid drive can effect a reduction in signal harmonic content. Convenient tuning of the output system, inclusion of low-pass output filters. and insertion of power line filters may also be considered.

One interesting suppression approach that does not appear to have been explored completely is the possibility of designing diathermy electrodes in such a manner that far-field radiation patterns will substantially cancel. Some type of combination inductance or serrated-capacitance arrangement might be possible that would produce two or more fields of such polarity to effect a resultant zero-field some distance away from the electrode. An experimental model of an inductive electrode is shown in Fig. 4.

Shielding

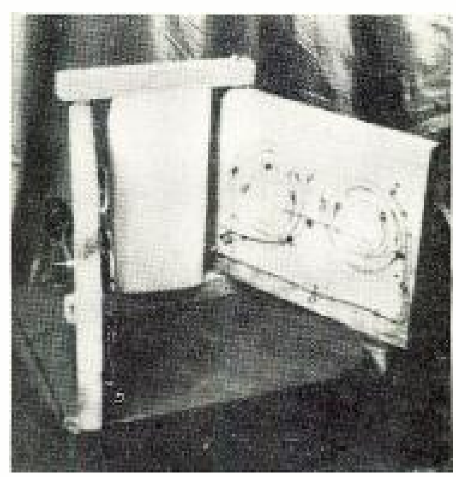
It might be well to indicate here some general shielding requirements that are applicable not only to diathermy equipment, but to any devices which radiate spurious signals. An ideal equipment enclosure from this standpoint should have no openings and should be sufficiently thick to prevent direct case penetration. In practice (See Fig. 1) there obviously must be openings for ventilation, signal and power leads, control shafts, and meter faces, and accessibility for maintenance. To provide these openings and still maintain shielding effectiveness it will be necessary to consider the following:

(1) Seams which are riveted or bolted are ineffective for shielding at radio frequencies. The cabinet joints must be made continuous by welding, brazing, or soldering operations.

(2) Removable panels or covers should have the finish removed from all mating surfaces. Spring-contact fingers or conductive gaskets may be used to provide good electrical contact around the edges of the panel.

(3) All openings for ventilation shafts, drainage, or metering over

Fig. 4: Modified inductive electrodes.



1/16 in. in diameter should be covered with fine copper mesh screening. As an alternative, the opening may be provided with a sleeve which is properly dimensioned to act as a cut-off waveguide.

(4) To prevent interference from being conducted out of the case on connecting leads, all leads entering or leaving the enclosure should be well filtered. The filters will probably take the form of L-C networks for diathermy units, and should be shielded and mounted to eliminate the possibility of their being bypassed by the interference.

Audiometer

An audiometer is essentially an audio oscillator, with provision for headset output, or for aural injection by contact with the mastoid bone. These units incorporate a masking tone-generator for masking the ear not being tested, as well as a patient signal-switch.

Several sources of interference can exist with this equipment. Unless the audiometer is capable of producing pure sine-wave signals, harmonics of the audio carrier will be present in the output circuit. Radiated measurements on some instruments of this type have disclosed significant harmonic components beyond 100 KC. Radiation occurs primarily from the head-set or bone-conduction transducer and associated leads. In addition, switching transients from operation of either the patient signal-switch or the masking tone-generator switch produce both radiated and conducted interference.

The reduction of switching interference will not be considered in detail here, since this aspect of suppression is a subject of considerable magnitude in itself. Resistance-capacitance filter networks have been successfully applied to the audiometer switching circuits. They must be inserted directly across the switch contacts, and be well shielded. Many patient indicator bulbs operate from a 6 v. winding of the power-transformer; insertion of a filter resistor will require use of a higher-voltage output winding or a bulb with lower voltage rating.

Electro-Surgical Units

The surgical cutting equipment investigated by Foundation personnel all were spark-gap type devices with high-frequency cutting and coagulation currents. Each unit is provided with an on-off foot control.

Most of the suppression techniques already cited may be applied to these instruments to reduce the radiated and conducted interference caused by the spark-gap generator and the actuation of switches. The case and leads, exclusive of the cutting stylus and the bare-metal return electrode, should be completely shielded. The power line and switches must be filtered. To further reduce foot-control switch interference, consideration may be given to mechanically actuating a switch located in the main system enclosure, or to use low-voltage remote switching to actuate a relay in the enclosure.

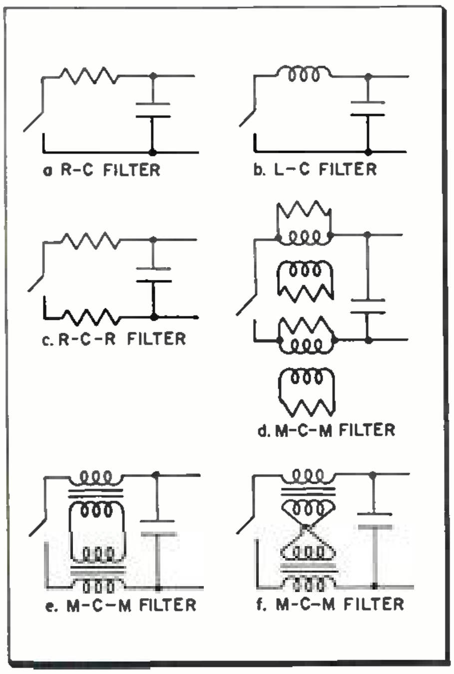


Fig. 5: Switching transient filters.

X-Ray Units

X-Ray equipment can produce objectionable conducted interference because of requirements for switching high-current circuits containing inductive source and load impedances. The transients of this switching are very large, producing spurious output frequencies. Radiated interference from these units is usually negligible.

Low Q, dissipative filters must be applied across the offending relay and switch contacts and in other leads where transient effects occur. Resistance-capacitance or inductance-capacitance units may be necessary. (See Fig. 5.) One switch-contact filter that has proven satisfactory for many applications (called an R-C-R filter) consists of a resistor in series with each contact and a condenser across the ends of the resistors farthest from the contacts. Values of resistance from 3 to 33 ohms and condensers from 0.1 to 1.0 µfd have been used, depending on the nature and severity of the interference, and the circuit impedances. In this application it is extremely important that the capacitor lead length be kept very short to prevent disturbances by series-resonance effects. The resistors should be as large as possible without introducing a serious power loss in the circuit being suppressed.

Where it is necessary to use dissipative filters, and resistors cannot be tolerated due to excessive voltage drop, it is possible to realize a pseudo-resistance by placing the primary of a bifilar-wound transformer in series with the line to be filtered. The secondary resistive load of between 1 and 100 ohms results in a reflected resistance into the line over a wide range of frequencies, without disturbing normal circuit operations. The procedure in the past has been to wind the transformer (called an M filter) on a 2-watt insulated composition resistor serving as the secondary load. Four layers of bifilar-wound No. 18 enameled wire were used. The units were very broad in response and have proved very effective in suppressing transient interference. Fig. 5 schematically illustrates the R-C-R and M filters.

Miscellaneous

Many other types of electro-medical apparatus have been encountered, including such devices

(*Continued on page* 156)

Bias Stabilization of Tandem Transistors

Inherent bias stability factors derive from the tandem transistor connection. Analysis shows theoretical conditions for perfect bias stability and points to practical compromises

By R. B. HURLEY

The "tandem transistor" [1] consists of two transistors in a single container. The emitter of the first (low-level) transistor is internally connected directly to the base of the second (high-level) transistor. There is no external terminal return to this tie-point. The other four internal connections, however, are brought out to terminals as shown in Fig. 1.

The first stage of the tandem transistor is constrained to operate in the common-collector orientation. The second stage can, of course, be used as either a grounded-emitter or a grounded-collector. Therefore, as far as signals are concerned, the tandem transistor behaves like a single transistor, in common-emitter or common-collector orientation, with a very high current gain.

R. B. Hurley, Design Specialist, Convair, Pomona, Calif.

Bias

In considering the bias of a tandem transistor, the constraining factor is that all of the emitter current of the first stage constitutes all of the base current of the second. Thus, the first transistor is made much smaller than the second so that each unit can be biased in its normal or optimum region. In any event, however, if the small difference current (base) of one transistor is the entire large current (emitter or collector) of another, bias stability[2, 3] may be a primary concern. That is, a difference current is highly subject to variations with temperature and from unit-to-unit, since it is a function of one minus alpha. Therefore, it is conceivable that the operating point (emitter current) of the first stage may be subject to the "whims" of the second.

Bias Stability

The direct coupling between the two stages of a tandem transistor can incorporate compensating features that will aid in bias stability (temperature) and predictability (unit-to-unit).[4] Direct coupling improves bias stability to the extent that adjacent stages are similar. Furthermore, this similarity must be both in the saturation currents of the transistors and in the dc networks of the adjoining stages. In general, the relative polarities of the transistors (NPN, PNP) and the particular terminal connections between the stages, as well as the transistor and network characteristics, must be considered before it can be determined whether direct coupling will aid or hinder bias stabilization.

In a single stage with dc isolation, emitter current tends to increase with increasing temperature (or saturation current) and base current tends to decrease. Hence, it appears that the tandem transistor is properly connected to obtain some benefit from direct coupling. That is, the emitter current of the first stage tends to increase when the base current of the second stage is attempting to decrease. Since these two currents are restricted to be one and the same, some cancellation or

(*Continued on page* 139)

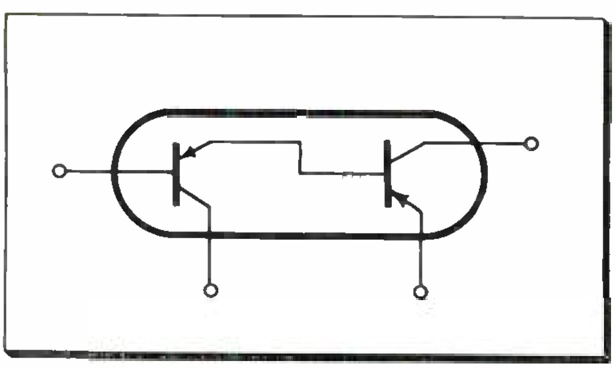


Fig. 1: Tandem transistor schematic (PNP)

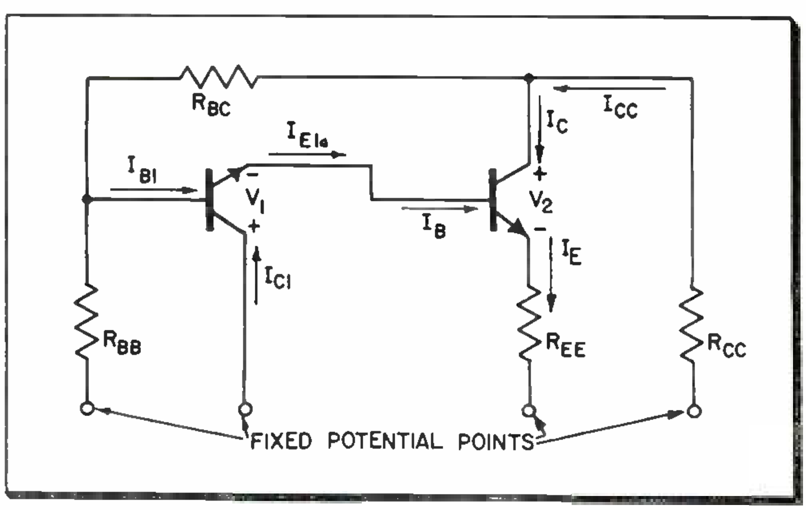
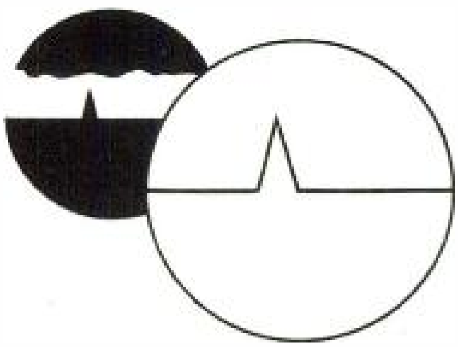


Fig. 2: Net dc bias circuit (NPN)

Minimizing Noise In Electronic Systems



Internally generated noise is a constant problem to equipment designers. Discussed here are the causes of capacitive, leakage, conductive, and inductive noise pickup, and practical preventive measures.

By R. L. WENDT
Engr. Dept. Head
Sperry Gyroscope Co.
Great Neck, N. Y.

ONE of the serious problems facing every engineer who works with electronic equipment is the reduction or elimination of electrical noise from his circuits. Obviously, any signal that alters the desired intelligence signal is undesirable, if only because it lowers the efficiency of the device. When noise can cause the loss of a hostile target by an anti-aircraft radar system, or where it causes an electronic navigation computer to be inaccurate, or where a teletyped message to a commander in the field is in error from garbled or missing letters—in all these cases noise can have disastrous effects.

In any electronic system there are two general types of noise to be considered. The first is externally generated and must be separated from the desired signal as it is processed in the device. Typical cases include static in a radio receiver, which can be suppressed by the use of frequency modulation techniques, or radar jamming signals, which can be suppressed by special circuits. In general, noise of this type is best combated by the use of special techniques and circuits that act to separate signal from noise.

The other type of noise is that which is internally generated in the electronic device or system itself. Typical cases include hum pickup from filament leads, usually remedied by the use of twisted wiring, and electrostatic coupling between power and signal leads, which is prevented by the use of shielded wire. This article considers these latter types of internally generated noise.

The Problem

Noise in a signal circuit may be defined as any voltage that alters the desired intelligence signal. In an analogue computer system energized by 400 cps power, for example, noise will consist of 400 cps voltages (both in-phase and in quadrature with the signals), harmonics of 400 cps, and random noise of various frequencies. These spurious signals may be generated internally by the computing elements, or they may come from sources external to the signal circuit, yet within the system.

An ac tachometer or a synchro, for example, produces internal noise, while all "pickup" signals fall into the second category. Noise signals developed within a circuit element closely resemble "externally generated noise" in that they usually cannot be prevented but must be discriminated against by artful system design. Pickup signals, on the other hand, can almost always be prevented or minimized by proper wiring techniques. Since they constitute the more important and troublesome source of noise in the average electronic system, their study and control becomes a vital problem. The four main types of pickup may be defined as follows:

Conductive pickup occurs where two or more currents from otherwise isolated circuits pass through a common circuit resistance.

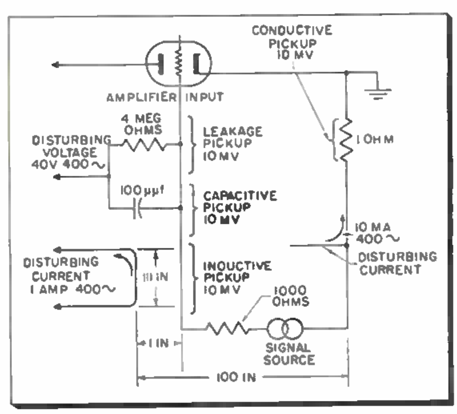


Fig. 1: Sources of principal pickup types

Electrostatic pickup is due to capacitive coupling between two circuits.

Leakage pickup results from stray resistance paths across insulating surfaces between conductors.

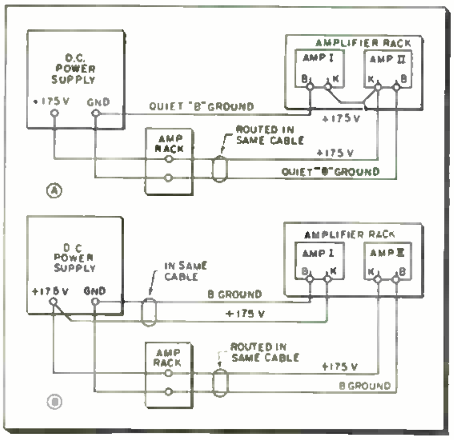


Fig. 2: Separate ground return reduces noise

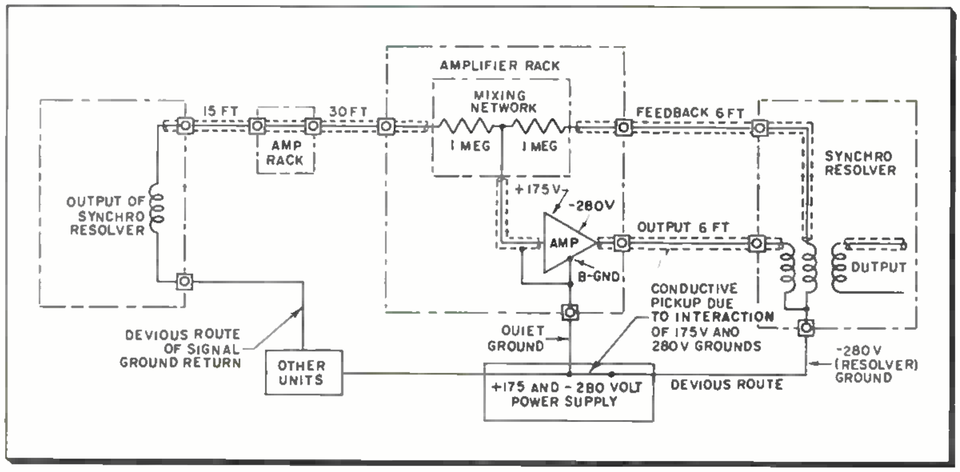


Fig. 3: This circuit developed high noise level due to magnetic and inductive pickup troubles

Electromagnetic pickup occurs where a signal lead is cut by the magnetic field from a nearby current-carrying wire or transformer. Impedance level and electrostatic shielding bear no relation to the magnitude of this induced noise. The important factors are the size and shape of the pickup loop, proximity to the current-carrying lead, and magnitude of the disturbing current.

These definitions are graphically illustrated in Fig. 1, which also serves to indicate how severe these sources of pickup may be. All of the circuit parameters were chosen to produce a 10 mv noise signal.

Noise Tolerance

The effects which these several types of noise will produce in an electronic system are varied. In a particular amplifier, for example, noise may cause errors due to saturation effects, and perhaps may even render the amplifier inoperative. All of the types of noise mentioned above can produce this effect, although quadrature voltages are usually the most troublesome. An amplifier's tolerance of such noise signals (as well as its behavior with abnormally large error signals) is primarily a matter of amplifier design, and therefore will not be covered in this discussion.

An important point, however, is the fact that noise of the types described above can easily cause errors in a particular servo or computing loop; these errors may exceed the loop error specifications without regard for the normal contribution of component inaccuracies. Errors of this type will in general be produced only by in-phase or harmonic noise signals. Some idea of the magnitude of noise tolerable in a signal circuit can be obtained from the following examples, which illustrate the relationship between signal circuit scale factor, allowable data error, and noise level.

Example 1—Servo Loop

In a typical servo, the output shaft is positioned in response to two-speed synchro data received from a remote transmitter.

Servo error due to noise pickup in the signal circuit is to be kept below 1¼ angular min of data. The signal circuit scale factor is:

$$\textit{synchro scale factor} \times \textit{fine-coarse gear ratio} \times \textit{mixer attenuation} = 10\ v/rad \times 27/1 \times 1/10 \times (1000\ mv/v)\ /\ (3440\ min/rad) = 8\ mv/min\ of\ arc$$

Therefore, an in-phase noise voltage of 10 mv would introduce a data error of 1¼ min in the output.

Example 2—Computing Loop

In a typical computing loop a potentiometer feeds a signal to a synchro resolver through an isolating network-amplifier combination.

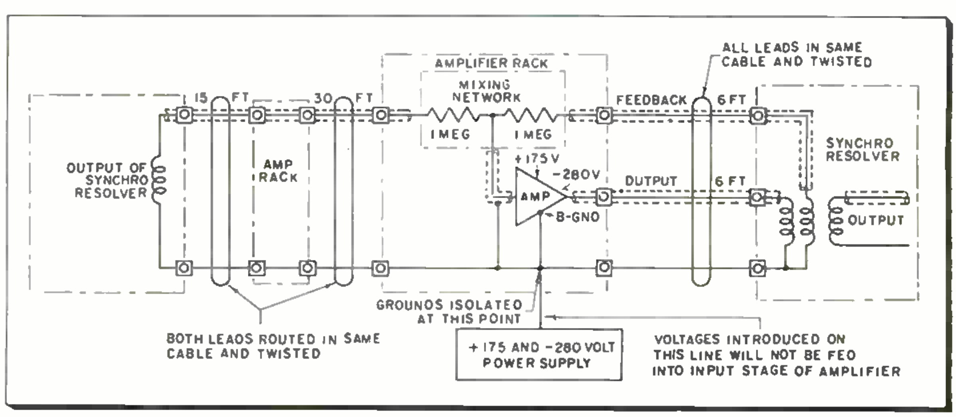
The scale factor on the signal lead has been chosen as 12 v = 900 knots. If the noise error in the signal circuit is to be less than a desired ¾ knot, the allowable in-phase noise voltage must be less than:

$$\tfrac{3}{4}\ kn \times 12\ v/900\ kn \times 1000\ mv/v = 10\ mv$$

It must be realized, of course, that in a complete electronic system noise errors will combine with the other computing errors in an unpredictable manner based on chance addition and cancellation effects. This will be particularly evident if the noise happens to be of a frequency differing slightly from the signal system supply frequency. The resulting "beats" are often particularly troublesome and hard to minimize.

Aside from the steady-state errors thus far considered, it should be noted that pick-up of current and voltage surges in other devices can result in circuit transients. These may start oscillations in feedback amplifers of marginal

Fig. 4: Redesigned circuit has lowered noise level by minimizing both types of pickup



Minimizing Noise (cont.)

stability, or they may cause temporary saturation in other amplifiers with resulting servo forcing errors, cross-modulation, or the like.

Possible Solutions

The criterion to use in judging the effectiveness of any solution is the attainment of a high signal-to-noise ratio. This ratio can be improved, obviously, by increasing the voltage scale factor of the signal system or by decreasing the severity of noise interference. Since component limitations often prevent free choice of voltage scale factors, noise reduction techniques assume the greatest importance. These generally fall into two categories: those providing protection against external noise and those that reduce the intensity of the noise source itself.

Electrostatic Shielding

When it can be used, electrostatic shielding is very effective in eliminating capacitive pickup. In theory, a conducting material at a constant potential is interposed between the noise source and the signal lead. The effectiveness of the method depends on the completeness of shielding. In some critical leads, a capacitive coupling of as little as 0.05 mmf to a noise source may be excessive. In leads of this type, such as the outputs of precision mixing networks, shielding should exist over their entire length—not only inside the network containers, but also while passing through connectors and relays.

The quality of the ground to which the shield is connected is also of great importance. If noise on the shield ground is high (referred to the signal lead's ground), the protected lead, intimately coupled to the shield, will pick up an appreciable noise signal. For example, if the average voltage between the shield and the signal circuit ground is 100 mv, a 20-foot length of shielded wire (100 mmf/-ft) will detect a capacitively coupled noise of five mv if the signal lead impedance to ground is only 10,000 ohms.

If the shield is tied to signal ground to keep this noise pickup low, care must be taken to see that the shield is grounded at only one place. If this is not done, ground loops will be formed in the signal ground system, thus rendering them susceptible to inductive pickup, as mentioned below.

Electromagnetic Shielding

One way to provide electromagnetic shielding is to use magnetic materials to isolate noise sources. In this case, flux lines that would ordinarily cut a conductor are intercepted by a material of high permeability, such as Mumetal. This method can be used easily in shielding noise sources, such as transformers and inductors, but is obviously unsuitable for the protection of individual leads.

The other effective way to achieve reduction of magnetic pickup is to force ground leads to accompany their signal leads, so that no net magnetic flux can act on the signal circuit. For this purpose, using the insulated shield of a lead as its ground return is believed to be about as effective as twisting the signal lead and its ground return. In addition to signal leads, it is recommended that ac and high voltage dc power supply leads be twisted with their ground returns. If capacitive pickup is to be kept to a minimum, the twisted pair may also be shielded.

(*Continued on page* 75)

TABLE I. DESIGNER'S CHECKLIST

Steps	Capacitive	Leakage	Conductive	Inductive	Component Noise
A	1. Determine accuracy requirements of all loops 2. Establish voltage scale factors 3. Convert allowable data errors to equivalent voltages				
B	1. Ascertain impedance level 2. Estimate magnitude of disturbing voltage 3. Estimate degree of coupling	3. Determine specs. on resistance	1. Estimate signal ground resistances 2. Determine signal ground currents	1. Estimate magnitude of disturbing currents 2. Estimate degree of coupling	1. Determine manufacturer's spec. on noise voltages
C	Compute possible errors—based on above				
D	Add shielding, and reduce impedance level with preamps where necessary	Provide special connectors, isolate leads, and reduce impedance level with preamps where necessary	Isolate ground circuits and decrease resistance of ground leads	Use shielded leads as coax, twist signal and power leads with ground returns, shield magnetic noise sources, increase scale factors with preamps where needed	Use filters, choppers and phase sensitive devices, if applicable
E	Where noise is still a problem give special consideration to relocating units for minimum lead length				

When using either of these methods ground loops must be avoided strictly (i.e., the return wire must be grounded at only one point), since the desired noise cancellation would not be obtained if there were parallel ground circuits not all cut by the noise flux. Therefore, if more than one grounded load is to be fed from a signal source, an isolation transformer should be used with each additional load.

Isolation of Ground

Conductive pickup can be prevented by isolating the ground return of a circuit from ground returns which carry significant amounts of current. What constitutes a significant amount depends on the allowable noise in the critical circuit and the magnitude of the common ground resistance. It is obvious, for example, that a separate grounding system should be used to carry the heavy currents used for amplifier tube filaments, motors, and the like. It may be necessary also to have a number of separate grounding systems for sensitive components and amplifiers.

Where computing circuits require the maintenance of very precise excitation voltages, this ground system should be completely isolated from any of the other ground systems. Precautions should be taken to avoid ground loops, but the extremely low voltage drops allowed indicate the need for many parallel paths to give low circuit resistance.

In addition to the isolation of signal ground leads, isolation and decoupling of plate power supply lines also may be necessary to prevent circuit interaction. Coupling between amplifiers sometimes can be avoided by running a separate supply lead directly from the power supply to a critical amplifier, although the internal impedance of the power supply itself may be great enough over the amplifier passband to cause coupling problems. In some amplifiers two plate voltage supplies are used, one returning to signal ground and the other to power ground. A certain amount of difficulty may be avoided by completely isolating these two

(*Continued on page* 144)

Radar Power-Energy Nomograph

By **W. YOUNG, Convair,** Pomona, Calif.

Nomograph correlates power, energy, duty cycle, and pulse characteristics.

In radar system design, the energy available from the transmitter is quite often the limiting factor in determining the maximum free space range. In using magnetron and klystron performance characteristics as specifications, it is important that the engineer be able to easily translate the various items into units with which he is familiar. The accompanying nomograph correlates the four interdependent equations involving Peak Power, Average Power, Energy, Duty Cycle, Pulse Width, Pulse Repetition Rate, and Pulse Interval. These equations

$$\frac{P_{AV}}{P_p} = d = \tau f_r \qquad (1)$$

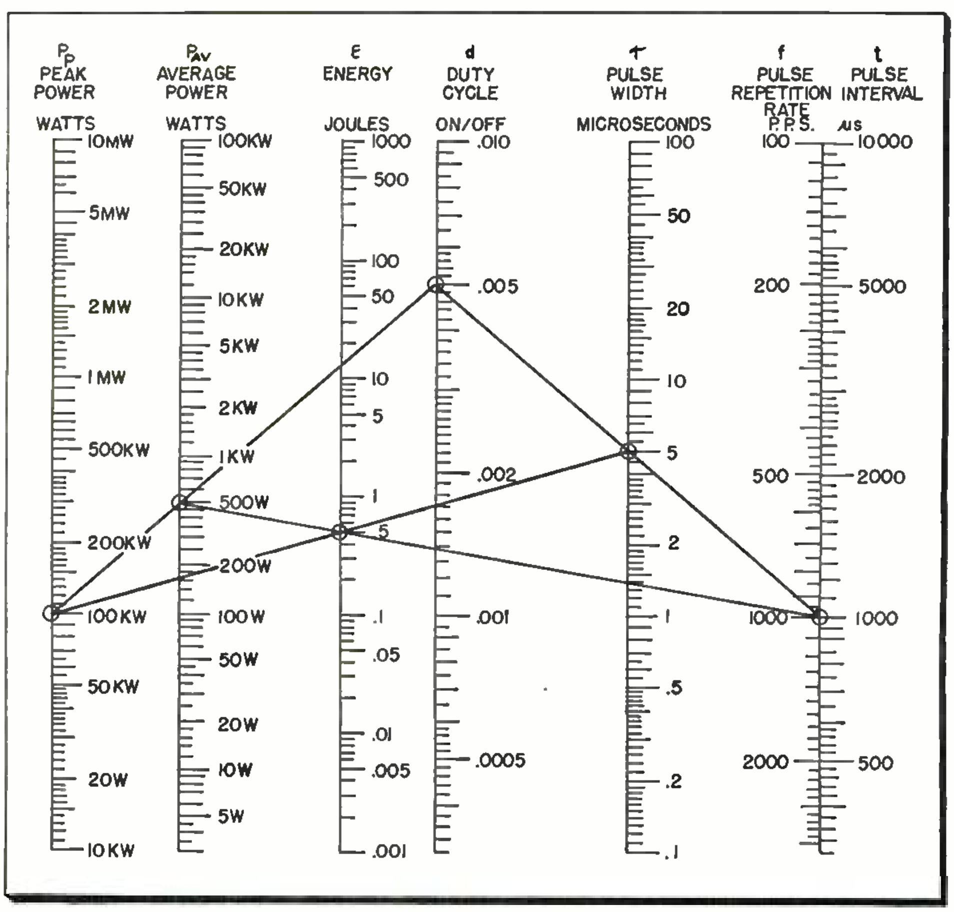
$$P_p \tau = E = P_{AV} t \qquad (2)$$

are quite familiar to the engineer but are seldom combined.

The following example will clarify the use of the nomograph.

If the Pulse Repetition Rate (f_r) of 1000 Pulses per Second (PPS) and the Pulse Width (τ) of 5 µs have been determined, a straight edge joining these two values on the scales on the right and extending to the center scale will give a Duty Cycle (d) of 0.005.

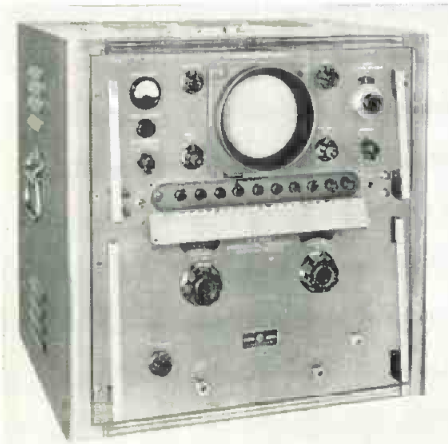
If a Peak Power (P_p) of 100 KW is desired, a straight line joining this value on the scale on the extreme left with the value of 0.005 on the Duty Cycle scale will give an Average Power (P_{AV}) of 500 Watts. Joining the value of 100 KW Peak Power with the Pulse Width scale crosses the Pulse Energy scale at a value of 0.5 joule. A cross check can be made by joining the value of Average Power of 500 Watts and the 1000 PPS Pulse Repetition Rate also yielding a Pulse Energy value of 0.5 joule.



New Test Equipment

ANALYZER

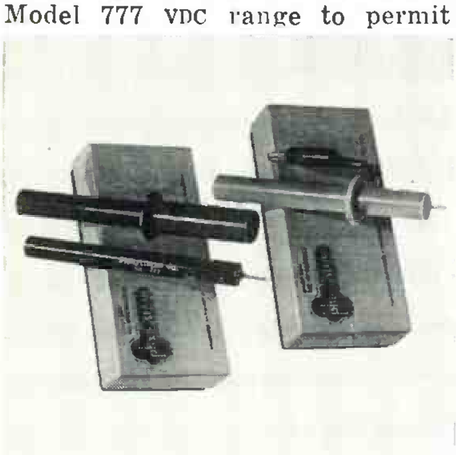
A Broadband Spectrum Analyzer, FXR Model No. L701A, with broadband r-f heads, that combines superior specifications with simplicity of design is a late mi-



crowave test equipment development. The broadband r-f heads of FXR's Spectrum Analyzer permit operation with 1 head in the range from 950 to 16,000 MC. This improved microwave receiver affords greater sweep width and range, display is better and all controls are more convenient. **Electronics & X-Ray Div., F-R Machine Works, Inc., Woodside, N. Y. (Ref. No. 11-15).**

PROBES

The availability of a Hi-voltage probe (left) and RF probe (right) for Model 777 vacuum tube voltmeter has been announced. The Hi-voltage probe extends the Model 777 VDC range to permit



measurements to 50,000 v. The RF probe makes possible measurements up to 400 MC. These new probes are available for $15.00 each complete. **Phaostron Instrument and Electronic Co., South Pasadena, Calif. (Ref. No. 11-24).**

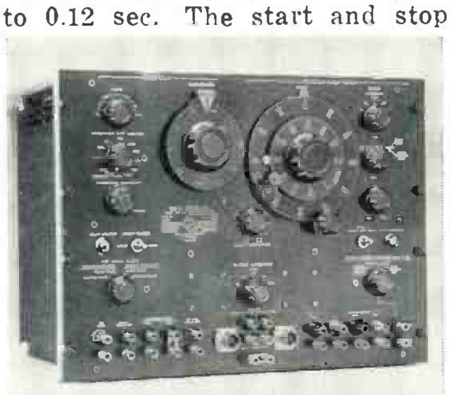
AMPLIFIER ANALYZER

A new, versatile test device for Brown Electronik "Continuous Balance" Amplifier Units, which makes it possible to trouble-shoot these amplifiers while installed, is

available. It features portability and simplicity to permit suspected amplifier malfunctioning to be quickly confirmed or discounted. The Analyzer is connected for in-the-field amplifier check-out through the tube socket plug adapters without disturbing either input or output amplifier connections. **Parameters, Inc., New Hyde Park, N. Y. (Ref. No. 11-18).**

PULSE GENERATOR

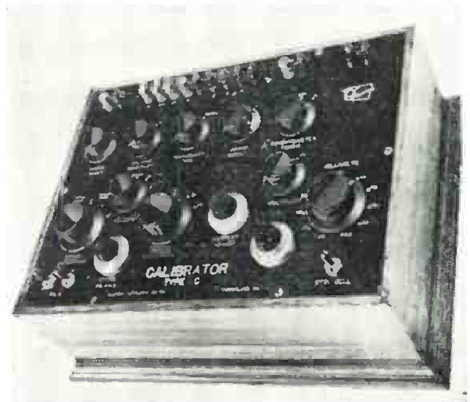
The new Versatile Generator is a pulse source and measuring device designed to meet the diverse requirements of laboratories engaged in time-domain measurements. The time-delay generator has a calibrated range from one μsec to 1.1 sec.; the linear sweep generator produces saw-tooth waveforms ranging from 3.0 μsec to 0.12 sec. The start and stop



times of pulses, which are continuously adjustable in duration from 0.05 microsecond to 0.1 sec., can be precisely set at any point by amplitude comparators. **General Radio Co., Cambridge, Mass. (Ref. No. 11-32).**

CALIBRATOR

A new, versatile instrument for the universal calibration of wire strain gages, their transducers, and thermocouples has been developed. The devices will cali-



brate four-arm systems without the necessity of complicated hookups. All loads applied to a transducer are read directly in force, acceleration, torque, pressure, etc., and the usual tedious arithmetic is eliminated in a linearity check. Accuracy of the instrument is ±0.05 per cent while total thermal EMF is less than 3 μv. **Allegany Instrument Company, Metuchen, N. J. (Ref. No. 11-19).**

WAVEFORM GENERATOR

This generator is the first of a line of fully-transistorized, battery-powered test equipment. It provides clipped-sawtooth and rectangular waveform output with a variable repetition rate from 10 cps to 50 KC. A square wave output is available from 5 cps through 25 KC. At full battery

voltage an output of 7 volts at 2000 ohms impedance is available. The rectangular wave shape is continuously variable in pulse width from 5 to in excess of 200 μsec. **Cubic Corp., San Diego. (Ref. No. 11-23).**

New Circuit Components

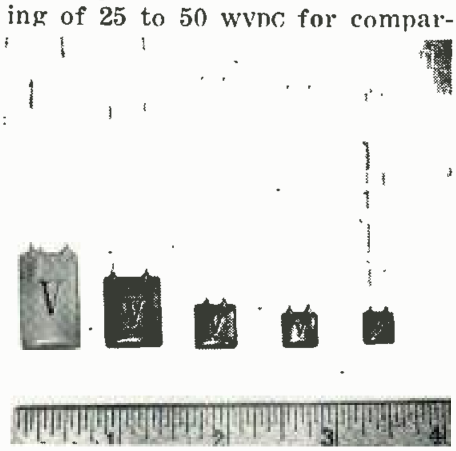
TUBES

Two new 7-pin miniature beam power amplifiers, designed for portable television sets up to the 14-inch size, have been announced. The two new tubes—termed the

12R5, 600 ma. heater, and 17R5. 450 ma. heater—are of particular use in series string TV sets with relatively low B-plus supply. They have pentode connected deflection amplifier ratings which permit peak positive pulse plate voltages up to a value of 1500 v., and the plate dissipation of 4.5 w. Sylvania Electric Products, Inc., New York (Ref. No. 11-21).

CERAMIC CAPACITOR

A new 2000K series sub-miniature extended temperature range ceramic capacitor known as VAL-CAP has been announced. Over 90 per cent of capacitance is maintained through temperatures ranging from —55° through +125°C. The Val-Cap is rated at 200 WVDC as compared to a more usual rating of 25 to 50 WVDC for compar-



able size. Series is offered in 5 sizes ranging from ¼ in. x ¼ in. x .050 thick with capacitance of .0033 µf to ½ in. x ¾ in. x .080 thick with capacitance of .05 µf. Valco Engineering Sales Co., Los Angeles (Ref. No. 11-25).

COUNTING UNIT

The direct reading Model 101A is designed to provide an output pulse at a selected number at rates in excess of 40,000 counts per second. If reset is not required, they

are capable of counting at a 100,000 cps rate. Specifications input: negative pulse, 75-100v. peak; Rise Time—1 µsec max; Duration—at least 2 µsec; Input Impedance—100 µµf in series with 16,000 ohms; Preset Coincidence Output—positive pulse, approximately 50 v. peak. Computer-Measurements Corp., North Hollywood, Calif. (Ref. No. 11-22).

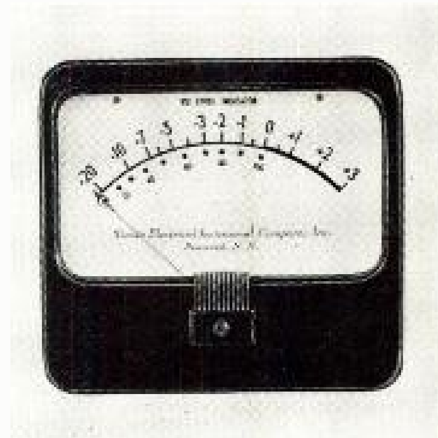
POWER TRANSISTOR

A new germanium p-n-p audio power transistor to operate from a 12-v. battery is being manufactured. This transistor can readily dissipate 5 w. at a 75°C mounting base temperature and 25 w. at room temperature. The collector current rating is 2 amp at 75°C. Its power gain is 30-40 db and it

has ac gains up to 100 at 0.5 amp collector current and 50 at 2 amp. 2N235A is the JETEC designation reserved for this transistor. Red Bank Division, Bendix Aviation Corp., Long Branch, N. J. (Ref. No. 11-27).

VU METER

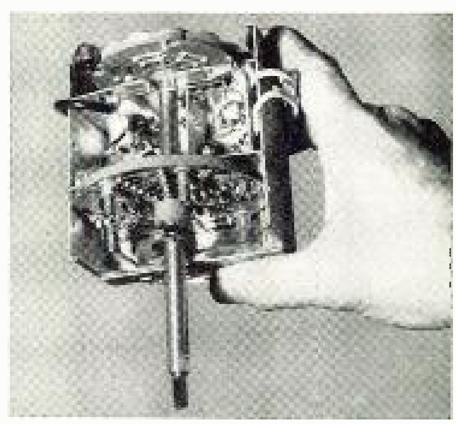
VU meters now built into Beede styled cases, in the clear Model No. 23 plastic or satin black Model No. 16. The Beede VU meter is built to conform to ASA and JAN



specifications. Zero power level 1 Milliwatt in 600 ohm line. Instrument impedance is 3900 ohms, 3600 ohms external resistance, supplied only on special request. to give a total of 7500 ohms. Beede Electrical Instrument Co., Inc., Penacook, N. H. (Ref. No. 11-26).

TV TUNER

New disk type television tuner, 20 per cent smaller, yet more sensitive than conventional turret type, has been developed. Tuner's circuitry and components are easily accessible, thereby reducing servicing problems to a minimum. It is disassembled in seconds by removal of only 3 retainer and index springs. In place of tuning



strips, antenna and osc. circuits are located on 2 disks or rotors connected by a tuning shaft. Eventually it will be incorporated in the new 10-, 14-, and 17-inch portables. Admiral Corp., Chicago (Ref. No. 11-28).

New Tech Data for Engineers

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

Rare Earths Data

Of interest to researchers in electron tube design; engineers; and physicists, this folder is called Latest Data on High Purity Rare Earths. Prepared by St. Eloi Corp., Newtown, Ohio, material includes tabulation of physical properties for lanthanons and oxides and a pure rare earth oxide price schedule (by the gram). Brief information about rare earths, applications and bibliographical reference is included. (Ask for B-11-1)

Potentiometer

Data Sheet 54-49, issued by Helipot Corp., Div. of Beckman Instruments, Newport Beach, Calif., describes and illustrates the 2-in. Series 5600 precision potentiometer. Data sheet gives specs, construction, coil characteristics and available modifications. (Ask for B-11-2)

Large Waveguide

Mechanical and electrical characteristics and standard shape data for new waveguide for multi-megawatt radar and communications systems are provided in Bulletin EPW-656, offered by I-T-E Circuit Breaker Co., Philadelphia. Material includes specs, drawings and basic information. (Ask for B-11-3)

Phenolic Molding

Brochures have been issued for three phenolic molding compounds available from General Electric, Pittsfield, Mass. GE 12906 compound is an improved impact compound (Brochure CDC-325); two general purpose phenolic molding compounds are GE 12920 (black) and GE 12921 (brown), described in Brochure CDC-326; and automatic molding applications of the one-stage compound GE 12902 are described in Brochure CDC-324. (Ask for B-11-4)

Electronic Micrometers

Hand-operated electronic micrometers are described and illustrated in a brochure which includes specs and principles of operation. Material issued by J. W. Dice Co., Englewood, N. J. (Ask for B-11-5)

Amplifier, Generator, etc.

Three engineering bulletins and a general brochure on product line are available from Magnetic Research Corp., El Segundo, Calif. Bulletin EB-201-A discusses Micromag, a low-level magnetic signal amplifier, Models MM-411, 421 and 431. Bulletin EB-204 is concerned with Magnepulse magnetic pulse generator, Model MP-85. Stablvolt Type A power supplies is the subject of Bulletin EB 203. All brochures are illustrated, and give specs and applications. General brochure lists and illustrates eight of the firm's products, and gives background of services and facilities. (Ask for B-11-6)

Wire Catalog

Featuring improved design characteristics, a wire catalog has been prepared by Sylvania Electric Products' Parts Div., Warren, Pa. Catalog carries complete listing of wire, ribbon, weld and carbostrip products; wire and ribbon types include alloy, clad and plated. (Ask for B-11-7)

Signal Generator-Control

Eight-page folder illustrates and describes a signal generator and control from Brush Electronics Co., Cleveland. Instrument has been designed to meet varied requirements of a signal source for electrical, electro-acoustical and acoustical measurements. Literature is divided into sections for easier reference. (Ask for B-11-8)

Remote Metering System

A bulletin from Sparton Control Systems Div., Jackson, Mich., describes features, applications, future expansion provisions of simple remote metering system with plug-in construction. (Ask for B-11-9)

Electrical Connections

Reports on customer experience and applications with automatic wire twisters, and with methods of stripping insulated wire are highlights of Bulletin No. 7 of a series, dealing with ideas on the subject of reliable electrical connections. Four-page illustrated publication is compiled by Rush Wire Stripper Div., The Eraser Co., Inc., Syracuse, N. Y. (Ask for B-11-10)

Industrial Tube Types

Complete listing of renewal items is featured in the new 10th Edition of the Technical Manual, published by Sylvania Electric Products, Inc., Buffalo, which includes late information on industrial tube types. (Ask for B-11-11)

Tubing Materials

Data Memorandum No. 1, issued by Superior Tube Co., Norristown, Pa., lists 121 metals and alloys from which standard and special small diameter tubing are produced. Analyses are grouped into carbon, alloy and stainless steels, nickel and nickel alloys, nickel cathode materials, etc. Standard or special analyses groups are also given. (Ask for B-11-12)

Electrical Contacts

Detailed information about contact materials, material characteristics, types of contacts and application to industry are included in a 28-page catalog on Electrical Contacts and Contact Materials. Contact Div. of Baker & Co., Inc., a subsidiary of Engelhard Industries, Newark, N. J., has published the material, which reviews contact materials such as silver, platinum, gold, palladium and their alloys. (Ask for B-11-13)

Process Instruments

A 4-page bulletin of process instruments is available from the Scientific Instruments Div., Beckman Instruments, Inc., Fullerton, Calif. Bulletin 491 contains pictures and brief descriptions of various instruments. (Ask for B-11-14)

Relays Data Sheet

Featuring the BB Series Relay, a data sheet has been issued for inclusion in the existing bulletin on Relays by the Telephone Div., Stromberg-Carlson Co., Rochester, N. Y. Sheet is illustrated and has specs. (Ask for B-11-15)

Industrial Instrumentation

A four-page illustrated bulletin on recording, indicating and controlling instruments used in industrial processing has been issued by Fielden Instrument Div., Robertshaw-Fulton Controls Co., Philadelphia. Bulletin is No. F-403. (Ask for B-11-16)

Service Guide

Covering all commercial products manufactured from 1948 to May, 1956, a Service Guide has been released by Hoffman Radio Div., Hoffman Electronics Corp., Los Angeles. Bound guide has 200 pages, schematic diagrams, chassis parts lists, cabinets parts lists and tuner data on all black-and-white and color TV receivers, plus radios and phonographs. Guide features a multiple-indexing system for easy reference. Available via distributors for $3.00. (Ask for B-11-17)

Germanium Glass Diodes

Bulletin #G-60 covers line of subminiature germanium glass diodes. Available from Radio Receptor Co., Inc., Brooklyn, N. Y. (Ask for B-11-18)

Transistorized Equipment, etc.

Complete line of transistorized and tubeless equipment is covered in an eight-page catalog, which includes new line of transistorized power supplies from Electronic Research Associates, Inc., Nutley, N. J. (Ask for B-11-19)

Thermistor Manual

Illustrated with charts and drawings, Thermistor Manual No. TH-13A (superseding No. TH-13) has been issued by General Electric's Metallurgical Products Dept., Detroit 32. Manual gives general, material and operating characteristics; general types of application; thermistor assemblies; stock order numbers; specifications; and basic thermistor characteristics. (Ask for B-10-2)

Power Supply Bulletin

Bulletin EB-203 describes the Stablvolt DC power supply made by Magnetic Research Corp., 200 Center St., El Segundo, Calif. Power supply has a short circuit-proof feature. (Ask for B-10-3)

Fuse Resistor

Catalog Data Bulletin P-3 on the Type FR fuse resistor is available from International Resistance Co., 401 N. Broad St., Philadelphia 8. Material describes applications, advantages, design, ranges, and detailed charts and graphs. (Ask for B-10-4)

Plug-In Units Guide

Fully illustrated, a four-page Quick Index Guide of Basic Components for plug-in unit construction is offered by Alden Products Co., 117 N. Main St., Brockton 64, Mass. Booklet contains a complete series of hardware components needed for electronic or electrical circuitry, and gives specs and prices on each component. (Ask for B-10-8)

Loudspeakers

Catalog No. 1070, issued by Jensen Mfg. Co., 6601 S. Laramie Ave., Chicago 38, describes new line of Professional Series loudspeakers designed for commercial, industrial, institutional and public address applications. Specific info. on all equipment in line is contained in the 24-page catalog. (Ask for B-10-9)

Personnel

A brochure describing current opportunities in physics, electrical engineering, mathematics, and psychology is available to graduate engineers and Doctors from R&D, MIT Lincoln Lab., Box 24, Lexington, Mass. (Ask for B-9-14)

Core Testing

"Pulse Patterns for Testing Cores" (Tech. Bulletin 136) gives the latest information on how users can benefit from using pulse control systems to test cores by digital techniques. Electronic Inst. Div., Burroughs Corp. is the publisher. (Ask for B-9-15)

Drafting

A 56-page booklet, Standard and Simplified Drafting Practices, is being offered by American Machine & Foundry Co. (Ask for B-9-16)

Teflon Products

The Crane Packing Co., 6400 Oakton St., Morton Grove, Ill., has made available a new brochure (Form T-110) on Chemlon, "John Crane" products fabricated from DuPont Teflon. (Ask for B-9-17)

New Communication Products

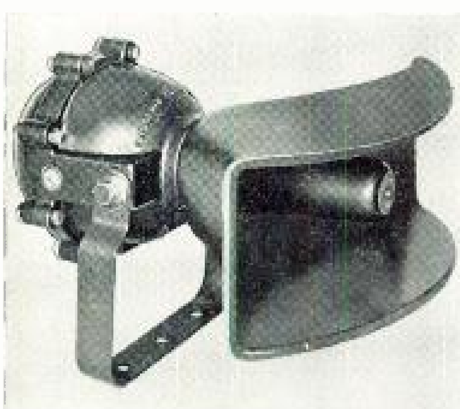
INTERCOM

Home-owners and offices are being offered a new electronic appliance which features all-master intercom service in a "packaged" system, available in flush, desk,

and wall surface mountings. This is the only single amplifier packaged system which permits any station to call any one or all other stations. The single amplifier is a plug-in type which can be installed in minutes. All stations have a privacy switch to prevent eavesdropping. When the privacy switch is "on" the station being called can be signalled by a buzzer. **Rayovox Mfg. Co., Brooklyn (Ref. No. 11-49).**

PA SPEAKERS

Approved for hazardous service by the UL, several sizes and types of approved explosion-proof high-efficiency public address loudspeakers have been released. These new loudspeakers are available in Class I and Class II.



Type HLE-1-30, shown in photo, is for paging and talk-back applications and is $66.00 User Net. All four models are available with built-in line matching transformers. **Atlas Sound Corp., Brooklyn (Ref. No. 11-50).**

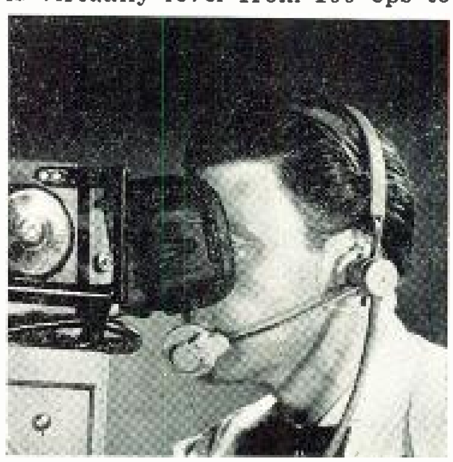
MINIATURE TV CAMERA

A cigar-shaped TV camera, called the "Peepsqueek," believed to be the world's smallest, now opens a completely new era for industrial, scientific and medical TV

viewing. The new camera is less than 6 in. long, measuring only 1⅞ in. in diameter. Equipped with two sets of spring-loaded guide rollers, it travels through pipes that have an I.D. of 2⅜ in. or more, and a bending radius of a mere 14 inches. This remote-controlled unit contains a miniresistron and a number of subminiature tubes that serve as amplifying elements. **Majestic International Corp., Chicago (Ref. No. 11-45).**

STUDIO HEAD SETS

This equipment has been specially developed for the studio operator. The earphone units are designed to give a response which is virtually level from 100 cps to



3.3 KC. A boom mounted carbon microphone is provided. Movement of the arm is restricted by stops to 90 degrees allowing adequate adjustment when in use. **Amplivox Ltd., London, England. (Ref. No. 11-47).**

MUSIC-MONITOR

Simple finger-tip selection on this new radio and intercommunication system brings safety, convenience and entertainment. This complete built-in system provides

radio broadcast reception in six areas, plus two-way intercommunication between the master station—and five remote stations. The "Music-Monitor," when not being used in a functional manner, makes work more pleasant by allowing music to be beamed into all areas from the master station. **David Bogen Co., Inc., New York. (Ref. No. 11-31).**

PREAMPLIFIER-EQUALIZER

This transistor preamplifier-equalizer was developed to solve some of the outstanding problems inherent in present vacuum tube preamplifiers. The signal-to-noise ratio of the unit is better than 65 db below 10 mv input. Output signal reveals complete absence of hum. Microphonics are totally non-existent, both in listening

tests and actual measurement. An input of 2 mv in the low impedance position will give an output of 0.6 volts with 0.26 per cent distortion, or less. **Fisher Radio Corp., Long Island, N. Y. (Ref. No. 11-29).**

 For product information, use inquiry card on page 137.

WASHINGTON
News Letter

Latest Radio and Communication News, from The National Capital, and Previews of Things to Come

INVESTIGATION SCOPE—To be given concentrated attention by the FCC Commissioners the microwave inquiry is to encompass an across-the-board survey of this field. The proceeding will include a blueprint of all types of use of microwave—private intercity television relay, common carrier facilities, industrial microwave systems such as in the petroleum, electric and gas utilities, state police departments, aviation, and trucking industry fields. Possibly the use for microwave of the 890-940 megacycle space which is allocated primarily to industrial, scientific and medical services with present secondary use by telephone and telegraph companies is another key facet of the inquiry. The survey by the FCC is expected to embrace not only representative groups of prospective microwave users now operating private facilities but also users planning such operations in the future.

EDUCATIONAL TV GROWTH—Expansion of educational television both by colleges and school systems and by networks and stations is being closely followed by the FCC and Congress. In addition, the growth of educational television is being watched by equipment manufacturers as a future major market outlet, particularly in closed circuit operations. At present there are 23 non-commercial (educational TV) stations in regular operation and the prospect is eight more on the air by next June. According to the Educational TV Joint Council, the coverage now is around 40 million persons but by June it will soar to 56 million. Illustrating the potentialities of closed circuit operations in this field General Electric cited closed circuit equipment sales this year will total $6 million and will rise to $75 million annually in ten years.

SPACE USE DOUBLED—The FCC's new split-channel rule for mobile radio operations in the 152-162 MC band which became final October 15th almost doubles the 166 assignable frequencies for those services. The split-channel rules do not reduce channel separations if the 25-50 MC users "consider the feasibility of transferring" their operations to higher frequency bands as far up as 1000 megacycles. The Commission plans a series of proceedings to determine what services and users will be the beneficiaries of the newly available frequencies.

MILITARY OUTLOOK—Under Secretary of the Army Charles C. Finucane recently characterized the communications and electronics industries as "the fastest growing and most challenging industry in the nation today" and termed its developments and equipment as "the most essential and extremely vital" to the modern military forces of the United States in its efforts to maintain the national defense strength as a deterrent to any potential communist aggressor. Electronics is the principal tool of atomic and missile weapons systems as well as in firepower target acquisition and battle area surveillance, he cited.

PETROLEUM COMMUNICATIONS—The National Petroleum Council's communications subcommittee has formulated a program under which the oil and gas industries' radio and microwave systems can be compressed into high-priority circuits for liaison with government agencies in event of a wartime mobilization. There are more than 41,000 radio transmitters as of mid-1956 in the petroleum industry alone.

MICROWAVE SURVEY—One of the most important steps in the advancement of radio in its history by the FCC is to be launched early next year in a broad survey of microwave both in its uses and value and to implement its expansion. The inquiry will be in two phases—an extensive fact-finding investigation which will include policies on uses of this medium of communication and transmission and then a rule-making proceeding. The guideposts for the overall microwave investigation were slated to be issued by the Commission early in October and all parties concerned with microwave then submit their comments.

TV ALLOCATIONS—The industry allocations conference on UHF television research and development, which was proposed by the FCC, inaugurated early in October the implementation of its program by the formation of an organization to carry forward the assignments for both the broadcasting and manufacturing segments of the industry. The manufacturing and engineering side of the project has strong representation of the industry's leadership as the members of the Radio-Electronics-Television Manufacturers Association group in the program. These included: Dr. W. R. G. Baker, RETMA President and General Electric Vice President; RCA Senior Executive Vice President E. W. Engstrom; Motorola President and Chairman Paul V. Galvin; Philco Vice President-product development Larry F. Hardy. National Assoc. of Radio and TV Broadcasters, President Harold Fellows headed that organization's group.

National Press Building
Washington 4

ROLAND C. DAVIES
Washington Editor

FOR THE PRINTED CIRCUIT

CINCH SOCKETS

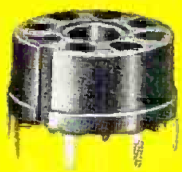
MEET EVERY REQUIREMENT

CINCH 7 AND 9 PIN STANDARD SOCKETS STAND-OFF TYPE FOR THE PRINTED CIRCUIT:

56P22352

53P22698

45P22470



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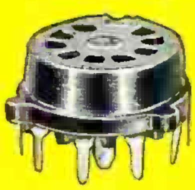


44P22661

The CINCH sub-miniature and miniature sockets insure positive electrical contact, hold transistors and tubes securely in place, permit easy maintenance and replacement, provide maximum insulation resistance and minimum high frequency loss.

Utilizing the latest manufacturing procedures with unlimited capacity, CINCH assures you of a dependable source of supply regardless of quantities required.

53P20683

Cinch ELECTRONIC COMPONENTS

SOCKETS SHOWN ACTUAL SIZE

Centally located plants in Shelbyville, Chicago, LaPuente, St. Louis.

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

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

44P20684

CINCH will design, or re-design, components to fit specific needs, and will assist in the assembly of components through proven automation technique.

CINCH automatically assembled sockets assure the uniformity and quality mandatory for use in AUTOMATION in the end users equipment.

YOU CAN DEPEND ON CINCH

Telerad

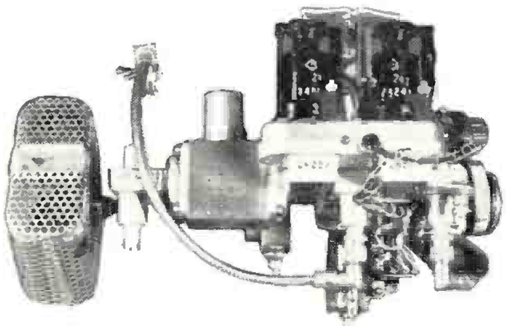
MANUFACTURING CORPORATION

TELE-FLEX

FLEXIBLE WAVEGUIDE

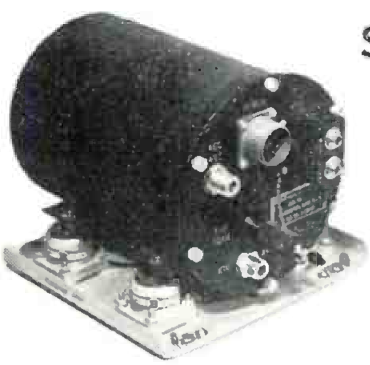
TELE-GUIDE

RIGID WAVEGUIDE &
COAXIAL COMPONENTS

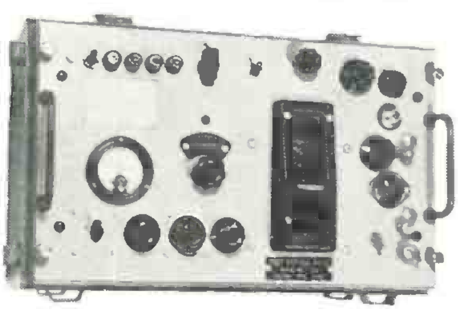


SPECIAL PRODUCTS

"S" & "L" BAND
GUIDED MISSILE BEACONS



TEST SET
TSG-147D



FREQUENCY
METER
TFM-186

Telerad **MANUFACTURING CORPORATION**
GENERAL OFFICES
1440 BROADWAY, NEW YORK • BRyant 9-0893

Electronic Industries' 1957 Directory of Microwave Equipment Manufacturers

Latest compilation provides names and addresses of companies who make the principal microwave products for today's markets

AMPLIFIERS

Air Associates Inc 511 Joyce St Orange NJ
Airborne Instruments Lab 160 Old County Rd Mineola NY
Amerac Inc Wenham Mass
ARF Products 7627 Lake St River Forest Ill
Atlas Precision Products Co 3801 Castor Ave Phila 24 Pa
Bruno-New York Ind 460 W 34 St New York 1 NY
Budelman Radio Corp 375 Fairfield Ave Stamford Conn
Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif
Collins Radio Co 855 35 St NE Cedar Rapids Iowa
Conn Telephone & Electric Corp 70 Britannia St Meriden Conn
Cossar (Canada) Ltd 301 Windsor St Halifax NS Canada
Daystrom Instrument Archbald Pa
De Mornay-Bonardi Inc 780 S Arroyo Pkwy Pasadena 1 Calif
Digital Products Inc 7643 Fay Ave La-Jolla Calif
Douglas Microwave Co 11 Beechwood Ave New Rochelle NY
Dynamic Electronics-NY Inc 73-39 Woodhaven Blvd Glendale LI NY
Electronic Specialty Co 5121 San Fernando Rd Los Angeles 39 Calif
Electron-Radar Products 4806 W Chicago Ave Chicago 51 Ill
Espey Mfg Co 200 W 57 St New York 19
Federal Telephone & Radio Co Div of IT&T 100 Kingsland Rd Clifton NJ
F-R Machine Works 26-12 Borough Pl Woodside 77 NY
General Electric Co Broadcast Equip Commercial Equip Dept Electronics Park Syracuse NY
General Electric Co Electronics Div Communication Equip Electronics Park Syracuse NY
G & M Equip Co 7315 Varna Ave N Hollywood Calif
Grem Eng'g Co 257 Alliston Rd Springfield Pa
G W Associates PO Box 2263 El Segundo Calif
Hallamore Mfg Co 2001 E Artesia Long Beach 5 Calif
Hallicrafters 4401 5 Ave Chicago 24 Ill
Hewlett-Packard Co 275 Page Mill Rd Palo Alto Calif
J-V-M Eng'g Co 8846 W 47 St Brookfield Ill
Kay Electric Co 14 Maple Ave Pine-brook NJ
Kings Electronics Co 40 Marbledale Rd Tuckahoe NY
Korb Engr & Mfg Co 30 Ottawa Ave Grandville Mich
Lear Inc 3171 S Bundy Dr Santa Monica Calif
Leonard Electric Products Co Inc 67 34th St Brooklyn 32 NY
Levinthal Electronic Products 2821 Fair Oaks Ave Redwood City Calif
Litton Industries 336 N Foothill Rd Beverly Hills Calif
Maxson Corp W L 460 W 34 St New York 1
Microwave Associates 22 Cummington St Boston 15 Mass
Polarad Electronics Corp 43-20 34 St Long Island City 1 NY
Polytechnic Res & Devel 202 Tillary St Brooklyn 1 NY
Premier Instrument Corp 52 W Houston St New York 12
Pye Corp of America 270 Park Ave New York 17 NY
Radio Corp of America Camden NJ
Radio Eng'g Labs 36-40 37th St Long Island City 1 NY
Radio Receptor Co 251 W 19 St New York 11
Raytheon Mfg Co Equip Marketing Div 100 River St Waltham Mass
Sanders Associates Inc 137 Canal St Nashua NH
Scott Radio Labs Liberty & Penna St Plymouth Ind
Sperry Gyroscope Co Division of Sperry Rand Corp Great Neck NY
Standard Electronics Research Corp 2 East End Ave New York 21
Standard Labs 1661 Broadway Redwood City Calif
Stanford Labs Co PO Box 252 Menlo Park Calif
Stavid Eng'g Inc U S Hwy 22 Plainfield NJ
Telemarine Communications Co 3040 W 21 St Brooklyn 24 NY
Telephonics Corp Park Ave Huntington LI NY
Telerad Mfg Corp 1440 Broadway New York 18
Transmitter Equipment Mfg Co 35 Ryerson St Brooklyn 5 NY
Ultrasonic Corp 640 Memorial Dr Cambridge Mass
Varian Associates 611 Hansen Way Palo Alto Calif
Vectron Inc 1611 Trapelo Rd Waltham 54 Mass
Virginia Electronics Co River Rd at B&O RR Washington 16 DC
Visual Electronics Corp 500 5 Ave New York 36
Waveline Inc Passaic Ave Box 470 Caldwell NJ
Westinghouse Electric Corp Electronics Div 2519 Wilkens Ave Baltimore 2 Md
Weston Labs Inc Old Littleton Rd Harvard Mass
White Electron Devices Inc Roger 4 Ave Haskell NJ
Wright Eng'g Co 180 E Calif St Pasadena 1 Calif

COAXIAL CABLE

Accurate Insulated Wire Corp 25 Fox St New Haven 13 Conn
Advanced Insulated Wire & Cable PO Box 1026 Plainfield NJ
Aero Specialties Inc Pleasant Valley Rd Sutton Mass
Airborne Electronics Inc 155 1 St Mineola NY
A-K Mfg Co 115 S Northwest Hwy Barrington Ill
Alpha Wire Corp 200 Varick St New York 14 NY
Amphenol Electronics Corp 1830 S 54 Ave Chicago 50 Ill
Anaconda Wire & Cable Co 25 Broadway New York 4
Andrew Corp 363 E 75 St Chicago 19 Ill
Ansonia Wire & Cable Co 63 Main St Ansonia Conn
Atlantic Wire & Cable Co 119-14 14 Rd College Point NY
Barlow Electrical Mfg Co 155 E 128th St New York 35
Belden Mfg Co 4647 W Van Buren St Chicago 44 Ill
Birnbach Radio Co 145 Hudson St New York 13
Boston Insulated Wire & Cable 65 Bay St Dorchester 25 Mass
Brand Co Wm North & Valley Sts Willimantic Conn
Burndy Eng'g Norwalk Conn
Burroughs Corp Electronic Instruments Div 1209 Vine St Phila 7 Pa
Carol Cable Div Crescent Co 20 Central Ave Pawtucket RI
CBC Electronics Co 2601 N Howard St Phila 33 Pa
Chester Cable Corp 1000 Hill St Chester NY
Coleman Cable & Wire Co 4515 W Addison St Chicago 41 Ill
Columbia Technical Corp 5 E 57 St New York 22
Columbia Wire & Supply Co 2850 Irving Park Rd Chicago 18 Ill
Commonwealth Wire & Cable Pleasant Valley Rd Sutton Mass
Consolidated Wire & Associated Co's 1635 S Clinton St Chicago 16 Ill
Dielectric Materials Co 5315 Ravenswood Ave Chicago 40 Ill
Electrical & Physical Instrument Corp 42-19 27 St Long Island City NY
Electronicraft Inc 27 Milburn St Bronxville 8 NY
Federal Electric Corp 6446 Santa Monica Blvd Los Angeles 38 Calif
Federal Labs Co 500 Washington Ave Nutley 10 NJ
Federal Telephone & Radio Co Div IT&T 100 Kingsland Rd Clifton NJ
Fenton Co 15 Moore St New York 4
General Cable Corp 420 Lexington Ave New York 17
General Insulated Wire Works 69 Gordon Ave Providence 5 RI
General Radio Co 275 Mass Ave Cambridge 39 Mass
Graybar Electric Co 420 Lexington Ave New York 17
Guardian Electric Mfg Co 1621 W Walnut St Chicago 12 Ill
Gulton Mfg Corp 212 Durham Ave Metuchen NJ
Hallet Mfg Co 1601 W Florence Ave Inglewood Calif
Hitemp Wires Inc 26 Windsor Ave Mineola LI NY
Imperial Radar & Wire Corp 1661 Boone Ave New York 60
International Telemeter Corp 2000 Stoner Ave Los Angeles 25 Calif
Jefferson Products Pleasant Valley Rd Sutton Mass
JFD Mfg Co 6101 16 Ave Brooklyn 4 NY
Lenz Electric Mfg Co 1751 N Western Ave Chicago 47 Ill
McRix Chemical 1021 E 55 St Chicago Ill
Microdot Inc 1826 Fremont Ave S Pasadena Calif
Mohawk Wire & Cable Corp 320 River St Fitchburg Mass
Okonite Co 220 Passaic St Passaic NJ
Petroff Peter A 127 Water St New York 5
Phalo Plastics Corp 25 Foster St Worcester 8 Mass
Phelps Dodge Copper Products Corp 300 Park Ave New York 22
Philco Corp C & Tioga Sts Phila 34 Pa
Plastic Wire & Cable Corp E Main St Jewett City Conn
Plastoid Corp 42-61 24 St Long Island City 1 NY
Precision Tube Co Wissahickon Ave & Church Rd North Wales Pa
Prodelin Inc 307 Bergen Ave Kearny NJ
Rego Insulated Wire Co 830 Monroe St Hoboken NJ
Rex Corp W Acton Mass
Rhode Island Insulated Wire Co 50 Burnham Ave Cranston RI
Rockbestos Products Corp Nicoll & Canner Sts New Haven 4 Conn
Rome Cable Corp Rome NY
Saxton Products Inc 1661 Boone Ave Bronx 60 NY
Sequoia Process 871 Willow St Redwood City Calif
Standard Wire & Cable Co 3440 Overland Ave Los Angeles 34 Calif
Suprenant Mfg 172 Sterling Clinton Mass
Tensolite Wire Co Tarrytown NY
Transradio Ltd 138A Cromwell Rd London SW 7 England
Uniform Tubes Inc Level Rd Collegeville 2 Pa
Union Plastics Corp Wire & Cable Div 1627 Patterson Plank Rd Secaucus NJ
Univox Corp 102 Warren St New York 7
U S Rubber Co 1230 Ave of the Americas New York 20

(Continued on page 86)

PERSONAL

Roger Somerville has been appointed Chief Engineer of Telectro Industries Corp., Long Island City, N. Y.

C. Roger Moe has been named Senior Scientist at the Palo Alto labs of Lockheed Missile Systems Div.

John P. Day is now Technical Director at the San Diego facility, Marvelco Electronics Div. of National Aircraft Corp.

Ralph A. Lamm has been appointed Director of Engineering, Pacific Div., Bendix Aviation Corp., North Hollywood, Calif.

R. A. Lamm

Dr. I. Travis

Dr. Irven Travis has been named Vice President of Research and Engineering by Burroughs Corp., Detroit. He joined Burroughs as Director of Research in Philadelphia seven years ago and has been Vice President-Research at Burroughs' Paoli, Pa., labs since 1952. **Raymond G. Bower** has retired as Burroughs' Vice President-Engineeering.

Dr. Torben H. Meisling has joined Stanford Research Institute, Menlo Park, Calif., as a Senior Research Engineer in the Computer Lab.

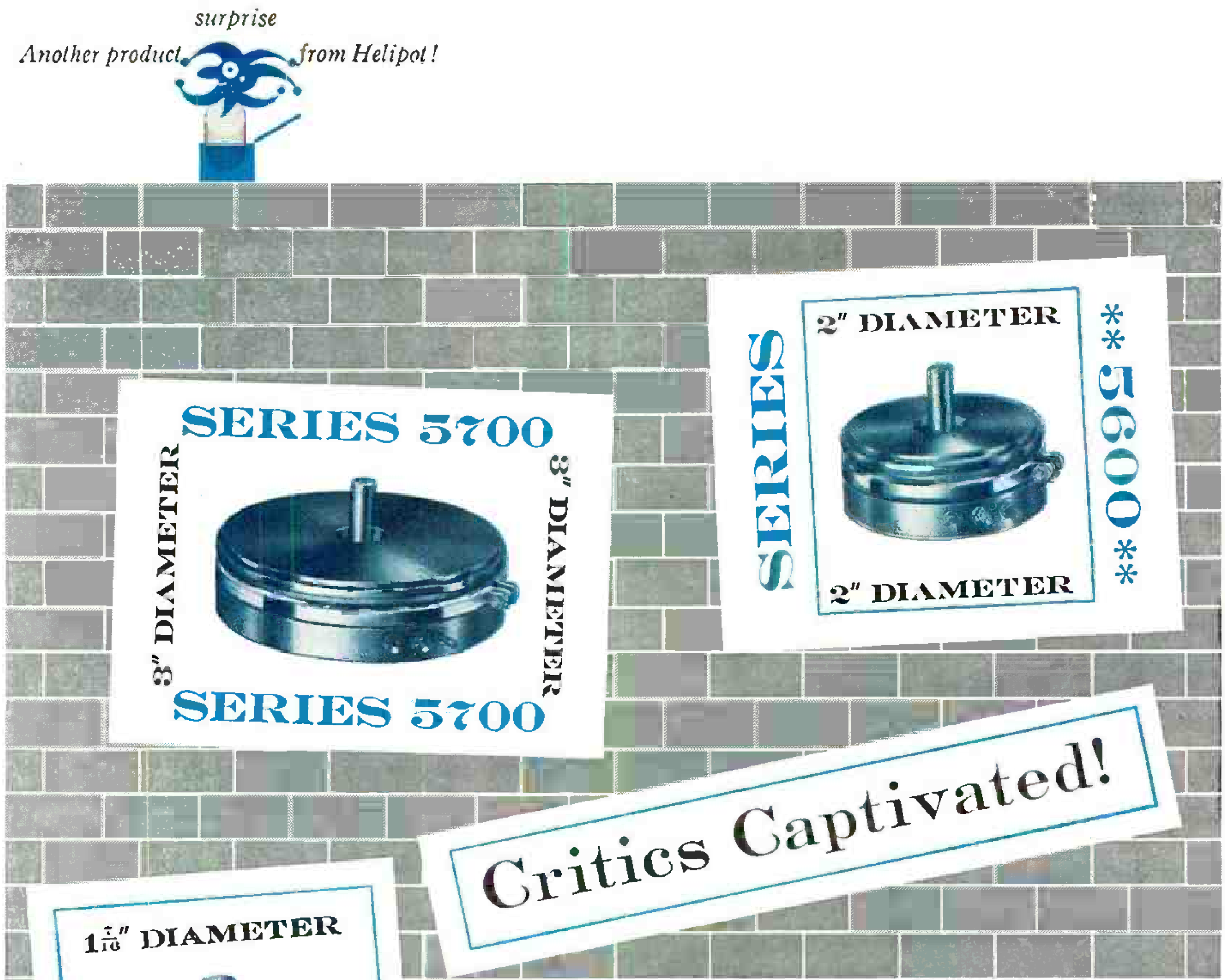
Walt Edwards has been appointed Chief Systems Engineer and **Ed Klein** has been made Project Engineer at the National Cash Register Co. Electronics Div., Hawthorne, Calif.

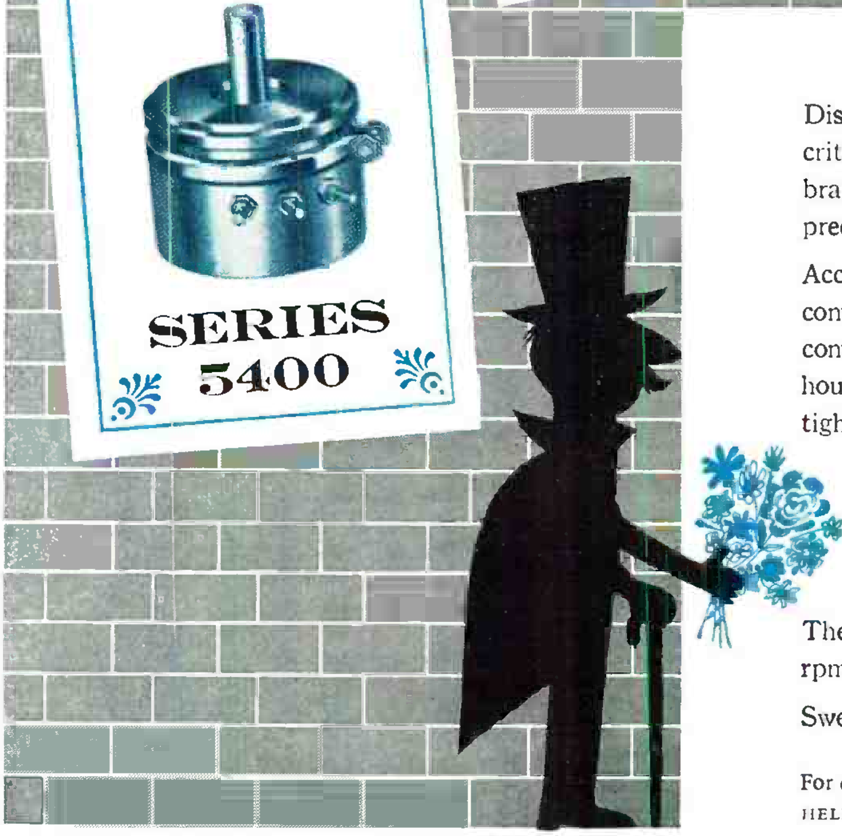
W. H. Budd

A. M. Daily

Arthur M. Daily has been elected Vice President—Research & Development, and **Wilbert H. Budd** is now Vice President—Marketing, at Chicago Telephone Supply Corp., Elkhart, Ind.

Sidney Moskowitz has been appointed Director of Engineering and **Martin Parry** has become Chief Engineer at Electronic Research Associates, Inc., Nutley, N. J.





Discriminating engineers, the world's toughest critics, applaud the brilliant performance of Helipot's brand new trio -- series 5400, 5600 and 5700 single-turn precision potentiometers.

According to the program notes, these three virtuosi come in a choice of five mounting-and-bearing combinations. A one-piece, dimensionally-stable plastic housing eliminates a separate rear lid. There are tighter tolerances on linearity and mechanical run-out.

A new rotor design reduces mass . . . permits lower contact pressure . . . results in decreased coil wear, more reliable operation, greater life expectancy. Incidentally, torque is lower.

They're a quiet trio, too. Maximum noise, at 100 rpm, with 1 milliamp of slider current, is 100 millivolts.

Sweet music to any electronic designer's ear!

For complete information and specifications on these three new HELIPOT* precision potentiometers, write for data file 1124.

Beckman®

Helipot *Corporation: Newport Beach, California*
a division of Beckman Instruments, Inc.
Engineering representatives in principal cities

708 *REG. U. S. PAT. OFF.

For product information, use inquiry card on page 137.

Directory of Microwave Manufacturers (cont.)

U S Wire & Cable Progress & Monroe Sts Union NJ
Visual Electronics Corp 500 5 Ave New York 36
Warren Wire Co Pawnal Vt
Western International Co 45 Vesey St New York 6
Western Mfg Co 1400 W 22 St Kearney Nebr
Wright Eng'g Co 180 E Calif St Pasadena 1 Calif

CONNECTORS

Antenna 1
Coaxial Cable 2

1-2—**Aerolite Electronics Corp** 507 26 St Union City NJ
1—**Aircraft Marine Products** 2100 Paxton St Harrisburg Pa
1—**Alden Products Co** 123 A N Main St Brockton Mass
1-2—**American Electronics Co** 1203 Bryant Ave New York 59
2—**American Lava Corp Sub Minn Mining & Mfg** Cherokee Blvd and Mfrs Rd Chattanooga 5 Tenn
2—**American Radio Hdw Co** 152 Mac Questen Pkwy S Mt Vernon NY
1-2—**Amphenol Electronics Corp** 1830 S 54 Ave Chicago 50 Ill
2—**Andrew Corp** 363 E 75 St Chicago 19 Ill
1-2—**Anton Electronic Labs** 1226 Flushing Ave Brooklyn 37, NY
1-2—**Automatic Metal Products Corp** 315 Berry St Brooklyn 37 NY
1-2—**Barker & Williamson** 237 Fairfield Ave Upper Darby Pa
1—**Birnbach Radio Co** 145 Hudson St New York 13 NY
2—**Blonder-Tongue Labs** 526 Worth Ave E Westfield NJ
2—**Burndy Eng'g Co** Norwalk Conn
2—**Cannon Electric Co** 3208 Humboldt St Los Angeles 31
1-2—**Cinch Mfg Co Jones Div** 1026 S Homan Ave Chicago 24 Ill
1—**Circon Component Co** Santa Barbara Municipal Airport Goleta Calif
1-2—**Coaxial Connector Co** 37 N 2 Ave Mt Vernon NY
2—**Commercial Radio Sound Corp** 652 1 Ave New York 16
1—**Connector Corp** 6025 N Keystone Ave Chicago 30 Ill
2—**Connector Corp of America** 3223 Burton Ave Burbank Calif
2—**Dage Electric Co** 67 N 2 St Beech Grove Ind
2—**Danbury Knudsen Inc** Box 170 Danbury Conn
2—**Defiance Eng & Microwave Corp** 81 Albion St Wakefield Mass
2—**Diamond Microwave Corp** 7 North Ave Wakefield Mass
2—**Dielectric Products Eng'g** Raymond Me
2—**Dow-Key Co** PO Box 57 Warren Minn
2—**Eagle Electronics Corp** 177 Hart St New Britain Conn
1-2—**Electronic Specialty Co** 5121 San Fernando Rd Los Angeles 39 Calif
2—**Entron Inc** 4902 Lawrence St Bladensburg Md
1—**Garde Mfg Co** 588 Eddy St Providence 3 RI
1-2—**Gee-Lar Mfg Co** 418 S Wyman St Rockford Ill
1—**General Cement Mfg Co** 919 Taylor Ave Rockford Ill
2—**General Radio Co** 275 Mass Ave Cambridge 39 Mass
2—**General RF Fittings Inc** 702 Beacon St Boston 15 Mass
1-2—**Graybar Electric Co** 420 Lexington Ave New York 17
1-2—**Gremar Mfg Co** Wright St Lynn Mass
2—**Gulton Mfg Corp** 212 Durham Ave Metuchen NJ
2—**Hallett Mfg Co** 1601 W Florence Ave Inglewood Calif
2—**Hermetite Corp** 702 Beacon St Boston 15 Mass
1—**Industrial Hdw Mfg Co** 109 Prince St New York 12
1-2—**Industrial Products** Box 148 Danbury Conn
1—**Javex** PO Box 646 Redlands Calif
1-2—**JFD Mfg Co** 6101 16 Ave Brooklyn 4 NY
1—**Johnson Co E F** Wasecca Minn
1-2—**Kings Electronics Co Microwave Div** Tuckahoe NY
1—**Krueger & Hudepohl** 5 E 3 St Cincinnati 2 Ohio
1—**Mandax Mfg Co** 2608 W 16 St Chicago 8 Ill
2—**Microdot Inc** 1826 Fremont Ave S Pasadena Calif
2—**Microlab** 71 Okner Pkwy Livingston NJ
1-2—**Mosley Electronics Inc** 8622 St Charles Rock Rd St Louis 14 Mo
1-2—**Mutual Electronics Industries** 85 Beechwood Ave New Rochelle NY
1—**National Fabricated Products Div Hoffman Electronics** 2650 W Belden Ave Chicago 47 Ill
1-2—**Nichols Products** 325 W Main St Moorestown NJ
2—**Prodelin Inc** 307 Bergen Ave Kearney NJ
1-2—**Pye Corp of America** 270 Park Ave New York 17
2—**Pyle-National Co** 1334 N Kostner Ave Chicago 51 Ill
1—**Rau Fastener Co** 142 5 Ave New York NY
2—**Raytheon Mfg Co Ceramic Sales Div** Foundry Ave Waltham Mass
2—**Scintilla Div Bendix Aviation Corp** Sidney NY
1-2—**Smith Inc Herman H** 2326 Nostrand Ave Brooklyn 10 NY
1—**Sylvania Electric Products** 1740 Broadway New York 19
1-2—**Technical Material Corp** PO Box 142 Mamaroneck NY
2—**Transradio Ltd** 138A Cromwell Rd London SW 7 England
1-2—**Ucinite Co Div United-Car Fastener** 459 Watertown St Newtonville Mass
1-2—**Union Electronic & Machine Corp** Moulton & Monroe St Georgetown Mass
2—**Univox Corp** 102 Warren St New York 7
2—**U S Components** 454 E 148 St New York 55
1-2—**Vibraseal Corp** 2832 E Grand Blvd Detroit 11 Mich
1-2—**Western Int'l Co** 45 Vesey St New York 7
2—**Winchester Electronics** Willard Rd Norwalk Conn

MICROWAVE COMPONENTS

Antennas 17
Assemblies 1
Attenuators 2
Bends 3
Cavities 4
Converters 5
Couplers 6
Crystal mounts 7
Discriminators 8
Duplexers 9
Filters 10
Flanges 11
Horns 12
Hybrid junctions 13
Isolators 14
Joints, fixed 15
Joints, rotating 16
Mixers 18
Oscillators 32
Parabolas 19
Phasers 20
Probes 21
Shutters 22
Sliding loads 23
Slotted lines 24
Switches 25
Terminations 26
Towers 34
Transformers 33
Tuners 27
Waveguides, flexible 28
Waveguides, rigid 29
Waveguide stands 30
Waveguide switches 31

17—**Abel Mfg Co** 147 72 Ave Flushing LI NY
1-2-10-17-26-29—**ACF Electronics** 800 N Pitt St Alexandria Va
2-6-7-10-27—**Admittance Inc** 5 Marine St Farmingdale NY
2-6-28-29—**Aero Electronics Co** 1512 N Wells St Chicago 10 Ill
17—**Aero Instrument Co** 11423 Vanowen St N Hollywood Calif
10—**Aerovox Corporation** 740 Belleville Ave New Bedford Mass
6—**Air Associates Inc** 511 Joyce St Orange NJ
2-6-10-17-26-28-29 — **Airborne Instruments Lab** 160 Old Country Rd Mineola NY
4-9-10-21-24-27-32 — **Aircom Inc** 354 Main St Winthrop 52 Mass
1-2-6-9-10-17-22—**Aircraft Armaments** Cockeysville Md
1—**Aircraft-Marine Products Inc** 155 Park St Elizabethtown Pa
1-2-3-6-9-11-14-16-17-18-25-26-28-29-31 —**Airtron Inc** 1101 W Elizabeth Ave Linden NJ
17-25-34—**Alford Mfg Co** 299 Atlantic Ave Boston 10 Mass
1-2-26—**Allen-Bradley** 1342 S 2 St Milwaukee 4 Wis
3-13-17-29—**Allied Res & Eng'r** 6916 Santa Monica Blvd Hollywood 38 Calif
1-2-5-10-17-27-32—**Amerac Inc** Wenham Mass
10-17—**American Electronics Labs Inc** 641 Arch St Phila 6 Pa
28-29—**American Helicopter Div Fairchild Engine & Airplane Corp** 1800 Rosecrans Ave Manhattan Beach Calif
9-10-17-19-20-25-29—**Andrew Corp** 363 E 75 St Chicago 19 Ill
33—**Ampex Coil & Transformer Corp** 1919 S Fairfield Chicago 8 Ill
17-34—**Andrew Corp** 363 E 75th St Chicago 19
17—**Ansley Electronics Inc** 85 Tremont St Meriden Conn
7-12—**Antlab** 4950 N High St Columbus 14 Ohio
10—**Applied Research Inc** 163-07 Depot Rd Flushing 58 NY
10-17-27—**ARF Products Inc** 7627 Lake St River Forest Ill
1—**Arnold Engrg** Marengo Ill
33—**Atlas Coil Inc** 205 Main St Ansonia Conn
33—**Audio Development Co** 2833 13 Ave S Minneapolis 7 Minn
25—**Automatic Metal Products Corp** 315 Berry St Brooklyn 11 NY
25—**Automatic Switch Co** 291 Lakeside Ave Orange NJ
1-10—**Axel Electronics** 134-20 Jamaica Ave Jamaica 18 NY
18—**Baird Associates** 33 University Rd Cambridge 38 Mass
10—**Balco Research Labs** 49 Edison Pl Newark 2 NJ
33—**Ballastron Corp** 1701 N Calhoun St Fort Wayne Ind
8-20-25—**Barker & Williamson** 237 Fairfield Ave Upper Darby Pa
17—**Barlow Electrical Mfg Co** 155 E 128 St New York 35
3-4-12-17-29—**Bart Mfg Corp** 227 Main St Belleville NJ
10-33—**Basler Electric Co** 605 5 St Highland Ill
10—**Bellaire Electronics Inc** 62 White St Red Bank NJ
33—**Berkshire Transformer Corp** 15 South Ave New Milford Conn
33—**Better Coil & Transformer Corp** 202 W Union St Goodland Ind
10-26-28-29—**Bird Electronic Corp** 1800 E 38 St Cleveland 14 Ohio
34—**Blaw-Knox Co** Pittsburgh 38 Pa
1-2-4-6-7-9-11-12-13-16-17-18-21-22-24-25-26-27-29-31-32—**Bogart Mfg Corp** 315 Siegel St Brooklyn 6 NY
2-4-6-8-9-10-13-22-25-31-32 — **Bomac Labs** Salem Rd Beverly Mass
17—**Bone Eng'g Co** 701 W Broadway Glendale 4 Calif
17-19—**Brach Mfg Corp** 200 Central Ave Newark NJ
18—**Bradley Labs** 168 Columbus Ave New Haven 11 Conn
2—**Brew & Co Richard D** Concord NH
31—**Bristol Co** PO Box 1790 Waterbury Conn
1-2-6-7-9-10-13-17-18-22-26-27-29-31—**Budd-Stanley Co** 43-01 22 St Long Island City 1 NY
17—**Budelman Radio Corp** 375 Fairfield Ave Stamford Conn
7—**Bulova Watch Co** Dept of Govt & Indust'l Sales 62-10 Woodside Ave Woodside 77 LI NY
2-10—**Byron Jackson Co** 2010 Lincoln Ave Pasadena 3 Calif
33—**Calif Magnetic Control Corp** 11922 Valerio St N Hollywood Calif
1-2-4-5-6-9-10-14-16-17-18-26-33 — **Canoga Corp** 5955 Sepulveda Blvd Van Nuys Calif
10—**Carad Corp** 2850 Bay Rd Redwood City Calif
2-31—**Cascade Research Corp** 53 Victory Lane Los Gatos Calif
4-32—**Cavitron Oscillator Co Div Short Wave Plastic Forming Co** 2921 W Alameda Ave Burbank Calif

(Continued on page 88)

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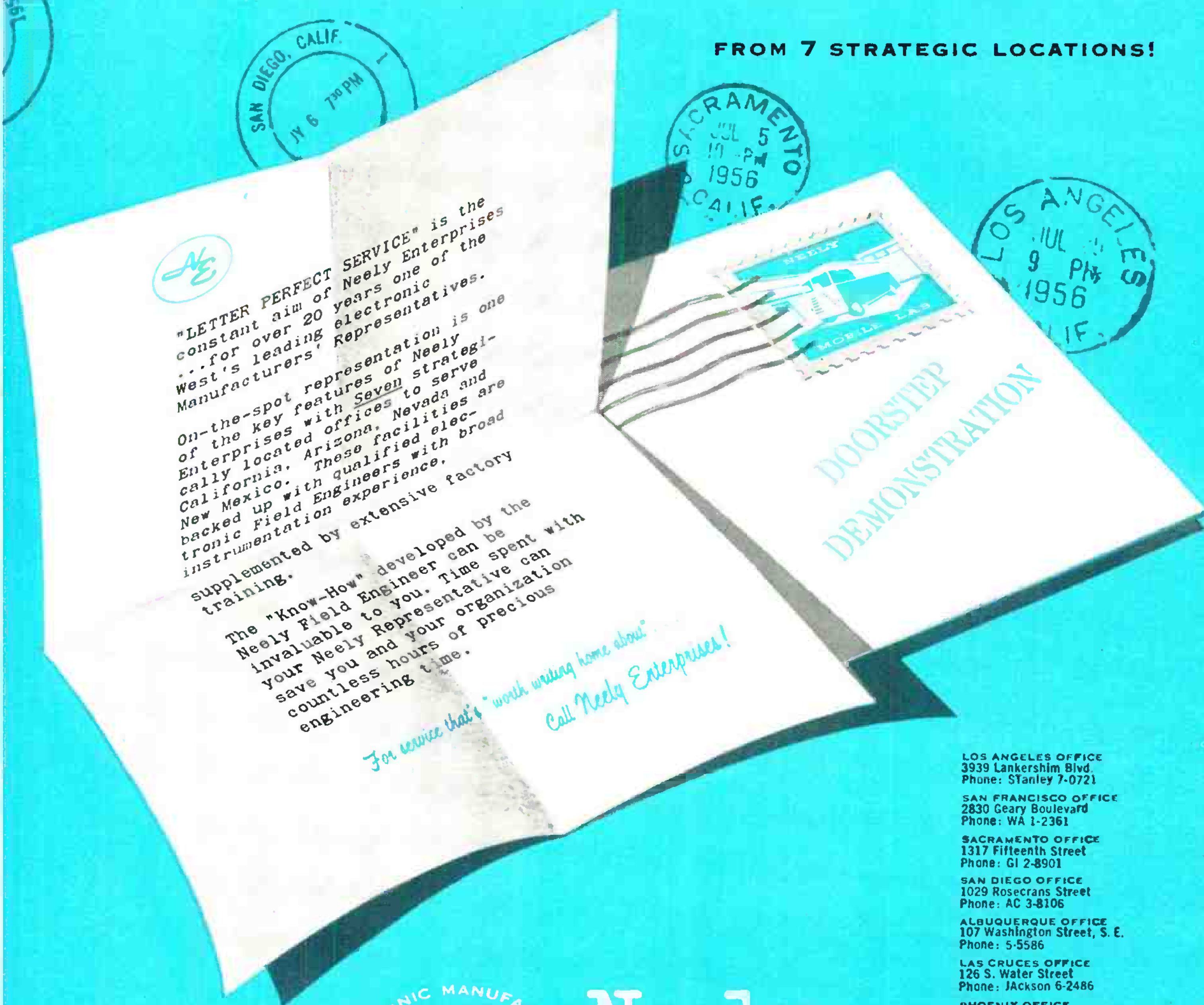

LOS ANGELES OFFICE
3939 Lankershim Blvd.
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SAN FRANCISCO OFFICE
2830 Geary Boulevard
Phone: WA 1-2361

SACRAMENTO OFFICE
1317 Fifteenth Street
Phone: GI 2-8901

SAN DIEGO OFFICE
1029 Rosecrans Street
Phone: AC 3-8106

ALBUQUERQUE OFFICE
107 Washington Street, S. E.
Phone: 5-5586

LAS CRUCES OFFICE
126 S. Water Street
Phone: JAckson 6-2486

PHOENIX OFFICE
641 E. Missouri Avenue
Phone: CR 4-5431

ELECTRONIC MANUFACTURERS' REPRESENTATIVES

Neely Enterprises

Directory of Microwave Manufacturers (cont.)

2-10—**Centralab Div Globe-Union Inc** 900 E Keefe Ave Milwaukee 1 Wisc

3-4-9-10-29-31—**Central Sales & Mfg Corp** 2 Richwood Pl Denville NJ

33—**Central Transformer Co** 910 W Jackson Blvd Chicago 7 Ill

17-27—**Century Electronics** 14844 Oxnard St Van Nuys Calif

32—**CGS Labs** 391 Ludlow St Stamford Conn

17-29—**Chemalloy Electronics Corp** Gillespie Airport Santee Calif

33 — **Chicago Standard Transformer Corp** 3501 Addison St Chicago 18 Ill

17—**Chu Associates** 634 Waverly St Framingham Mass

18—**Clevite Transistor Products** 241 Crescent St Waltham 54 Mass

1-13-17—**Coaxial Connector Co** 37 N 2 Ave Mt Vernon NY

17—**Collins Radio Co** 855 35 St NE Cedar Rapids Iowa

17-32—**Color Television Inc** 973 E San Carlos Ave San Carlos Calif

8—**Communication Accessories Co** 110 St & 71 Hwy Hickman Mills Mo

11-28-29—**Connector Corp of America** 3223 Burton Ave Burbank Calif

10—**Conn Telephone & Electric Corp** 70 Britannia St Meriden Conn

28-29—**Co-Operative Ind** 100 Oakdale Rd Chester NJ

17—**Corbin Corp** 5419 56 Pl Riverdale Md

2—**Corning Glass Works** Corning NY

17—**Cossor (Canada) Ltd** 301 Windsor St Halifax NS Canada

19—**Craig Systems Inc** 90 Holten St Danvers Mass

17-19—**Creative Eng'g Corp** 10816 Burbank Blvd N Hollywood Calif

12—**Crouse-Hinds** Wolf & N 7th Sts Syracuse 1 NY

1-2-6-9-10-26—**Cubic Corp** 2841 Canon St San Diego 6 Calif

2-26—**Custom Components Inc** PO Box 248 Caldwell NJ

17—**Dage TV Div Thompson Products Inc** Michigan City Ind

17-27-29-31—**Dalmo Victor Co Div Textron American Inc** 1414 El Camino Real San Carlos Calif

2-18—**Daven Co** Route 10 Livingston NJ

8—**Davies Labs** 4705 Queensbury Rd Riverdale Md

28-29—**Decade Instrument Co** Box 153 Caldwell NJ

1-2-6-9-10-17-26-27-29-30-31 — **Defiance Eng & Microwave Corp** 81 Albion St Wakefield Mass

2-3-6-10-12-13-16-17-18-21-24-26-27-29-30-31-33—**De Mornay-Bonardi Inc** 780 S Arroyo Pkwy Pasadena 1 Calif

10—**Deutschmann Corp Tobe** 921 Providence Hwy Norwood Mass

1-2-5-6-9-10-12-13-15-16-17-18-19-21-23-24-26-27-29-32 — **Diamond Microwave Corp** 7 North Ave Wakefield Mass

4—**Dielectric Products Eng'g** Raymond Me

12—**Dilks Co** Box 139 Seymour Conn

17-28-29—**Dorne & Margolin** 30 Sylvester St Westbury LI NY

1-2-4-6-9-10-11-12-13-17-18-21-24-25-26-27-29-30-31—**Douglas Microwave Co** 11 Beechwood Ave New Rochelle NY

1-17—**Downing Crystal Co** 191 Shaffer Ave Westminster Md

12—**DuKane Corp** St Charles Ill

17—**Dumont Labs Inc Allen B Communication Products Div** 1500 Main St Clifton NJ

27—**Dunn Eng'g Associates** 186 Mass Ave Cambridge 29 Mass

9-12-17-19-24-28-29-30-31—**D&S Mfg Co Inc** 424 Burk Ave Ridley Park Pa

1-2-10—**Dynamic Electronics-NY** 73-39 Woodhaven Blvd Forest Hills NY

18—**Electrend Products Corp** State & Water Sts St Joseph Mich

25—**Electrical & Physical Instrument Corp** 42-19 27 St Long Island City NY

17—**Electromec Inc** 3200 N San Fernando Blvd Burbank Calif

8—**Electro - Mechanical Research** 64 Main St Ridgefield Conn

1-2-5-9-10-16-17-27-31-33 — **Electronic Specialty Co** 5121 San Fernando Rd Los Angeles 39 Calif

2-17—**Electron-Radar Products** 4806 W Chicago Ave Chicago Ill

10—**Electronic Transformer Co** 70 Washington St Brooklyn 1 NY

17—**Emerson & Cuming** 869 Washington St Canton Mass

1-4—**Emerson Radio & Phonograph Corp** 14 & Coles Sts Jersey City 2 NJ

1-2-18—**Empire Devices Products Corp** 38-15 Bell Blvd Bayside 61 NJ

2-10—**Empire State Laboratories** 2608 Merrick Rd Bellmore LI NY

27—**Eng'g Associates** 434 Patterson Rd Dayton 9 Ohio

13—**Entron Inc** Bladensburg Md

10—**ESC Corp** 534 Bergen Blvd Palisades Park NJ

1-2-3-4-10-27-33—**Espey Mfg Co** 200 W 57 St New York 19 NY

8-10—**Essex Electronics** 550 Springfield Ave Berkeley Heights NJ

11—**Eugene Eng'g Co** 1217 Hyde Park Ave Hyde Park 36 Mass

2-6-28-29—**Farnsworth Electronics Co Div IT&T Corp** PO Box 810 Fort Wayne Ind

29—**Federal Mfg & Eng'g** 1055 Stewart Ave Garden City NY

17—**Federal Telecommunication Labs** 500 Washington Ave Nutley 10 NJ

2-9-17-26—**Federal Telephone & Radio Co Div IT&T** 100 Kingsland Rd Clifton NJ

2—**Fisher Radio Corp** 21-21 44 Dr Long Island City NY

17—**FKB Opticon Inc** 202 E Fairview South Bend 14 Ind

11—**Florman & Babb** 68 W 45 St NY

8—**Forbes & Wagner** 345 Central Ave Silver Creek NY

10—**Frequency Standards** PO Box 66 Eatontown NJ

17—**Fretco Inc** 406 N Craig St Pittsburgh 13 Pa

1-2-6-7-9-10-11-13-17-21-25-26-27-30-31-32—**F-R Machine Works** 26-12 Borough Pl Woodside 77 NY

10-17—**Gabriel Electronics** 135 Crescent Rd Needham Hts 94 Mass

18—**Gates Radio Co** 123 Hampshire St Quincy Ill

25—**Gee-Lar Mfg Co** Rockford Ill

19-28-29—**General Bronze Corp** 200 Central Ave Newark 3 NJ

2-25-32—**General Communication Co** 681 Beacon St Boston 15 Mass

17—**General Electric Co** Electronics Div Syracuse NY

18—**General Magnetics Inc** 135 Bloomfield Ave Bloomfield NJ

1-4-6-10-17—**General Precision Lab** 63 Bedford Rd Pleasantville NY

1-6-7-17-21-29—**General RF Fittings Inc** 702 Beacon St Boston 15 Mass

2—**Goodrich B F Co** Shelton Conn

17—**Goodyear Aircraft Corp** 1210 Massillon Rd Akron 15 Ohio

33 — **Gramer - Halldorson Transformer Corp** 2734 N Pulaski Rd Chicago 39 Ill

16—**Graphite Metallizing Corp** 1002 Nepperhan Ave Yonkers NY

12-17-18—**Graybar Electric Co** 420 Lexington Ave New York 17 NY

17-27—**G W Associates** Box 2263 El Segundo Calif

17—**Haller Raymond and Brown** 124 N Atherton State College Pa

32—**Hallicrafters Co** 4401 5 Ave Chicago 24 Ill

2—**Hansen Electronics Co** 7117 Santa Monica Blvd Los Angeles 46 Calif

25—**Hart Mfg Co** 218 Bartholomew Ave Hartford 1 Conn

12—**Hawley Products** St Charles Ill

26—**Hermatite Corp** 702 Beacon St Boston 15 Mass

7—**Hermetic Seal Products** 29 S 6 St Newark NJ

2-6-10-13-23-24-26-30-31-32 — **Hewlett-Packard Co** 275 Page Mill Rd Palo Alto Calif

8—**Hill Electronic & Eng'g & Mfg** New Kingston Pa

2-26—**Holland Electronics** 2133 Central Drive S East Meadow LI NY

17—**Houston Fearless Div Color Corp of America** 11801 W Olympic Blvd Los Angeles 64 Calif

1-2-3-4-7-9-10-17-18-27-28-39 — **Hycon Electronics Inc** 321 S Arroyo Pkwy Pasadena Calif

7-18-32—**Hycon Eastern Inc** 75 Cambridge Pkwy Cambridge Mass

8-18—**Hycor** Div Int'l Resistance Co Sylmar Calif

13-15-25-29 — **Industrial Products** Box 148 Danbury Conn

8-20—**Industrial Test Equip Co** 55 E 11 St New York 3 NY

2-3-6-9-11-15-16-17-20-23-24-26-28-29-31—**I-T-E Circuit Breaker Co** 19 & Hamilton Sts Phila 20 Pa

1-2-10-14-26—**Jackson Electronics Inc** 23 Woodcrest Rd West Chester Pa

7-14—**Jasvex** PO Box 646 Redlands Calif

6—**Jones Electronics Co M C** 185 N Main St Bristol Conn

1-2-3-4-5-6-7-9-10-12-15-16-17-21-25-26-27-29-30-31-32-33 — **J-V-M Eng'g Co** 8846 W 47 St Brookfield Ill

17—**Kaiser Metal Products Inc** Bristol Pa

2-29-32—**Kay Electric Co** Pinebrook NJ

14-29—**Kearfott Co** 1378 Main Ave Clifton NJ

2-6-10-17-26-27—**Kearfott Co** Western Mfg Div 4844 Oxnard St Van Nuys Calif

7-17-19-25-31—**Kennedy & Co D S** 155 King St Cohasset Mass

3-17-29—**Kent Co F C** Irvington NJ

10—**Keystone Products Co** 904 23rd St Union City NJ

2-6-10-17-26-27-28-29—**Kings Electronics Co** 40 Marbledale Rd Tuckahoe NY

17-27—**Kings Microwave Co** 719 Main St New Rochelle NY

27—**Kingston Products Corp** 1412 N Webster St Kokomo Ind

29—**Kinney Co Joseph** Carnegie Pa

12—**Klipsch & Associates** PO Box 64 Hope Ark

7—**Knights Co James** Sandwich Ill

6-26-27-28-29—**Korb Eng'g & Mfg Co** 30 Ottawa Ave Grandville Mich

14—**Korfund Co** 48-15 32 Pl Long Island City 1 NY

27-32—**Lab for Electronics Inc** 75 Pitts St Boston Mass

7—**La Magna Mfg Co** Rutherford NJ

2-3-6-17—**Lambda-Pacific & Eng'g Inc** PO Box 105 Van Nuys Calif

29—**Lamtex Incl Inc** 51 State St Westbury NY

4-21—**Lavoie Labs Inc** Matawan-Freehold Rd Morganville NJ

1-2-4-6-9-11-13-16-17-18-21-25-26-27-29-31—**Lieco Inc** Ocean Ave Lynbrook NY

6-27-28-29—**Litton Industries Components Div** 336 N Foothill Rd Beverly Hills Calif

14—**Lord Mfg Co** 1635 W 12 St Erie 6 Pa

6-20-28-29—**Luhrs & Co C H** 297 Hudson St Hackensack NJ

6-20-28-29—**Luhrs & Co C H** 297 Hudson Hackensack NJ

17—**Lurin-Cournand Inc** Havre De Grace Md

33—**Magnatran Inc** PO Box 211 Kearny NJ

8—**Magnetic Research Corp** 200 Center St El Segundo Calif

9-29—**Makepeace Co D E Div Union Plate & Wire** Attleboro Mass

17—**Marchand Electronic Labs** 255 Mill St Byram Conn

1—**Marconi Instrument Ltd** 44 New St NY 4

17-26—**Mark Products Co** 6412 W Lincoln Ave Morton Grove Ill

10-17—**Maryland Electronic Mfg Corp** 5009 Calvert Rd College Park Md

17—**Mathis Co G E** 5745 S Claremont Ave Chicago 36 Ill

8—**Mattson Electronics Corp** 1487 Lincoln Ave Pasadena Calif

17—**Maxson Corp W L** 460 W 34 St New York 1

4-8—**Maxson Instruments** 47-37 Austell Pl Long Island City 1 NY

2-26—**McMillan Industrial Corp** Brownville Ave Ipswich Mass

10-17—**Melpar** 452 Swann Ave Alexandria Va

1-2-6-9-10-12-17-18-21-22-24-25-26-29-30-31-33 — **Meridian Metalcraft Inc** 8739 S Millergrove Dr Whittier Calif

29—**Metal Fabricators Corp** 73 Pond St Waltham Mass

17-32—**Microfleet Co** 2300 S 25 St Salem Ore

2-7-10-26-27—**Microlab Inc** 71 Okner Pkwy Livingston NJ

1-2-4-6-10-17-18-25-26-27-31-33—**Microphase Corp** PO Box 1166E Greenwich Conn

1-2-4-5-6-7-10-17-26-31—**Microwave Associates** 22 Cummington St Boston 15 Mass

17—**Microwave Devel Labs** 22D Grove St Waltham 54 Mass

7—**Midland Mfg Co Inc** 3155 Fiberglass Rd Kansas City 15 Kan

2-6-26-28-29—**Model Eng'g & Mfg Co** 50 Frederick St Huntington Ind

5—**Mohawk Electronic Research Labs** Box 126-A RD#4 Amsterdam NY

33—**Moloney Electric Co** 5390 Bircher Blvd St Louis 20 Mo

8-18—**Mount Sopris Instrument Corp** 1320 Pearl St Boulder Colo

1-2-4-6-9-10-13-17-18-21-22-24-26-27-29-30-31-33—**Narda Corp** 160 Herricks Rd Mineola LI NY

7—**National Fabricated Products Div Hoffman Electronics** 2650 W Belden Ave Chicago 47 Ill

17—**National Instrument Co** 23 E 26 St New York 10

7—**Nebel Lab R E** 1634 E 12 St Brooklyn 29 NY

(Continued on page 91)

MICROWAVE AIRLIFT...

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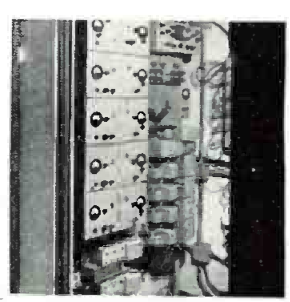

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IBM INTERNATIONAL BUSINESS MACHINES CORPORATION

Directory of Microwave Manufacturers (cont.)

26—**New London Instrument Co** 82 Union St New London Conn
33—**New York Transformer Co** 3 Ave Alpha NJ
1-11-17-21-24-26-29-31 — **Nichols Products Co** 325 W Main St Moorestown NJ
10—**Northeast Scientific Corp** 617 Concord Ave Cambridge 38 Mass
33—**Nothelfer Winding Labs** PO Box 455 Trenton 3 NJ
1-2-6-7-10-11-12-16-17-25-26-27-29-31-33—**N R K Mfg & Eng'g** 4601 W Addison St Chicago 41 Ill
33—**Nyt Electronics Inc** 2979 N Ontario St Burbank Calif
1-2-3-4-6-13-18-21-24-25-26-27-30-31—**Omega Labs Inc** Haverhill St Rowley Mass
8—**Ortho Filter Corp** 196 Albion Ave Paterson 2 NJ
27—**Parts Producing Corp** Manhattan Div 1861 2 Ave New York 28
12—**Patrick & Wilkins** 51 N 7 St Phila 6 Pa
18—**Pentron Corp** 777 S Tripp Ave Chicago Ill
17—**Philco Corp** 4700 Wisshickon Ave Phila 44 Pa
2—**Photo Crystals Inc** 15 S 1 St Geneva Ill
17—**PM Industries** 280 Fairfield Ave Stamford Conn
1-2-4-10-17-32 — **Polarad Electronics Corp** 43-20 34 St Long Island City 1 NY
2-4-5-6-10-24-26-27-30-32 — **Polytechnic Res & Devel Co** 202 Tillary St Brooklyn 1 NY
1 thru 31—**Portchester Instrument Corp** 114 Wilkins Ave Port Chester NY
1-32—**Precision Associates** 354 Cumberland St Brooklyn 38 NY
18—**Precision Scientific Co** 3737 W Cortland St Chicago 47 Ill
1-2-6-9-10-13-17-18-25-26-27-29-31-33—**Premier Instrument Corp** 52 W Houston St New York 12
21-24-26—**Press Wireless Laboratories Inc** 25 Prospect Place West Newton 65 Mass
9-10-13-17-21-29—**Prodelin Inc** 307 Bergen Ave Kearny NJ
1-17—**Pye Corp of America** 270 Park Ave New York 17
17—**Q-Line Mfg Corp** 1562 61 St Brooklyn 19 NY
20—**Quare Associates** PO Box 95 Canton Mass
2-6-10-26-28-29 — **Radalab Inc** 87-17 124th St Richmond Hill 18 NY
2-27—**Radiation Inc** Box "Q" Melbourne Fla
10-17-28-29—**Radio Corp of America** Camden 2 NJ
17—**Radio Engineering Labs** 36-40 37 St Long Island City 1 NY
18—**Radio Frequency Labs** Powerville Rd Boonton NJ
9—**Radio Receptor Co** 251 W 19 St NY 11 NY
13—**Railway Communications** PO Box 67 Raytheon Mo
33—**Raypar Inc** 7810 W Addison St Chicago 34 Ill
14—**Raytheon Mfg Co Ceramic Sales Div** Foundry Ave Waltham Mass
2-10-17-26-27-28-29-33 — **Raytheon Mfg Co Equip Marketing Div** 190 Willow St Waltham 54 Mass
16—**Reeves Instrument Corp** 215 E 91 St New York 28 NY
18—**Rheim Sound Systems** PO Box 112 Marion Ill
14—**Robinson Aviation** Teterboro NJ
17—**Roesch Co D J** 2200 S Figueroa St Los Angeles 7 Calif
34—**Rohn Mfg Co** 116 Limestone Bellevue Peoria Ill
13—**Rollins Electronics Corp** Schley Ave Lewes Del
6-17—**RS Electronics Corp** 435 Portage Ave Palo Alto Calif
3-4-6-7-9-10-13-15-16-17-18-21-24-25-26-27-31—**Sage Labs** 30 Guinan St Waltham 54 Mass
2-4-5-6-10-17-26-27—**Sanders Associates Inc** 137 Canal St Nashua NH
33—**Sangamo Operators Sub Sangamo Electric Co** Springfield Ill
12—**Scaico Controls Inc** Market St Palmyra NJ
21—**Scala Radio Co** 2814 19 St San Francisco 10 Calif
17-27—**Schutter Mfg Co., Carl W** 80 E Montauk Hwy Lindenhurst NY
6-17-26-28-29—**Scientific Associates Inc** 580 Virginia Ave NE Atlanta Ga
18—**Seismograph Service Corp** PO Box 1590 Tulsa 1 Okla
4-6—**Sierra Electronic Corp** 1050 Britton Ave San Carlos Calif
12—**Siesler Design Products** 10460 San Pablo Ave El Cerrito Calif
17—**Sightmaster of Calif** Gillespie Airport Santee Calif
18—**Simpson Mfg Co Mark** 38-28 49 St Long Island City 3 NY
17—**Skyline Tower Co** 2436 W 59 St Chicago 29 Ill
18—**Special Products Co** PO Box 188 Rockville 1 Md
3-29 — **Specialty Automatic Machine Corp** 88 Gorrish Ave Chelsea 50 Mass
2-6-7-10-12-13-21-25-26-27-30-31-32-33—
2-6-7-9-10-12-13-14-21-25-26-27-30-31-32-33—**Sperry Gyroscope Co. Div of Sperry Rand Corp** Great Neck NY
12—**Sperti Faraday Inc** 1322 E Church St Adrian Mich
33—**Sprague Electric Co** Marshall St N Adams Mass
34—**Stainless Inc** N Wales Pa
29—**Standard Metals Corp** 262 Broad St N Attleboro Mass
1—**Stanford Labs** PO Box 252 Menlo Park Calif
1-5-10-17-27-31-32 — **Stavid Eng'g** US Hwy 22 Plainfield NJ
12—**Stephens Mfg Corp** 8538 Warner Dr Culver City Calif
1-17—**Sterling Precision Corp Instrument Div** 34-17 Lawrence St Flushing LI NY
1-12-16—**Suffolk Products Corp** Northport LI NY
4-7-28—**Sylvania Electric Products** 1740 Broadway New York 19
18—**Tare Electronics Inc** 48 Urban Ave Westbury LI NY
17—**Technical Appliance Corp** 1 Taco Ave Sherburne NY
1-2-3-4-6-9-10-11-12-17-18-20-22-24-25-26-27-28-29-31-33 — **Technicraft Labs Inc** Thomaston-Westbury Rd Thomaston Conn
17—**Teiner Eng'g Corp** 116 Madison St Maldon Mass
8—**Telechrome Inc** Amityville LI NY
1-2-3-4-6-7-9-10-11-12-13-15-16-17-18-20-22-23-25-26-27-28-29-31 — **Telerad Mfg** 1440 Broadway New York 18 NY
28-29-31—**Telerad Mfg Corp** 1440 Broadway New York
33—**Tel-Rad Electronics Corp** 73-20 Trotting Course Lane Glendale LI NY
2—**Telewave Labs Inc** 43-20 34 St LI City 1 NY
26—**Thompson-Bremer Co** 520 N Dearborn St Chicago 10 Ill
25-31—**Thompson Products Inc Electronics Div** 2196 Clarkwood Rd Cleveland 3 Ohio
33 — **Thordarson - Meissner Mfg Div Maguire Industries** Mt Carmel Ill
28-29—**Titeflex Inc** 500 Frelinghuysen Ave Newark 5 NJ
10-17—**Torngren Co C W** 236 Pearl St Somerville Mass
17-19—**Tower Construction Co** 2700 Hawkeye Dr Sioux City Iowa
2-26—**Transline Assoc** PO Box 251 Bloomfield NJ
25—**Transco Products** 12210 Nebr Ave Los Angeles 25 Calif
33—**Transonic Inc** 808 16 St Bakersfield Calif
33—**Tresco Inc** 3824 Terrace St Philadelphia 28 Pa
17—**Trilsch Co John D** 1310 McKinney Ave Houston Tex
34—**Truscon Steel Div Republic Steel** 1092 Albert St Youngstown 1 Ohio
1-2-8-10-12-27—**Union Electric & Mfg Co** 1057 Summit Ave Jersey City 7 NJ
33—**Union Electric Products Co** 24 Edison Pl Newark 2 NJ
10-33—**United Transformer Co** 150 Varick St New York
29—**Universal Mfg Co** 410 Hillside Ave Hillside NJ
2-6-10-17-26-27-28-29—**Universal Microwave Corp** 380 Hillside Ave Hillside NJ
17—**U S Tower Co** 219 Union Trust Bldg Petersburg Va
8—**Vanguard Electronics Co** 3384 Motor Ave Los Angeles 34 Calif
27—**Varian Associates** 611 Hansen Way Palo Alto Calif
2-24-27-32—**Vectron Inc** 1611 Trapello Rd Waltham 54 Mass
Victor R F & Microwave Co 36 W Water St Wakefield Mass
18—**Virginia Electronics Co** River Rd at B&O RR Washington 16 DC
1-17-26—**Visual Electronics Corp** 500 5 Ave New York 36 NY
6-7-21-23-24-26—**Wac Line Inc** 35 S St Clair St Dayton 2 Ohio
2-6-26-28-29—**Waveguide Inc** 14837 Oxnard St Van Nuys Calif
1-2-5-6-9-10-17-18-22-23-24-26-27-29-30-31—**Waveline Inc** Passaic Ave Box 470 Caldwell NJ
2-26-27-32 — **Weinschel Eng'g & Mfg. Corp** 10505 Metropolitan Ave Kensington Md
6—**Western Int'l Co** 45 Vesey St NY 7
17—**Western Mfg Co** 1400 W 22 St Kearney Nebr
1-19-27 — **Westinghouse Electric Corp Electronics Div** 2519 Wilkens Ave Baltimore 3 Md
2-6-17-26-27-32—**Weston Labs Inc** Old Littleton Rd Harvard Mass
10-17-27 — **Weymouth Instrument Co** 1140 Commercial St E Weymouth 89 Mass
1-2-3-5-6-9-10-13-16-17-26-27-32—**Wheeler Labs Inc** 122 Cutter Mill Rd Great Neck NY
12—**Wheelock Signals Inc** Long Branch NJ
2-9-25-31-32—**White Electron Devices Inc** Roger 4 Ave Haskell NJ
17—**White & Son James L** 374 Verona Ave Newark 4 NJ
8—**Wiegand Mfg Co** 120 E Hawthorne Ave Valley Stream LI NY
17-34—**Wind Turbine Co** W Chester Pa
2-6-10-17-28-29—**Wright Eng'g Co** 180 E Calif St Pasadena 1 Calif

RECEIVERS, MICROWAVE

Air Associates Inc 511 Joyce St Orange NJ
Airborne Instruments Lab 160 Old County Rd Mineola NY
Aircraft Armaments Inc P O Box 126 Cockeysville Md
Aircraft Radio Corp Boonton NJ
A R F Products Inc 7627 Lake St River Forest Ill
Amerac Inc 116 Topsfield Rd Wenham Mass
Avion Div ACF Industries 299 State Hwy 17 Paramus NJ
Bomac Labs Salem Rd Beverly Mass
Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif
Collins Radio Co 855 35 St NE Cedar Rapids Iowa
Continental Electronics Mfg Co 4212 S Buckner Blvd Dallas 27 Tex
Cossor (Canada) Ltd 301 Windsor St Halifax NS Canada
Daystrom Instrument Archbald Pa
DuMont Laboratories Inc Allen B Communication Products Div 1500 Main Ave Clifton NJ
Dynamic Electronics NY Inc 73-39 Woodhaven Blvd Glendale LI NY
Electronicraft Inc 27 Milburn St Bronxville 8 NY
Elk Electronic Labs 333 W 52 St New York 19
Emerson Radio & Phonograph Corp 14 & Coles Sts Jersey City 2 NJ
Engineering Associates 434 Patterson Rd Dayton 9 Ohio
Espey Mfg Co 528 E 72 St New York 21
Federal Telecommunication Labs 500 Washington Ave Nutley 10 NJ
Federal Telephone & Radio Co Div of IT&T 100 Kingsland Rd Clifton NJ
F-R Machine Works 26-12 Borough Pl Woodside 77 NY
General Electric Co Electronics Div Communication Equip Electronics Park Syracuse NY
General Electric Co Broadcast Equip Commercial Equip Dept Electronics Park Syracuse NY
Goodyear Aircraft Corp 1210 Massillon Rd Akron 15 Ohio
Grem Eng'g Co 257 Alliston Rd Springfield Pa
J-V-M Eng'g Co 8846 W 47 St Brookfield Ill
Kings Electronics Co 40 Marbledale Rd Tuckahoe NY
Korb Eng'g & Mfg Co 30 Ottawa Ave Grandville Mich
Lambda-Pacific Eng'g Inc PO Box 105 Van Nuys Calif
Meridian Metalcraft Inc 8739 S Millergrove Dr Whittier Calif
Microwave Associates 22 Cummington St Boston 15 Mass
Motorola Communications & Electronics 4501 W Augusta Blvd Chicago 51 Ill
National Company 61 Sherman St Malden 48 Mass
Palmer Inc M V 4002 Fruit Valley Rd Vancouver Wash
Phelco Inc 3640 Woodland Ave Baltimore 15 Md

(Continued on page 160)

New Research Labs For Westinghouse

On a 72-acre site in Churchill Borough, east of Pittsburgh, the new Westinghouse Research Laboratories were recently dedicated. The modern, 3-story, L-shaped structure of red face brick, trimmed with stainless steel panels, houses 11 departments, the names of which run the alphabet from chemistry and electromechanics to solid state physics and technology. Even during dedication, plans were being formulated for the construction of an addition this fall.

A library of over 30,000 volumes services the more than 700 working at the Labs. The modular planning makes for easy conversion of separate work areas to larger areas as the demand for a project is increased.

The research program devotes about 55 per cent of its effort to long-range plans of product divisions, most of it being basic research. Holding a high priority in this field is Electroluminescence, light emission by suitable phosphor powders embedded in an insulator and subjected only to the action of an alternating electric field.

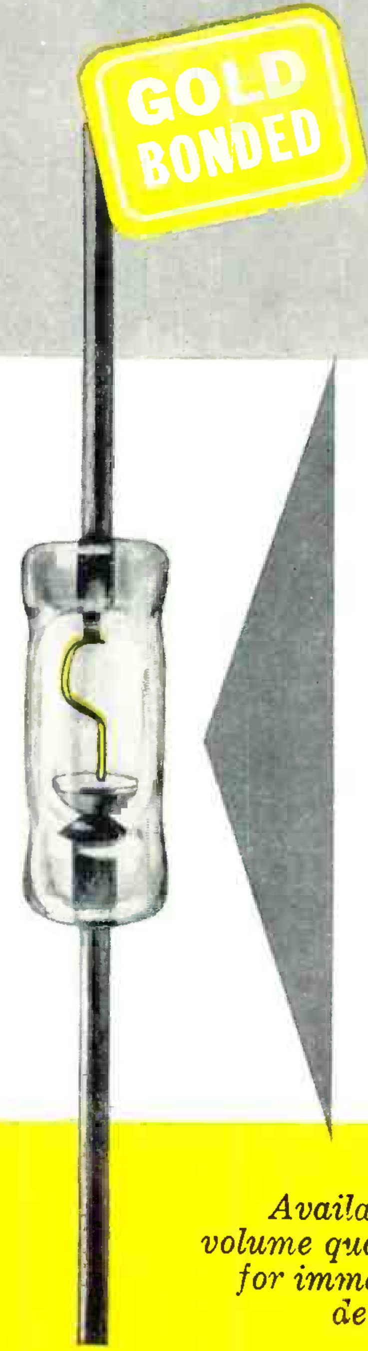
The phenomenon was first discovered in 1936 by Georges Destriau, a French scientist and Westinghouse consultant. During the last 2 decades, the art has developed slowly until the last 2 or 3 years. In this latter period, new electroluminescent phospors have been made, the first electroluminescent flashlight produced, the first four-color cell made, and the first room lighted by panels on the ceiling and three walls.

Electroluminescent panels light room.

(*Continued on page* 136)

RADIO RECEPTOR

has hard-to-find HIGH CONDUCTANCE



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DR 309	400	100	10 @ 10V; 50 @ 50V
DR 327	300	125	100 @ 50V
DR 330	300	100	10 @ 10V; 50 @ 50V
DR 308	200	100	10 @ 10V; 50 @ 50V

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For product information, use inquiry card on page 137.

1957 Roster of Associations Serving the Electronic Industries

A listing of the technical, religious and fraternal organizations functioning for the professionally employed in the electronic arts and sciences. Shown are the name of the organization; the number of members; mailing address; principal officers; date and location of prime annual meeting; and summary of the aims and objectives of the group.

ACOUSTICAL SOCIETY OF AMERICA—220 Members—57 E. 55th St., New York, N. Y. EL 5-5850 . . . R. Bruce Lindsay, Pres.; Wallace Waterfall, Sec. . . . Annual Conv. May 23-25 . . . At New York City . . . To disseminate information on the subject of acoustics and to promote practical applications.

AIRCRAFT INDUSTRIES ASSOCIATION OF AMERICA, INC.—139 Members—7660 Beverly Blvd., Los Angeles, Calif. WE 1-1141 . . . D. C. Ramsey, Pres.; L. D. Webb, Western Mgr. & V.P. . . . No annual conv. . . . Concerned with industry-wide expansion of aeronautical research, development and production.

AMERICAN ASSOCIATION OF ENGINEERS—5450 Members—8 S. Michigan Ave., Chicago 3, Ill. RA 6-9085 . . . Patrick J. Lucey, Pres.; M. E. McIver, Sec. . . . Meeting May 22-24 . . . At Chicago . . . Promote social and economic welfare of the engineering profession and the professional engineer.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—50,000 Members—33 W. 39th St., New York 18, N. Y. PE 6-9220 . . . M. S. Coover, Pres.; N. S. Hibshman, Sec. . . . Meeting June 24-28 . . . At Montreal, Que., Canada . . . Advancement of theory and practice of electrical engineering and of allied arts and sciences.

AMERICAN INSTITUTE OF PHYSICS, INC.—17,000 Members—57 E. 55th St., New York 22, N. Y. EL 5-5850 . . . Frederick Seitz, Chairman; Wallace Waterfall. Sec. . . . Annual Conv. none . . . The advancement and diffusion of knowledge of the science of physics and its application to human welfare.

AMERICAN RADIO RELAY LEAGUE—75,000 Members—38 LaSalle Rd., W. Hartford 7, Conn. AD 3-6268 . . . G. L. Dosland, Pres.; A. L. Budlong, Sec. . . . Annual Conv. Aug. 30-Sept. 1 . . . At Palmer House, Chicago . . . Association of amateur radio operators.

AMERICAN SOCIETY FOR QUALITY CONTROL—9850 Members—161 W. Wisconsin Ave., Milwaukee 3, Wis. Broadway 2-3347 . . . Dale L. Lobsinger, Pres.; L. S. Eichelberger, Exec. Sec. . . . Meeting May 22-24 . . . At Detroit, Mich. . . . Advancement and diffusion of knowledge of the science of quality control and its application to industrial processes.

AMERICAN SOCIETY FOR TESTING MATERIALS—8,500 Members—1916 Race St., Phila. 3, Pa. RI 6-5315 . . . R. A. Schatzel, Pres.; R. J. Painter, Exec. Sec. . . . Annual Conv. June 16-21 . . . At Chalfonte-Haddon Hall, Atlantic City . . . To disseminate information on engineering materials, specification standardization and testing.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—41,600 Members—29 W. 39th St., New York 18, N. Y. PE 6-9220 . . . Wm. F. Ryan, Pres.; C. E. Davies, Sec. . . . Meeting Dec. 1-6 . . . At Hotel Statler, N. Y. . . . Educational professional body concerned with mechanical engineering; allied arts.

AMERICAN SOCIETY OF TOOL ENGINEERS—35,000 Members—10700 Puritan Ave., Detroit, Mich. UN 4-7300 . . . H. C. McMillen, Pres.; William Moreland, Sec. . . . Annual Conv. March 25-27 at Houston, Texas . . . Dissemination of knowledge of tool engineering.

AMERICAN STANDARDS ASSOCIATION—2,400 Members—70 E. 45th St., New York 17, N. Y. MU 3-3058 . . . Vice Adm. G. F. Hussey, Jr. (USN Ret.), Sec. . . . Annual Conv. Nov. 13-15 . . . At St. Francis Hotel, San Francisco, Calif. . . . Provide an orderly set of voluntary coordinated standards and to promote their knowledge and use.

AMERICAN WOMEN IN RADIO AND TELEVISION—1,400 Members—501 Madison Ave., New York 22, N. Y. PL 3-2029 . . . Edythe F. Melrose, Pres.; Margo Anderson, Exec. Sec. . . . Annual Conv. none . . . An organization for interchange of information and mutual benefit of women in broadcasting.

ARMED FORCES COMMUNICATIONS AND ELECTRONIC ASSOCIATION—9,785 Members—1624 Eye St., N.W. Washington, D. C. EX 3-3033 . . . Percy G. Black, Pres.; Rear Adm. Henry C. Bruton, 1st V.P. . . . Annual Conv. May 20-22 . . . At Sheraton Park Hotel, Washington, D. C. . . . A patriotic educational and non-profit communication and electronic society for military, scientific and industrial preparedness.

ASSOCIATED POLICE COMMUNICATION OFFICERS, INC.—1500 Members—528 Tully Rd., San Jose, Calif. CY 7-4633 . . . Harry Duncan, Pres.; Robert A. Mason, Sec. . . . Annual Conv. July or Aug. . . . At Daytona Beach, Fla. . . . Technical, operations and administration of police and public safety communications systems.

ASSOCIATION FOR COMPUTING MACHINERY, INC.—2,200 Members—2 E. 63rd St., New York 21, N. Y. TE 2-8665 . . . J. W. Carr, Pres.; J. Moshman, Sec. . . . Annual Conv. June 19-21 . . . At University of Houston, Houston, Texas . . . Advancement, design and development of modern mathematical machinery for logic, statistics and kindred fields.

ASSOCIATION OF ELECTRONIC PARTS & EQUIPMENT MANUFACTURERS—132 Members—11 S. LaSalle St., Chicago, Ill. Dearborne 2-4217 . . . A. N. Haas, Pres.; Kenneth C. Prince, Exec. Sec. . . . Annual Conv. none . . . To treat all problems relating to the sales and distributors of electronic items through distributors.

ASSOCIATION OF FEDERAL COMMUNICATIONS CONSULTING ENGINEERS—30 Members—14 Assoc. Members—810 International Bldg., 1319 F. St., N.W. Washington, D. C. DI 7-1319. . . . Everett L. Dillard, Pres.; John Creutz, Sec. . . . Annual Conv. April . . . To provide for mutual improvement of consulting engineers before the FCC and to promote the proper application of the radio communication regulations from the proper federal agencies.

AUDIO ENGINEERING SOCIETY—1,753 Members—Box 12, Old Chelsea Station, New York 11, N. Y. OR 5-7820 . . . Walter O. Stanton, Pres.; C. J. LeBel, Sec. . . . Annual Conv. Sept. 1957(T) . . . At Trade Show Building, N. Y. . . . Advance theory and practice of audio engineering and closely related arts.

ELECTROCHEMICAL SOCIETY, INC.—2,500 Members—216 W. 102nd St., New York 25, N. Y. RI 9-6020 . . . H. Thurnauer, Pres.; Dr. H. B. Linford, Sec. . . . Annual Meeting May 12-16 . . . At Washington, D. C. . . . Advancement of the theory and practice of electrochemistry, electrometallurgy, electrothermics; allied subjects.

ELECTRONIC MANUFACTURERS ASSOCIATION, INC.—28 Members—55 W. 42nd St., New York 36, N. Y. PE 6-4864 . . . David Wald, Pres.; J. W. Martindale, Exec. Sec. . . . Annual Conv. none . . . Assist members in handling of their labor relation problems.

ENGINEERS JOINT COUNCIL—8 Societies—29 W. 39th St., New York 18, N. Y. PE 6-9220 . . . Dr. Thomas H. Chilton, Pres.; E. Paul Lange, Sec. . . . Annual meeting Jan. 17-18 . . . At the Statler Hotel, New York . . . To provide information for and assist Governmental activities on professional engineering matters and to advance the science and profession of engineering.

FEDERAL COMMUNICATIONS BAR ASSOCIATION—471 Members—300 American Bldg., Washington, D. C. ST 3-4004 . . . George O. Sutton, Pres.; Verne R. Young, Sec. . . . Annual Conv. undetermined . . . To maintain the standards and ethics of lawyers practicing before the FCC.

INDUSTRIAL COMMUNICATIONS ASSOCIATION—103 Members—30 E. 42nd St., New York 17, N. Y. MUrray Hill 7-8000 . . . Raymond A. McAvoy, Pres.; Vincent J. Murphy, Sec. . . . Annual Conv. May 22-24 . . . At Denver or Atlantic City . . . Exchange experience, information and encourage communication developments and research.

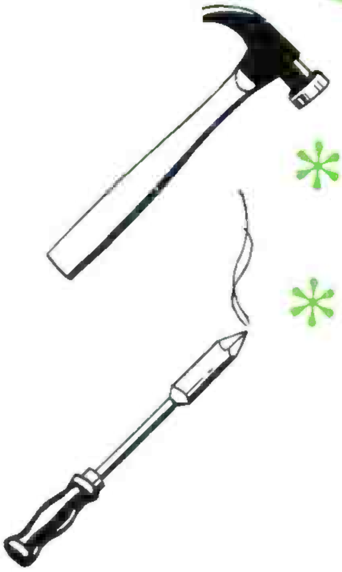
INSTITUTE OF RADIO ENGINEERS—52,000 Members—1 E. 79th St., New York 21, N. Y. LE 5-5100 . . . A. V. Loughren, Pres.; Haradan Pratt, Sec. . . . Annual Conv. March 18-21 . . . At Waldorf-Astoria Hotel, and Coliseum, New York . . . Advancement of the theory and practice of radio and allied branches of engineering and of the related arts and sciences.

PROFESSIONAL ENGINEERING GROUPS OF I.R.E.

AERONAUTICAL & NAVIGATIONAL ELECTRONICS—2400 Members—James L. Dennis, Chairman . . . IRE Conference on Aeronautical Electronics May 13-15 . . . At Dayton, Ohio . . . "Electronics in Aviation Day." Jan. 30 . . . Sheraton-Astor Hotel, New York . . . The application of electronics to operation and traffic control of aircraft and to navigation of all craft.

(*Continued on page 107*)

FUSITE introduces "torture-proof" solid glass headers with V-24 glass



- ***greater resistance to mechanical shock and vibration***
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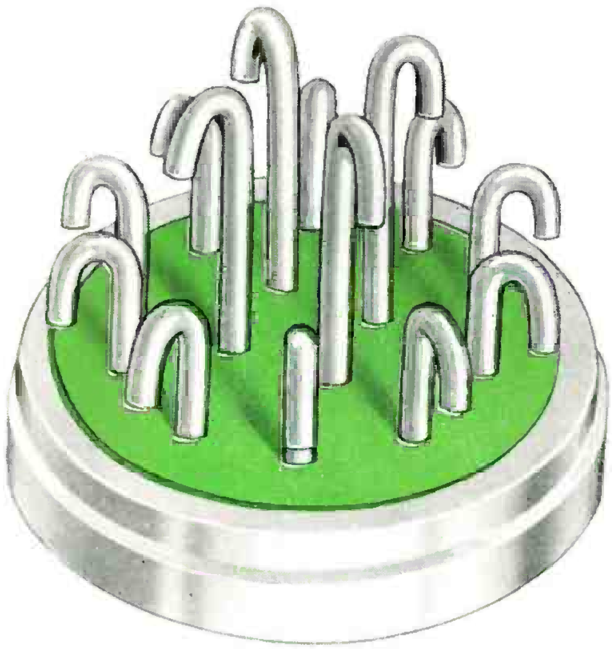

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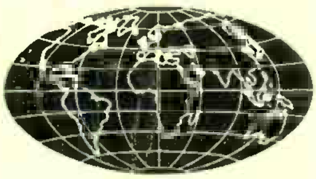
NOVEMBER 1956

ABSTRACTS & REVIEWS of WORLDWIDE ELECTRONIC ENGINEERING



ELECTRONIC INDUSTRIES & TELE-TECH

International ELECTRONIC SOURCES

PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name	Abbreviation	Publication Name	Abbreviation	Publication Name
Ann. de Radio	Annales de Radioelectricite	El. Ind	ELECTRONIC INDUSTRIES & Tele-Tech	Proc. AIRE.	Proceedings of the Institution of Radio Engineers (Australian)
Arc. El. Uber	Archiv der elektrischen Ubertragung	El. Mfg.	Electrical Manufacturing	Proc. BIEE.	Proceedings of the Institution of Electrical Engineers (British)
ASTM Bul.	ASTM Bulletin	El. Rund.	Electronische Rundschau	Proc. IRE.	Proceedings of the Institute of Radio Engineers
Auto. Con.	Automatic Control	Freq.	Frequenz	Radiotek.	Radiotekhnika
Av. Wk.	Aviation Week	Hochfreq.	Hochfrequenz-technik und Elektroakustik	RCA	RCA Review
Avto. i Tel.	Avtomatika i Telemekhanika	J. BIRE.	Journal of the British Institution of Radio Engineers	Rev. Sci.	Review of Scientific Instruments
BC News	Broadcast News	Nach. Z.	Nachrichtentechnische Zeitschrift	Syl. Tech.	The Sylvania Technologist
Bell J.	Bell System Technical Journal	NBS J.	Journal of Research of the National Bureau of Standards	Vide.	Le Vide
Bell Rec.	Bell Laboratories Record	Onde.	L'Onde Electrique	Wirel. Eng.	Wireless Engineer
El.	Electronics	Phil. Tech.	Philips Technical Review		
El. Des.	Electronic Design				
El. Eng.	Electronic Engineering				
El. Eq.	Electronic Equipment				

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

ANTENNAS, PROPAGATION

Designing Open Grid Parabolic Antennas, by E. F. Harris. "El. Ind." Nov. 1956. 3 pp. Design considerations for large open grid parabolic antennas for microwave are discussed. Design curves relating element diameter, frequency, and spacing are included.

Topics in Guided-Wave Propagation in Magnetized Ferrites, by Morris L. Kales. "Proc. IRE." Oct. 1956. 7 pp. A review is given of the contributions of various authors to the linear theory of propagation in magnetized ferrites.

Radiation from Ferrite-Filled Apertures, by D. J. Angelakos and M. M. Korman. "Proc. IRE." Oct. 1956. 6 pp. Deviations of the radiation lobe from a rectangular waveguide terminating in the plane of an infinite ground screen are obtained by varying the magnetic field applied to a ferrite slab located in the aperture of the waveguide.

The Problem of Calculating the Effective Area Of a Surface Target In the Microwave Region, by G. I. Perov. "Radiotek." July 1956. 3 pp. Remarks are made concerning the erroneous approach encountered in the literature with respect to calculating the effective reflecting area of a surface which produces diffuse reflection of a radiowave. It is shown that the formulas given in certain papers for the effective reflection area and the efficiency of the antenna in the panoramic radar unit of an airplane must be made more accurate.

The Calculation of Field Intensity In Shadow and Semi-shadow Zones When Microwaves Are Propagated Along the Smooth Spherical Surface of the Earth, by A. I. Kalinin. "Radiotek." June 1956. 7 pp. The paper gives a unified approximate method for calculating the field intensity in the shadow and semi-shadow zones. The limits of applicability for this method are given. Detailed mathematical and qualitative discussion, and illustrative graphs are included.

Remarks Concerning the Theory of the Radiation Field and the Impedance of Antennas, by K. Fraenz. "Arc. El. Uber." July 1956. 5 pp. It is shown how the antenna inductance is related to the frequency response of the radiation resistance. Reactive power near the antenna is proven to be finite. An enclosed antenna and a radiating antenna are compared. The classes of fields are derived for which it is possible to find conductor configurations satisfying the boundary conditions.

Anomalous Propagation in Ferrite-Loaded Waveguide, by Harold Seidel. "Proc. IRE." Oct. 1956. 5 pp. The birefringent character of the gyromagnetic medium is suggested as the physical basis of several anomalous phenomena observed in waveguides.

The Effect of Inhomogenities in the Ground on the Results from Direction Finding Equipment, by J. Grosskopf and K. Vogt. "Nach. Z." Aug. 1956. The authors examine the effect of conductivity variations and secondary reflectors on the results from direction finding equipment.

The Magnetic Field Strength in the Corners of Shielded Rooms (Corner Effect), by H. Daden. "Arc. El. Uber." July 1956. 8 pp. If the direction of the magnetic field is parallel to the shielding wall, the field inside the shield is uniform. However, for an outside field at right angles to the wall, the inside field strength rises rapidly as a corner is approached. The theory of this effect is developed and the results illustrated.

AUDIO

Absolute Method for Sound Intensity Measurement, by D. Pardue and A. Hedrich. "Rev. Sci. Inst." Aug. 1956. 2 pp. An electronic thermometer capable of measuring fast, small-amplitude temperature variations is described. By means of this equipment, the adiabatic temperature fluctuation accompanying sound propagation through media for which the specific heat ratio is greater than one can be measured. Through the application of the equation of state, the measured temperature fluctuation may be related to the intensity of the sound wave.

A Development of the Collard Principle of Articulation Calculation, by D. L. Richards and R. B. Archbold. "Proc. BIEE." Sept. 1956. 13 pp. Many talker-listener assessments of speech links could be avoided if the theoretical framework propounded in 1929 by Collard were more generally applied, the calculation technique enables a large amount of information to be interpolated from a relatively small number of measurements on key conditions.

Audio Applications in the Home, by R. Stewart. "Proc. AIRE." May 1956. 4 pp. Controlled listener tests for checking home reproduction system performance are discussed.

FOR MORE INFORMATION ON SUBJECTS REVIEWED HERE

Contact your nearest library subscribing to publications noted. Excellent technical periodical sections are maintained by many large public libraries, engineering universities and electronic companies.

To obtain copies of any articles or complete magazines reviewed here, contact the respective publishers directly. Names and addresses of publishers may be obtained upon request, stating publications of interest, by writing to: "Electronic Sources" Editors, ELECTRONIC INDUSTRIES & Tele-Tech, Chestnut & 56th Sts., Philadelphia 39. The editors can recommend translation agencies.

To obtain copies of U.S. patents, and research reports on military and government projects reviewed here, send payment indicated directly to federal agency as instructed in section entitled "U.S. Government."

Mechanical Phenomena in Gramophone Pick-Ups at High Audio Frequencies, by J. B. S. M. Kerstens. "Phil. Tech." Sept. 14, 1956. 9 pp. A study is presented of the mechanics of the pick-up system, particularly at high audio frequencies. The physical aspect of the phenomena is emphasized, and only a simplified mathematical presentation made. Included are discussions of: deformation of the groove walls, the stylus motion, static tracing loss and cut-off frequency, dynamic pick-up characteristic and tracing loss, and the actual pick-up characteristic.

The Univox, by Alan Douglas. "El. Eng." Oct. 1956. 4 pp. A dual triode sawtooth generator for electronic musical instruments is described.

CIRCUITS

Minimizing Noise In Electronic Systems, by R. L. Wendt. "El. Ind." Nov. 1956. 4 pp. Internally generated noise is a constant problem to equipment designers. Discussed in this article are the causes of capacitive, leakage, conductive, and inductive noise pickup, and practical preventive measures.

The Design of Cold-Cathode Valve Circuits, by J. E. Flood and J. B. Warman. "El. Eng." Oct. 1956. 6 pp. The characteristics of diodes and triodes are described and the limitations which these place on circuit design are discussed.

The Basic Transfer Functions of a Low-Pass Network, Their Properties and the Problem of Their Realization, by J. Dorr. "Nach. Z." Aug. 1956. 9 pp. Mathematical methods for the calculation of special and general basic transfer function of low-pass filters are evolved for the calculation of transient responses.

Modern Synthesis Network Design from Tables—I, by Louis Weinberg. "El. Des." Sept. 15, 1956. 4 pp. The design of ladder networks is discussed.

Polar Co-ordinate Oscilloscopes, by G. F. Craven. "El. Eng." Oct. 1956. 4 pp. The generation of a circular time-base is explored. Special reference is made to the employment of a Magslip transmitter as the time-base generator.

Ferrites as Microwave Circuit Elements, by Gerald S. Heller. "Proc. IRE." Oct. 1956. 8 pp. A description is given of the effects of magnetically saturated ferrites in microwave structures—from the general approach of microwave circuit theory. The properties of the scattering of microwave junctions containing magnetically saturated media are discussed.

Network Properties of Circulators Based on the Scattering Concept, by Milton A. Treuhaft. "Proc. IRE." Oct. 1956. 9 pp. A practical application of symmetry analysis is made to the design of circulators.

Nonlinear Amplifier Design for Pulse-Height Analyzers, by G. Hutchinson. "Rev. Sci. Inst." Aug. 1956. 5 pp. An amplifier is described which, by inclusion of the nonlinear elements of the amplifier in its negative feedback loop, extends the range of pulse sizes which can be simultaneously recorded by a kick sorter.

On the Dependence of the Characteristics of a Lossless Four-Terminal Network on the Associated Reactive Transformation Diagram, by F. Gemmel. "Arc. El. Uber." July 1956. 2 pp. A method is presented which permits the determination of the characteristics of a lossless four-terminal network from the perspective axis of the reactive transformation diagram.

A Method for Retaining a Unified Tuning Characteristic In Circuits Which Operate with Different Overlap Coefficients, by A. L. Kharinsky and N. I. Svetlov. "Radiotek." June 1956. 8 pp. The paper examines the problem from the point of view of using one variable capacitor for tuning purposes, and of coupling such circuits to heterodyne circuits in superheterodyne receivers. An "auxiliary circuit" is used; additional fixed capacitors are inserted whose values are calculated.

Regenerative Current Feedback In Low-Frequency Amplifiers, by G. Ya. Gurovich. "Radiotek." June 1956. 5 pp. Circuits are examined in which regenerative current feedback is used for the purpose of compensating frequency and phase distortion in low-frequency amplifiers. It is shown that under certain definite conditions regenerative current feedback theoretically allows complete compensation of certain types of distortion without lowering the gain of the stage.

Determination of the Rate of Change of the Pulse Which Is Produced at the Instant a Device Is Cut In, by V. M. Rudny. "Radiotek." June 1956. 3 pp. The paper analyzes a method for determining the rate of change of the current and voltage pulses which occur at the instant a circuit is connected to a source, or at the instant a previously charged device is discharged. Various types of filter circuits are examined.

Design of a Single-Crystal Quartz Filter, by L. G. Sodin. "Radiotek." July 1956. 10 pp. Expressions are derived for the gain and for the resonant response of an amplifier with a single-crystal quartz filter. The cases of tuned and untuned (with respect to the quartz resonator) filter circuits are analyzed.

A Multi-Phase Multivibrator, by Ya. E. Belenky, A. N. Svenson. "Radiotek." July 1956. 7 pp. The paper examines a new multiphase multivibrator circuit which requires half the number of tubes and parts required in existing circuits. The operation of the multivibrator is described, and a basic quantitative analysis is made of this class of circuits.

Design of a Three-Tube RC Oscillator, by S. V. Svechnikov, V. A. Kuzmenko. "Radiotek." July 1956. 4 pp. The special features of the operation of a three-tube RC oscillator at low frequencies is examined. It is shown that stable low-frequency oscillations can be obtained by introducing dissymmetry into one of the stages or by introducing negative current feedback into all three stages. A design method for such circuits is given.

Synchronization of a Vacuum Tube Sine-Wave Oscillator By Means of a Subharmonic EMF, by T. A. Gailit, I. I. Minakova. "Radiotek." July 1956. 7 pp. The paper investigates the synchronization of the oscillator by means of an external emf that has a frequency which is close to the frequency of one of the subharmonics of the oscillator output wave. Both the "soft" and "hard" operating modes of the oscillator are analyzed.

Energy Considerations In a UHF Vacuum Tube Oscillator, by L. N. Kolesov. "Radiotek." June 1956. 16 pp. The basic energy functions are derived for a UHF triode oscillator. These functions quantitatively take into account the effect of electron inertia and the parameters of the tuned system. The functions remain valid for appreciable variations in the operating frequency, electrode voltages and plate load.

Effects of External Factors Upon a Self-Excited Oscillator, by S. I. Evtianov. "Radiotek." June 1956. 10 pp. The paper discusses the engineering design principles for a self-excited oscillator which is subjected to external effects. The design calculation is not associated with the polynominal approximation of the plate current and permits self-bias to be taken into account. A new feature of the analysis is the introduction of the method of modulation characteristics which is based upon double Fourier series. Both synchronous and asynchronous regimes are examined.

Relay Contact Protection, by R. H. Gumley. "Bell Rec." Sept. 1956. 5 pp. The cause and correction of contact erosion resulting from sparking and arcing as contacts open or close are discussed.

The Relationship Between the Equivalent Gain Coefficient of a Nonlinear Element and the Characteristic of the Element, by Ya. Z. Tsypkin. "Avto. i Tel." April 1956. 4 pp. This paper derives the relationships which permit the approximate determination of S(A) directly and explicitly from the characteristic of a nonlinear element. Such a relationship substantially simplifies calculation, but what is more important, it permits a simple explanation of the effect of changes in the characteristic of the nonlinear element upon S(A).

Contributions to the Theory of Oscillators, by W. Herzog and E. Frisch. "Nach. Z." July 1956. 5 pp. The possibilities for connecting a three-terminal network to a tube for the generation of oscillations are investigated and the conditions for oscillation are discussed.

Device for Integrating a Slowly Changing Time Function Which is Given in the Form of an Angle of Turn, by I. P. Pal'tov. "Avto i Tel." April 1956. 14 pp. This paper examines an electromechanical integrating device which operates in a regime of self-oscillations. The self-oscillations are investigated with the method of harmonic linearization of nonlinearities. The Mikhailov stability criterion for symmetrical and non-symmetrical static characteristics of nonlinear elements is applied while taking perturbation into account.

COMMUNICATIONS

Transistor Pulse Regenerative Amplifiers, by F. H. Tendick, Jr. "Bell J." Sept. 1956. 30 pp. In the pulse regenerative amplifier, a bistate circuit introduces gain and pulse reshaping in a pulse transmission or digital data. A pulse regenerative amplifier is a bistate circuit which introduces gain and pulse reshaping in a pulse transmission or digital data processing system. Frequently it is used also to retime the pulses which constitute the flow of information in such systems. An illustrative design of such an amplifier for use in a specific digital computer is presented.

Dualex Selcal Bid Offers 100,000 Codes, by Philip Klass. "Av. Wk." Aug. 27, 1956. 2 pp. A description and comparison is offered of the Motorola/Arinc Selcal and the Sequential (Dualex) selcal systems whereby communications calling codes are generated and received.

The Effectiveness of Dual Reception When Interference Is Present Due to Radio Stations Which Are Operating on Adjacent Frequencies, by V. M. Rozov. "Radiotek." July 1956. 12 pp. The effectiveness of dual reception is characterized by the decrease in the average percentage of distorted telegraph symbols as compared to the analogous quantity in ordinary reception. The analysis is made for long-range radio-communications. A detailed mathematical analysis is given.

Design of a Device for Comparing Coded Pulses with Protection Against False Responses, and the Investigation of Its Operation, by B. V. Rybakov. "Radiotek." July 1956. 13 pp. The paper describes the principle of designing an electronic code-pulse comparator which is based upon a newly developed anti-matching circuit that incorporates protection from false responses. The unit permits comparison of code pulses which appear at the outputs of various types of accumulators or digital computers. The operational analysis of the unit makes it possible to calculate the basic parameters of the circuit which correspond to the specified operating conditions.

Single-Side-Band Modulation by Means of Phase Systems, by B. B. Shtein. "Radiotek." June 1956. 14 pp. The paper develops the principle of segregating one side-band by means of three-phase modulation. It examines various methods of solving this problem, the elementary circuit diagram, the circuit elements and their requirements. The possibility of suppressing the second side-band by more than 40 db is experimentally verified.

On the Formation of Code Words, by R. Schauffler. "Arc. El. Uber." July 1956. 10 pp. Codes with code words having a uniform number of digits are investigated. Formulas and charts to find such codes are derived and compared. The establishment of the derivation formula of a code from a number of words is explained. Examples are included.

Amplitude Modulation of Centimetre Waves by Means of Ferroxcube, by H. G. Beljers. "Phil. Tech." Sept. 14, 1956. 5 pp. A means of modulating a centimeter wave transmitter is described which uses variable gyromagnetic losses in ferrites in an absorption modulation system.

Radio Link Teleprinter Systems with Automatic Error Correction, by F. Hennig. "Nach. Z." Aug. 1956. The author reviews the difficulties peculiar to teleprinter operation over radio links, and discusses in detail a 7-unit code and error detection and correction system.

On the Use of the Lower Centimeter-Wave Region for Radio Communication, by G. Megla. "Hochfreq." May 1956. 6 pp. A detailed investigation of the attenuation indicates that, in specific instances, 2-cm waves are suitable for radio communication service. A table listing the advantages and disadvantages of various transmitting media for 4-cm waves is included. It is stated that the most important drawback of the radio transmission is the general availability of the transmitted signal.

What to Emphasize in Maintenance Manuals, by P. Sherrill. "El." Sept. 1956. 3 pp. A survey is reported, indicating technician preference for certain types of information.

COMPONENTS

Selection And Application Of Quartz Crystals, by Harold Edelstein. "El. Ind." Nov. 1956. 3 pp. As a guide to circuit designers, this article reviews the various cuts of crystals and their applications in electronic circuits. Testing procedures are described and operational problems are viewed from several viewpoints. The comparative ability of several crystal oscillator circuits is studied.

Ferrite-Tunable Microwave Cavities and the Introduction of a New Reflectionless, Tunable Microwave Filter, by Conrad E. Nelson. "Proc. IRE." Oct. 1956. 7 pp. Experimental X-band data on ferrite tuning of conventional filter cavities are presented. A description is given of a reflectionless filter with very low loss which uses a single circularly polarized cavity.

Ferrite-Tunable Filter for Use in S-Band, by James H. Burgess. "Proc. IRE." Oct. 1956. 3 pp.

Induction Linear Potentiometer, by Yu. M. Poul'er. "Avto. i Tel." July 1956. 17 pp. Induction linear systems transforming rotation angle of a rotor into proportional a-c voltage when output voltage phase is almost stable are analyzed.

A New Ferrite Isolator, by Bengt N. Enander. "Proc. IRE." Oct. 1956. 10 pp. Closed rings of ferrites with a square-loop magnetization curve are used in the design of a ferrite isolator. The closed ferrite rings enclose a section of helical transmission line to form an isolator requiring no externally applied magnetic field.

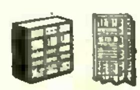
Ferrite Directional Couplers, by A. D. Berk and E. Strumwasser. "Proc. IRE." Oct. 1956. 7 pp. The nonreciprocal scattering properties of a ferrite cylinder joining two waveguides can result in directional coupling. Experimental data and approximate theoretical expressions for coupling and directivity in X-band couplers are presented.

Three New Ferrite Phase Shifters, by Howard Scharfman. "Proc. IRE." Oct. 1956. 4 pp. Three methods for electrical control of microwave phase shift are discussed: a bucking rotator phase shifter, a reciprocal unit; a non-reciprocal phase shifter; and an electrically controllable short circuit—the last two being based on the use of a circular polarized phase shifter between quarter wave plates.

Ferrite-Tuned Resonant Cavities, by Clifford E. Fay. "Proc. IRE." Oct. 1956. 4 pp. Results are presented of experiments in which a slab of ferrite placed against one side wall of a dominant-mode rectangular cavity is subjected to different applied static magnetic fields.

A Delay Unit with Computing Amplifiers and Capacities, by Ya. I. Grienya and P. N. Copie-Gora. "Avto. i Tel." June 1956. 8 pp. Construction of a delay unit for various frequencies and dead time parameters is considered. A delay unit circuit with computing amplifiers and capacities is described.

Reliable Soldered Connections Without Mechanical Joints, by J. Smith. "El. Mfg." Sept. 1956. 2 pp. Careful experiments seem to bear out what has been practiced by many experimenters for years. Laborious mechanical joints prior to soldering are not necessary and may contribute to failure due to stresses during the fastening operation. Experiments at the U. S. Navy Electronics Laboratory are described.



COMPUTERS

Flat Display Device With Matrix Selection, by B. Findeisen. "El. Ind." Nov. 1956. 4 pp. Described in this article is a flat display device which is essentially a large array of closely stacked gas discharge or fluorescent bulbs connected by a crossed wire matrix. Application of proper potentials allows individual cells to be turned on or off independently.

Transistorized Binary Pulse Regenerator, by L. R. Wrathall. "Bell J." Sept. 1956. 36 pp. The author reports the successful construction of a simple transistorized device for amplifying and regenerating binary code signals as they are transmitted over substantial lengths of transmission line. By the use of simple circuitry, means are provided whereby the distortion in the output of one repeater due to low frequency cutoff is compensated in the next repeater. A brief discussion of the theory of the circuit is presented along with measured results and oscillograms showing its performance.

High-Frequency Electronic Counter, by A. V. Lord and S. J. Lent. "Wirel. Eng." Sept. 1956. 7 pp. The article outlines the principles involved and describes a practical arrangement of a binary counter which is characterized by a high counting rate.

Filamentary Subminiature Scalers, by C. Harris and P. Bell. "Rev. Sci. Inst." Aug. 1956. 3 pp. A scaling circuit with reduced power requirements and heat dissipation is described. The low-wattage scale-of-two employs filamentary subminiature tubes and exhibits great reliability and long life. A Higinbotham version for great reliability in very long cascades and for battery operation is also described. Both designs show promise of extremely long life and usefulness wherever bistable switching circuits are used.

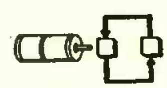
Analog Integrator Has Wide Dynamic Range, by George H. Myers. "El. Eq." Sept. 1956. 3 pp. Saturation limitations on the dynamic range of an RC integrator can be circumvented by the techniques presented in this article.

How to Cool a Computer, by Robert J. Lang. "El. Eq." Sept. 1956. 3 pp. Heat dissipation needs and refrigeration equipment for the RCA Bizmac computer are discussed.

The Solution of Algebraic, Transcendental, and Integral Equations by Means of Analog Computers, by I. M. Vietenberg and E. A. Gloosberg. "Avto. i Tel." July 1956. 11 pp. The authors discuss the use of analog computers for solving algebraic and transcendental equations, some types of integral equations, and linear and nonlinear differential equations.

Calculator for Some rf Problems in Accelerator Design, by K. MacKenzie. "Rev. Sci. Inst." Aug. 1956. 4 pp. A simple mechanical calculator is described for solving the transmission line equations when the characteristic impedance is a variable. The speed of computation is some two orders of magnitude faster than analytical methods. The theoretical basis is described and also the way in which it can be used. Some representative problems which have benefited by use of the calculator are discussed.

Three-Dimensional Cam Circuit, by Max Fogiel. "El. Des." Sept. 15, 1956. 2 pp. An electronic circuit, the output of which is a function of two input variables, is described. Heart of the circuit is a tapped potentiometer, the taps of which are variable in response to one of the input functions.



CONTROLS

An Electronic Governor, by S. C. Hine. "El. Eng." Oct. 1956. 2 pp. The electronic governor described by the author is a device for accurately controlling the speed of a shaded-pole squirrel-cage induction motor.

The Control of Nuclear Reactors, by R. J. Cox and J. Walker. "Proc. BIEE." Sept. 1956. 13 pp. The physical principles of nuclear reactors which affect the design of their control and instrumentation are described. Data are presented for the kinetic behavior of the neutron flux for reactivity changes in a variety of reactor types.

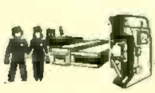
Nuclear-Reactor-Control Ionization Chambers, by W. Abson and F. Wade. "Proc. BIEE." Sept. 1956. 7 pp. The authors describe the design and the electrical characteristics of a neutron-sensitive dc ionization chamber suitable for a wide range of applications in nuclear-reactor-control instrumentation systems.

Initial Parameters and Design Values of Characteristics of Two-Phase Micromachines and Their Determination. by G. M. Kasprgurk and E. I. Slepooshkin. "Avto. i Tel." July 1956. 11 pp. The calculation of rotor current symmetrical components of induction two-phase machine with arbitrary asymmetric action is described. The equations for operational characteristics of two-phase servomotors and tachogenerators are obtained.

The Control and Instrumentation of a Nuclear Reactor, by A. B. Gillespie. "Proc. BIEE." Sept. 1956. 13 pp. Presents a survey of the overall instrumentation of a typical research reactor. Emphasis is placed on the less-well-known problems of measurement and control.

Some Design Aspects of Nuclear-Reactor Control Mechanisms, by G. E. Lockett. "Proc. BIEE." Sept. 1956. 11 pp. Outlines some of the practical design problems associated with the engineering of control mechanisms in nuclear reactors. Safety is emphasized in all the design aims, and examples are given of some of the systems in use at Harwell.

The Variable Interval Automation Controller, by M. L. Klein, H. C. Morgan, and J. R. Wood. "El. Eng." Oct. 1956. 5 pp. The device described was designed primarily as a paper saver for high speed oscillographs.



INDUSTRIAL ELECTRONICS

Suppressing Radiation From Medical Electronic Equipment, by Herbert M. Sachs and Arnold L. Albin. "El. Ind." Nov. 1956. 3 pp. The problems of generation and susceptibility to interference signals are reviewed, and new filters and enclosure shielding for solving the problems at their source are discussed.

Combination Magnetic Servo Amplifier, by William A. Geyger. "Auto. Con." Sept. 1956. 3 pp. A method employing positive magnetic feedback and negative electric feedback to achieve half-cycle transient response. stability, and reduction of zero-drift is described.

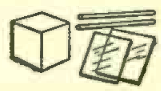
Fire Thyratrons with Reset Magnetics, by James H. Burnett. "Auto. Con." Sept. 1956. The author describes a magnetic circuit that fires thyratrons within 180°. Typical applications are suggested.

Servo-Operated Recording Instruments, by A. J. Maddock. "Proc. BIEE." Sept. 1956. 16 pp. A general review is presented, in historical form, of the several types of servo-operated recording instruments that have been devised since 1897.

New Application of Hot-Cathode Gas-Filled Diodes—Low-Voltage Fluorescent Lamps, by M. Laporte. "Vide." May-June 1956. 7 pp. The first realization of fluorescent lamps with permanent hot cathodes and either dc or ac voltages of less than 14 volts is discussed. These lamps require no special provisions for starting or stabilization and may be built to any desired shape. They are as easily installed as conventional incandescent bulbs.

Anomalies in the Response for Power Output and Modulation Sensitivity of Reflex-Generators, by J. Labus. "Nach. Z." Aug. 1956. 4 pp. The effect of electronic delay variations on the power output of reflex-generators is explained. Variations in the modulation sensitivity are attributed to space charges in the vicinity of the reflector.

Ionization and Dissociation of the Trifluoromethyl Halides by Electron Impact, by Vernon H. Dibeler, Robert M. Reese, and Fred L. Mohler. "NBS J." Aug. 1956. 6 pp. A new calculation of the ionization potential of the CF_3 radical as well as estimates of fluorocarbon bond-dissociation energies are made on the basis of experimental work described in this article.



MATERIALS

Dielectric Testing in the Service of the Development of Circuit Components, by P. Henninger, G. Kremmling and H. Eisenlohr. "Freq." Aug. 1956. 12 pp. The behavior of dielectric materials at various temperatures and humidities is studied. A survey of dielectric theory is followed by a description of test equipment. Examples of problems encountered in designing are included and their solution is explained. Curves are included.

Impregnating and Coating Materials in Radio Engineering, by W. M. H. Schulze. "Freq." Aug. 1956. 13 pp. The properties of the natural and synthetic substances used for the impregnation and coating of dielectric components to displace the air in the capillaries of dielectrics and to shield the dielectrics from the effects of the surrounding humidity, respectively. are discussed in detail. Tables and curves contain pertinent information.

Electron Microscopy of Ceramics, by S. E. Koonce and F. M. Berting. "Bell Rec." Sept. 1956. 5 pp. Techniques of microscopy and results of microscopic studies of a porcelain and of a multicrystalline barium titanate are discussed.

Arc Resistance: Radio-Frequency Corona Resistance, by Murray Olyphant, Jr. "ASTM Bul." Sept. 1956. 9 pp. The resistance of a variety of thermosetting materials to corona discharges has been studied. Findings indicate that failure of insulation is principally dependent on the heat input to the specimen.

A Survey of the Properties and Applications of Ferrites Below Microwave Frequencies, by C. Dale Owens. "Proc. IRE." Oct. 1956. 15 pp. This comprehensive survey includes a discussion of the nature of ferrites, their magnetic and electrical properties, the use of the μQ product as a design index of efficiency, core losses, and the effects of air gaps. Applications are discussed, and a Bibliography is included.

Fundamental Theory of Ferro- and Ferri-Magnetism, by J. H. Van Vleck. "Proc. IRE." Oct. 1956. 11 pp.

Magnetic Resonance in Ferrites, by Nicolaas Bloembergen. "Proc. IRE." Oct. 1956. 11 pp. The author reviews ferromagnetic resonance in ferrites, and includes a discussion of the concept of tensor permeability. magnetic anisotropic influences, demagnetizing fields, and damping mechanisms.

Dielectric Properties of and Conductivity in Ferrites, by Legrand G. Van Uitert. "Proc. IRE." Oct. 1956. 10 pp. Various factors affecting the dielectric properties of ferrites are reviewed.

Methods of Preparation and Crystal Chemistry of Ferrites, by Donald L. Fresh. "Proc. IRE." Oct. 1956. 9 pp.

Intrinsic Tensor Permeabilities on Ferrite Rods, Spheres, and Disks, by E. G. Spencer, L. A. Ault. and R. C. LeCraw. "Proc. IRE." Oct. 1956. 7 pp. This article presents a discussion of the transformation relations between the measured permeability components and the values intrinsic to the material which then do not involve the sample shape. General theoretical curves are given.

Nonlinear Response of NaI(T1) to Photons, by D. Engelkemeir. "Rev. Sci. Inst." Aug. 1956. 3 pp. Contrary to the view commonly held, research now shows distinct nonlinearity in the photon energy response of sodium iodide crystals. Experimental methods, results, and possible causes of the observed nonlinearity are discussed.

MEASURING & TESTING

Resistive Fins Improve Wavemeter Tuning, by Koryu Ishii. "El. Ind." Nov. 1956. 2 pp. A finned power absorber is described which eliminates spurious responses in cavity wavemeters and gives greatly improved tuning characteristics.

Instrumentation For High "G" Tests. by S. Bond. "El. Ind." Nov. 1956. 4 pp. The author gives a description of methods and equipment used to test small components at accelerations up to 300,000 g's. Data includes construction details and operational problems.

"Glo-Ball" Development, by J. Steinhaus. "Rev. Sci. Inst." Aug. 1956. 6 pp. The author describes a small, thin-walled, partially evacuated glass sphere containing helium, used for investigating electric field distributions in rf resonant cavities. Ionization of the gas in the glo-ball indicates a given potential gradient across it; in field investigations a monitoring loop is used to record the voltage required in the cavity to produce this ionization. Other characteristics of glo-balls pertinent to their use as field measuring devices are reported.

Permeability Tensor Values from Waveguide Measurements, by E. B. Mullen and E. R. Carlson. "Proc. IRE." Oct. 1956. 7 pp. Unlike the usual techniques of measuring the components of the microwave permeability tensor of ferrites, the technique described makes use of measurements on a ferrite rod placed along the axis of a circular waveguide.

Resonance Loss Properties of Ferrites in 9 KMC Region, by Samuel Sensiper. "Proc. IRE." Oct. 1956. 20 pp. Typical data resulting from an investigation of the resonance loss properties of a large number of ferrites are presented. Tests were run at room temperature and at 8.2, 8.9, and 10.1 kmc.

The Problem of the Accuracy of Measuring Impedances by Means of Long Lines, by R. M. Dombrugov. "Radiotek." June 1956. 5 pp. The paper analyzes the errors which arise when measuring the resistive and reactive components of the load impedance when the load is attached to a long transmission line. The use of both nomograms and formulas is discussed.

A Compact Crystal Clock, by D. R. Ollington. "El. Eng." Oct. 1956. 2 pp. A time standard providing 10 kc, 1 kc, and 100 cps outputs, and accurate to 0.5 second per week is described. Only 13 tubes are used.

A Time Marker for Electrophysiology, by R. H. Kay. "El. Eng." Oct. 1956. 3 pp. Using cold cathode tubes for increased reliability, the device described has the further advantage that divider stages are not self oscillatory.

A Sensitive Quick Reacting Cardiotachometer, by M. Manzotti. "El. Eng." Oct. 1956. 3 pp. An instrument is described which, at every heart beat, gives a signal proportional to the reciprocal of the time interval between that beat and the previous one.

Technique of Microwave Measurements, "J BIRE." July 1956. 16 pp. A wide variety of measurement techniques are discussed, and a select bibliography on the subject is appended.

Absolute Calibration of a Standard Temperature Noise Source for Use with S-Band Radiometers, by V. A. Hughes. "Proc. BIEE." Sept. 1956. 4 pp. To provide a standard temperature noise source for use with S-band radiometers, the noise power from the argon discharge tube CV1881 has been calibrated at 2860 MC using radiometer techniques.

Noise Measurements in the 3-CM Waveband Using a Hot Source, by H. Sutcliffe. "Proc. BIEE." Sept. 1956. 4 pp. The method discussed uses the noise power produced in a waveguide termination at temperatures up to 600°C as a standard source of low-level power. Some experimental results are given of measurements on the effective temperature of a gas-discharge tube used as a secondary standard source.

Investigation of an Alternating-Current Bridge for the Measurement of Core Losses in Ferromagnetic Materials at High Flux Densities, by Irvin L. Cooter and William P. Harris. "NBS J." Aug. 1956. 10 pp. Accurate values are obtainable at higher flux densities through the use of a correction term derived from the harmonic components of the exciting current. Theory and experiment are described.

Method for the Continuous Registration of Harmonics, by H. Nottebohm. "El Rund." Sept. 1956. 1 p. A method is described for making distortion measurements which combines high resolving power with ease of measurement in a continuous frequency spectrum. Measurement is achieved by means of a display of the fundamentals of the analysed wave and its harmonics.

Anisotropy of Cobalt-Substituted Mn Ferrite Single Crystals, by P. E. Tannenwald and M. H. Seavey. "Proc. IRE." Oct. 1956. 2 pp. Measurements by the usual microwave techniques are reported during which both composition and temperature were varied.

Recording Magnetic-Resonance Spectrometer, by M. Strandberg, M. Tinkham, I. Solt, Jr., and C. Davis, Jr. "Rev. Sci. Inst." Aug. 1956. 10 pp. Apparatus for studying electron paramagnetic resonance is described and discussed. The microwave sample cavity is analyzed to determine conditions for optimum operation. The klystron stabilization problem is examined, and appropriate lumped circuits for low-frequency operation described.

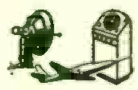
Recording Decay of Electron Density in Ionized Gases, by G. Deakins and C. Crain. "Rev. Sci. Inst." Aug. 1956. 3 pp. The authors describe a method for the measurement and photographic recording of electron density loss in an ionized gas utilizing a microwave system operating near 9400 MC. The region between initial density level (upon removal of a 24.5 MC ionizing voltage) and 500 μsec later was investigated. The equipment used and the results obtained are discussed.

Frequency and Loss Characteristics of Microwave Ferrite Devices, by Benjamin Lax. "Proc. IRE." Oct. 1956. 19 pp. The loss properties of the Faraday rotator, the resonance isolator, the nonreciprocal phase shifter, and the field displacement devices are discussed; and figures of merit derived.

Birefringence of Ferrites in Circular Waveguide, by N. Karayianis and J. C. Cacheris. "Proc. IRE." Oct. 1956. 8 pp. Measurements of birefringence of different ferrite configurations in circular waveguide are reported.

The Limit of Applicability of the Correction to High-Frequency Insulator Test Voltages when Correcting for the Relative Density of the Air in Order to Normalize to Ordinary Atmospheric Conditions, by G. Ya. Muravieva. "Radiotek." July 1956. 5 pp. It is shown that when testing high-frequency insulation at small values of relative air density the use of this quantity in the capacity of a correction coefficient for the purpose of normalizing the discharge voltages to usual atmospheric conditions leads to very large errors. Correction coefficients are calculated for various values of relative air density and of the insulation-reinforcement radius. The use of these coefficients permits a considerable reduction in the error.

Measurement of VHF and UHF Voltages by Vacuum Tube Voltmeter, by J. Hacks and B. Schumacher. "El. Rund." Sept. 1956. 3 pp. Effective voltage division is obtained by use of capacitive dividers.



RADAR, NAVIGATION

Radar Power Power-Energy Nomograph, C. W. Young. "El. Ind." Nov. 1956. 1 p. An engineering tool is presented in the form of a nomograph correlating the four interdependent equations involving peak power, average power, energy, duty cycle, pulse width, pulse repetition rate, and pulse interval.

The Elements of Nonreciprocal Microwave Devices, by C. Lester Hogan. "Proc. IRE." Oct. 1956. 24 pp. An elementary, but complete introduction is given to the basic theory of nonreciprocal microwave devices.

The Nonlinear Behavior of Ferrites at High Microwave Signal Levels, by Harry Suhl. "Proc. IRE." Oct. 1956. 15 pp. After a discussion of various anomalous power absorption characteristics of ferrites, the author proceedes to an evaluation of the steady state of magnetization beyond the threshold signal for one type of anomalous absorption.

Microwave Resonance Relations in Anisotropic Single Crystal Ferrites, by Joseph O. Artman. "Proc. IRE." Oct. 1956. 10 pp.

Effects of Hydrometeors on cm Waves, by B. Abild. "El. Rund." Sept. 1956. 4 pp. Reflection and attenuation phenomena to which radar signal energy is submitted by rain drops, rain, snow flakes, wet snow, clouds are discussed with reference to optimal wave lengths; resulting application possibilities of weather radar are also considered. Examples are observation of precipitation areas and clouds, and precipitation measurements. Equipment applicable to these purposes is specified, a brief survey of pertinent experiences gained in Germany is given.

SEMICONDUCTORS

Bias Stabilization of Tandem Transistors, by R. B. Hurley. "El. Ind." Nov. 1956. 3 pp. The direct coupling between the two stages of a tandem transistor can incorporate compensating features that will aid bias stability and predictability. Analysis shows theoretical conditions for perfect bias stability and points to practical compromises.

A Tetrode Transistor Amplifier for 5-40 MC, by R. R. Webster. "El. Ind." Nov. 1956. 4 pp. The author describes investigations into the operation of junction transistors at high temperatures in the 5-40 MC region.

Point-Contact Transistor Action, by A. Uhlir, Jr. "Bell Rec." Sept. 1956. 4 pp. A general review of the point-contact transistor is presented, outlining the continuing development since the original announcement.

Grain Boundary Transistors, by H. F. Mataré. "El. Rund." Sept. 1956. 3 pp. In a continuation of the article started in the August issue the electrical properties of lattice defects are considered. The calculation of potential difference between grain boundary level and probe contact points on both sides of the crystal is discussed, also with reference to the energy band structure carrier liberation from grain boundary phenomena.

Transistor Power-Gain Formulas, by Richard B. Hurley. "El. Eq." Sept. 1956. 1 p. Formulas are listed for power gain, transducer gain, available gain, maximum available gain, and insertion gain.

Design Silicon Diodes into Reference and Regulator Circuits, by W. B. Mitchell. "El. Eq." Sept. 1956. 3 pp. Diode characteristics, circuitry, and design considerations of importance to reference and regulator circuits are discussed.

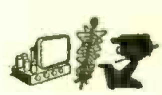
Cartridge Rectifiers Use Silicon, by J. T. Cataldo. "El. Eq." Sept. 1956. 1 p. Physical and electrical characteristics of cartridge silicon rectifiers are presented.

Rectifying Semiconductor Contacts, by H. Henisch. "Syl. Tech." July 1956. 7 pp. The author presents a review of theoretical progress in the field of contact rectification. Some of the problems which still await solution are outlined.

Impurity Band Conduction in Germanium and Silicon, by E. Conwell. "Syl. Tech." July 1956. 3 pp. Elementary concepts are discussed in order to clarify the theory for non-specialists. Anomalous low temperature behavior is explored.

Grain Boundary Transistors, by H. Matare. "El. Rund." Aug. 1956. 3 pp. Starting from general lattice disturbance effects, phenomena occurring at such lattice disturbances especially as represented by grain boundaries are considered. Energy conditions, especially photon or phonon transfer possibilities to the lattice, also the influencing of charge carrier passage through grain boundaries are discussed.

Behavior of the Transistor at High Current Densities, by F. H. Stieltjes and L. J. Tummers. "Phil. Tech." July 27, 1956. 8 pp. The current amplification factor of a transistor is dependent upon the current density, as shown by the falling off of the current amplification factor if the current density is raised sufficiently. An extension of the theory given in an earlier article, to include those cases where the minority concentrations are not everywhere negligible with respect to the majority concentrations, accounts for this effect and indicates how it can be reduced.



TELEVISION

An Experimental Picture-phone. "Bell Rec." Sept. 1956. 2 pp. A slow-scan transmission system is described which presents a new frame each two seconds. Transmission is limited to a 600 cps bandwidth; a 1200 cps carrier is used, thus enabling the use of ordinary telephone lines for the system.

A Magnetic Tape System for Recording and Reproducing Standard FCC Color Television Signals, by Harry F. Olson, et. al. "RCA." Sept. 1956. 63 pp. Compared to the system announced in 1953, the equipment described in this article offers reduced tape speed (down from 30 ft per sec to 20 fps) and increased resolution.

The Effective Output Circuit of a Television Transmitter, by E. S. Glazman. "Radiotek." July 1956. 11 pp. The paper develops concepts concerning methods of suppressing the lower side-band and obtaining the selective frequency characteristic of a television transmitter. On the basis of analyzing the properties of the filter circuits it is shown that there is an advantage in constructing the tuned system of the final stage in the form of a band pass filter. The parameters of the filter are calculated, and experimental results are cited for operational tests of the filter.

High-Resolution Flying-Spot Scanner for Graphic Arts Color Applications, by L. Shapiro and H. E. Haynes. "RCA." Sept. 1956. 16 pp. A high-resolution, slow-speed scanning and reproducing system is described which provides color correction in the production of half-tone plates for color printing. Over-all performance is such that on full-page pictures, prevailing requirements in high-quality magazine printing applications are satisfied. This article deals with the scanner and recorder, in particular.

New Equalizers for Local TV Circuits, by H. M. Thomson. "Bell Rec." Sept. 1956. 4 pp. A variable equalizing attenuator for correction of the accentuated high frequency attenuation of TV transmission cables is described. Loss characteristics of a wide variety of cable lengths can be compensated.

Proposal of a Colour-TV System for the "Gerber"-Standards and the Effect of the Chrominance Subcarrier on the Received Black and White Picture, by J. Piening. "Nach Z." Aug. 1956. 6 pp. Color TV systems for a possible future introduction into the European network are summarized and discussed. This is followed by a report on interference of the added chrominance signal in the black and white TV picture reception.

Color Test Equipment and Test Procedures, by J. Wentworth. "BC News." Aug. 1956. 6 pp. Progress is reported in standardization of differential gain and differential phase measurements. A general discussion of the subject is presented.

The Crystal Palace Television Transmitting Station, by F. C. McLean, A. N. Thomas, and R. A. Rowden. "Proc. BIEE." Sept. 1956. 11 pp. The requirements with which the installation had to conform are given, and the building, plant, and equipment are described. The considerations determining the design of the aerial system are discussed, and its construction and performance described.

The Broadcasting House-Crystal Palace Television Link, by A. R. A. Rendall and S. H. Padel. "Proc. BIEE." Sept. 1956. 7 pp. After a description of present and future needs and equipment, the performance of the link is described in terms of the measured amplitude and differential delay characteristics, transient response, linearity, and signal-to-noise ratio.

Band I Television-Transmitter Design, with Particular Reference to the Transmitters at Crystal Palace, by V. J. Cooper and W. J. Morcom. "Proc. BIEE." Sept. 1956. 13 pp. Description is given of television transmitting equipment designed to operate in two parallel chains to insure reliability.

A Pentode Gun for Television Picture Tubes, by J. C. Francken, J. de Gier and W. F. Nienhuis. "Phil. Tech." Sept. 14, 1956. 9 pp. The gun described is the result of efforts to position the prefocusing lens as near as practicable to the cathode. A description of the development work and the construction of a pentode tube are given.

Image Orthicon for Pickup at Low Light Levels, by A. A. Rotow. "RCA." Sept. 1956. 11 pp. It is shown that signal-to-noise ratio is a direct function, and time lag an inverse function of the ratio of signal current to beam current, and that the beam modulation may be increased by an increase in the spacing between the glass target and mesh screen.

TRANSMISSION LINES

H-Guide—A New Concept in Microwave, by Dr. Friedrich J. Tischer. "El. Ind." Nov. 1956. 3 pp. The unique construction described by the author favors a wave propagation characterized by standing waves reflected between parallel conducting strips; less than 0.1% of the energy travels outside the guide. Design data and typical applications illustrating economy and flexibility are included.

Resonant Phenomena in Two Coupled Low-Loss Transmission-Line Stubs, by N. S. Kochanov. "Radiotek." July 1956. 3 pp. The paper shows that when a fourpole circuit is used to connect the two coupled transmission-line stubs a system is obtained which has a very narrow pass band.

Canonical Presentation of a Group of Dissipative Networks, by B. Gross. "Arc. El. Uber." July 1956. 4 pp. A mathematical transformation leads to an equivalent presentation of dissipative networks consisting of a regular arrangement of two identical systems and purely reactive networks. The method is applied to a dissipative uniform transmission line.

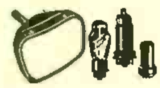
Coupled High-Frequency Transmission Lines for Use as Directional Couplers, by H. Wolf. "Nach. Z." Aug. 1956. 8 pp. A scatter matrix for a simple and easy calculation of the properties of eight-terminal networks consisting of two coupled high-frequency transmission lines is included in the discussion.

Impedance Transformers: Experimental Results with Non-Uniform Lines, by J. Willis and N. K. Sinha. "Wirel. Eng." Sept. 1956. 5 pp. The equipment required for the experimental investigation of the use of non-uniform transmission lines as impedance transformers is discussed and a termination developed to give negligible reflection over a wide frequency band.

Oscillator Frequency Stability: Load Coupled through Long Feeder, by A. S. Gladwin. "Wirel. Eng." Sept. 1956. 12 pp. The author shows that in addition to the well-known hysteresis effects which occur in an oscillator connected to a mismatched load through a long feeder, there also exists a form of periodic modulation of the oscillation frequency which can occur when the load is a resonant circuit. A basic theory is developed from which stability criteria appropriate to the two types of instability and to various circuit arrangements are derived.

The Equivalent Noise-Four-Terminal Network of Transit-Time Tubes, by H. Bauer and H. Rothe. "Arc. El. Uber." July 1956. 16 pp. The parameters of the four-terminal equivalent noise network derived in a previous paper (Arc. El. Uber. 10, 1956) are applicable also to transit-time tubes. The measurement of the parameters of a low-noise traveling-wave tube with inherent defects is given as an example.

Relations Between the Structure of Ferrites and the Conditions for Their Resonance in Wave Guides. Uni-Directional Wave Guides, by J. Suchet. "Onde." June 1956. 12 pp. After a brief recapitulation of fundamental ideas of the physical significance of magnetism in solids, the author indicates the relations which exist between the structure of ferrites and their magnetic properties. The nature of the factor g (effective value) and its derivation from spectroscopic factors of the ions of the system, the calculation of the magnetic moment, as well as the effective field, the nature of the internal compensating field, as well as the influence of manufacturing conditions are all in turn examined.



TUBES

Modern High Power Transmitter Tubes, by O. Pfetscher. "El. Rund." Sept. 1956. 5 pp. A survey of development work and the present stage of high power transmitter tube design is given. Points of view influencing the design of tube components such as cathode, grid, anode, cooling system, and glazing structures are considered.

Noise of Gas Discharge Tubes and its Application for Microwave Noise Measurements, by E. Suchel. "El. Rund." Sept. 1956. 5 pp. The physical mechanism of gas discharge noise is considered from a qualitative and quantitative point of view. The special gas discharge noise diode Valvo K 50 A is described.

The Operation of Glow Transfer Tubes, by J. Adams. "Syl. Tech." July 1956. 5 pp. A general description is given of glow transfer tubes as circuit elements.

Factors in the Design of Computer Tubes, by H. Herbert. "Syl. Tech." July 1956. 5 pp. Interface impedance, gas, grid emission, intermittent shorts, and leakage between elements and their causes are discussed, and the development of a tube in which they are minimized is described. The new tube is a double triode designed specifically for operation in electronic computers. Tests, together with results on 2.5 million tube operating hours, are described.

Low Voltage Beam Switching Tube, by Rudolph A. Cola. "El. Des." Sept. 1956. 4 pp. Design and application considerations are presented for a beam switching tube intended for use with voltages existing in aircraft electrical systems.

Radar Receiver Built Into New CRT Tube, by Philip J. Klass. "Av. Wk." Sept. 17, 1956. 2 pp. A cathode ray tube is described, which, by means of a traveling wave tube amplifier incorporated in the neck of the tube, performs nearly all the functions of a complete radar receiver.

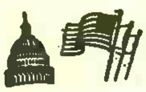
Notes on a Source of Intermittent Noise in Oxide-Cathode Receiving Valves, by M. R. Child. "Proc. BIEE." Sept. 1956. 2 pp. A source of intermittent noise in oxide-cathode receiving tubes is identified with the presence of variable leakage paths between certain electrodes.

A Study of the Modes of Oscillation of the Carcinotron M, by M. de Bennetot. 'Ann. de Radio." July 1956. 9 pp. In a continuation of the previously published portion of this article, the author establishes relations which express the energy exchange between the beam and the field guided by the tube's delay line and the boundary conditions for the interaction space.

New Method of Filling Discharge Vessels, by R. Hubner. "El. Rund." Aug. 1956. 1 p. Present methods for introducing mercury into evacuated vessels (rectifier tubes and thyratrons) are reviewed and a new method described. The new process employs a mercury tablet in which, by thermal disintegration in the presence of a reaction-delaying substance, mercury oxide originates oxygenium which is associated with a reducing agent; a thermite reaction initiated after the degassing process causes the precipitation of mercury.

Magnetic Tuning of Resonant Cavities and Wide-Band Frequency Modulation of Klystrons, by G. R. Jones, J. C. Cacheris, and C. A. Morrison. "Proc. IRE." Oct. 1956. 8 pp. The authors present general expressions for the perturbation of transmission cavities at microwave frequencies by the use of ferrite slabs and magnetic fields.

Performance and Design of Low-Noise Guns for Traveling-Wave Tubes, by R. C. Knechtli and W. R. Beam. "RCA." Sept. 1956. 15 pp. The authors discuss qualitatively the factors determining the performance of low-noise guns in microwave beam amplifiers.



U. S. GOVERNMENT

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Orders for reports designated (OTS) should be addressed to Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. Make check or money order payable to "OTS, Department of Commerce." OTS reports may also be ordered through Department of Commerce field offices.

When an agency other than LC or OTS is the source, use the full address included in the abstract of the report. Make check or money order payable to that agency.

Development of Capacitor, Variable, Hermetically Sealed, Three Sections. Final Report Under Contract No. DA 36-039-sc-15356. (PB 111961), Sprague Electric Co. June 1955. 139 pp. $3.50 (OTS) Describes and reviews in detail the activities conducted in an attempt to produce a hermetically sealed, oil filled, 3-gang tuning capacitor suitable for operation at high altitudes over the temperature range of −70° to 200°C, and which would be unaffected by humidity and vibration.

Research Investigations of Magnetic Material, Permanent Ceramic Type. Second Quarterly Progress Report for the Period Nov. 1, 1954-Jan. 31, 1955 Under Contract No. DA-36-039-sc-56759 (PB 119610), by F. Brockman, P. Beck, and W. Steneck, Jr., Philips Laboratories. Feb. 1955. 22 pp. Mic $2.70, pho $4.80. (LC) Samples of anisotropic material with energy product of 3 x 10^6 gauss-oersteds and over were supplied to the Signal Corps. Studies of the chemical reaction involved were continued using both magnetic analysis and differential thermal analysis.

Distribution Analyzer (PB 119535), by M. Gordon and A. Noyes, Brown U. Jan. 1955. 22 pp. Mic $2.70, pho $4.80. (LC) An 8 channel distribution analyzer was designed to measure the probability distributions of gated and processed signals in the presence of noise.

Ground Calibration of the VOR (PB 121012), by R. Flint and W. Wright, CAA. Oct. 1955. 21 pp. 75¢. (OTS) Report describes a simple and accurate method of calibrating VOR stations with a portable detector mounted on the edge of the counterpoise. Calibration data obtained from ground checks was confirmed by flight tests.

Refractory Materials for Use in High Temperature Areas of Aircraft (PB 121046), Pennsylvania State University for Wright Air Development Center. July 1955. 97 pp. $2.50. (OTS) The report reviews investigation of fracture patterns and microstructures of TiC-cermet stator blades exposed to a simulated service test. Theoretical and experimental studies were made on the oxidation behavior of cermets. The ternary system TiC-TaC-NbC was examined using sintering temperatures up to 2530°C. The sintering behavior of cermet-equivalent oxides was given preliminary study.

Amplitude and Phase Curves for Ground-Wave propagation in the Band 200 Cycles Per Second to 500 Kilocycles (NBS Circular 574). May 21, 1956. 17 pp. 20¢. Government Printing Office. Washington 25, D. C. Curves are presented which provide basic information on ground-wave propagation in the low, very low, and ultra-low frequency bands. Only slightly affected by ionospheric disturbances for ranges up to about 200 miles, they are suitable for communication, navigational systems and geophysical prospecting.

Self-Diffusion in Crystalline Solids and in Liquids (PB 121066), University of Chicago. Dec. 1954. 72 pp. $2. (OTS) Self-diffusion studies at atmospheric pressure are made on pure solid and liquid sodium, alpha-white phosphorus, and single crystal high purity lead. The effect of high hydrostatic pressures on the kinetics of self-diffusion is described for three pure substances; solid sodium, alpha-white phosphorus, and liquid mercury.

Investigation of Methods of Producing Single Crystals of Non-Metallic Ferromagnetic Substances (PB 111934), Brush Laboratories. 66 pp. ($1.75, OTS), (mic. $2.40, LC). A report is given of the successful growth of magnetite crystals during experimentation with the hydrothermal process. Growth occurred in steel autoclaves containing ammonium chloride solution. Pressure was about 22,500 psi. Among various aqueous media used, only ammonium chloride promoted crystal growth through a hydrogen-producing reaction to steel alloys in the pressure vessels. The specific function of the solution is not yet clear.

On-Line Automatic Data Reduction, Tunnel E-1, Gas Dynamics Facility (PB 111810), Arnold Engineering Center. April 1956. 27 pp. 75¢. (OTS) An automatic data reduction system capable of measuring, scanning, computing and presenting results of a wind tunnel test in one continuous operation is described. Operating modes of the system's components are presented as applied to an actual wind tunnel test. The on-line system, which produces reduced data for each test point as a test progresses, is said to tabulate data within minutes after completion of the test.

A High-Speed Shift Register (PB 121060), Ballistic Research Laboratories, U. S. Army. Sept. 1956. 14 pp. 50¢. (OTS) A shift register is described for application to computing machines which operate in the parallel, asynchronous mode—specifically the ORDVAC. The central feature of two designs illustrated is the use of a single-phase shifting pulse which allows optimum utilization of the information-handling rate of the register flip-flops.

Medium-Speed Digital Plotter (PB 121056), Ballistic Research Labs. Oct. 1955. 35 pp. $1. (OTS) An inexpensive solution is given for the problem of digital plotting at medium speeds. Built around a commercially available cutting machine, the system will plot six points per second on a stencil suitable for reproduction by mimeograph or offset.

Sonar Digital Recorder — "Digiter." (PB 121220), Naval Research Laboratory. June 1956. 10 pp. 50¢. (OTS) The Digiter system was developed for automatic processing of sonar data at sea and may have applications in studies other than sonar. Instrumentation is described which prints automatically the acoustic level of a sonar signal in decibels accurate to plus or minus 0.2 db and having a dynamic range of 50 db. The associated range may also be printed.

Reactor Shielding Design Manual (TID-7004), Naval Reactors Branch, AEC, March 1956. 478 pp. $2.10. (OTS) Chapters in the manual cover the basic shielding theory; setting allowable radiation levels; shielding the reactor core and cooling system; plant layout and other factors affecting shield design; shield engineering; radioactivity of shutdown system; effect of irregularities in shield; effect of geometry of radiation; and basic data.

Conference on Materials and Design for Low Temperature Service (PB 121009), U. S. Army Engineer Research and Development Laboratories. Aug. 1956. 400 pp. $10. (OTS) Valuable in particular as a background guide for designers and fabricators of low-temperature equipment, the volume contains papers presented at a conference of materials and design for low-temperature service sponsored by the Scientific Council, Engineer Research and Development Laboratories, held in 1952.

An Experiment in Universal Coding (PB 121055), Ballistic Research Laboratories, U. S. Army. Aug. 1955. 83 pp. $2.25. (OTS) Results are reported of a machine experiment with a simplified, semi-automatic system of universal coding, or a code system common to a large class of different types of modern high-speed digital computers. The test, conducted on EDVAC and ORDVAC, involved two executive routines for each machine and one executive in universal code which each machine translated into its own code.

High-Speed Reader For Perforated Tape (PB 121057), Ballistic Research Labs., U. S. Army. Sept. 1955. 17 pp. 50¢. (OTS) A perforated-tape reader which is simple in concept, trouble-free, and very fast is described, including schematic diagrams and typical observed wave shapes.

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D. C.

Pulse Signaling Systems, #2,756,274. Inv. L. Ch. Stenning. Assigned General Electric Co. Ltd. Issued July 24, 1956. A particular instant or a succession of instants are identified by at least two separate electric pulse signals which consist of trains of pulses having recurrence frequencies which are not commensurable. These pulse signals are combined by addition to a pulse signal in which the pulses themselves can not be distinguished.

Cathode Input Amplifiers, #2,756,283. Inv. H. M. Bach. Assigned RCA. Issued July 24, 1956. The input is applied to the cathode of a triode which is so connected that it will operate as an amplifier for certain frequencies and as a diode for other frequencies. The effective diode interelectrode capacities are neutralized to minimize signal transmission at the diode-operating frequencies.

Transistor Multivibrator, #2,757,286. Inv. C. L. Wanlass. Assigned North American Aviation, Inc. Issued July 31, 1956. Reactive impedances are connected in the collector circuits of a pair of transistors, and a diode each is connected between the emitter electrode of each transistor and a common resistor.

Impedance Inverter, #2,757,345. Inv. B. P. Bogert. Assigned Bell Tel. Labs., Inc. Issued July 31, 1956. To provide an input impedance bearing an approximately reciprocal relation to a load impedance, the input impedance of a tube is made much larger than the output impedance, which is much larger than a feedback resistance, which is much larger than the load impedance, which is much larger than its product with the transconductance of the tube, which product is much larger than unity.

Precision Phase Measuring Circuit, #2,756,390. Inv. W. J. Albersheim. Assigned Bell Tel. Labs., Inc. Issued July 24, 1956. A stable reference voltage vector is combined with the signal voltage vector subject to phase variations and residual amplitude variations and their algebraic sum is measured. The circuit includes provisions for adjusting the phase of the signal voltage to oppose that of the reference voltage to have equal average amplitude. Then the phase of the signal may be shifted from 20 to 60 degrees while the amplitude is adjusted proportional to the cosine of the angle by which it is shifted, whereby the algebraic sum will change with phase variations.

Class B Signal Amplifier Circuits. #2,761,917. Inv. A. U. Aronson. Assigned RCA. Issued Sept. 4, 1956. A pair of transistors constitutes a driver stage and is dc coupled to a pair of resistors constituting the output stage; all transistors operate as push pull class B amplifiers. To stabilize the operation of this amplifier, a further transistor, responsive to the difference of the current flow through the drive and output stage transistors, is provided. Its output is applied to the driver stage.

Phase Rotator, #2,762,012. Inv. D. M. Kaltenbacher. Assigned Bendix Aviation Corp. Issued Sept. 4, 1956. The plate and cathode output of opposite phase of an amplifier tube are combined over a pair of serially connected resistors. One resistor being connected by a continuously variable to one output terminal, the tap being coupled to an input-phase reversing switch.

Semiconductor Signal Translating Devices, #2. 756,285. Inv. Wm. Shockley. Assigned RCA. Issued July 24, 1956. Four adjacent zones of alternately opposite conductivity are arranged to extend longitudinally to form a signal transducing device. Biasing potentials are applied to produce a space charge region at each of the junctions between adjacent zones which increases in thickness from the input to the output end. Charges are induced on the two intermediate zones at the input end and an output circuit connected to these zones at the output end.

Audio-Noise Responsive Squelch Circuit, #2,-756,328. Inv. D. J. Braak. Assigned Hartford National Bank and Trust Co. Issued July 24, 1956. The radio receiver includes a detector whose noise output level decreases substantially upon occurrence of a signal voltage. The noise output of the detector is fed to an amplifier tube adapted to produce in the absence of a signal voltage a control signal which blocks the detector-output amplifying channel only during the existence of a noise voltage.

Tone Generator System, #2,756,332. Inv. A. Bissonette. Assigned Baldwin Piano Co. Issued July 24, 1956. A system for producing a plurality of harmonically related frequencies consists of a master oscillator and a plurality of series connected inductively coupled blocking oscillators. Each grid-cathode circuit of the blocking oscillators includes a frequency-determining unit consisting of a resistor and a grounded capacitor. A further resistor in series with the first resistor is connected to a voltage source, the output being taken off the junction of the two resistors.

Subscription Television System, #2,758,153. Inv. R. Adler. Assigned Zenith Radio Corp. Issued August 7, 1956. The encoding arrangement uses a beam type tube, the beam being sheet-shaped. The video signal intensity-modulates the beam which is alternately deflected to two beam-receiving electrodes in accordance with a coding schedule. One of the beam-receiving electrodes feeds the received signal to a delay line; the delayed and undelayed signals are combined to supply the output so that the resulting video signal components correspond to the impressed video-signal components but have a coded timing schedule.

Microwave Amplifier Employing a Microwave Resonant Gas as the Amplifying Element, #2,762,872. Inv. R. H. Dicke. Issued Sept. 11, 1956. A hollow wave chamber contains gas capable of molecular resonance at low pressure. A static perturbing field is applied to the gas near one chamber wall. Microwave energy at the gas resonance frequency is applied to the gas, whereby gas molecules striking the wall are tuned to resonance. These tuned molecules present negative attenuation to microwave energy at a different frequency traveling through the gas.

Transistor Bias Circuit with Stabilization, #2,762,873. Inv. H. C. Goodrich. Assigned RCA. Issued Sept. 11, 1956. A battery negatively biases the collector electrode of a transistor. A high resistance dc path connects the collector to the base for stabilization. For further stabilization a resistive dc path connects the emitter with the base, this path including a dc potential source, to stabilize the operating point which varies due to the static operating characteristics of the transistor.

Device Comprising an Electric Discharge Tube Having a Concentrated Electron Beam, #2,-762,916. Inv. A. J. W. M. v. Overbeek. Assigned Hartford National Bank and Trust Co. Issued Sept. 11, 1956. The electron beam of a tube extends into a field free region where it enters a cage-like electrode. The operating potential at this and other electrodes are of such magnitudes that a space charge is established in the cage-like electrode which space-charge is controlled by the input signal. This results in a splitting of the beam between a first and a second collector electrode in accordance with the intensity of the input signal, one of these electrodes providing the output.

Low-Frequency Relaxation Oscillator, #2,762,-919. Inv. H. D. Kimp. Assigned Hoffman Electronics Corp. Issued Sept. 11, 1956. A repetition frequency of one cycle or less is obtained from a gaseous discharge oscillator having a long time-constant resistance-capacitance circuit coupled to its cathode from which feedback is derived for the grid. A relay and capacitor in parallel are connected in the plate circuit, the relay contact being adapted to short-circuit the resistance-capacitance circuit when the relay is energized and to apply a positive voltage thereto when the relay is de-energized.

Blocking Oscillators, #2,762,920. Inv. T. A Weil. Assigned Raytheon Manufacturing Co. Issued Sept. 11, 1956. A transformer primary is connected into the plate circuit of a tube, the transformer secondary in parallel with a resistor supplying the output. A trigger pulse is fed to a grid transformer, the secondary of this transformer being in series with the primary of the first transformer, its other terminal being connected to the plate supply, whreby a regenerative current feedback proportional to the load circuit current is effected.

Pulse Frequency Divider, #2,762,923. Inv. B. O. Quinn. Assigned Stewart-Warner Corp. Issued Sept. 11, 1956. A timing circuit is triggered by the output of an amplifier tube. The trigger circuit supplies a negative potential for a predetermined time interval after being triggered which potential is used to cut off the current through the amplifier tube for this time interval.

Method for Assembling Transistors, #2,762,954. Inv. Meyer Leifer. Assigned Sylvania Electric Products Inc. Issued Sept. 11, 1956. A body of semi-conductive material engages a large area contact while it has, preferably on its other side, an upstanding rib between laterally extending surfaces constituting a base portion. The two sides of the rib form a pair of inside corners with the base portion at their junction. A pair of whiskers engage the rib from opposite sides and in the pair of inside corners, the rib being sufficiently thin to enable interaction between the whiskers.

Carrier-Sensing Anti-Noise Receiving System, #2,761,062. Inv. W. H. Wirkler. Assigned Collins Radio Co. Issued Aug. 28, 1956. A received carrier is passed through a first and second frequency conversion stage, part of the output of each conversion stage being fed to a product detector responsive to simultaneous signal reception. Two rectifying channels are connected in parallel to the product detector output, both channels being excited in phase-quadrature by the local oscillator for the second conversion stage. The direct rectifier output, representing the carrier, is separated from the alternating output, representing the noise.

Synchronizing Circuit, #2,761,895. Inv. R. M. Snyder. Assigned International Telephone and Telegraph Corp. Issued Sept. 4, 1956. An oscillator feeds a line-frequency wave to the grids of a full-wave rectifier. The plates of the rectifier are connected to a field-scanning frequency multivibrator in such a manner that it operates as a half-wave rectifier of alternate half-wave polarity, which are used for the generation of line-scanning pulses. The multivibrator output is converted to provide a signal having twice the field-scanning frequency.

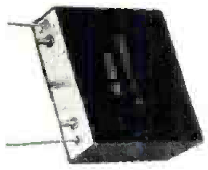
Electronic Device for Automatically Discriminating Between Speech and Music Forms, #2,761,897. Inv. R. C. Jones. Issued Sept. 4, 1956. A level change indicator responsive to predetermined rapid changes in signal level and producing an output indicative of the amplitude and speed of the change receives the audio signal. An electronic memory providing a measure of the immediate past history of the indicator output controls a two-position unit, indicating speech and music, respectively.

Traveling-Wave Tube Automatic Gain Control, #2,752,430. Inv. D. A. Watkins. Assigned Hughes Aircraft Co. Iss. June 26, 1956. A signal wave is propagated along a path having two substantially exclusive parallel portions at a velocity substantially less than that of light. A first electron beam interacts with the wave along the first portion of the path to amplify the wave and a weaker second electron beam along the second portion of the path. The amplified signal controls the current of the second electron stream which in turn controls the amplitude of the signal wave.

Tone-Control Circuit Arrangement for Use in Low-Frequency Amplifier, #2,752,432. Inv. G. R. Richter. Assigned Hartford National Bank and Trust Co. Iss. June 6, 1956. The unbypassed cathode resistors of two successive stages are connected by a resistor for producing positive feedback. A capacitor, bypassing the high-frequency components of the signal, is inserted between a point on the feedback resistor and ground. A negative feedback impedance connected to the signal side of the capacitor can be switched into the circuit to the input side of the first stage.

Method and Apparatus for Electrical Filtering, #2,752,574. Inv. H. F. Ragland. Assigned G.E. Iss. June 26, 1956. To attenuate only the undesired frequency components of a signal, a variable function inversely related to the desired signal components is produced. The original signal is multiplied by the variable function, resulting in an electric quantity having a substantially constant component which is a function of the desired signal component. Attenuation of the high frequency components and electrically dividing by said variable function reproduces the desired signal component.

Automatic Signal Level Versus Time Analyzer, #2,752,589. Inv. C. O. De Long. Assigned Collins Radio Co. Iss. June 26, 1956. The apparatus indicates the percentage of time which a signal exceeds a plurality of set levels. The signal is passed through a plurality of independently adjustable threshold circuits, each followed by a gate tube controlled by a suitably shaped pulse. Counters receiving, respectively, the outputs of the gate tubes, indicate the desired quantity.



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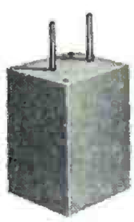

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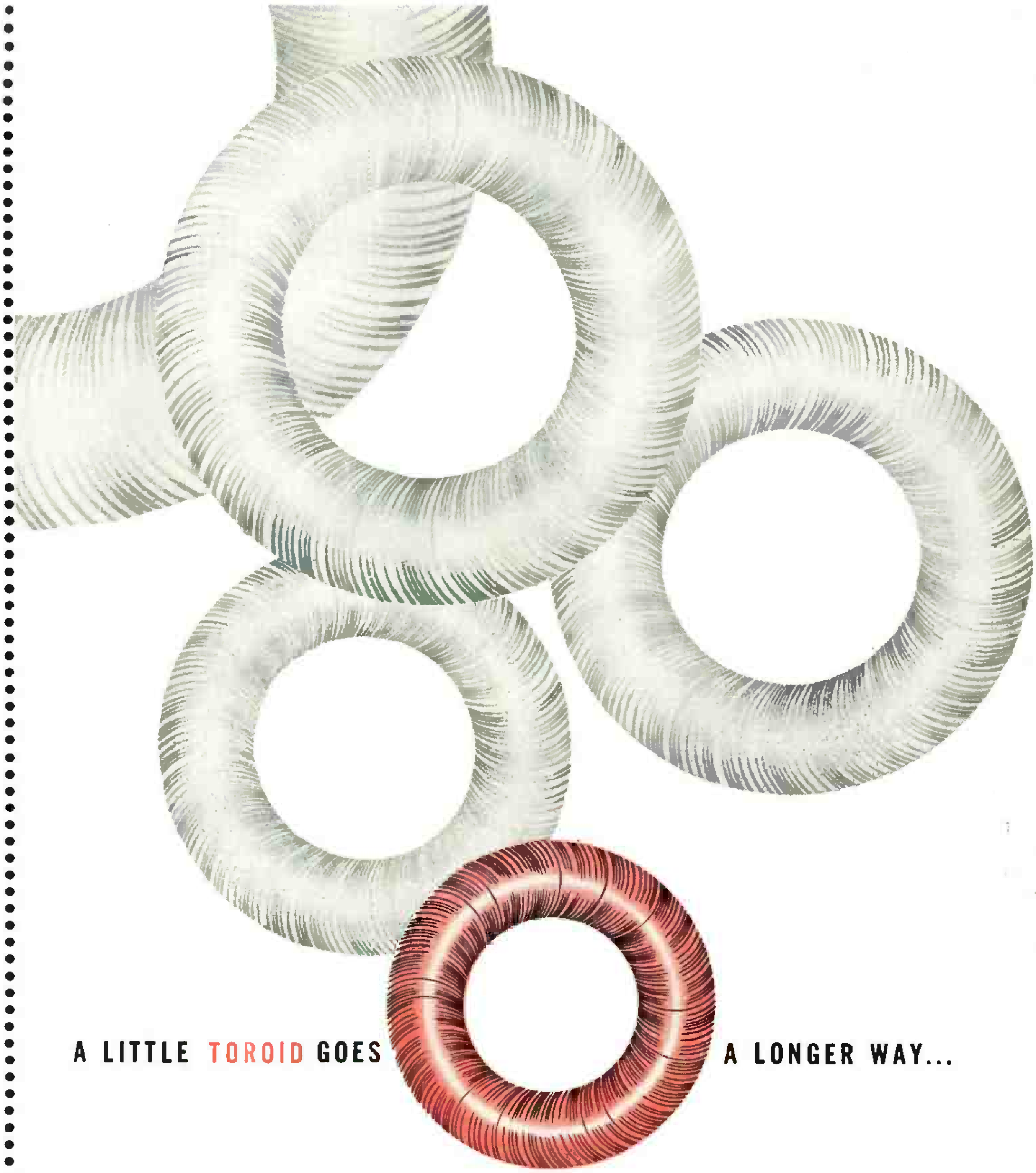

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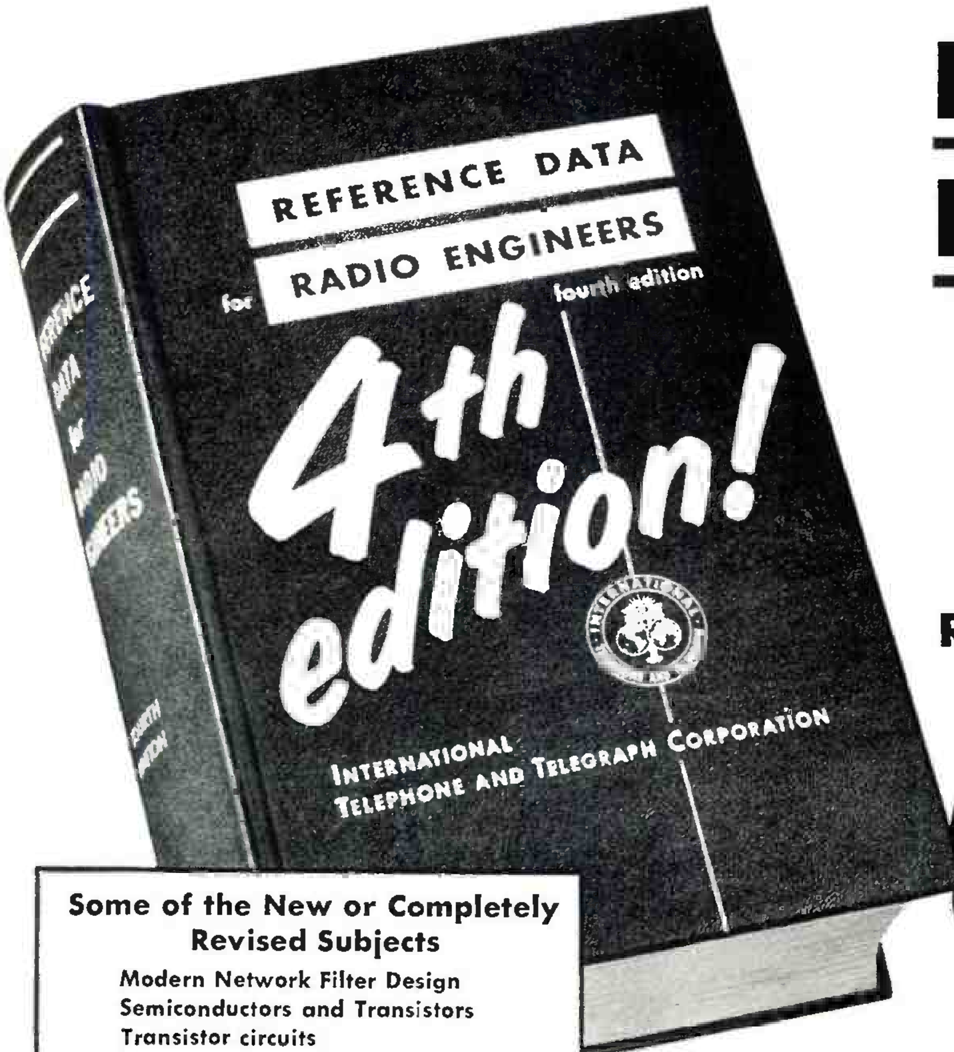

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ELECTRON DEVICES—3000 Members—Russell R. Law, Chairman; Harry L. Thorson, Sec. . . . Annual Meeting Oct. 25-26 . . . At Washington, D. C. . . . Electron devices, including particularly electron tubes and solid state devices.

ELECTRONIC COMPUTERS—4970 Members—Dr. Jerre D. Noe, Chairman; . . . Design and operation of electronic computers.

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INDUSTRIAL ELECTRONICS — 1600 Members—Carl E. Smith, Chairman . . . Educational Conference, April . . . Inst. of Tech., Chicago, Ill. . . . Industrial Conference, Sept. or Oct. . . . Electronics pertaining to control, treatment and measurement, specifically in industrial processes.

INFORMATION THEORY—2450 Members—Dr. M. J. DiToro, Chairman . . . Symposium on Information Theory, Fall 1957—place unknown . . . Information theory and its application in radio circuitry and systems.

INSTRUMENTATION — 3000 Members — Frank G. Marble, Chairman . . . IRE Annual Instrumentation Conf. & Exhibit, Dec. 5-7, Atlanta, Ga. . . . Measurements and instrumentation utilizing electronic techniques.

MEDICAL ELECTRONICS—1675 Members—Dr. V. K. Zworykin, Chairman . . . Annual Conference on Electrical Techniques in Medicine and Biology, Nov. 8, McAlpin Hotel, New York . . . The application of electronics engineering to the problems of the medical profession.

MICROWAVE THEORY AND TECHNIQUES — 3000 Members — Herbert F. Engelmann, Chairman; . . . Microwave theory, circuitry and techniques, measurements and the generation and amplification of microwaves.

MILITARY ELECTRONICS—3000 Members—2480 16th St., N.W. Washington. D. C. ADams 4-6830 . . . Capt. Christian L. Engleman, Chairman; . . . Annual Conv. June 17-19 . . . At Sheraton Park Hotel, Washington, D. C. . . . This group is concerned with the electronic sciences, systems, activities, and services germane to the requirements of the military.

NUCLEAR SCIENCE—1238 Members—W. E. Shoupp, Chairman . . . Meeting Sept. (T), New York City Area (T) . . . To promote interest and advancement of the practice of engineering in the field of nuclear science.

PRODUCTION TECHNIQUES—725 Members—R. R. Batcher, Chairman . . . New advances in methods, processes, materials and components in design and manufacture of electronic equipment.

RELIABILITY AND QUALITY CONTROL — 1200 Members — Victor Wouk, Chairman; . . . Meetings Jan. 14-15 . . . At Washington, D. C. . . . Techniques of determining and controlling the quality of electronic parts and equipment manufacture.

TELEMETRY AND REMOTE CONTROL—1189 Members—Miffourne 800 . . . Conrad H. Hoeppner, Chairman; . . . Annual Conv. March 21-23 . . . At Phila., Pa. . . . The control of devices and the measurement and recording of data from a remote point by radio.

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INSTRUMENT SOCIETY OF AMERICA—10,000 Members—313 6th Ave., Pittsburgh 13, Pa. Atlantic 1-3171 . . . J. T. Vollbrecht, Pres.; Robert J. Jeffries, Sec. . . . Annual Conv. Sept. 9-13 . . . At Cleveland, Ohio . . . Devoted exclusively to the fields of instrumentation, automatic control and automation.

INTERNATIONAL MUNICIPAL SIGNAL ASSOCIATION—1650 Members—130 W. 42nd St., New York 36, N. Y. CH 4-4663 . . . Larry H. Soare, Pres.; Irvin Shulsinger, Sec. . . . Annual Conv. Sept. 16-19 . . . At Hotel Fontainebleau, Miami Beach, Fla. . . . Advancement and improvement of municipal signal and communication systems.

JOINT ELECTRON TUBE ENGINEERING COUNCIL OF RETMA AND NEMA—6 Members—11 W. 42nd St., New York 36, N. Y. . . . V. M. Graham, Chairman; F. J. Martin, Sec. . . . Annual Conv. not determined . . . To develop standards, proposals, and data dealing with electron tubes and allied sealed devices.

JOINT TECHNICAL ADVISORY COMMITTEE—8 Members—1 E. 79th St., New York 21, N. Y. LE 5-5100 . . . Dr. Ernest Weber, Chairman; L. G. Cumming, Sec. . . . Annual Conv. none . . . To assist the Federal Government and Industry on electronic engineering matters and on an engineering basis.

MAGNETIC RECORDING INDUSTRY ASSOCIATION—37 Members—274 Madison Ave., New York 16, N. Y. OR 9-0030 . . . Joseph F. Hards, Pres.; Herman Kornbrodt, Sec. . . . Annual Conv. May(T) . . . At Chicago (T) . . . Further the uses of magnetic recording and to bring about a better understanding among the dealers, distributors and manufacturers in the industry.

NATIONAL ALLIANCE OF TV & ELECTRONIC SERVICE ASSNS.—58 Members—5908 S. Troy Ave., Chicago 29, Ill. GR 6-6363 . . . Frank J. Moch, Exec. Dir.; Robert Hesfer, Pres. . . Meetings Aug. 23-25 . . . At Sheraton Hotel, Chicago . . . To unite ethical local and regional associations into a national group working cooperatively.

NATIONAL APPLIANCE AND RADIO-TV DEALERS ASSOCIATION — 1141 Merchandise Mart, Chicago 54, Ill. Michigan 2-5505 . . . A. W. Bernson, Managing Dir. . . . Annual Conv. Jan. 13-15 . . . At Conrad Hilton Hotel, Chicago, Ill. . . . Build better dealers by closer relationship, further their knowledge and provide various services.

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NATIONAL ASSOCIATION OF MUSIC MERCHANTS — 1500 Members — 25 E. Jackson Blvd., Chicago 4, Ill. HA 7-2150 . . . Paul E. Murphy, Pres.; William R. Gard, Exec. Sec. . . . Annual Conv. July 15-18 . . . At Palmer House Hotel, Chicago, Ill. . . . For the mutual advancement of individuals and organizations selling at retail.

NATIONAL ASSOCIATION OF RADIO AND TELEVISION BROADCASTERS—2115 Members—1771 N. St., N.W. Washington 6, D. C. DE 2-9300 . . . Harold E. Fellows, Pres.; Everett E. Revercomb, Sec. . . . Annual Conv. April 7-11 . . . At Conrad Hilton Hotel, Chicago, Ill. . . . Advancement of aural and visual broadcasting arts.

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(Continued on page 114)

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Grid Parabola

(Continued from page 61)

The parabolic grid itself is easily de-iced by means of heater wire fastened to the back side of the tubes and run along the various grids. Both the heat lamp and the heater wires are conveniently controlled from a thermostat controller which operates in the range of 25 to 35 degrees F.

H-plane pattern for open grid parabolas are shown in Fig. 3. The beam widths and minor lobe structure are almost identical to those obtained with a solid spun parabola or a mesh dish. The front-to-back ratio has been measured at better than 30 db for the grid parabolas. This represents about the best attainable with commercial units today and probably is due primarily to spill over from the feed rather than feed through the grid structure, since front-to-back ratios of 30 db are representative of good solid spun parabola designs.

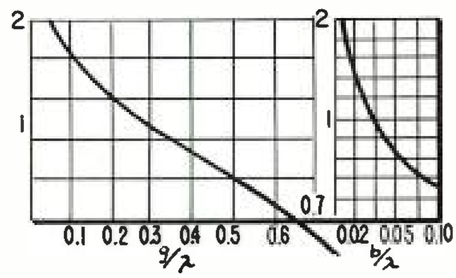

Fig. 4: Bar diam. for reflection.

All gain measurements on these parabolic designs have been made utilizing a gain standard horn[3] and measurements obtained by this comparison method check closely with predicted values from theory as well as integrated patterns.

Within the range of frequencies especially adapted to this grid structure such as the 890-960 MC region, the multi-element grid parabola presents distinct advantages of low weight, low wind resistance, ease of fabrication especially in the larger sizes, and appreciable savings in tower and erection costs over installations utilizing standard spun or mesh dishes.

References

1. Harris, E. F. "An Experimental Investigation of the Corner Reflector Antenna"; Proceedings of the IRE, May 1953, pp. 645-651.
2. Moullin, E. B. "Radio Aerials," Oxford at the Clarendon Press, 1949.
3. Slayton, W. "Design of Microwave Gain Standard Horns," Electronics, July 1955, pp. 150-154.

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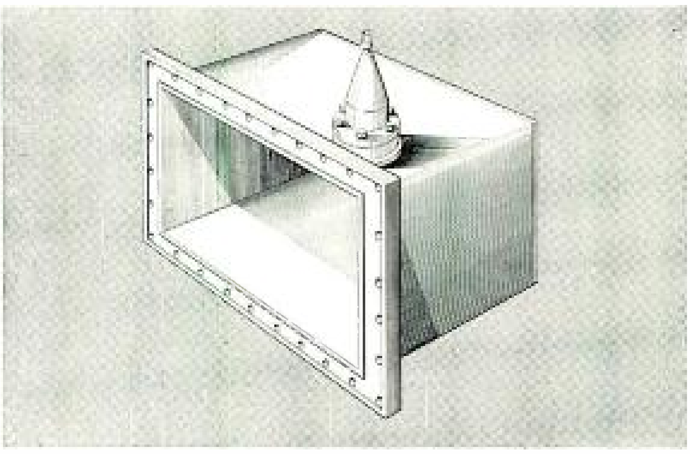

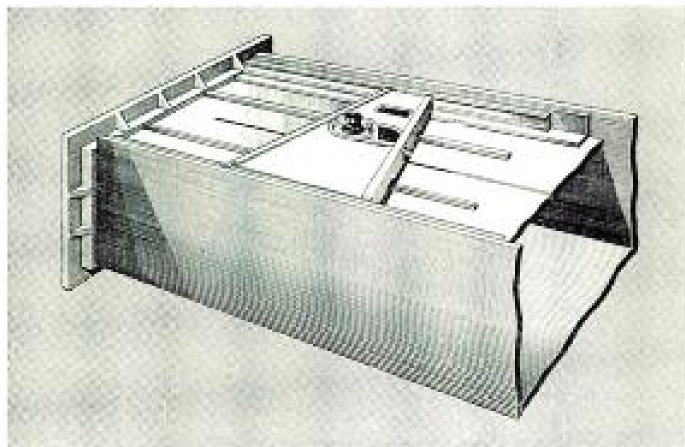

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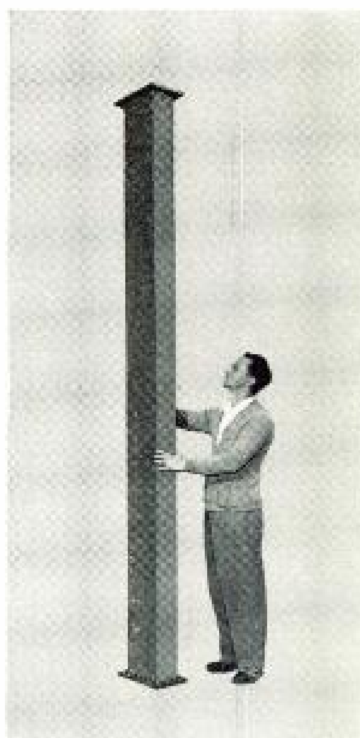

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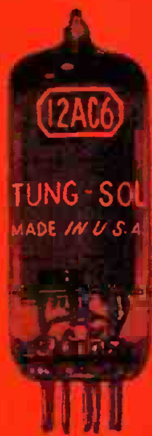

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NATIONAL CONFERENCE ON AERONAUTICAL ELECTRONICS—321 W. Norman Ave., Dayton 5, Ohio . . . Saul Weisman, Pres.; Margret T. Penman, Sec.; . . . Annual Meeting May 13-15 . . . At the Biltmore Hotel, Dayton, Ohio . . . To disseminate the latest developments in aeronautical electronics.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION—570 Members—155 E. 44th St., New York 17, N. Y. MUrray Hill 2-1500 . . . J. W. Corey, Pres.; Joseph F. Miller, Mgr. Dir. . . . Annual Conv. Nov. 11-15. . . . At Hotel Traymore, Atlantic City, N. J. . . . To disseminate information and to develop industry standards.

NATIONAL ELECTRONIC DISTRIBUTORS ASSOCIATION—450 Members—4704 W. Irving Park Rd., Chicago 41, Ill. AV 3-6445 . . . Joseph A. DeMambro, Pres.; John G. Bowman, Sec. . . . Annual Conv. Meeting May 19 . . . At Hilton Hotel, Chicago . . . The dissemination of information concerning the electronics industry.

NATIONAL ELECTRONICS CONFERENCE, INC.—84 E. Randolph St., Chicago 1, Ill. FR 2-1211 . . . Officers not elected yet . . . Annual Conv. Oct. 7-9 . . . At Hotel Sherman, Chicago . . . A national forum on electronics.

NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS—38,000 Members—2029 K St., N.W. Washington 5, D. C. ME 8-6112 . . . Robert J. Rhinehart, Pres.; Paul H. Robbins, Exec. Dir. . . . Annual Conv. June 6-8 . . . At Statler Hotel, Dallas, Texas . . . Devoted to social, professional, economic, and ethical aspects of engineers.

OPERATIONAL FIXED MICROWAVE COUNCIL—38 Members—No fixed address . . . Robert W. Olin, Chairman; Robert L. Abel, Sec. . . . Annual meeting undetermined . . . To foster mutual interest of organizations concerned with operational fixed radio systems.

PHONOGRAPH MANUFACTURERS ASSOCIATION — 10 Members — 562 5th Ave., New York 36, N. Y. CI 6-2940 . . . Joseph Dworken, Pres.; A. D. Adams, Exec. Sec. . . . A non-profit organization to foster the mutual interests of its members in the electronic industries.

PURCHASING AGENTS OF THE RADIO & TV INDUSTRY—80 Members—282 22nd St., Brooklyn 15, N. Y. SO 8-7754 . . . Herb Katz, Pres.; B. J. Trimboli, Sec. . . . Provide a better understanding of the industry.

RADIO AND TELEVISION EXECUTIVES SOCIETY—1000 Members—The Biltmore, New York 17, N. Y. MUrray Hill 9-3480 . . . Robert J. Burton, Pres.; Claude Barrere, Sec. . . . No annual convention . . . A fraternity of persons professionally interested in radio and television broadcasting and allied fields.

RADIO CLUB OF AMERICA, INC.—450 Members—11 W. 42nd St., New York 36, N. Y. LO 5-6622 . . . Frank A. Gunther, Pres.; James Morelock, Sec. . . . Annual dinner in Dec. . . . To interchange ideas among all radio enthusiasts.

RADIO - ELECTRONIC - TELEVISION MANUFACTURERS ASSOCIATION—375 Members—177 14th St., N.W. Washington 5, D. C. National 8-3902 . . . W. R. G. Baker, Pres.; James D. Secrest, V.P. & Sec. . . . Annual Conv., May 15-17 . . . At Sheraton Hotel, Chicago . . . Non-profit association of the radio-electronics-television industry.

(*Continued on page 116*)

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...they chose Microwave

When the South Carolina Continental Telephone Company wanted to provide toll circuit facilities, they compared the cost of expanding existing land line circuits with the cost of a Microwave Carrier System. They found the difference of installation costs to be very small.

Maintenance costs and quality of service then became the deciding factors . . . so they chose Microwave. Now, customers between Bishopville and the toll center of Sumter, South Carolina, get excellent toll service, regardless of weather conditions. In addition, the company has eliminated 21 miles of right-of-way maintenance problems. Initially equipped with 12 channels, the system can be easily expanded to 24 channels.

An important part of this system is a 100 foot Blaw-Knox hot dip galvanized steel tower erected adjacent to the Telephone Company's building. The Lenkurt Electric Company Microwave and Channelizing equipment was supplied by Automatic Electric Sales Corporation.

We'd like to help you plan better service for *your* customers. Write today for Booklet 2516, which illustrates Blaw-Knox Microwave Towers and describes Blaw-Knox tower engineering, design, fabrication and erection services.

BLAW-KNOX COMPANY

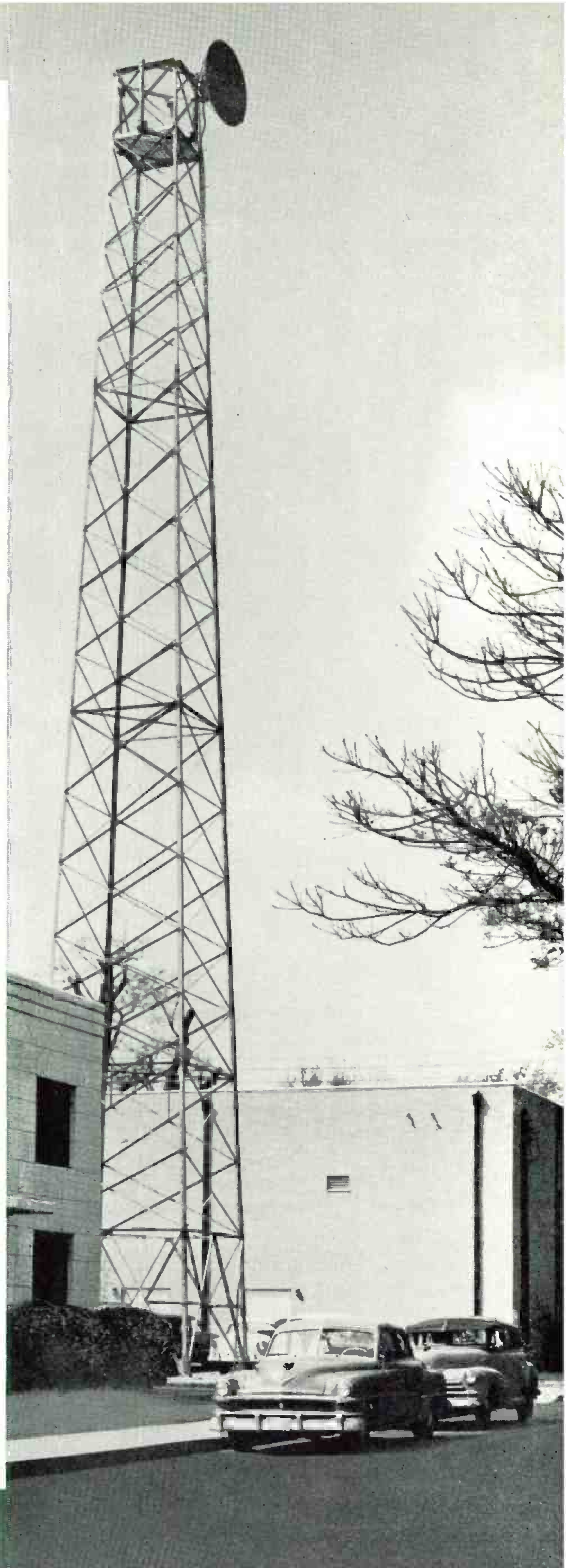
BLAW-KNOX EQUIPMENT DIVISION
PITTSBURGH 38, PENNSYLVANIA

MICROWAVE TOWERS

50th Anniversary BLAW-KNOX 1906-1956

Guyed and self-supporting type towers for Microwave • AM • FM TV • Communications • Radar

Member



Electronic Associations (cont.)

RADIO PIONEERS—1050 Members—589 5th Ave., New York 17, N. Y. PL 9-1500 . . . Clair McCullough, Pres.; M. H. Shapiro, Sec. . . . Annual Conv. April 10 . . . Conrad Hilton Hotel, at Chicago . . . Persons with long years of service in radio.

RADIO TECHNICAL COMMISSION FOR AERONAUTICS — 120 Members — Rm. 2036, Bldg. T-5, 16th and Constitution Ave., N.W. Washington 25, D. C. ST 3-8984 . . . Dr. J. Howard Dellinger, Chairman; L. M. Sherer, Sec. . . . Annual Conv. undetermined . . . To advance the art and science of aeronautics through the applications of the telecommunication art.

RECORD INDUSTRY ASSOCIATION OF AMERICA—50 Members—1 E. 57th St., New York 22, N. Y. MU 8-3778 . . . Frank B. Walker, Pres.; John W. Griffin, Exec. Sec. . . . Annual Conv. March . . . At New York Athletic Club . . . To disseminate information to its members, and promote beneficial relations.

REPRESENTATIVES OF ELECTRONIC MANUFACTURERS PRODUCTS, INC. —515 Members—600 S. Michigan Ave., Chicago 5, Ill. HArrison 7-2402 . . . R. W. Farris, Pres.; R. Diethert, Sec. . . . Meeting May . . . At Chicago, Ill. . . . Express purpose is to bring the representative and manufacturer together.

SCIENTIFIC APPARATUS MAKERS ASSOCIATION — 221 Members — 20 N Wacker Dr., Chicago 6, Ill. STate 2-0277 . . . Henry F. Denver, Pres. . . . Annual Conv. . . . April 27-May 2 . . . At White Sulphur Springs, W. Va. . . . Companies manufacturing and distributing laboratory and industrial instruments, apparatus and supplies.

SOCIETY OF MOTION PICTURE AND TELEVISION ENGINEERS—5842 Members—55 W. 42nd St., New York 36, N. Y. LO 5-0172 . . . Officers for 1957 not available . . . Annual Conv. 81st—April 29-May 3 . . . At Shoreham Hotel, Washington, D. C. . . . Advancement of theory and practice of engineering in motion pictures, television, allied arts and sciences.

SOCIETY OF PLASTICS ENGINEERS, INC.—5000 Members—34 E. Putnam Ave., Greenwich, Conn. GR 8-5617 . . . Jerome Formo, Pres.; Peter W. Simmons, Sec. . . . Annual Conv. Jan. 16-18 . . . At St. Louis, Mo. . . . To promote arts, sciences, standards, and engineering practices of plastics.

ULTRA HIGH FREQUENCY TV ASSOCIATION—55 Members—600 Continental Bldg., 1012 14th St., N.W. Washington, D. C. NA 8-0032 . . . Lou Poller, Pres.; Wm. A. Roberts, Gen. Counsel . . . To promote and foster use of UHF for television broadcasts.

ULTRASONIC MANUFACTURERS ASSNS.—19 Members—67 Mulberry St., Hartford 3, Conn., Wm. C. Potthoff, Pres.; N. B. Branson, Sec. . . . Promote growth of the ultrasonics industry.

VETERAN WIRELESS OPERATORS ASSOCIATION—400 Members—149 President St., Lynbrook, N. J. WH 4-1700 . . . Wm. J. McGonigle, Pres.; Wm. C. Simon, Sec. . . . Meetings, May and Oct. . . . At Sheraton-Astor Hotel, New York . . . To foster and extend esprit de corps among wireless operators.

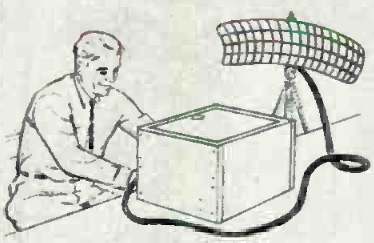
WEST COAST ELECTRONIC MANUFACTURERS ASSOCIATIONS—225 Members—342 N. LaBrea, Los Angeles, Calif. . . . Thomas P. Walker, Pres.; John A. Chartz, Sec. . . . Annual Conv. Aug. 20-23 . . . At Cow Palace, San Francisco, Calif. . . . To advance electronic industries in the west.

MAXIMUM BROADBAND
MICROWAVE
POWER

650 to 10,750 mc

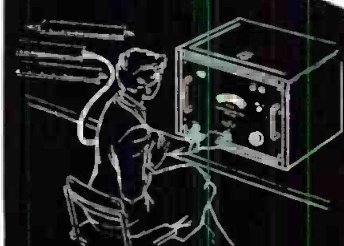
for standing wave determinations

Fast Uni-Dial operation saves engineering manhours in the laboratory.



for antenna and transmission loss measurements

Assured full power output throughout range.



for testing microwave components on the production line

±1% frequency accuracy.

microwave signal sources

When you need power — and frequency accuracy — Polarad Microwave Signal Sources provide a maximum power output 10 to 20 db greater than comparable signal generators. They are excellent for standing wave determinations, antenna and transmission loss measurements, and testing microwave components on the production line.

These units are direct reading and continuously tuned with Polarad's UNI-DIAL control that automatically tracks the reflector voltage as the klystron cavity is being tuned. There are no slide rule interpolations, no mode charts needed. The frequency range of these signal sources is approximately 2:1 except for the X band unit.

Maximum power output is assured throughout the entire range of each instrument by means of a power set control. For improved stability a temperature compensated klystron tube is utilized in an external precision cavity. All Polarad Signal Sources can be externally modulated with either square wave or FM signals.

Polarad Model KX Klystron Power Supply is especially designed to work with all 5 Models of the Polarad Signal Sources. Has special 1,000 cps square wave output for modulating purposes.

Available on the Equipment Lease Plan. Contact the Polarad representative in your locality for complete information.

MINIMUM POWER AVAILABLE FROM POLARAD SIGNAL SOURCES IN THE RANGE OF 650 TO 10,750 MC

FREQUENCY RANGE		MODEL SSR 650-1300MC	MODEL SSL 1050-2250MC	MODEL SSS 2140-4600MC	MODEL SSM 4450-8000MC	MODEL SSX 7850-10,750MC	MODEL SSXA 7850-11,500MC
MINIMUM POWER AVAILABLE (mw)	LOW RANGE	100	80	50	15	13	Available on Special Order
	MIDDLE RANGE	400	150	100	45	35	
	HIGH RANGE	400	150	60	15	20	

A complete line of Extremely High Frequency Microwave Signal Sources also available in a range of 12.4 to 50.0 KMC

Immediate Maintenance Available by Field Service Specialists

POLARAD PROVEN RELIABILITY

ELECTRONICS CORPORATION

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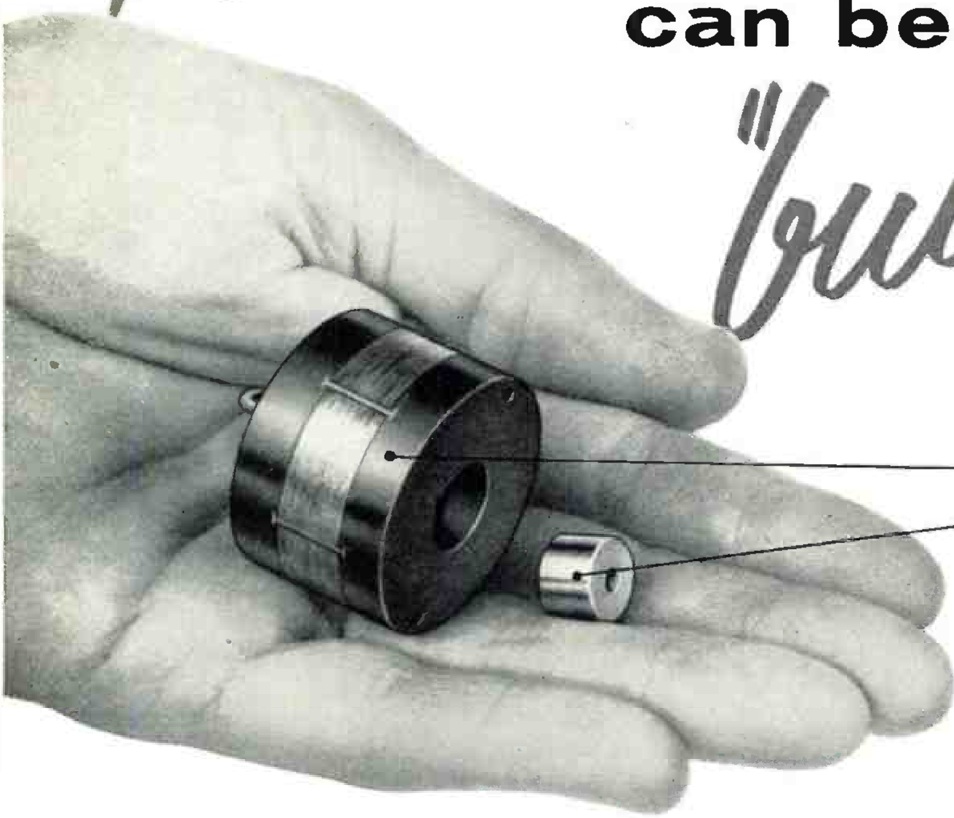
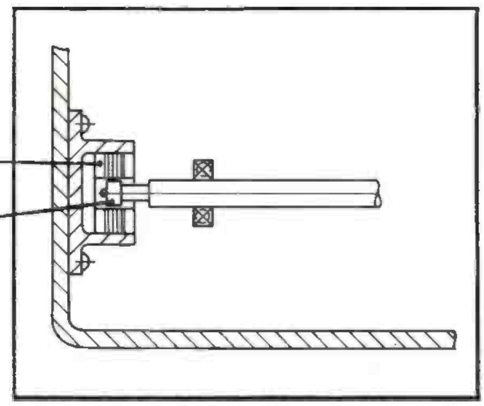
For product information, use inquiry card on page 137.

Now... The TACHOMETER GENERATOR can be *"built-in"*

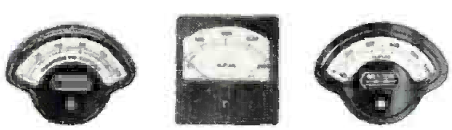




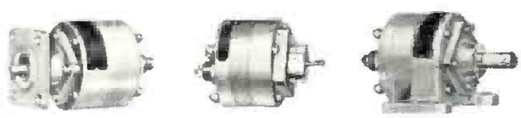
Weston bearingless tachometer generator mounted inside equipment housing. Where external mounting is required, however, pad type projects only 2½″.

WESTON Bearingless Tachometers save Space . . . Weight . . . Cost!

With the Weston bearingless design, the tachometer generator can now be built-in, rather than attached to, rotary equipment. But where external mounting is essential, the special pad housing projects only 2½″. Either way, it means big *weight saving* and *space saving;* and lends itself to better overall design. Best of all, the compact rotor and stator are oil-resistant and virtually trouble-free . . . and initial costs are now 'way down. Can be used with individual or duplicate and remote indicators, and with Weston recorders. Speed ranges, low as 500 and up to 80,000 rpm full scale. For the complete Weston Tachometer story, send for catalog to-day. *Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N.J.* A subsidiary of Daystrom, Incorporated.



Weston Indicators are available in required sizes and shapes, calibrated in any function of RPM.



Weston A-C and D-C Generators available in all external mounting types including explosion proof and heavy duty.

WESTON TACHOMETERS

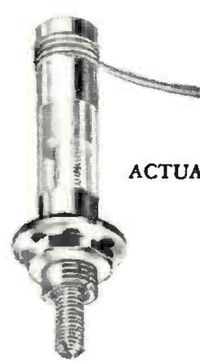
For product information, use inquiry card on page 137.

PISTON CAPACITORS AT WORK

You're a jet fighter pilot streaking home to your carrier 200 miles distant . . . somewhere in the dead of night . . . above a pea-soup fog. No margin for error here . . . minutes, yards mean the difference between success and failure. Yet you're guided unerringly every second of the flight. Safely . . . swiftly you let down to home base—thanks to *TACAN* (Tactical Air Navigation).

Federal Telecommunication Laboratories specified the Model VC11 *JFD Variable Trimmer Piston Capacitors* in its *TACAN* development program for the U. S. Navy and U. S. Air Force. Used in the Ferris discriminator circuit of the IF amplifier, the VC11 is used in adjusting critical band pass frequencies to prevent adjacent channel interference. Compactness . . . stability . . . shock-resistance . . . imperviousness to temperature variations . . . — these are a few of the reasons why today Federal Telephone and Radio Co., Hoffman Laboratories, Inc., and Stromberg-Carlson Co. (A Division of General Dynamics Corporation), are building JFD VC11 Capacitors into *TACAN* equipment.

The VC11 is one of 50 miniature and subminiature trimmer capacitors up-grading performance in today's most sensitive printed and conventional electronic circuits. Wouldn't you like to see how they can help you on *your* project?



ACTUAL SIZE

MODEL **VC11**
Approx. zero temperature coefficient,
1 to 10 mmf.,
fused quartz dielectric,
invar rotor

JFD ELECTRONICS CORPORATION
1462—62 STREET BROOKLYN, N. Y.

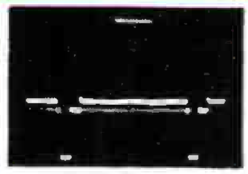
Go Forward with JFD Engineering!

ALL VIDEO TRANSMISSION TEST

STANDARDS in a suitcase

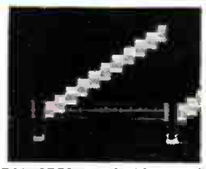
The Original Full Rack and the Portable Unit Produce the same Precise Test Signals!

MULTI-FREQUENCY BURST AMPLITUDE vs FREQUENCY. Check wide band coaxial cables, microwave links, individual units and complete TV systems for frequency response characteristics without point to point checking or sweep generator.



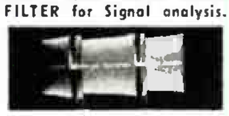
WHITE WINDOW

LOW & HIGH FREQUENCY CHARACTERISTICS. Determine ringing, smears, steps, low frequency tilt, phase shift, mismatched terminations, etc. in TV signals or systems.

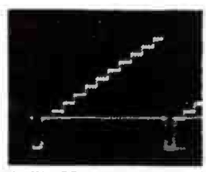


STAIRSTEP SIGNAL modulated by crystal controlled 3.579 mc for differential amplitude and differential phase measurement. Checks amplitude linearity, differential amplitude linearity and differential phase of any unit or system.
Model 1003-C includes variable duty cycle stairstep (10-90% average picture level).

Model 608-A HI-LO CROSS FILTER for Signal analysis.



MODULATED STAIRSTEP signal thru high pass filter. Checks differential amplitude.



MODULATED STAIRSTEP signal thru low pass filter. Checks linearity.

TELECHROME INCORPORATED

Model 1003-B

Video Transmission Test Signal Generator

★ Completely self contained ★ Portable
★ Multi-frequency burst ★ Stairstep ★ Modulated stairstep
★ White window ★ Composite sync ★ Regulated power supply.

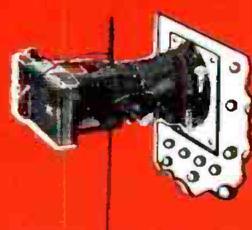
New, Telechrome Video Transmission Test Equipment is available at a completely portable 12¼" standard-rack mounting unit.

Everyday these Test Signals generated by Telechrome equipment, are transmitted Coast-to-Coast by NBC, CBS, ABC, the Bell System, Canadian Bell and leading independent TV stations throughout the U.S. and Canada. Hundreds of network affiliated TV stations and telephone TV centers thus check incoming video signals.

The compact, inexpensive, portable Model 1003-B is all that is required to generate signals for local and remote performance checking of your entire video, cable, or micro-wave facilities.

DELIVERY 30 DAYS

Literature on the above and more than 100 additional instruments for monochrome and color TV by TELECHROME are available on request.



1521-A OSCILLOSCOPE CAMERA—Polaroid type for instantaneous 1 to 1 ratio photo-recording from any 5" oscilloscope.

1004-A VIDEO TRANSMISSION TEST SIGNAL RECEIVER for precise differential phase and gain measurements. Companion for use with 1003-B.

TELECHROME INCORPORATED

The Nation's Leading Supplier of Color TV Equipment
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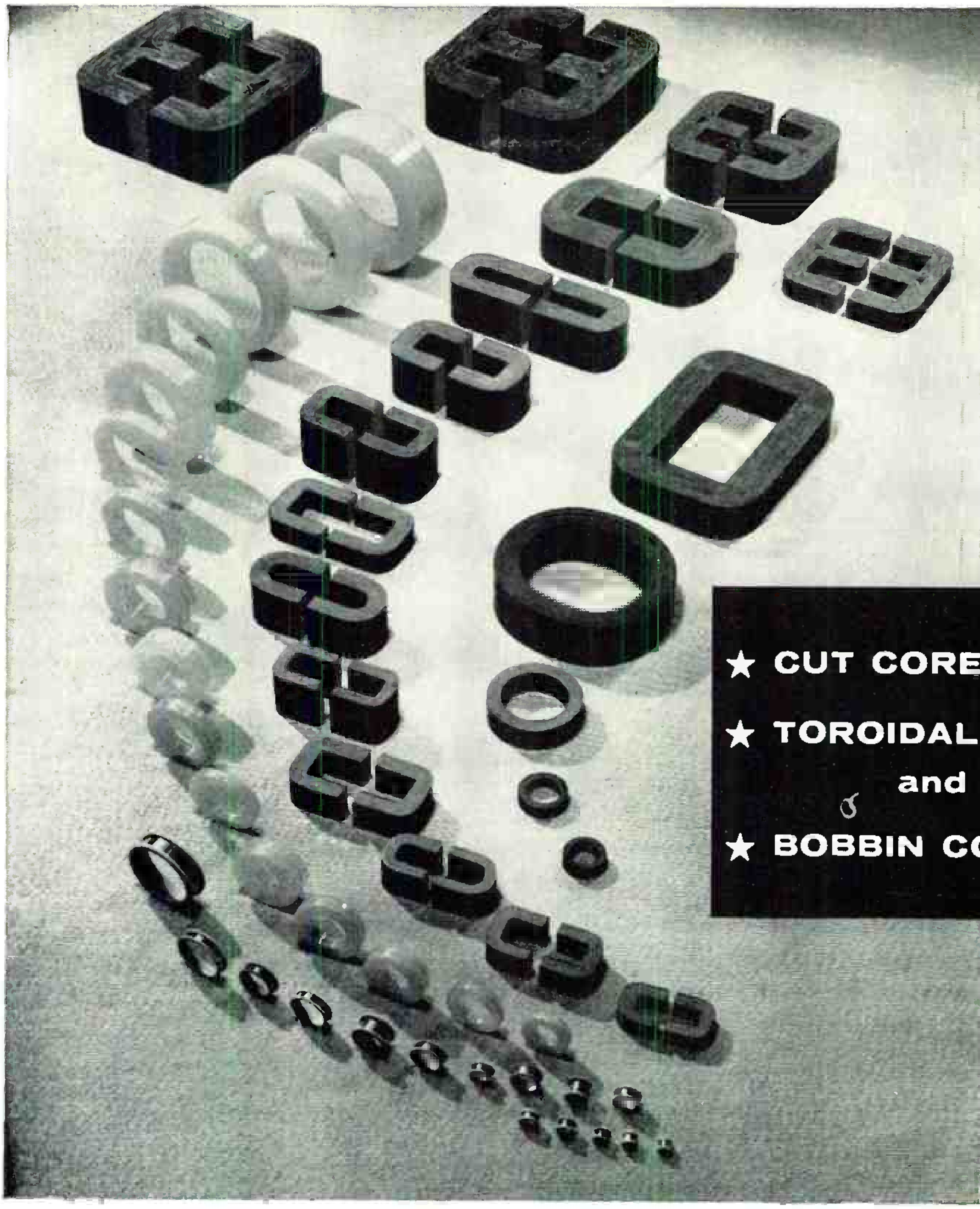

★ CUT CORES, Types C and E

★ TOROIDAL CORES, Cased and Uncased

★ BOBBIN CORES

It's ARNOLD for EVERYTHING in TAPE-WOUND CORES

Applications

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

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Write for Bulletins:

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

ADDRESS DEPT. T-611

MATERIALS: Deltamax, 4-79 Mo-Permalloy, Supermalloy, Mumetal, 4750, Monimax, Silectron, Permendur: all are available for cores depending upon the specific properties required.

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

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

OTHER PRODUCTS: In addition to Tape-Wound Cores, we also produce a complete line of Mo-Permalloy Powder Cores, Iron Powder Cores, and permanent magnets. • *Let us work with you.*

WSW 5618 B

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION

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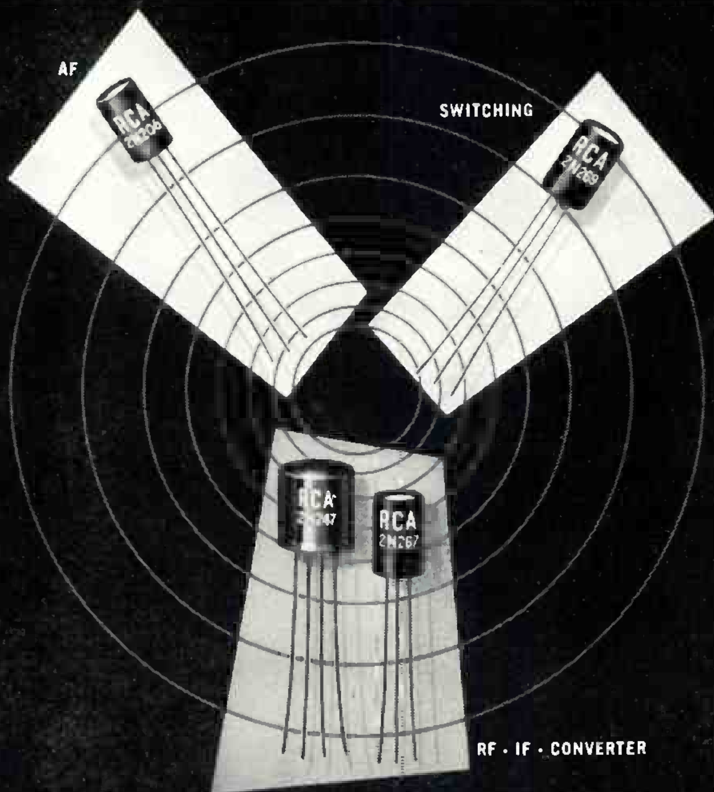
For product information, use inquiry card on page 137.

ELECTRON TUBES
SEMICONDUCTOR DEVICES
BATTERIES
TEST EQUIPMENT
ELECTRONIC COMPONENTS

RCA DATA



RCA TRANSISTORS

NEW RCA HIGH-QUALITY TRANSISTORS –for HIGH-FREQUENCY...COMPUTER...MILITARY APPLICATIONS

TRANSISTOR MEETS MIL-T-25380/4 (USAF) SPECS . . . RCA-2N206. Manufactured under rigid controls to insure extreme stability and uniformity of characteristics both initially and throughout life, this transistor undergoes temperature cycling and moisture-resistance tests, to give reliable performance even under severe environmental conditions! RCA-2N206 is a hermetically sealed, germanium p-n-p type intended for use in military and commercial audio-frequency applications. In a common-emitter type circuit with base input, the 2N206 has current transfer ratio of 47, low-frequency power gain of 46 db, noise factor of 9 db, and max. collector dissipation of 75 mw.

"DRIFT" TRANSISTOR OFFERS NEW CONCEPT IN TRANSISTOR DESIGN FOR HIGH-FREQUENCY APPLICATIONS . . . RCA-2N247 germanium p-n-p type with "built-in" accelerating field is intended for use as an rf amplifier in military, commercial, and entertainment-type equipment operating at frequencies covering the AM broadcast band and up into the short-wave bands. Also useful as intermediate-frequency amplifier or mixer-oscillator (converter). This transistor features low base resistance and very low feedback capacitance (1.7 μμf) which permits the design of rf amplifier circuits having high input-circuit efficiency, excellent operating stability, good automatic-gain-control capabilities over a wide-range of input signal levels, and good signal-to-noise ratio. RCA-2N247 has four flexible leads and utilizes shielding to minimize interlead capacitances and coupling to adjacent circuit components. The RCA-2N267 drift transistor having three flexible leads and intended for compact designs, is also available.

TRANSISTOR FOR COMPUTER AND OTHER "ON-OFF" CONTROL APPLICATIONS . . . RCA-2N269. Having excellent stability and uniformity of characteristics during life, this hermetically sealed germanium p-n-p type transistor is especially suited for use in low-level, medium-speed "on-off" control applications such as flip-flop and gating circuits. Careful control of the characteristics of the junctions with respect to saturation current, leakage current, and breakdown voltage insure dependable performance in switching applications. Max. emitter and collector currents, 100 ma; minimum alpha cut-off frequency, 4 Mc; large-signal current transfer ratio, 35 at a collector-to-emitter voltage of -0.15 volt.

NEW MASTER VOLTOHMYST Features WIDE-VISION METER FACE

RCA-WV-87B . . . designed for high accuracy, this new instrument is well suited to general laboratory use as a portable or rack-mounted vacuum tube voltmeter/ohmmeter and ammeter. The 7½-inch meter face provides large, easy-to-read scales. A mirror-strip on the meter face enables the reader to eliminate needle-to-scale parallax. Tracking error of the meter movement is only ±1% or less. The meter movement is accurate to ±2%. Overall accuracy is ±3% full-scale on all ranges. RCA-WV-87B is supplied complete with WG-299C probe with built-in switch for selecting DC/AC-Ohms. The probe has an exceptionally flexible low-capacitance cable. Frequency response 30 cps to 3 Mc (for source impedance of 100 ohms) on ranges to 500-v. rms, 1400-v. peak-to-peak.

NEW HIGH-SPEED TOROIDAL FERRITE CORE

RCA-221M1 . . . is characterized by a hysterisis loop which permits the core to reverse its magnetic flux polarity when the correct current combination from two associated windings is coincidentally applied. Because of this characteristic, the 221M1 is used in matrices of the coincident-current type as a storage device for digital computers. Diameter is 0.081 inch.

Static Characteristics at Ambient Temperature of 25°C

Magnetizing Force required for optimum squareness	1.8 oersteds
Maximum Flux Density	1730 gausses
Maximum Remanent Flux Density	1620 gausses
Coercive Force	1.2 oersteds
Squareness Ratio	0.86

FOR DESIGNERS

THREE NEW "PENCIL" TUBES FOR UHF EQUIPMENT DESIGNS

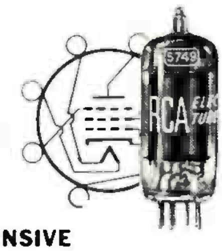
These new "A" versions retain the desirable characteristics of their prototypes but, in addition, undergo special tests for fracture, vibrational acceleration, low-frequency vibration, heater-cycling, survival, and one-hour stability life performance. All of these tubes can be operated at altitudes up to 60,000 feet in unpressurized equipment and are particularly suitable for use in mobile equipment and aircraft transmitters.

RCA-5876-A is a general-purpose, high-mu triode for use in cathode-drive circuits as an rf power amplifier and oscillator, if amplifier, or mixer tube at frequencies up to 1000 Mc; to 1500 Mc as a frequency multiplier; and to 1700 Mc as an oscillator. It is capable of giving a useful power output of 5 watts at 500 Mc as an unmodulated class C rf amplifier; 3 watts at 500 Mc and 750 milliwatts at 1700 Mc as an unmodulated class C oscillator.

RCA-6263-A is a medium-mu triode with integral plate radiator, and is intended primarily for use as an rf power amplifier and oscillator in cathode-drive applications. At 500 Mc, it is capable of giving a useful power output of 10 watts (ICAS) as an unmodulated class C rf power amplifier, or 7 watts (ICAS) as an unmodulated class C oscillator. The tube may be operated with reduced ratings up to 1700 Mc.

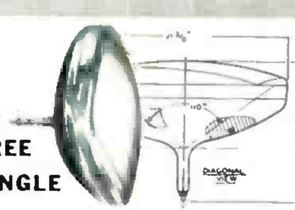
RCA-6264-A is similar to the 6263-A, and is intended for use particularly as a frequency multiplier. It is also useful as an rf power amplifier and oscillator. As a frequency tripler to 510 Mc, RCA-6264-A is capable of 3.4 watts output; at 500 Mc it is capable of 10 watts output as an unmodulated class C rf power amplifier, and 6 watts as an unmodulated class C oscillator.

ANOTHER TUBE TYPE ADDED TO RCA's COMPREHENSIVE "PREMIUM" QUALITY LINE



RCA-5749 . . . is a remote-cutoff pentode of the 7-pin miniature type designed especially for use as an rf or if amplifier in critical military and industrial applications where dependable performance under conditions of shock and vibration is paramount. Characteristics are similar to RCA-6BA6.

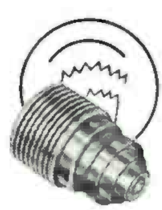
RCA OFFERS NEW PICTURE TUBE with 110-DEGREE DEFLECTION ANGLE



RCA-21CEP4 . . . first commercially available 110° deflection-angle picture tube developed by RCA engineers, establishes new concepts in TV-set styles. Tube depth is approximately 5½" shorter than 90° deflection types. New "straight gun" with "prefocus lens" maintains image sharpness over the entire screen area. The new small neck diameter makes possible the design of a more efficient yoke requiring only slightly more power than is needed for 90° deflection. Tube is aluminized; needs no ion-trap magnet.

Designed for use in 110° deflection-angle systems—for horizontal deflection, RCA-6DQ6-A; for vertical deflection, RCA-6CZ5. Both of these types are now commercially available. In addition, a developmental horizontal deflection transformer and a developmental deflecting yoke—both designed especially for use with 110° tubes—are available on a sampling basis to TV equipment manufacturers.

CERAMIC BUSHINGS—DESIGN FEATURES OF NEW UHF BEAM POWER TUBES



RCA-6816 and -6884 . . . capable of 80 watts cw output at 400 Mc and 40 watts cw at 1200 Mc and **only 1⅞" high, 1¼" in diameter, and 2 ounces in weight**—RCA-6816 and RCA-6884 are exceptionally well suited for oscillator, multiplier, and amplifier use in compact mobile and fixed equipment. Coaxial electrode structure and low-inductance large-area rf electrode terminals **insulated from each other by low-loss ceramic bushings** facilitate the use of these tubes in circuits of the coaxial-cylinder cavity type. Efficient cooling of the plate is effected by a forced-air-cooled integral radiator. RCA-6816 has a 6.3-volt heater. RCA-6884 has a 26.5-volt heater.

"RCA POWER & GAS TUBES" BOOKLET—REVISED Up-To-Date Edition NOW AVAILABLE

PG101C . . . contains descriptions, terminal connections, technical information on RCA vacuum power tubes, rectifier tubes, thyratrons, ignitrons, magnetrons, and vacuum-gauge tubes. The most up-to-date booklet of its kind in the industry. 24 pages. Please use coupon for your copy.

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MIDWEST: Whitehall 4-2900, Suite 1181, Merchandise Mart Plaza, Chicago 54, Ill.

WEST: RAymond 3-8361, 6355 East Washington Blvd., Los Angeles 22, Calif.

For copy of the PG-101C Booklet, or for technical data on the following RCA items, please use this coupon. Check the items in which you are interested. Mail to:

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Section K50R, Harrison, N. J.

- ☐ PG-101C
- ☐ 5876-A,* 6263-A,* 6264-A*
- ☐ 221M1
- ☐ WV-87B
- ☐ 21CEP4
- ☐ 6DQ6-A
- ☐ 6816,* 6884*
- ☐ 5749
- ☐ 2N247, 2N267
- ☐ 2N206
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Transistor Amplifier

(*Continued from page* 64)

will give substantially complete neutralization from 15 to 40 MC, while a combination series parallel arrangement would work well from 4 to 40 MC. Thus admittance neutralization can be extremely wide band if properly designed.

Feedback Neutralization

It has been common practice at lower frequencies to utilize the coupling winding to the following stage for neutralization. This is generally not possible at the higher frequencies because of the difficulty in obtaining high coefficient of coupling when large turns ratios are used. The loading of the following stage results in fairly large phase shifts, and neutralization is not possible. A separate neutralizing winding avoids this difficulty, since the loading of the neutralizing winding is fairly light.

A fairly large turns ratio between collector winding and feedback winding is advantageous for two reasons. First, it minimizes stray and distributed capacity at the collector winding, and secondly, the loading of the neutralizing circuit on the collector is reduced as turns ratio is increased. This follows because R_n and X_n decrease linearly as turns ratio increases, but the reflected impedance varies as the square of the turns ratio. Ideally, a turns ratio equal to the square root of the output to input impedance ratio will result in equal distribution of neutralizing circuit losses between input and output and reduces losses to a few tenths of a db. The practical limit is reached when the coefficient of coupling is lowered sufficiently and loading increased sufficiently to give undesirable phase shift between the collector and neutralizing winding. A 7 to 1 turns ratio has been established. This has apparently resulted in a sufficient phase shift so that R_n may be deleted and nearly exact neutralization is accomplished by the use of capacity only. If coupling between neutralizing and collector winding is sufficient, input impedance variations due to reverse feedback may usually be kept to 5% or less at the input over the frequency

(*Continued on page* 126)

MALLORY

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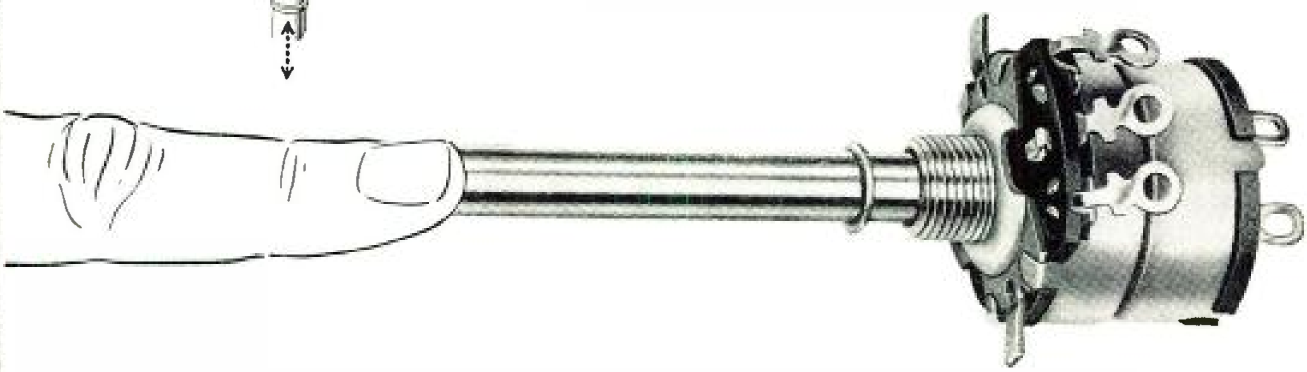

Mallory Controls Now Available With New Push-Pull On-Off Switch

FOR YOUR new designs for television receivers, home and auto radios, investigate the unusual, merchandisable performance features of Mallory controls with the new push-pull switch. This new kind of switch turns off when the shaft is pushed in . . . turns on when the shaft is pulled out.

No "groping" for volume setting. The set is turned on at the *same volume control* position as it was turned off.

Longer control life. The control needs to be rotated only for minor volume changes, instead of being moved through a major portion of its travel every time the line switch is actuated.

New switch design. The switch itself uses a unique "floating ring" contact design. Make and break is performed by spring-snapped motion of small rings made of special Mallory contact alloy. The rings float freely on pins . . . automatically align themselves perfectly. They rotate with each operation, exposing a new contact surface. Service life is extremely long. Make and break action is clean and positive.

Single and dual types of Mallory carbon controls are now available with this new switch . . . and with an improved carbon element that has even greater stability, better wearing quality and lower noise than ever before. Write or call Mallory for full details.

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The new "floating ring" contact design is also available in a switch with conventional rotary action, on Mallory single and dual carbon controls. It gives exceptionally long service . . . positive snap action "feel" . . . protection against loss of spring tension during overloads. Write to Mallory for data.

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(*Continued from page* 124)

range as collector is alternately opened and shorted.

Transformer Design

If bandwidth requirements permit, single tuned transformers with proper step down ratio may be used. Already mentioned is the fact that the coefficient of coupling may be appreciably less than unity. Typical values ran from 0.5 to 0.75 at these frequencies. Because of the appreciable leakage reactance and relatively large input capacity a rather peculiar phenomenon can result, in that the pass band may resemble a greatly overcoupled double tuned transformer pass band, which in fact it is. Very little control is possible over the pass band characteristics, but by the simple expedient of resonating the transistor input capacitance with a small inductance the double tuned effect disappears. Fortunately, the Q of the transistor input is very low, and tuning is very broad. Thus, one small fixed inductor is usually sufficient for all transistors.

Gain and Bandwidth

Table 1 shows typical silicon tetrode characteristics and gain and bandwidth possible at 25 MC.

None of the above makes allowance for the fact that if a flat response is obtained the maximum gain possible is the gain at the highest frequency to be amplified. The table does point up the fact that an arbitrary 3-db loss in gain per stage must be taken if staggered pairs are used. The loss is more severe if large n-uples are used.

The table also shows the large bandwidths obtainable with double tuned amplifiers. Single stages have been constructed with gains in excess of 12 db at 30 MC with bandwidths of 15 to 20 MC.

Gain Control

Two methods have been used to control the gain of the silicon tetrodes: emitter current control, and base two current control. Both permit 25- to 30-db gain control per stage with reasonable linearity and overload characteristics. Base two current control results in less change of the operating character-

(*Continued on page* 128)

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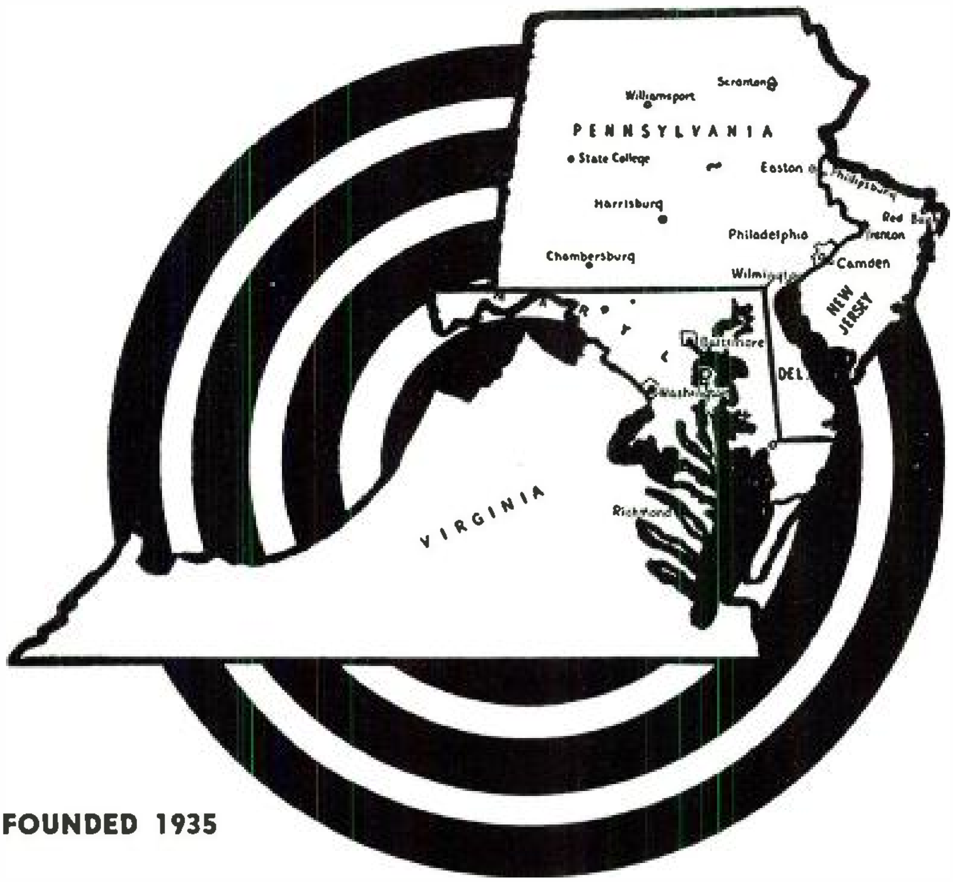

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(*Continued from page* 126)
istics, and in single tuned amplifiers it has been possible to realize less than a 10% change in band pass, and 1% shift in center frequency as gain is changed with no especial circuit precautions. Double tuned amplifiers are more sensitive to impedance variations, however, and circuit stabilization is required for either method of gain control. Diodes placed across the transistor input which supplement transistor loading as current changes, have worked very satisfactorily, but it has been found that a more direct correlation exists between emitter current and input impedance than base two current and input impedance. Thus, emitter current control has generally been used in double tuned amplifiers, although either can be made to work.

Temperature Effects

Measurement of gain versus temperature from room temperature to +100° C shows an approximately linear decrease in gain versus temperature, with gain down 3 to 4 db per transistor at 100° C. Thus, depending on total gain requirements, one or two stages may be added with substantially zero gain at room temperature, and by controlling emitter or base two current with a temperature sensitive element, such as a thermistor, essentially constant gain may be achieved. Fig. 4 shows the gain versus temperature of one such amplifier.

Performance Comparison

Measured gain and bandwidth of an admittance neutralized amplifier with the gain and bandwidth predicted from admittance neutralization has consistently showed excellent agreement. Table 2 has been tabulated to show the design data of an experimental 25 MC 5-stage synchronous tuned amplifier.

High frequency amplifiers with gains up to 100 db have been constructed with the same sort of agreement.

Band pass is symmetrical, tuning of each stage may be accomplished without regard to the stage preceding or following, and the amplifiers have generally exhibited an excellent degree of stability.

Noise figures of 8db at 25 MC and 9 db at 30 MC have been achieved with these transistors.

Resistive Fins

(*Continued from page* 59)

The conventional power absorber was then removed and the new type having radial resistive fins was substituted and the tests run again. Fig. 3 shows the tuning characteristics of the cavity wavemeter equipped with the experimental finned power absorber. It is evident from the experimental results that greatly improved tuning characteristics can be obtained through the use of a power absorber having resistive radial fins.

The author is indebted to Mr. Hitoshi Murakami, Nihon Tsushinki Co., for the use of experimental instruments, and to Mr. Kenichi Fujinawa, Dr. S. Nakamura, Dr. K. Owaki, and Dr. I. Yokochi of Nihon University.

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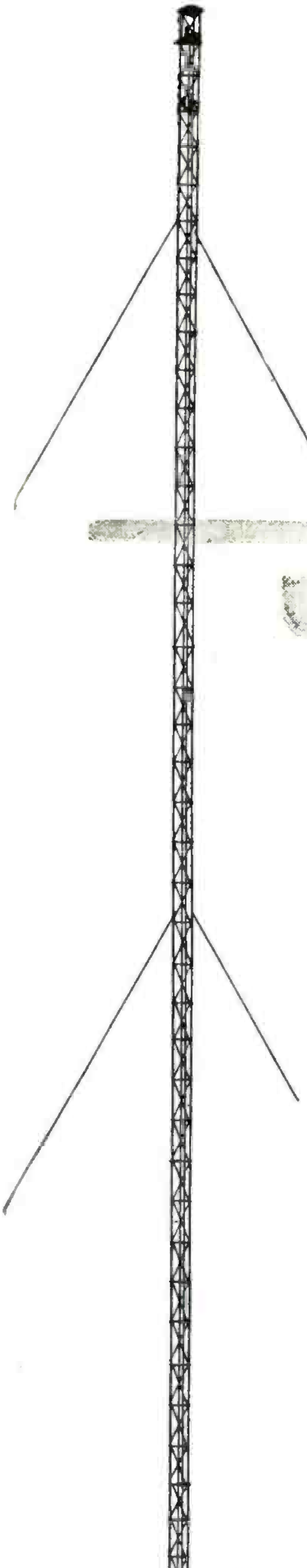

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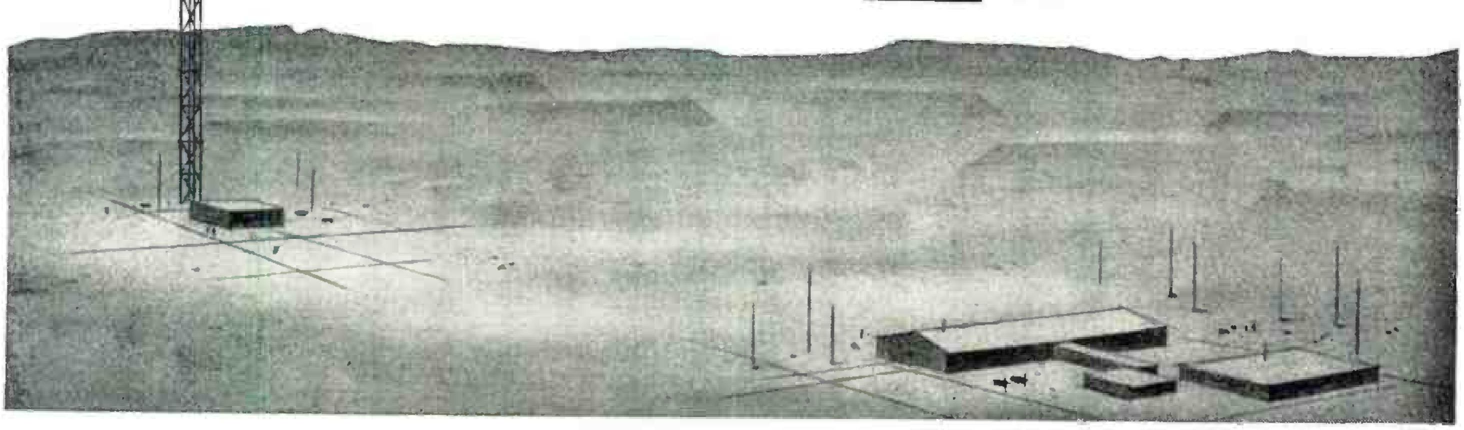


H-Guide

(*Continued from page* 51)

width of the strips. This is permitted since the field distribution in the central part is affected very little by the boundary effects at the openings. As a result of the finite width of the strips a fraction of the electromagnetic energy is transported outside along the guide and is partially radiated into space. However, the greatest part of the energy travels inside in the vicinity of the dielectric slab.

Considering first the energy transport in a guide with infinite walls, let us compare the total energy transported along the guide with that concentrated and traveling in the central part h/2 wide on both sides of the dielectric slab. The comparison gives approximately the ratio of energy traveling outside the guide with strips h wide to the total amount transported along it. Some values of this ratio (P_{out}/P_{tot} = 0.001, 0.01 and 0.1) are plotted in Fig. 4 dependent on the geometry and the dimensions of the guide relative to the free space wave length ($\varepsilon_r = 2.53$).

Attenuation

The attenuation of the H-guide is mainly caused by energy dissipation in the walls and dielectric losses in the slab. If the slab is assumed thin, the greatest part of the energy is transported in the air space between the strips, and the latter part of the losses is negligible. Thus the attenuation constant is given by

$$\alpha = \frac{P_D}{2P} \qquad (8)$$

where P_D is the dissipated power per unit length, P the total power transported through a cross section of the guide. Neglect of the power traveling in the dielectric, as a part of the total power P, reduces the error of the above neglect and simplifies the calculation. We obtain under these conditions

$$\alpha = \frac{r_s}{\frac{b}{2} Z_o} \qquad (9)$$

where r_s is the surface resistance of the strips, Z_o the impedance of free space,

$$r_s = \sqrt{\omega\mu/2\sigma},\ Z_o = \sqrt{\mu_o/\epsilon_o},$$

$$m = \frac{1}{\lambda_o/\lambda_g} \frac{(\lambda_o/\lambda_{co})^2}{(\lambda_o/\lambda_{co})^2 + (\lambda_o/\lambda_g)^2}.$$

m is a form factor which depends on the geometry and the relative dimensions of the guide width with respect to λ_o.

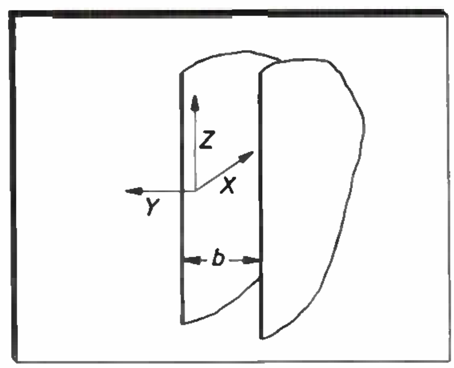
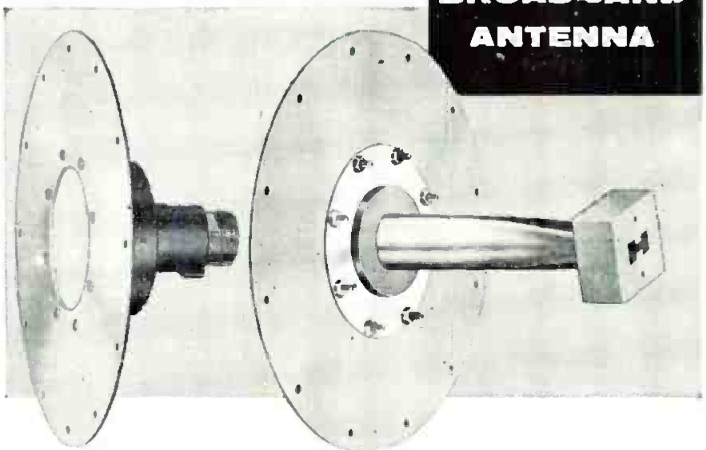


Fig. 5: Propagation between parallel walls

In Fig. 3, the attenuation of an H-guide is compared with that of an ordinary rectangular and a circular guide at X-band frequencies (10 KMC) by use of Eq. 9. The diagram not only shows the attenuation being rather low compared with that of the rectangular waveguide but also that it decreases with increasing frequency in a similar

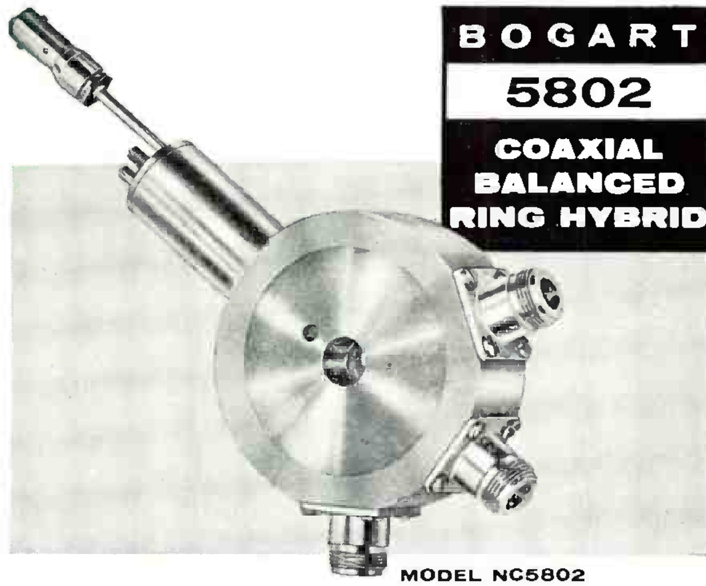
(*Continued on page* 134)



BOGART 9303 BROADBAND ANTENNA

MODEL S9303 MODEL X9303

The Bogart 9303 Series of Broadband Antennas is used primarily for countermeasure applications. The circularly polarized antennas shown above are each designed to operate over approximately a 45% bandwidth centered about 10 CM. and 3 CM. respectively. Two basic designs are featured in this series. The S-9303 is a coaxially fed helix, designed to operate with RG-117/U coaxial cable and offering a minimum beamwidth of 50°. The X-9303 is a horn antenna with a dielectric phase shifter, designed to mate with Bogart Double Ridged Waveguide and also offering a minimum beamwidth of 50°. The Bogart Double Ridged Waveguide operates satisfactorily over the frequency range from 4750 to 11,000 MC/S. The Bogart L-9303 (30 CM.) and C-9303 (6 CM.) broadband antennas will soon be available. Our applications engineering group will be pleased to discuss your specific requirements with you.



BOGART 5802 COAXIAL BALANCED RING HYBRID

MODEL NC5802

The Growth of the Guided Missiles Field has provoked increased engineering activity directed towards the miniaturization of microwave components. Special techniques and materials have been developed due to severe space limitations and extreme temperatures. The Bogart Model NC-5802 balanced ring hybrid has been designed to replace single ended and balanced waveguide mixers where space and weight factors have made it impractical to employ these traditional waveguide components. In addition to the NC-5802 which is intended for operation centering about 10 CM., Bogart applications engineers have designed the NL-5802 for 15 CM. use.

An Exceptionally Broadband balanced coaxial ring hybrid mixer is presently under development. Intended to operate over a 50% bandwidth, this unit will present a compact, lightweight design that is ideal for aircraft or missile application. A detailed technical analysis of properties of coaxial ring hybrids is available upon request. Special applications of Bogart Broadband Mixers can be designed to meet your specific requirements. Our applications engineers will be pleased to discuss your particular problems with you.

BOGART 4063 VHP* DUMMY LOADS

MODEL H4063

The Bogart Model 4063 Series of VHP Dummy Loads has evolved from a need by the Armed Forces for very high power dummy loads for both field and laboratory use. Originally developed for the Army Ordnance Fire Control Instrument Group, the 4063 series has won wide acceptance by other service branches by providing R-F silence during tuning and maintenance, ease of maintenance and standard test conditions. Designed to operate with the highest power radar systems, these dummy loads are lightweight, compact, resistant to moisture absorption and intended to last at least the life of the equipment with which they will be used. Reduced operating temperatures are obtained through the use of cooling fins. The 4063 series, as adopted by Armed Forces agencies, are provided with flanges noted in the chart. However, non-standard flanges, or adapters, are available for special applications. High temperature pressure sealing "O" rings are available as accessory equipment. All units are finished in a black enamel.

Special Applications of Bogart VHP Dummy Loads can be designed to meet your specific requirements. Our applications engineers will be pleased to discuss your particular problems with you.

Model No	Equivalent AN Nomenclature	Frequency Range (KMC/S)	Max Peak Power (Mega Watts)	Minimum Average Power (Watts)	Maximum VSWR	Length (inches)	Width (inches)	Height (inches)	Approx. Weight (Lbs.)	Waveguide AN Type
X4063	DA 146/U	8.20-12.4	0.29	500	1.10	5¾	2¾	2¾	1	RG 67/U
B4063	DA 148/U	7.05-10.0	0.46	600	1.10	6⅛	2½	3⅛	1½	RG 68/U
C4063	DA 144/U	5.85-8.20	0.71	1000	1.10	8	3⅛	3⅞	2¾	RG 106/U
H4063	DA 149/U	3.95-5.85	2.0	2000	1.10	9¾	3⅜	4⅛	5	RG 95/U
S4063	DA 145/U	2.60-3.95	3.2	2500	1.10	14	4⅞	6⅜	9½	RG 75/U
L4063	DA 147/U	1.12-1.70	17.2	6000	1.10	32⅞	8⅞	11½	90	RG 103/U

BOGART 9306 WAVEGUIDE SWITCH AND DUMMY LOAD ASSEMBLY

MODEL 9306

The Bogart Model 9306 Waveguide Switch and Dummy Load Assembly is the result of an engineering program initiated with Bogart Manufacturing Corp. by one branch of the Armed Forces to retrofit an aircraft currently in the field. The purpose of this retrofit kit is to provide R-F silence during tuning and maintenance, ease of operation and maintenance, decrease vulnerability to jamming and permit standard test conditions. Due to the extreme space limitations, the utilization of standard components was not possible. It was necessary for the Bogart applications engineering group, working in conjunction with service engineers, to design a special waveguide switch and dummy load for this aircraft. This 9306 assembly is so uniquely tailored for this particular project, that it is doubtful that in its exact form, it may be used in another installation. However, where standard components cannot be used due to electrical or mechanical limitations, the Bogart applications engineers will work with the customers' engineers to modify existing components, or design new units for the particular application. The model 9306 is a typical result of just such an engineering program.

ELECTRO-MECHANICAL CHARACTERISTICS

Frequency Range	8500—9600 MC/S
Waveguide Flanges (Input and Output)	UG-135/U,—UG-136A/U UG-138/U OR UG-137A/U (Upon Customer's Request)
Max. V.S.W.R. Antenna Arm	1.10
Max. V.S.W.R. Dummy Load Arm	1.10
Switch Isolation	60 DB
Switching Time	0.05 SEC.
Peak Power	250 KW
Average Power	250 watts
Weight	Approx. 3¾ lbs.

This unit has been tested satisfactorily in accordance with MIL-E-5400 environmental test conditions.

Your inquiries are invited by our engineering staff who will be pleased to aid you in your problems.

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Microwave Frequency Meters

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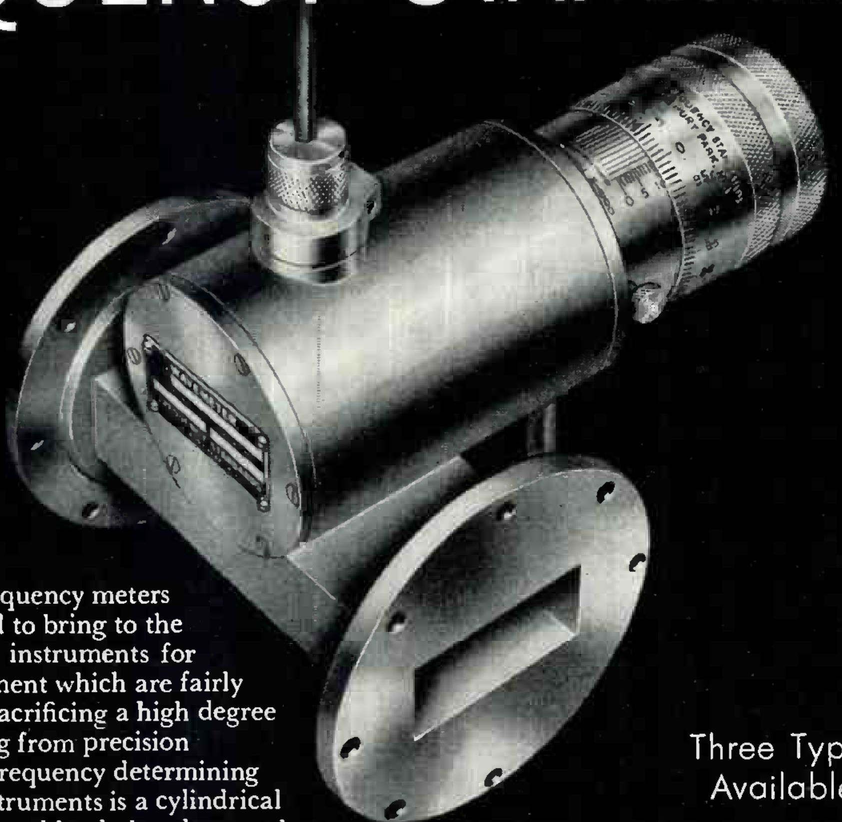
FREQUENCY STANDARDS



In offering these frequency meters we have endeavored to bring to the electronics industry instruments for frequency measurement which are fairly priced yet without sacrificing a high degree of accuracy resulting from precision manufacture. The frequency determining element of these instruments is a cylindrical resonator with a tuneable choke plunger that provides a smooth and accurate interpolation of frequency. Four models are offered, each model covering a wide frequency range and employing standard waveguide and flanges. Three types, described below, are offered in each frequency range. All models have been designed to use the standard FS Model M-1000 Micrometer Head which has been widely accepted by the electronics industry. Construction is of Invar and accuracy is .01% under laboratory conditions.

Three Types Available

WAVEGUIDE ABSORPTION TYPE I cavity is mounted on the broad face of waveguide. The transmission indication is secured by a crystal loop monitor located opposite the iris input coupling hole. (Type illustrated)

WAVEGUIDE FEED TYPE II cavity is mounted as the termination of a short section of waveguide. The cavity body and output coupling loop are the same as Type I.

WAVEGUIDE TRANSMISSION TYPE III cavity is the same as Types I and II but waveguide is used for input and output coupling.

DESCRIPTIVE LITERATURE AVAILABLE ON REQUEST

TYPE	FREQUENCY RANGE	WAVEGUIDE
Models 8211— 3	8200 to 11500 MC	RG-52/U
Models 7010— 3	7000 to 10000 MC	RG-51/U
Models 5882—1, 2, 3	5800 to 8200 MC	RG-50/U
Models 4458—1, 2, 3	4400 to 5800 MC	RG-49/U

Frequency Standards

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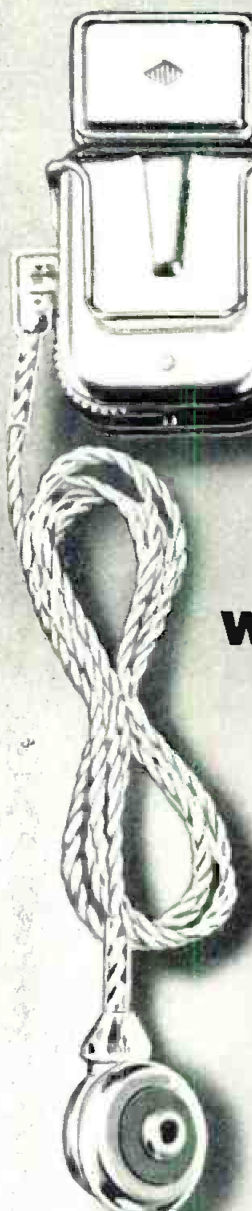
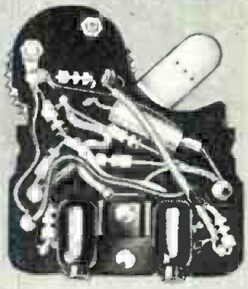
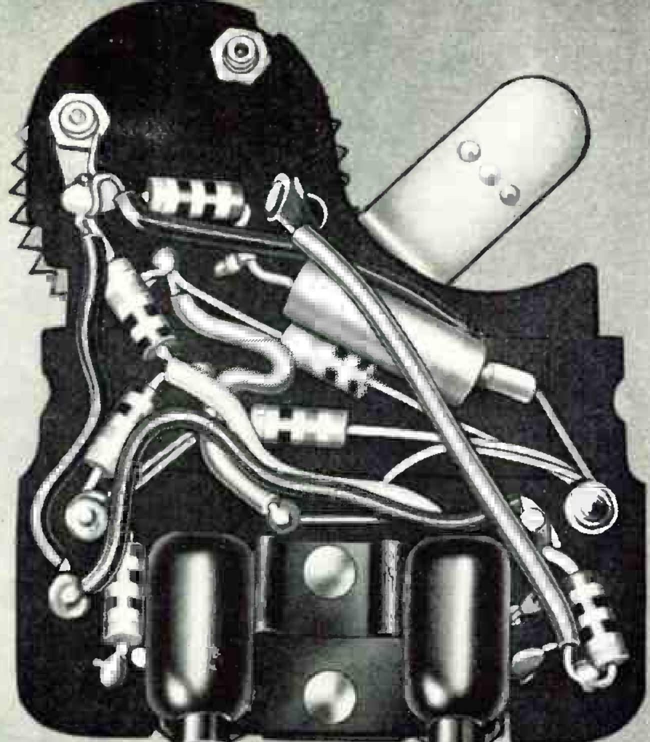


ZENITH
Hearing Aid Chassis



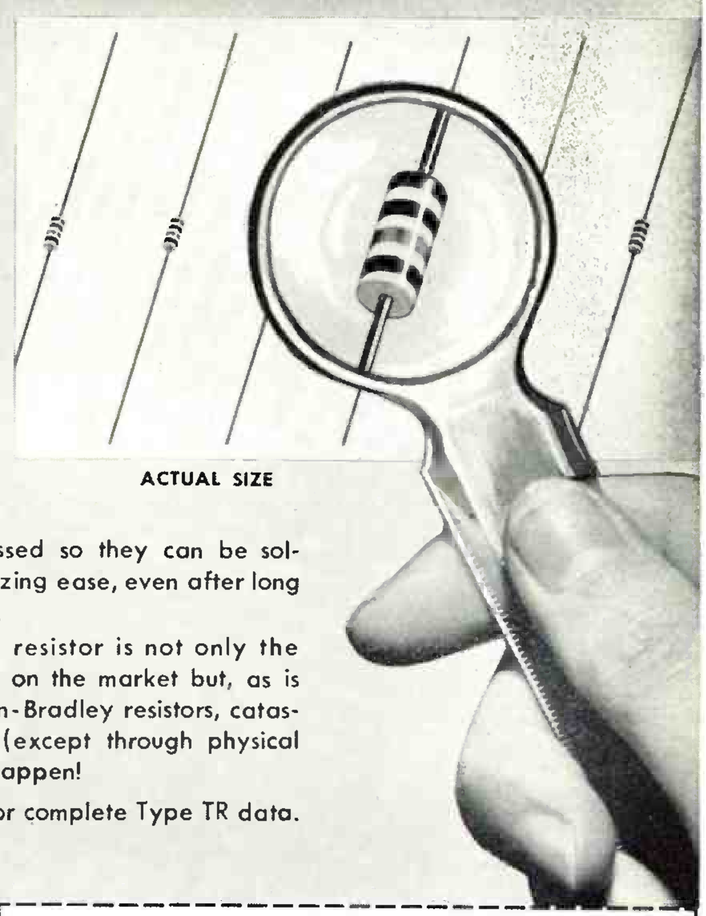
ACTUAL SIZE

The tiny chassis of the Zenith "Crest" hearing aid carries the components for the transistorized amplifier, with 6 Allen-Bradley Type TR tiny resistors.



Where space is cramped, use Allen-Bradley Type TR resistors

If you have a miniaturization problem and you must cramp a handful of components into an "impossibly small space," then install Allen-Bradley Type TR tiny resistors. They really are small . . . 0.067 in. diameter and 0.140 in. long. The maximum continuous wattage rating at 70 C is 0.1 watt.



ACTUAL SIZE

These solid molded units have an insulating coating and can be operated continuously with the insulation subjected to a maximum potential of 200 v, d-c.

Type TR resistors are available in standard RETMA and MIL resistance values at standard tolerances of plus or minus 5, 10, and 20%.

The lead wires are 1⅛″ long and are specially processed so they can be soldered with amazing ease, even after long periods in stock.

The Type TR resistor is not only the smallest resistor on the market but, as is true for all Allen-Bradley resistors, catastrophic failure (except through physical abuse) cannot happen!

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(*Continued from page* 130)

manner as that of the circular waveguide with TE_{01} waves.

Applications

The derived relations show favorable characteristics of the H-guide. The field strength distribution has no component of the magnetic field strength perpendicular to the direction of the wave propagation in the vicinity of the conducting walls. It follows that no currents occur in longitudinal direction on the conducting strips and that the wave propagation is unaffected by slots and gaps in the walls in transverse direction. Therefore, no connectors and flanges are needed to join H-guide sections.

The attenuation constant is lower than that of rectangular standard waveguides by a factor of approximately 6 and has the magnitude of that obtained for circular waveguides with TE_{01} waves. It decreases monotonically with increasing frequency. Both properties favor the application of the guide at extremely high frequencies, where the attenuation of the rectangular

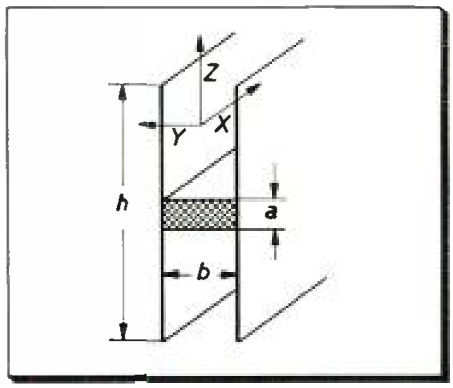

Fig. 6: Cross-sectional view of H-guide

waveguide is intolerably high. The cross-sectional dimensions greater than those of rectangular waveguides for the same frequency are one more reason to apply the H-guide in the millimeter wave region.

The simplicity of fabrication is a further advantage. Fig. 1 shows, as an example, the cross-sectional view of an H-guide designed for simple fabrication. The guide consists of two dielectric bodies, mirror images of each other. They can be fabricated by conventional plastic moulding techniques. The plane outer surfaces are metallized by electroplating. The two parts,

(*Continued on page* 136)

TYPICAL OPERATION
(Frequencies up to 175 Mc per tube)

	Class-C CW or FM Phone	Class-C AM Phone	Class AB_1 R-F Linear
D-C Plate Voltage	2000 volts	1500 volts	2000 volts
D-C Screen Voltage	250 volts	250 volts	350 volts
D-C Grid Voltage	—90 volts	—100 volts	—50 volts*
D-C Plate Current	250 ma	200 ma	
Zero-Sig D-C Plate Current			100 ma
Max-Sig D-C Plate Current			250 ma
Screen Current	25 ma	25 ma	15 ma max
D-C Grid Current	27 ma	17 ma	
Peak R-F Grid Voltage (approx.)	115 volts	121 volts	50 volts
Driving Power	2.8 watts	2.1 watts	0 watts
Plate Power Output	410 watts	250 watts	325 watts max

*Adjust grid voltage to obtain specified zero-signal plate current

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Dependability and performance put the new Eimac 4CX300A in a class by itself. Ceramic-metal construction, along with Eimac's high temperature processing techniques, means a "harder," cleaner tetrode. It inhibits deterioration of electrical characteristics while the tube operates continuously at an envelope temperature of 250°C. And it provides the ruggedness that enables the 4CX300A to take 11 millisecond, 50g shocks without internal shorts or mechanical damage.

Featuring extremely low series lead inductance, the 4CX300A functions at full ratings through 500 megacycles, and operates over a wide range of plate voltages — 500 to 2000 volts — with power inputs from 125 to 500 watts.

Shown with the 4CX300A is its new Eimac air system socket. In addition to providing the optimum in cooling arrangements, this air socket employs a screen-to-cathode bypass capacitor for stable high-gain operation, a lock-in socketing action, and extremely low inductance terminals.

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(*Continued from page* 134)

dued together, form the guide.

Microwave circuitry design can be based on this concept. The two parts of a ring type waveguide bridge are shown in Fig. 1. The new guide thus permits accurate. but nevertheless inexpensive, mass production of complicated microwave circuitry.

Research Labs

(*Continued from page* 92)

The panels are a sandwich-like construction consisting of a ⅛ in. thick square glass plate coated with a transparent, but electrically conducting, film. A thin layer of polyvinyl chloride plastic, embedded with a zinc sulphide-type phosphor is then applied. Topping it off is an aluminum conducting coating. The panel then resembles a capacitor, with 2 conducting layers separated by a dielectric.

One hundred and twelve panels, each one foot square and emitting a green light, are spread over the ceiling and 3 walls. Electricity applied is 350 v. at 3 KC. Brightness of the panels is 100 ft. lamberts and efficiency is 3 lumens/watt.

The laboratories are also putting much emphasis on two other projects, viz., "Vibragyro" and "Automex." The former is a new type gyroscope based on a method of stabilization used by the common housefly and other two-winged insects. The fly is equipped with small organisms called "halters" which, by vibrating rapidly, govern its balance during flight.

The "Automex" is a new "electronic brain" with a built-in intelligence, enabling it to distinguish between right and wrong decisions. The key to "Automex's" function is that it will, by repeated experimentation. try to reach a given goal with a capacity for dispassionate judgment in distinguishing between success and failure.

"A Discussion of Precision Computer Transformers"

The above article, in the Sept. 1956 issue of ELECTRONIC INDUSTRIES & Tele-Tech, carried two printing errors, On p. 72, col. 1, paragraph 5 the equation should read $I_o (ns/np) \neq I_{in}$ and on p. 129 line 38 should read $Z_L = \infty$.

(*Continued from page* 139)

$$S_C \equiv \frac{dI_C}{dI_{CO}} = 1 + \alpha_2 S_E, \qquad (5)$$

$$S_B \equiv -1 + (1 - \alpha_2)S_E, \qquad (6)$$

$$S_{CC} \equiv \frac{dI_{CC}}{dI_{CO}} = \frac{1 + \left(\alpha_2 - \frac{R_{EE}}{R_{BC}}\right)S_E}{1 + \frac{R_{CC}}{R_{BC}}}, \qquad (7)$$

and

$$S_V \equiv \frac{dV_2}{dI_{CO}} = -R_{CC}\,\frac{1 + \left(\alpha_2 + \frac{R_{EE}}{R_{CC}}\right)S_E}{1 + \frac{R_{CC}}{R_{BC}}}. \qquad (8)$$

The above stability factors are most closely related to the second stage. Stability factors alone do not tell a sufficiently complete story. It is important to know not only how rapidly a given current or voltage changes with respect to a saturation current, but also to know how large or significant the saturation current is with regard to the particular current or voltage. Therefore, it would not be correct to obtain the stability factors of the first stage in terms of the I_{CO} of the second stage. It is reasonable to assume that the two I_{CO}'s differ by a factor of the same order of magnitude as the operating voltages and currents of the two stages. Therefore, a more nearly accurate picture can be obtained by using I_{CO1} for the first stage stability factors, as follows:

$$S_{E1} \equiv \frac{dI_{E1}}{dI_{CO1}} = \frac{1}{K}\frac{dI_{E1}}{dI_{CO}} = \frac{1}{K}S_B = \frac{-1 + (1 - \alpha_2)S_E}{K}, \qquad (9)$$

$$S_{C1} \equiv \frac{dI_{C1}}{dI_{CO1}} = 1 - \frac{\alpha_1}{K}\left[1 - (1 - \alpha_2)S_E\right], \qquad (10)$$

$$S_{B1} \equiv \frac{dI_{B1}}{dI_{CO1}} = \frac{1}{K}\left[\frac{\alpha_1}{K} - 2 - (1 - \alpha_2)\left(\frac{\alpha_1}{K} - 1\right)S_E\right], \qquad (11)$$

and

$$S_{V1} \equiv \frac{dV_1}{dI_{CO1}} = -\frac{R_{EE}}{K}S_E. \qquad (12)$$

Examples

To obtain a practical appreciation of the stability factors, two

Bias Stabilization

(Continued from page 71)

improvement should result. A more complete analysis requires specific "figures of merit," such as circuit stability factors.

Stability

A somewhat general equivalent bias circuit for the tandem transistor is illustrated in Fig. 2. The resistances shown are net superposition values. The principle of superposition applies in the derivation of stability factors, since a small change in saturation current is assumed to be superposed upon an otherwise fixed set of currents and voltages. Therefore, in evaluating the resistances, all fixed potential points are tied together. For example, a divider network supplying the first base might be composed of one resistance from the positive supply and one to ground. In this case, R_{BB} would be numerically the parallel combination of these two resistance values.

Employing the usual assumptions that the alphas and the base-emitter voltage drops are constants, the bias circuit network (Fig. 2) is solved by the use of the following transistor equations:

$$I_{C1} = \alpha_1 I_{E1} + I_{CO1} \quad (1)$$

and

$$I_C = \alpha_2 I_E + I_{CO2}. \quad (2)$$

An additional equation,

$$I_{CO1} = KI_{CO2} = KI_{CO} \quad (3)$$

is introduced for notational convenience. Here it is assumed that the two I_{CO}'s are related by a constant factor.

Solution

A solution of the system yields the following stability factors:

$$S_E \equiv \frac{dI_E}{dI_{CO}}$$

$$= \frac{(1 + \alpha_1 - K) + (\alpha_1 - K)\dfrac{R_{CC}}{R_{BC}}}{\left\{ (1 - \alpha_2)(1 + \alpha_1) + [1 + \alpha_1(1 - \alpha_2)]\dfrac{R_{CC}}{R_{BC}} + \left[1 + \dfrac{R_{BB} + R_{CC}}{R_{BC}}\right]\dfrac{R_{EE}}{R_{BB}} \right\}} \quad (4)$$

(Continued on page 140)

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cases will be considered. The first case will be without voltage feedback (R_{BC} infinite), and the second case will include voltage feedback ($R_{BC} = R_{CC}$). In both cases the alphas will be set equal to 0.95, the second I_{CO} will be taken as five times the first, and attention will be focused on the emitter current stability factors.

	S_E	S_{E1}
Case I	+1.6	−4.6
Case II	+0.8	−4.8

Considering those emitter current stability factors near unity as very good, it can be seen for these cases that the first stage was fairly stable. Actually, the use of voltage feedback, while it helped the second stage due to the bucking effect of the direct coupling, slightly impaired the first stage. It can also be seen that the second stage is dominant, since the first stage stability factors were negative.

MOVING UP — Electrical parts and equipment ranked third in tonnage among all types of air freight flown in the first half of 1956, according to United Air Lines figures; machinery and machine parts maintained first place, with other top shipments including auto parts and accessories, aircraft parts and accessories, and movie and TV film.

An examination of eq. (9) shows that the stability of the first stage would be theoretically perfect for

$$S_E = \frac{1}{1 - \alpha_2}. \qquad (13)$$

This equation, however, requires the second stage to have a very poor (large) stability factor. Evidently, though, a compromise can be reached by setting the two stability factors equal to each other in magnitude (opposite in sign). This condition yields:

$$S_E = -S_{E1} = \frac{1}{1 - \alpha_2 + K}, \qquad (14)$$

which gives a magnitude of 4 for the cases treated. This value is quite satisfactory in many applications.

Conclusions

It appears that perfect stabiliza-

(*Continued on page* 143)

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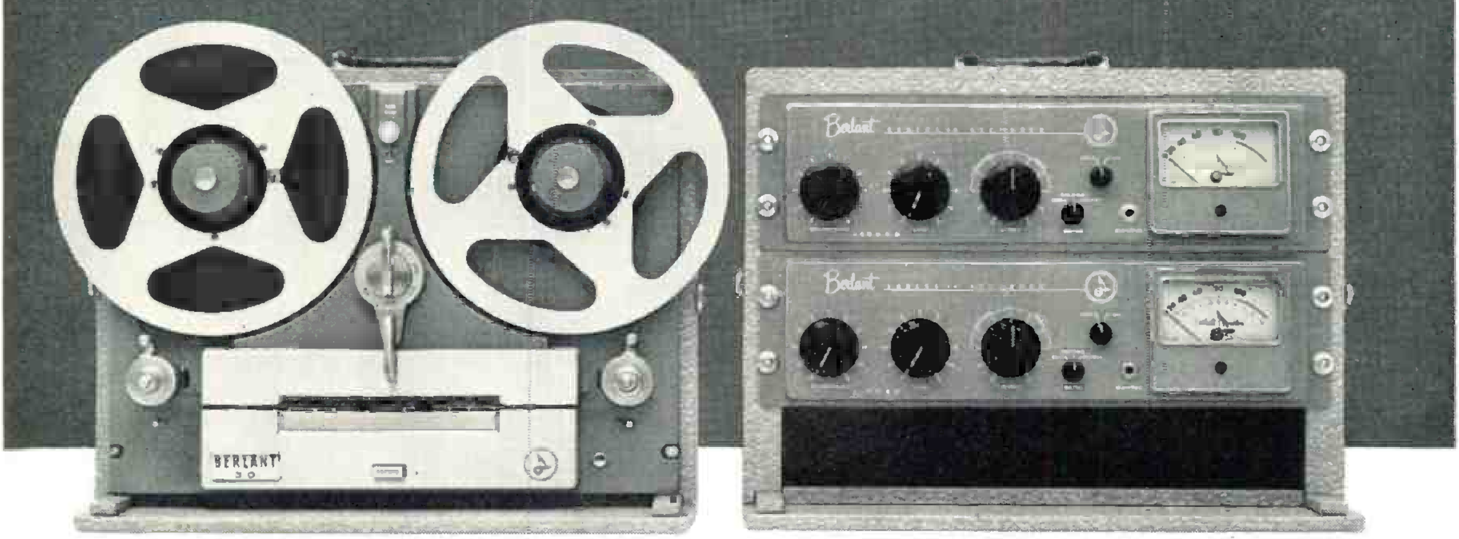

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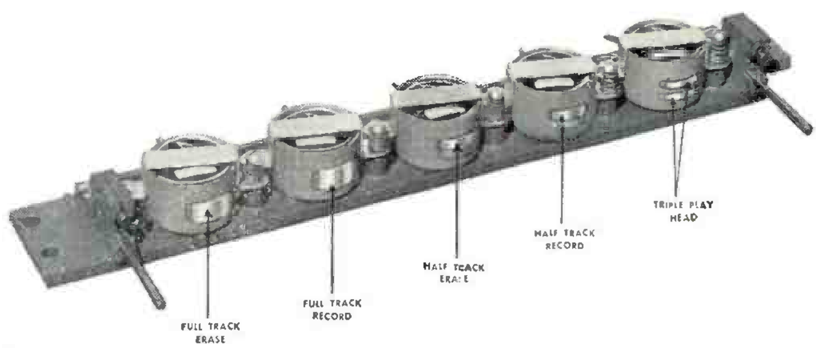

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(Continued from page 141)

tion of a tandem transistor is not possible through the usual brute-force methods of employing strong DC current and voltage feedback. The direct coupling, however, does act in a correct manner to aid in reducing the stability factors. That is, numerical differences exist in the numerators of the stability factor expressions. Furthermore, this "bucking" action can be the basis for a compromise between the first and second stage stability factors.

Per equation (14), it would seem that a low alpha in the second transistor would assist in reducing the compromised stability factors. This observation could be misleading, however, since the I_{CO} of a transistor is but a fraction of the collector-base body saturation current, and it can be shown that if alpha is reduced (all other factors held equal) I_{CO} increases by a compensating amount. Thus, any increase in one minus alpha may be lost through a decrease in K. Whether or not a profit would accrue would depend upon the surface leakage contributions to the saturation current and whatever factors went into decreasing alpha.

The key point in stabilizing the tandem transistor is thus seen to rest upon the relative magnitudes of the two I_{CO}'s. Requirements here appear conflicting, since it may be desirable that the second transistor be much larger than the first so that each stage may be biased in its appropriate region. If the two units are of different sizes, however, their I_{CO}'s may be too far apart to allow for a highly stable compromise. The stability may still be ample, however, for all but the most stringent requirements.

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1. H. E. Hollmann, "Applications for Tandem Transistors," Tele-Tech and Electronic Industries, February 1956, pp. 58-9, 113-4.
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3. R. B. Hurley, "Predictable Design of Transistor Amplifiers," Tele-Tech and Electronic Industries, August 1955, pp. 74-5, 132, 165-8.
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Minimizing Noise

(*Continued from page 75*)

supplies from each other, and by joining their grounds at only one point in the system. It also can happen that the normal difference in potential between these signal and power grounds can act as a noise voltage that is greatly amplified through some quirk of circuit design. All amplifiers should be carefully examined to see that this source of noise pickup is not present.

In the case of dual channel amplifiers and synchro resolvers, it is very desirable to isolate the ground sides of the two circuits. If this is not done when the unit is designed or specified, undesired and unavoidable ground loops may be created.

Insulation

Leakage pickup generally can be guarded against by operating the signal circuits at the lowest possible impedance level and by improving the quality of the volume and surface insulation between circuits.

Impedance Level

Lowering impedance levels in signal circuits minimizes capacitive and leakage pickup, while raising voltage scale factors usually reduces conductive and inductive pickup by increasing the signal-to-noise ratio. In most cases these two conditions are mutually exclusive; therefore, generalities cannot be made concerning their relative effectiveness, since each individual circuit has a different noise problem and since impedance levels and scale factors are established to a great extent by other considerations.

Wiring Planning

In general, reduction of electrical noise in a system can be effected best by elimination of conditions conducive to pickup. In many systems, the distance between the different units and the complexity of the cabling greatly increase the opportunities for pickup. Although a transducer and its amplifier may be located physically only 10 ft apart, many times this length of signal lead may exist between them in order to allow the signal to be operated on by components in other widely separated units. Concentration of system units would be one of the characteristics of an ideal system. Another would be a careful plan for the separation of signal, power, and pulse leads and/or cables.

Practical Limits

It must be recognized that many factors will combine to lessen the practical effectiveness of the noise reduction techniques outlined above. System units may have to be located at scattered points in an aircraft or ship installation; space and weight considerations may limit the amount of shielded or coaxial cable used; components may not exist with the desired scale factor and impedance level. Thus in almost every case compromises will be necessary, and it is in estimating an acceptable degree of compromise that the most mature engineering judgment will be required.

Then too, past experience indicates that engineering unawareness of or complacency about these problems during the design stage of a project often results in a less than optimum application of these noise reduction techniques. It is not at all unusual to overlook the probability of system trouble in service environments when the system is being developed under ideal laboratory conditions.

SALVAGE BY TV: A hand-held underwater television camera, small and inexpensive, has been developed by an English firm for use in salvage diving operations. Such work may be supervised from above the water by expert observers grouped around a large screen. Underwater loudspeaker equipment is available as an accessory to the camera so that precise direction can be given to one diver while another follows instructions from above.

Experimental Evaluation

Noise pickup of the types mentioned above was encountered in the laboratory development and in the system test of a recent ac analogue computer system. It was necessary to use many of the techniques suggested here to obtain satisfactory operation of the system, even though in the design of the system particular attention had

(*Continued on page* 146)

(*Continued from page* 145)

been paid to capacitive and conductive pickup problems. Actual experience revealed that inductive pickup was unexpectedly serious and that further attention was required by conductive troubles. Several typical cases showing the application of noise reduction techniques are outlined below:

a. The circuit as originally wired is shown in Fig. 2a. Two amplifiers (*I* and *II*) in the same circuit were mounted in the same amplifier rack and were supplied from the same + 175 v dc lead, yet the ac noise voltage from *K* (the +175 v dc pin) to *B* (the signal ground pin) was considerably higher in amplifier *I*. An examination of the wiring schematic showed that amplifier *II* had its signal ground return in the same cable as its +175 v dc lead, whereas amplifier *I* was grounded by a more direct route to the power supply. Although the *B* ground was quieter in amplifier *I*, the inductive pickup around its *B* to *K* loop was high enough to cause trouble. Amplifier *II*, while using the same +175 v dc lead as amplifier *I*, had less inductive noise from *K* to *B* because the area of its *B* to *K* loop was essentially zero.

b. A cure was effected by running a separate +175 v dc lead to amplifier *I* in the same cable as its signal ground return, as shown in Fig. 2b. In this manner the inductive pickup was reduced and the amplifiers were also isolated conductively.

c. A slightly more involved example, with both magnetic and conductive pickup, is shown in Fig. 3 and Fig. 4. For proper operation, the input source, the amplifier, and the output resolver must all be referred to the same ac ground potential. The original wiring scheme allowed inductive noise voltages to be generated around the input signal circuit in a loop with a circumference approaching 100 ft. In addition, inductive and conductive pickup were generated in the feedback circuit.

d. The solution here was to run the signal source ground and the resolver load ground with their respective "hot" leads as a twisted

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 For product information, use inquiry card on page 137.

(*Continued from page* 146)

pair, tying them both to signal ground (pin B) of the amplifier. This was possible since the input and feedback ground could be isolated from the rest of the system. This method could not be used where the signal source fed more than one amplifier as a load, since ground loops then were formed in the signal ground systems.

Conclusion

It is evident, from the complexity of the electrical noise problem and from its severity in modern electronic computing systems, that particular attention must be paid to the noise problem while the system is being designed. A recommended plan of action is summarized in Table I. If the system is rigorously analyzed as suggested, and if the selected techniques are carefully applied, electrical noise should not be a source of trouble once the system has been assembled.

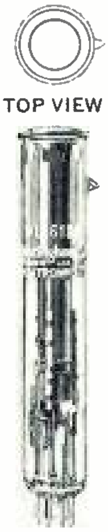
AF's Microwave Relay System Demonstrated

Representatives of major U. S. air commands attended a recent demonstration of the use of microwave equipment for the relaying of radar information at the Rome Air Development Center, Griffis Air Force Base, Rome, N. Y. Hans Ulander, of Motorola, which developed various microwave systems under RADC sponsorship, discussed details of the systems.

Demonstration consisted of a showing of two PPI radar indicators, one operating directly from a search radar, the other receiving its input from a two-hop microwave system totaling some 24 miles in length. It was pointed out that this system could be used to transfer voice, teletype, radar data and control information, and missile test range information over spans of hundreds of miles.

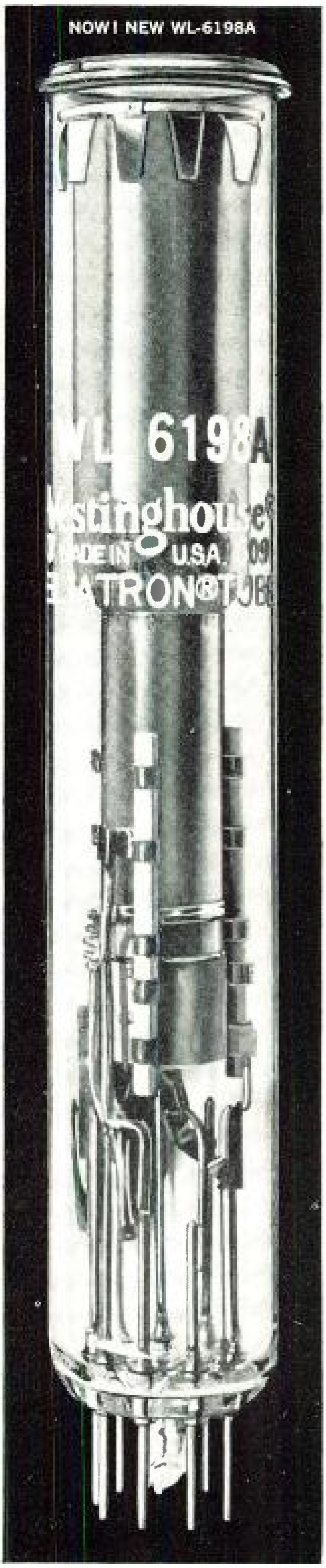
The Civil Aeronautics Authority has said that it will install such a system to help develop and evaluate techniques and procedures for improvements in air traffic control.

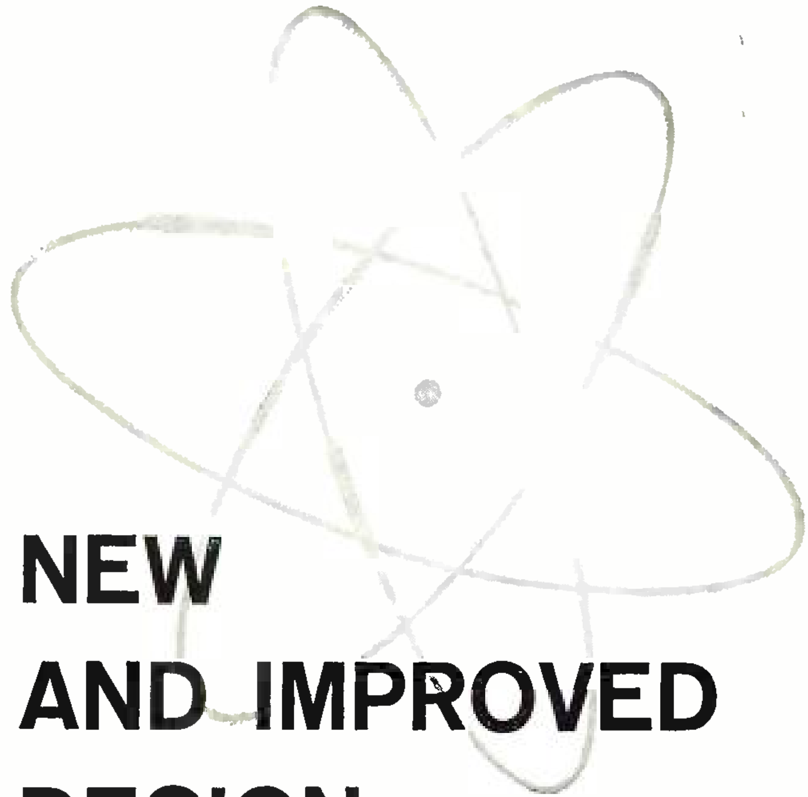
CURRENT WL-6198



TOP VIEW

The side appendage will no longer be necessary thanks to advanced Westinghouse design.





NEW AND IMPROVED DESIGN FROM WESTINGHOUSE

Westinghouse first with redesigned Type 6198 Vidicon Camera Pick-Up Tube . . . first to bring you these important improvements!

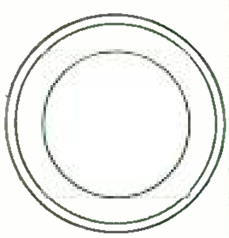
IMPROVED MECHANICAL DESIGN. Since the side appendage has been deleted, yoke construction can be greatly simplified because a slot does not have to be provided.

IMPROVED ELECTRICAL DESIGN. This advanced new design permits use of full-length deflection coils in the yoke, and provides focus uniformity to materially improve picture shading.
Further, the new WL-6198A permits the introduction of a more uniform photo-sensitive surface to reduce the mottling effects in the picture.

IMPROVED PERFORMANCE FEATURES. Now that mottling is reduced and picture shading improved, the resultant picture is of more uniform clarity . . . with a truer image . . . closer by far to the actual subject being observed and transmitted by the camera.

ENGINEERS! For challenge, security, growth potential, investigate career opportunities now being offered by Westinghouse Electronic Tube Division. Write Technical Placement Director, Westinghouse Electric Corp., Electronic Tube Division, Elmira, N. Y.

You will want full details on this new Westinghouse Vidicon Camera Pick-Up Tube. Get detailed technical data by writing to Commercial Engineering Dept., Westinghouse Electric Corp., Elmira, N. Y.



TOP VIEW
New orientation markings on the 6198A permit use of the full photo surface area.

WATCH WESTINGHOUSE
WHERE BIG THINGS ARE HAPPENING FOR YOU!

6ET-4118

High-G Tests

(Continued from page 53)

the reinforcement of deflection which occurs in a symmetrical system where various sections all resonate at approximately the same frequency.

An interesting, rapid, qualitative evaluation of mechanical resonant frequency was developed through the use of a magnetic pick-up and an oscilloscope. Upon impact excitation of the mechanical system, the section of the system under consideration will vibrate at a frequency somewhat related to its natural resonant frequency. This vibration can be measured on the scope via the pickup and in this simple and direct way definite sections of the mechanical system can be compared with each other. Strictly speaking, the critical frequencies obtained by this method are not exactly correct by virtue of the apparent increase of mass in the rotating system due to gyroscopic action. However, results check reasonably well on a quantitative basis and they are excellent on a comparative basis.

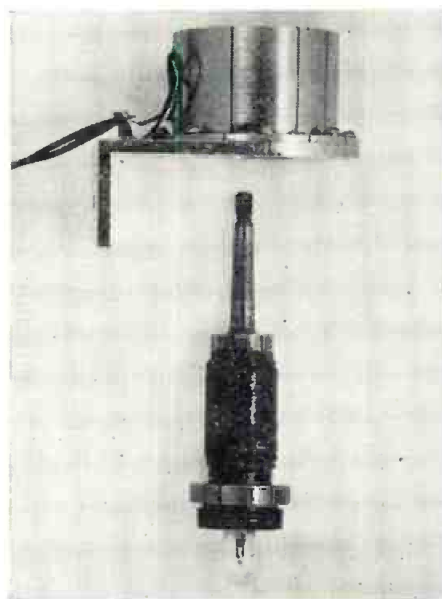


Fig. 4: Rotating secondary and stationary primary of information coupling xformer.

At speeds above 60,000 rpm, cooling becomes a problem perhaps more important than even lubrication. It has been estimated that 2 or 3 hp. of heat may be delivered to a 1 in. diam., well lubricated bearing at a speed of 100,000 rpm in a typical spin rig test. A rough thermal calculation will clearly show that in very few seconds of high speed operation the bearing will reach a temperature at which it may bind or at which the parts may deform, unless a deliberate effort is made to remove this rapid accumulation of heat. The heat removal is effectively done by passing a refrigerated gas through the bearing while it is in operation.

After exposure to the refrigerated gas, however, there invariably is moisture condensation on the bearings and on other internal parts of the bearing and shaft assembly. This moisture results in quick deterioration of the bearings unless it is removed. In order to effect this removal, a 4 kw heater supplies heat to the gas stream and effectively dries out the entire assembly. This heat must be carefully controlled, however, otherwise damage to the phenolic spacer rings in the ball bearings may occur.

Engineer Enrollments Rise, But Not Enough

There was an increase in engineering technicians' enrollments and graduates in 1955-56 over the previous school year, reported the American Society for Engineering Education, but even this increase "fell far short of needs." Enrollments in full-time programs were up 12 per cent to 32,664, and in part-time programs, 32,058. The Society said that annual demand for engineering technicians is 40,000 to 50,000, or nearly five times the number of graduates (11,403) this year from full-time programs. To meet demands, enrollments would have to be between 150,000 and 200,000 annually.

New Guided Missiles

At least four new types of long-range guided missiles are under development by the U. S., it was reported recently by Dr. Eger V. Murphree, Special Asst. to the Secretary of Defense for Guided Missiles. They are: Snark, Navaho, I. C. B. M. and I. R. B. M.; the first three are intercontinental, and the fourth is of intermediate range. Dr. Murphree said that guided missiles are beginning to replace many types of weapons used in World War II.

Quartz Crystals

(*Continued from page* 58)

tones, both faces develop like charges thus preventing any possibility of piezoelectric coupling to the mechanical system. By using a frequency-selective type of osc. circuit most any crystal plate may be made to operate at its mechanical overtones. It is quite remarkable that a sliver of quartz only 3 mils. thick will divide itself into a "seven-layer cake," alternate layers moving in opposite directions. Medium-frequency thickness-shear plates have been observed to operate at overtones higher than the 51st; however, these units attain their greatest application by the use of h-f plates at the 3rd, 5th and 7th overtones to achieve frequencies between 20 MC and 100 MC. A point to remember here is that the frequencies of the mechanical overtones are not exact multiples of the fundamentals but may differ from these by almost ½%. These frequencies, of course, may be electrically multiplied to any extent desired. At frequencies higher than 500-1000 MC, this method of frequency control becomes unattractive because of the complexity of multiplier and filter circuitry necessary to achieve them. Therefore in the UHF region, other methods are more promising.

Available Types

Getting back to crystals, of the approximately 55 types available from most U. S. manufacturers, two types alone will fill the bulk of all requirements. These are the types designated as CR-18/U and CR-23/U. More recently, the CR-23/U has been redesignated into two types known as the CR-51/U and CR-53/U. Any manufacturer can produce these types in almost any quantity at prices from $1.50 to $6.00 depending on quantity and frequency. Together, they cover the frequency range of 800 KC to over 100 MC. They will provide a frequency tolerance of .005% or 50 ppm over the temperature range of —55°C to +90°. This tolerance includes both temperature coefficient and setting tolerance. The latter may be partially or wholly compensated by circuit adjustment. This leaves only TC, which will average ±25 cycles per MC over the extreme temperature range. This is not a bad degree of control; the prospective user should always keep in mind that any requirement for control closer than this brings a penalty of greatly decreased reliability, increase in complexity, and loss of time in achieving operation.

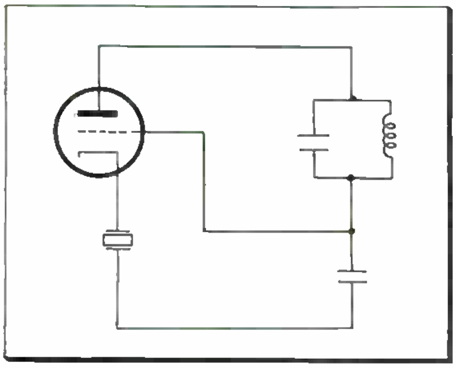


Fig. 8: Bridged-T Osc. for stability.

Quality Measurements

There are several ways of measuring the quality of a particular crystal unit. One convenient way is to place the crystal unit in an oscillating circuit such as the Pierce osc. shown in Fig. 4. This circuit, in which the crystal is connected between plate and grid, and in which all of the resonated inductance is supplied by the crystal, is easily adjusted to correlate with an arbitrary standard osc. The adjustable factors here are the load capacitance, and the amplitude of oscillation. The disadvantages of the circuit as a standard test circuit are, first, that an arbitrary standard is required, and it is difficult to maintain such a standard, and to set up a series of secondary, and tertiary standards which must be carefully carried all over the country in order to assure uniformity of quality in various production plants; secondly, it is extremely difficult to measure power dissipation in the crystal in such a circuit. Since the crystal operates at anti-resonance, the r-f voltages and current on either side of the crystal are out-of-phase, and there is a good deal of harmonic distortion present; thirdly, the activity of the crystal is measured arbitrarily in terms of rectified grid current in the circuit. This again brings up the necessity for corre-

(Continued on page 154)

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(*Continued from page* 153)

lation against a none-too-stable standard osc.

For these reasons, the Pierce osc. as a test circuit for crystals has been almost completely supplanted by the CI or Crystal Impedance Meter circuit, Fig. 3, which has been developed at Signal Corps Engineering Laboratories (SCEL). In this circuit, a tuned plate circuit is coupled to a tuned grid circuit by means of a coupling network of which the crystal is a part. When the plate and grid circuits are tuned to the series-resonance frequency of the crystal, oscillation occurs, and the frequency may be adjusted to the point where the crystal impedance is resistive only.

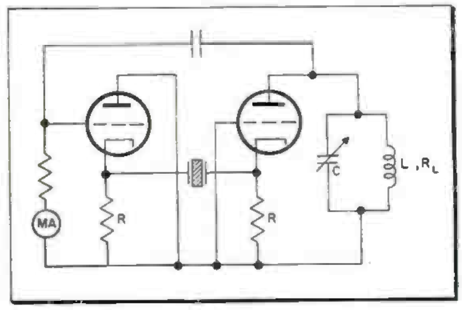

Fig. 9: Butler cathode coupled Osc.

By measuring the frequency of series resonance and that of anti-resonance of any crystal, the equivalent capacitance of that crystal may be calculated by the formula

$$C_1 = \frac{(C_o \div C_L)\Delta F}{F_s}$$

C_1 = Series Resonance Capacitance in Farads

ΔF = Frequency Difference between Series- and Anti-Resonance (cps).

C_o = Holder Capacitance

C_L = Load Capacitance in Test Circuit

F_s = Series Resonance Frequency (cps)

The inductance, L_1 may be calculated by the formula

$$L_1 = \frac{1}{4\pi^2 F_s^2 C_1}$$

Oscillators

Another popular circuit in this range is the Miller osc. (Fig. 5). In this circuit, the crystal is connected between grid and cathode, and the plate is tuned to the frequency of the crystal. This is a frequency-selective circuit, and can be operated at overtone frequencies; however, its crystal-drive characteristics are none too good, and it is quite sensitive to variations in supply voltage and to r-f loading.

Of course, AGC can be applied to any osc. circuit; this will always reduce sensitivity to variations in supply voltage. However, it involves the use of more vacuum tubes, and it drastically reduces osc. output.

In the higher frequency ranges, where the choice is more difficult, 4 additional osc. circuits are considered. These are the Bridged-T as shown in Fig. 8, the cathode coupled, or Butler circuit, Fig. 9, where the crystal unit is connected between the cathodes of a twin triode tube, the CI Meter circuit, already discussed, and which has been adopted by U. S. industry and is widely used by foreign nations as a standard test circuit, and the transformer coupled circuit shown in Fig. 10.

With regard to frequency stability, the relative merits of these 4 oscillators with regard to frequency deviation in ppm caused by a 10% change in plate supply voltage, a 10% change in heater voltage, and by r-f loading by a connecting buffer stage are shown in Fig. 6.

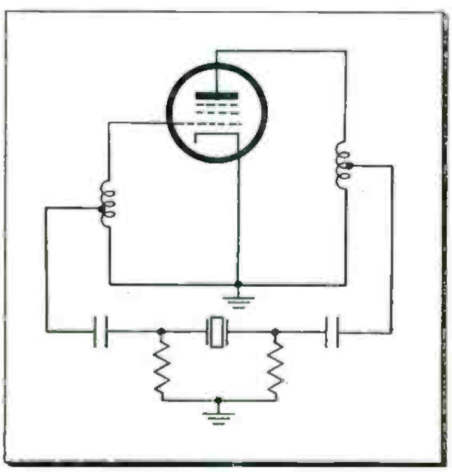

Fig. 10: Transformer coupled Osc.

From this figure the following general trends in osc. characteristics seem to be evident; frequency deviation with respect to changes in supply voltage increases with frequency; the effect of a change in heater voltage on the operating frequency increases slightly with frequency; the effect of r-f loading decreases with frequency.

The comparative ability of these oscillators to provide output power

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(*Continued from page* 155)

is shown in Fig. 7. The 3 bases of comparison are osc. output voltage, the ratio of osc. output voltage to crystal voltage, and output of a following buffer stage. Of these three, the one giving the best indication of relative output capabilities of a circuit is the ratio of osc. output voltage to crystal voltage. Here, the CI Meter shows a smaller ratio at all frequencies than any of the others. Except at the highest frequency, the Bridged-T shows the best ratio, and from the standpoint of power output also seems to be the best of the 4.

Suppressing Radiation

(*Continued from page* 70)

as ultra-violet lamps, oxygen tents, laboratory centrifuges, neurosurgical stimulators, dental units, and the like.

Ultra-violet quartz lamps produce a very high level of radiated interference in the 14 KC range during warmup, and steady levels of radiation as high as 12 MC. The latter noise is obviously the most significant, and can frequently be reduced by improved bonding and shielding, and insertion of an R-C-R filter across the lamp.

The offenders in oxygen tents include the thermostat control switch and the compressor motor system. Both of these units are associated with the intake oxygen temperature control. The system for oxygen circulation usually is not a problem. Motor noise was found to be a culprit in the centrifuges and dental units, while both dental units and the stimulators produced switching transients. Extensions of previously discussed shielding, bonding and filtering techniques apply here.

Specifications

To insure uniformity in limits and methods of measurement for electronic equipment procured for the military services, specifications have been issued covering specialized applications of electronic equipment. Those which apply to electro-medical equipment are listed below:

Specification MIL-S-11748 (Sig. C)[2] is employed by the Army for testing electronic equipment. Radiated measurements are required from 150 KC to 1000 MC, at test distances based on the minimum expected distance from susceptible equipment. Conducted measurements are made over the range of 150 KC to 40 MC.

For shipborne or ground-based electro-medical devices, MIL-I-16910A (Ships)[3] is utilized by the Navy Bureau of Ships and Rome Air Development Center. This specification covers radiated measurements over the frequency range of 14 KC to 1000 MC, and conducted interference from 150 KC to 100 MC. The antenna is located three ft. from the equipment under test for measuring radiated interference.

In the case where the aforementioned equipment might be used to outfit an airborne laboratory, MIL-I-6181B[4] would be employed by the Air Force or BuAer. Radiated measurements are required from 150 KC to 150 MC for equipment capable of producing broadband interference. It has been claimed by these services that suppression over this range will generally provide satisfactory interference reduction up to 1000 MC. On equipments emitting continuous-wave and pulsed-continuous-wave radiation, measurements are required from 150 KC to 1000 MC. The antenna is located 1 ft. from the equipment. Conducted interference measurements are made from 150 KC to 20 MC.

The F.C.C.[5] limits the extent of allowable radiation from medical diathermy equipment in the frequency range of 10 KC to 30,000 MC. Their regulations specify the confines of assigned channels for such devices; center-frequencies of these channels are at 13.56, 27.12, 40.68, and 2450 MC. Within these bands spurious and harmonic radiations must be limited to 25µv per meter at 1000 ft.; 15µv per meter at 1000 ft. is the maximum field intensity permitted outside the band. The commission may type-approve a manufacturer's product upon satisfactory completion of special tests or certification by a competent test laboratory. Existing equipments can be certified if they meet the regulations.

The authors are indebted to Mr.

Richard B. Schulz of Armour Research Foundation for his assistance in the preparation of this article. Patent applications are pending on the R-C-R filters and M-type filters discussed here. The cooperation of the Navy Bureau of Ships for permission to reprint some of their illustrations is also appreciated.

References

1. "A Study on the Reduction of Radio Interference," Armour Research Foundation, Final Report Project E035, Contract NOas53-694c.

2. MIL-S-11748 (Sig C), Suppression Requirements for Electrical and Electronic Equipment (Except Internal Combustion Engine—Drive Equipment), 14 February 1952.

3. MIL-I-16910A (Ships), Interference Measurement, Radio, Methods and Limits; 14 Kilocycles to 1000 Megacycles.

4. MIL-I-6181B, Interference Limits, Test and Design Requirements, Aircraft Electrical and Electronic Equipment, 29 May 1953.

5. Federal Communications Commission, Part 18—Rules and Regulations Relating to Industrial, Scientific, and Medical Service.

"Design Techniques for Interference-free Operation of Airborne Electronic Equipment," Frederick Research Corp., Contract AF 33(038)23341.

"Radio Interference Suppression Techniques," Suppression and General Engineering Branch, Coles Signal Lab., Ft. Monmouth, N. J., Contract DA 36-039sc 42596.

"Studies, Investigations, and Applied Research Concerning Radio Interference Instrumentation, Development of Pick-up Devices, and Evaluation of Electro-Medical Equipments," Electro-Search, Contract NObsr-52386.

"Proceedings of the Conference on Radio Interference Reduction," Armour Research Foundation, Dec., 1954, Contract NOas 53-694c.

"Design of Electronic Equipment for Radio Interference Reduction," A. L. Albin and H. M. Sachs, Presented at AIEE, Pacific General Meeting, Butte, Montana, Aug. 1955. Represented for discussion, AIEE Winter General Meeting, New York, N. Y., Feb. 1956.

AIEE in N. Y. Offers Special Study Groups

Five special study groups are being offered by the AIEE's New York Section on week night, except Fridays, in these fields: Digital and Analog Computer Engineering; New Concepts of Control Systems; Transformer and Switchgear Application; Management and the Engineer; and Modern Technical Report Writing. The Transformer, etc., group continues through Jan. 17; the other sessions conclude just before Christmas. For information: N. A. Bleshman, Room 7310, Public Service Gas & Electric Co., 80 Park Place, Newark 1, N. J.

Automation Forecast:

Blueprints and paper work can be torn up when office automation catches up with factory automation, because electronic machines will be making the decisions—so says H. Ford Dickie, Manager of General Electric's Production Control Service, New York. Speaking at the ASME's annual Fall meeting in Denver, Mr. Dickie pictured an automatic system in which the typing of the customer's order would be the first and last manual operation, and this system was seen as a key to reduced operating costs.

Plans Data Center

In a move to give scientists more access to information in 20,000 non-secret Federal technical reports, the National Science Foundation is sponsoring a program to be known as Government Research Information. Library of Congress and Office of Technical Services of the Dept. of Commerce will join in the program.

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General Sarnoff's Golden Anniversary

Last month, General David Sarnoff, Chairman of the Board, Radio Corp. of America, celebrated his 50th anniversary in the field of radio, television, and electronics. Many well known individuals such as President Eisenhower, Winston Churchill, Lee de Forest, and organizations such as the Radio Pioneers, the National Appliance & Radio-TV Dealers Association joined in the congratulations and in making tributes and awards. We, too, extend heartiest congratulations to General Sarnoff on his golden anniversary.

At a dinner given in honor of this occasion, General Sarnoff made some 20 predictions of developments that would take place over the next 20 years. We feel that many readers will be interested in reading them and keeping them on file. The 20 predictions were:

(In the field of Technological Progress)

1. Nuclear energy will be brought to a practical state of peace-time usefulness.
2. Effective harnessing of solar energy.
3. World-wide color television and person-to-person TV.
4. Guided missiles carrying mail and freight over vast distances, including oceans.
5. Automation will free millions of people from arduous and hazardous work.
6. Spectacular chemical strides will make available a tremendous array of new plastics, ceramics, lubricants, and categories of substances that as yet have no name.
7. Electroluminescence, or 'cold light,' will bring new types of illumination.
8. Recording and accounting will be taken over by computers.
9. Efficient farming of the ocean for nutritive products.
10. Improvements in medicine will extend life span, probably within hailing distance of the century mark.
11. The realization of the housewife's dream, the all-automatic home.
12. Perfection of weather forecasting and major steps toward control.

(Social and Political Areas)

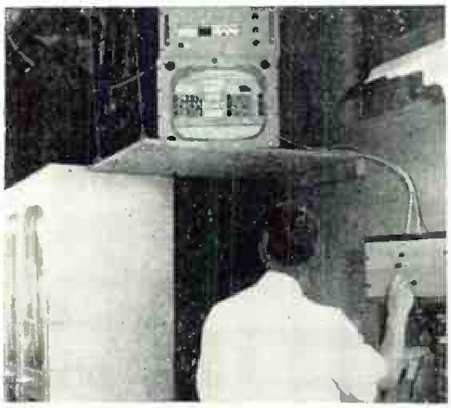
13. Collapse of Soviet Communism.
14. The intensification of the dynamics of a people's capitalism within a democratic framework.
15. An era of relative economic abundance whose most pressing problem will not be the use of labor but the intelligent and beneficent use of leisure.
16. Mounting demand for mental competence will tend to enlarge educational facilities and promote the arts and sciences.

17. Every form of art and every type of entertainment will be readily accessible within the home.

18. Public opinion, registered by electronic means, will be a more decisive element in political life of nations.

19. War as an instrument of international policy will be outlawed.

20. As a reaction against current cynicism and materialism, there will be an upsurge of spiritual vitality.



CLOSED-CIRCUIT TV is scanned in tote room by American Totalisor Co. engineer at Del Mar racetrack to be sure inside figures correspond with those on infield tote board. Equipment designed and made by Kay Lab.

Phototubes Catalog

Latest specs and additional circuit data on the entire line of multiplier phototubes are available in the revised edition of "Du Mont Multiplier Phototubes," a 64-page catalog issued by Allen B. Du Mont Labs, Clifton, N. J. Publication discusses operational theory, applications, and specs for standard and special multiplier phototubes. In three sections, the catalog has illustrations, graphs and circuit diagrams. Requests for catalog should be on company letterhead and sent to: Industrial Tube Sales Dept., Allen B. Du Mont Labs, 2 Main Ave., Passaic.

Science Taught Via TV

Televised courses in mathematics and physics are being given for high school students within 90 miles of Oklahoma City by the Oklahoma State Educational TV Authority. This project will enable students in smaller school systems, where teachers for these courses are not available, to take the subjects—algebra, trig, solid geometry and physics. Advanced courses are planned for the project.

Microwave Directory

(Continued from page 91)

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2—**Aeromotive Equip Corp** 1632 Central St Kansas City 8 Mo
2—**Airborne Electronics Co** Hangar 6 Metropolitan Airport Van Nuys Calif
1—**Airborne Instruments Lab** 160 Old Country Rd Mineola NY
2—**Aircraft Armaments** P O Box 126 Cockeysville Md
2-3—**Aircom Inc** 354 Main St Winthrop 52 Mass
3—**Aircraft Radio Corp** Boonton NJ

(Continued on page 162)

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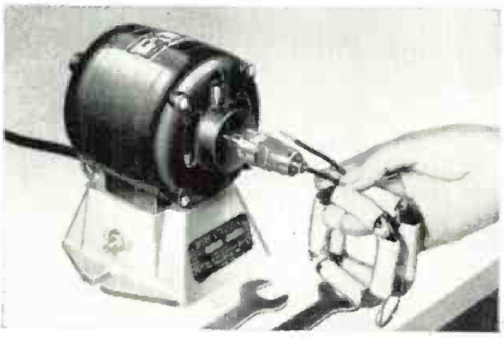

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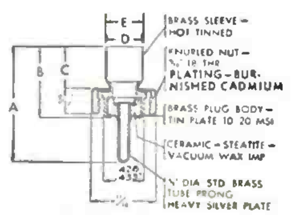

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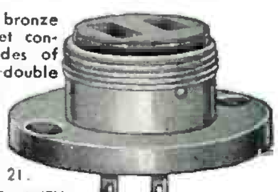
For quality construction thru-out, and fine finish, see diagram above. 101 Series furnished with ¼", .290", 5/16", ⅜", or ½" ferrule for cable entrance. Knurled nut securely fastens unit together. Plugs have ceramic insulation; sockets bakelite. *Assembly meets Navy specifications.* 202 Series Phosphor bronze knife-switch type socket contacts engage both sides of flat plug contacts—double contact area. Plugs and sockets have molded bakelite insulation. For full details and engineering data ask for Jones Catalog No. 21.

JONES MEANS *PROVEN* QUALITY

P-202-CCT

P-101-¼

S-101



S-202-B

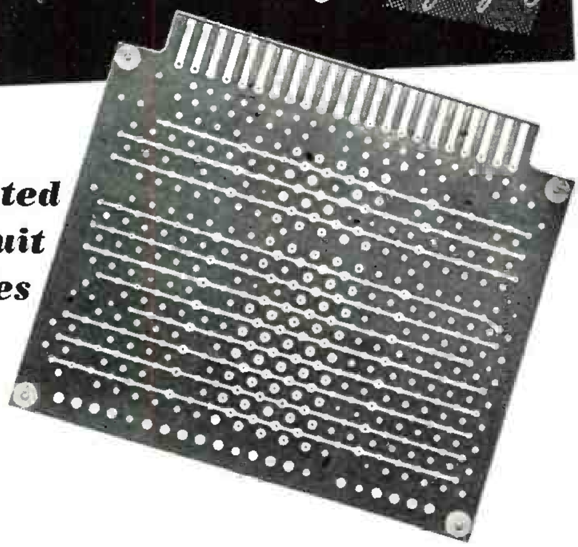
Jones

HOWARD B. JONES DIVISION
CINCH MANUFACTURING CORPORATION
CHICAGO 24, ILLINOIS
SUBSIDIARY OF UNITED-CARR FASTENER CORP.

TRACER-GUIDED DRILLING

100 HOLES P. M.

WITH NEW HERMES **Engravograph**

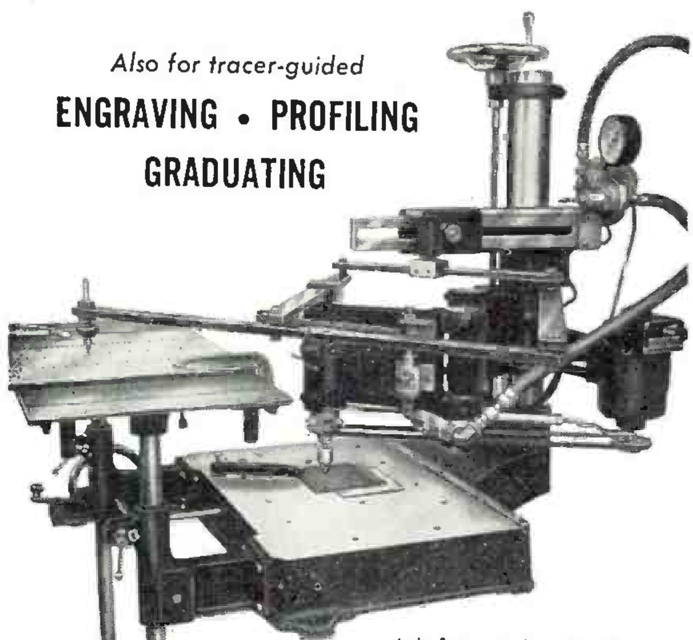


for printed circuit plates

- Pantograph reproduces drill pattern from template in any reduction ratio — assuring high accuracy.
- Allows drilling and routing of different size holes in one operation without changing tools.
- Pneumatic attachment with adjustable feed gives high speed production.

Also for tracer-guided

ENGRAVING • PROFILING GRADUATING



Ask for catalog H B5 describing pneumatic attachment.

new hermes
ENGRAVING MACHINE CORP.
13-19 University Place, New York 3, N.Y.

For product information, use inquiry card on page 137.

Microwave Directory

(Continued from page 160)

2—**Advance Electronics Inc** 451 Highland Passaic NJ
2—**Airtron Inc** Linden NJ
2—**Alfred Electronics** 897 Commercial St Palo Alto Calif
2-3—**Amerac Inc** Wenham Mass
2—**American Radio Co** 445 Park Ave New York 22 NY
2—**ARF Products** River Forest Ill
2—**Bellaire Electronics Inc** 62 White St Red Bank NJ
2—**Bird Electronic Corp** 1800 E 38th St Cleveland 14 O
2—**Bogart Mfg Co** 315 Siegel St Brooklyn 6 NY
2-4—**Bomac Labs** Salem Rd Beverly Mass
2—**Boonton Electronics Corp** Morris Plains NJ
3—**Bruno-NY Ind** 460 W 34 St NY 1
2—**Budd-Stanley Co** 43-01 22nd St Long Island City 1 NY
2—**Budelman Radio Corp** 375 Fairfield Ave Stamford Conn
3—**Byron Jackson Co Electronic Div** 2010 Lincoln Dr Pasadena 3 Calif
2-4—**Cal-Tronics Corp** 11307 Hindry Ave Los Angeles 45 Calif
1—**Canoga Corp** 5955 Sepulveda Blvd Van Nuys Calif
2—**Cascade Res Corp** 53 Victory Lane Los Gatos Calif
2—**Central Research Labs** Red Wing Minn
2—**Century Electronics Div Century Metalcraft Corp** 14844 Oxnard St Van Nuys Calif
2—**C G S Labs Inc** 391 Ludlow St Stamford Conn
2—**Chemalloy-Electronics Corp** Gillespie Airport Santee Calif
3-4—**Clegg Labs Inc** Morristown NJ
3—**Clough-Brengle Co** 6014 Broadway Chicago 40 Ill
2—**Collins Radio Co** 855 35 St NE Cedar Rapids Iowa
2—**Colortone Electronics Inc** 200 Frank Rd Hicksville LI NY
2-3-4—**Color TV Inc** 973 E San Carlos Ave San Carlos Calif
1-2—**Cossar (Canada) Ltd** 301 Windsor St Halifax NS Canada
2—**Crown Eng'g** Sta B Box 6127 Albuquerque N Mex
2—**Cubic Corp** 2841 Canon St San Diego 6 Calif
2—**Decade Instrument Co** Box 153 Caldwell NJ
2—**Defiance Eng & Microwave Corp** 81 Albion St Wakefield Mass
1-2-4—**De Mornay-Bonardi Inc** 780 S Arroyo Pkwy Pasadena 1 Calif
2-4—**Diamond Microwave Corp** 7 North Ave Wakefield Mass
2—**Douglas Microwave Co** 11 Beechwood Ave New Rochelle NY
1-4—**Dynamic Electronics-NY** 73-39 Woodhaven Blvd Forest Hills NY
2—**Eldico of N Y Inc** 70-72 E 2 St Mineola LI NY
2—**Electro Impulse Lab** 62 White St Red Bank NJ
1—**Electron-Radar Products** 4806 W Chicago Ave Chicago 51 Ill
4—**Electronic Control Systems** 2136 Westwood Blvd Los Angeles 25 Calif
2—**Elk Electronics Labs Inc** 333 W 52 St New York 19
2-3—**Empire Devices Products Corp** 38-15 Bell Blvd Bayside 61 NY
2—**Eng'g Associates** 434 Patterson Rd Dayton 9 Ohio
4—**Erca Tool Die & Stamping** 19 Ash St Brooklyn 22 NY
2-4—**Espey Mfg Co** 200 W 57 St New York 19
2—**Farnsworth Electronics Co Div IT&T** P O Box 810 Fort Wayne Ind
2-3-4—**Federal Telephone & Radio Co Div IT&T** 100 Kingsland Rd Clifton NJ
2—**Frequency Standards** Asbury Park NJ
2-3-4—**F-R Machine Works** 26-12 Borough Pl Woodside 77 NY
2-3-4—**General Communication Co** 681 Beacon St Boston Mass
2—**General Electric Co Germanium Products Div** Electronic Park Syracuse NY
4—**General Mills Inc Mechanical Div** 2600 Far Hills Bldg Dayton 9 Ohio
2—**General Radio Co** 275 Massachusetts Ave Cambridge 39 Mass
2—**Gertsch Products** 11846 Mississippi Ave Los Angeles 25 Calif
2—**Gilfillan Bros** 1815 Venice Blvd Los Angeles 6 Calif
2-4—**G & M Equipment Co** 7315 Varna Ave N Hollywood Calif

2—**Goodyear Aircraft Corp** 1210 Massillon Rd Akron 15 Ohio
2—**G W Associates** P O Box 2263 El Segunda Calif
3—**Hallamore Electronics Co Div Siegler Corp** Brockhurst & Santa Ana Freeway Anaheim Calif
2—**Hazeltine Electronics Corp** 58-25 Little Neck Pkwy Little Neck 62 NY
2-3-4—**Hewlett-Packard Co** 275 Page Mill Rd Palo Alto Calif
2—**Hickok Electrical Instrument Co** 10514 Dupont Ave Cleveland 8 Ohio
2—**Hycon Electronics Inc** 321 S Arroyo Pkwy Pasadena Calif
2—**Impedance Inc** 9 Alan St Farmingdale LI NY
1-3-4—**J-V-M Eng'g Co** 8846 W 47 St Brookfield Ill
2-3—**Jerrold Electronics Corp** 2300 Chestnut St Phila 3
2—**Kahn & Co** 541 Windsor St Hartford 1 Conn
1-2-3-4—**Kay Electric Co** 14 Maple Ave Pinebrook NJ
2-4—**Kearfott Co** 1378 Main Ave Clifton NJ
2-4—**Kearfott Co Western Mfg Div** 14844 Oxnard St Van Nuys Calif
2—**Kings Electronics Co** 40 Marbledale Rd Tuckahoe NY
4—**K V Transformer Corp** 20 E Franklin St Danbury Conn
3—**Laboratory for Electronics** 75 Pitts St Boston 14 Mass
2-3—**Lambda-Pacific Eng'g Inc** P O Box 105 Van Nuys Calif
2-3-4—**Lavoie Labs Inc** Matawan-Freehold Rd Morganville NJ
2—**Levinthal Electronics Products Inc** 2821 Fair Oaks Ave Redwood City Calif
2—**Lieco Inc** 147 Ocean Ave Lynbrook NY
2—**Litton Industries** 336 N Foothill Rd Beverly Hills Calif
2—**Lux Industries Inc** 38 Argyle Park Buffalo 22 NY
2-4—**Manson Labs** 207 Greenwich Ave Stamford Conn
1-3—**Marconi Instruments Ltd** 44 New St New York 4
2—**Mark Products Co** 6412 W Lincoln Ave Morton Grove Ill
2—**Maxson Corp W L** 460 W 34 St New York 1
2—**Measurements Corp** Boonton NJ
2—**Mercury Electronic Co** Box 450 Red Bank NJ
2-3—**Meridian Metalcraft Inc** 8739 S Millergrove Dr Whittier Calif
2—**Mico Instrument Co** 80 Trowbridge St Cambridge 38 Mass
2—**Microlab** 71 Okner Pkwy Livingston NJ
2-4—**Microphase Corp** PO Box 1166E Greenwich Conn
2-3—**Microwave Associates** 22 Cummington St Boston 15 Mass
2—**Model Eng'g & Mfg Co** 50 Frederick St Huntington Ind
1-2-4—**Narda Corp** 160 Herricks Rd Mineola NY
4—**Nevada Air Products Co** North Valley Rd Reno Nev
3—**New London Instrument Co** 82 Union St New London Conn
2—**Nichols Products** 325 W Main St Moorestown NJ
3—**Northeast Scientific Corp** 617 Concord Ave Cambridge 28 Mass
2—**Northeastern Eng'g Corp** S Bedford St Manchester NH
2-4—**Omega Labs Inc** Haverhill St Rowley Mass
2—**Pacific Mercury TV Mfg Corp** 5955 Van Nuys Blvd Van Nuys Calif
1—**Panoramic Radio Products** 10 S 2 Ave Mt Vernon NY
2—**Phebco Inc** 3640 Woodland Ave Baltimore 15 Md
2—**Philco Corp** 4700 Wissahickon Ave Phila 44 Pa
2—**Photo Crystals Inc** Geneva Ill
2—**Pitometer Log Corp** 237 Lafayette St New York 12
1-2-3-4—**Polarad Electronics Corp** 43-20 34 St Long Island City 1 NY
2-3—**Polytechnic Res & Devel Co** 202 Tillary St Brooklyn 1 NY
2-3—**Precision Associates** 354 Cumberland St Brooklyn 38 NY
2—**Premier Instrument Corp** 52 W Houston St New York 12
2—**Press Wireless Labs Inc** Prospect Place West Newton 65 Mass
2-3—**Presto Recording Corp** PO Box 500 Paramus NJ
2—**Radalab Inc** 87-17 124 St Richmond Hill 18 NY
2—**Radiation Inc** Box "Q" Melbourne Fla
2—**Radio Corp of America Eng'g Products Div** Camden 2 NJ

(*Continued on page* 164)

The answer to your current project ...or your next one...may be easier with one of these

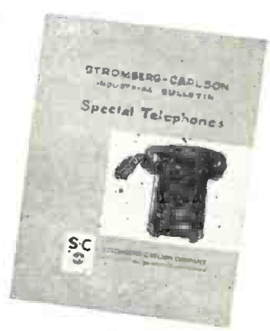
Special-Application Instruments

If you think Stromberg-Carlson makes telephones only for office or home conversation, you should know how many instruments we offer for specialized jobs.

Shown above are just a handful, developed for somebody's special project.

Suspended-type 'phones, great space-savers; used either in dial or manual service.

Remote-control instruments, such as we make to work with dictating machines. "*Press-to-talk*," "*Press-to-receive*" and "*Press-to-control*" handsets, very popular in two-way radio applications. "*1574*" telephones, with a special key for transferring calls (or other functions) from one line to another.



NEW CATALOGUE, with complete description of all special-project instruments, sent you on request. Or for a specific problem, just write

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STROMBERG-CARLSON

STROMBERG-CARLSON COMPANY

A DIVISION OF GENERAL DYNAMICS CORPORATION

Telecommunication Industrial Sales • 126 Carlson Road • Rochester 3, N. Y.

 For product information, use inquiry card on page 137.

Microwave Directory

(*Continued from page 163*)

2—**Raytheon Mfg Co Equip Marketing Div** 190 Willow St Waltham 54 Mass
2-4—**Sage Labs** 30 Guinan St Waltham 54 Mass
2—**Sierra Electronics Corp** 1050 Britton Ave San Carlos Calif
2—**Simpson Electric Co** 5200 W Kenzie St Chicago 44 Ill
1-2-3-4—**Sperry Gyroscope Division of Sperry Rand Corp** Great Neck NY
2—**Standard Electronics Res Corp** 2 East End Ave New York 21 NY
2—**Stanford Labs** 1661 Broadway Redwood City Calif
2-3-4—**Stavid Eng'g Co** US Hwy 22 Plainfield NJ
2—**Technicraft Labs Inc** Thomaston-Westbury Rd Thomaston Conn
2—**Telechrome Inc** 88 Merrick Rd Amityville LI NY
3-4—**Telerad Mfg Corp** 1440 Broadway New York 18
3—**Telonic Industries** 73 N 2 Ave Beech Grove Ind
2—**Universal Microwave** 380 Hillside Ave Hillside NJ
2—**Varian Associates** 611 Hansen Way Palo Alto Calif
1-2-4—**Vectron Inc** 1611 Trapelo Rd Waltham 54 Mass
1-2-3-4—**Visual Electronics Corp** 500 5 Ave New York 36
2—**Wac Line Inc** 35 S St Clair St Dayton 2, O
2—**Waldorf Instrument Corp** Park Ave Huntington NY
2-3—**Waveline Inc** Passaic Ave Box 470 Caldwell NJ
1-3-4—**Weinschel Eng'g & Mfg Corp** 10505 Metropolitan Ave Kensington Md
2-3-4—**Weston Labs Inc** Old Littleton Rd Harvard Mass
2—**Weymouth Instrument Co** 1440 Commercial St E Weymouth 89 Mass
2-3—**Wheeler Labs Inc** 122 Cutter Mill Rd Great Neck NY
2-3—**White Electron Devices Inc Roger** 4 Ave Haskell NJ
2—**Wright Eng'g Co** 180 E Calif St Pasadena 1 Calif

TRANSMITTERS

Air Associates Inc 511 Joyce St Orange NJ
Airborne Instruments Lab 160 Old County Rd Mineola NY
Aircom Inc 354 Main St Winthrop 52 Mass
Aircraft Armaments Inc PO Box 126 Cockeysville Md
Allied Research & Eng'g Inc 6916 Santa Monica Blvd Los Angeles Calif
American Radio Co 445 Park Ave New York 22
Bell Aircraft Corp Box 1 Buffalo NY
Budelman Radio Corp 375 Fairfield Ave Stamford Conn
Canoga Corp 5955 Sepulveda Blvd Van Nuys Calif
C G S Labs Inc 391 Ludlow St Stamford Conn
Collins Radio Co 855 35 St NE Cedar Rapids Iowa
Color TV Inc 973 E San Carlos Ave San Carlos Calif
Continental Electronics Mfg 4212 S Buckner Blvd Dallas 27 Tex
Corbin Corp 5419 56 Pl Riverdale Md
Cubic Corp 2841 Canon St San Diego 6 Calif
DeMornay-Bonardi Corp 780 S Arroyo Pkwy Pasadena 2 Calif
DuMont Laboratories Inc Allen B Communications Products Div 1500 Main Ave Clifton NJ
Electronicraft Inc 27 Milburn St Bronxville 8 NY
Federal Telecommunication Labs 500 Washington Ave Nutley NJ
Federal Telephone & Radio Co Div IT&T 100 Kingsland Rd Clifton NJ
General Electric Co Electronics Div Communication Equip Syracuse NY
Grem Eng'g Co 257 Alliston Rd Springfield Pa
Hallicrafters Co 4401 W 5 Ave Chicago 24 Ill
J-V-M Eng'g Co 8846 W 47 St Brookfield Ill
Kay Electric Co 14 Maple Ave Pine Brook NJ
Kings Electronic Co 40 Marbledale Rd Tuckahoe NY
Lambda-Pacific Eng'g Inc PO Box 105 Van Nuys Calif
Levinthal Electronic Products 2821 Fair Oaks Ave Redwood City Calif
Litton Industries 336 N Foothill Rd Beverly Hills Calif
Measurement Eng'g Ltd John St Arnprior Ontario Canada
Motorola Communications & Electronics 4501 W Augusta Blvd Chicago 51 Ill
National Co 61 Sherman St Malden 48 Mass
Palmer Inc M V 4002 Fruit Valley Rd Vancouver Wash
Philco Corp 4700 Wissahickon Ave Phila 44 Pa
Pye Corp of America 270 Park Ave New York 17
Radio Corp of America Camden 2 NJ
Radio Eng'g Labs 36-40 37 St Long Island City 1 NY
Radio Receptor Co 251 W 19 St New York 11
Raytheon Mfg Co Equip Marketing Div 190 Willow St Waltham 54 Mass
Sanders Associates Inc 137 Canal St Nashua NH
Sierra Electronic Corp 1050 Britton Ave San Carlos Calif
Slate & Assoc Claude C 11370 W Olympic Blvd Los Angeles 64 Calif
Stavid Eng'g U S Hwy 22 Plainfield NJ
Sterling Precision Instrument Corp 34-17 Lawrence St Flushing NY
Tarzian Inc Sarkes 539 S Walnut St Bloomington Ind
Telerad Mfg Corp 1140 Broadway New York 18
Telescreen 36 Grove New Canaan Conn
Transmitter Equip Mfg Co 35 Ryerson St Brooklyn 5 NY
Varian Associates 611 Hansen Way Palo Alto Calif
Video Corp of America 229 W 28 St New York 1
Visual Electronics Corp 500 5 Ave New York 36
Western Mfg Co 1400 W 22 St Kearney Nebr
Westinghouse Electric Corp Electronics Div 2519 Wilkens Ave Baltimore 3 Md

TUBES

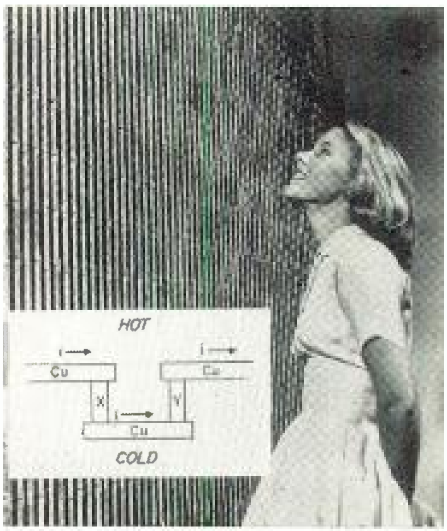
Backward Wave	1
Klystron	2
Magnetron	3
Travelling Wave	4

1—**American Radio Co** 445 Park Ave New York 22
2-3—**Amperex Electronic Corp** 220 Duffy Ave Hicksville LI NY
2-3—**Anton Electronic Labs** 1226 Flushing Ave Brooklyn 37 NY
2-4—**Bendix Aviation Corp** Red Bank Div Eatontown NJ
1-2-3-4—**Bomac Labs** Salem Rd Beverly Mass
1—**Cascade Research Corp** 53 Victory Lane Los Gatos Calif
2—**Eitel-McCullough Inc** 708 San Mateo Ave San Bruno Calif
3-4—**Federal Telephone & Radio Co Div IT&T** 100 Kingsland Rd Clifton NJ
2-3-4—**General Electric Co Tube Dept** Campbell Ave Schenectady 5 NY
1-4—**Huggins Labs** 711 Hamilton Ave Menlo Park Calif
2-3—**Industro Inc** 649 Broadway New York 12
4—**Lambda-Pacific Eng'g Inc** PO Box 105 Van Nuys Calif
2-3—**Litton Industries** 1025 Brittan Ave San Carlos Calif
3—**MacKay Research Labs** RR2 Box 401 McHenry Ill
3—**Microwave Associates** 22 Cummington St Boston 15 Mass
1-2-3-4—**Mullard Overseas** Shaftsbury Ave London England
4—**Penta Labs** 312 N Nopal St Santa Barbara Calif
2—**Polarad Electronics Corp** 43-20 34 St Long Island City 1 NY
1-2-3-4—**Radio Corp of America Tube Div** 215 S 5 St Harrison NJ
1-2-3-4—**Raytheon Mfg Co Microwave & Power Tube Operations** Foundry Ave Waltham Mass
1-2-4—**Sperry Gyroscope Co** Div Sperry Rand Corp Great Neck NY
1-2-4—**Stanford Labs PO Box** 252 Menlo Park Calif
1-2-3-4—**Sylvania Electric Products** 1740 Broadway New York 19
1-2-4—**Varian Associates** 611 Hansen Way Palo Alto Calif
Victoreen Instrument Co 3800 Perkins Ave Cleveland 14 Ohio
3—**Westinghouse Electric Corp** Elmira NY
4—**Westlabs Inc** PO Box 1111 Palo Alto Calif
1-4—**White Electron Devices Inc Roger** 4 Ave Haskell NJ

* * *

RCA Unveils New Electronic Heat Pump

Among the new electronic developments recently announced by RCA are an improved developmental TV tape playback unit and an electronic light amplifier having an amplification factor up to 1000. Invasion of yet another field by electronics is presaged by the improved electronic heat pump units developed at RCA's David Sarnoff Laboratories.



Hot side of electronic heat pump

The new units, twice as efficient as the units announced last year, can produce up to 80° F temperature difference between separated copper plates by the passage of an electric current through the unit. There are no moving parts—the effect is produced by an electric current passing through junctions between dissimilar metals. Completely electronic air conditioning and refrigeration is an actuality in the laboratory, and is expected to gain commercial significance within five years.

The basic principle, discovered by Peltier in 1834, is that a current passing through the junction of two dissimilar metals will cause heat to be evolved or absorbed in addition to the ohmic heat evolved. This knowledge remained a scientific curiosity until recent studies brought new knowledge of electron behavior in solid materials, and new concepts which are now being applied to develop new thermoelectric materials and techniques.

One configuration devised at RCA is shown in the inset above.

(Continued on page 166)

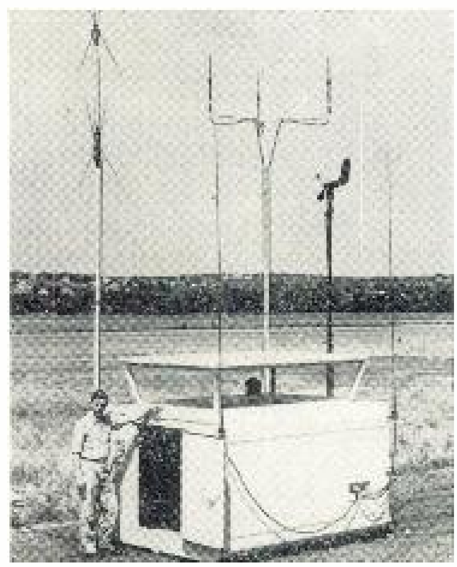
(*Continued from page* 165)

Materials X and Y are dissimilar thermoelectric materials giving opposite reactions when current passes from copper into them. If, when current flows from copper into material X, Peltier heat is evolved, then at the other end of X heat will be absorbed. Similarly, current entering material Y from copper will cause the absorption of heat, and will evolve Peltier heat in passing from Y to copper. A study of the configuration will show that both cold junctions are associated with the same copper bar and both hot junctions are at the opposite side of the unit. In refrigeration applications, the hot and cold bars are on opposite sides of an insulating wall. For efficient heat radiation, the hot bars may have fins added, as was done with the units shown in the picture.

Great strides have been made in development of more efficient units, and it is predicted by RAC scientists that further development will bring commercial significance within five years.

"Flying" Control Tower

For use in military or Civil Defense planning, the Helicop-Hut Air Traffic Control Set is a mobile,



HELICOP-HUT AIR TRAFFIC CONTROL SET, a lightweight, mobile airport control tower, can be transported by helicopter and put into operation within 30 minutes.

two-man airport control tower that can be transported by heli-

(*Continued on Page* 168)

Letters to the Editor

"Test Equipment For Rent"

Editors, ELECTRONIC INDUSTRIES:

Your editorial in the July issue entitled "Test Equipment for Rent?" was noted with great interest. Polarad has had an equipment lease plan for electronic test equipment in operation for several years.

I am attaching a brochure describing our lease plan, and would be pleased to send copies to any interested persons. There are many advantages to the plan in addition to the obvious financial ones. Prominent among these is the fact that under the lease plan, military contractors do not require approval for the purchase of facilities by a government agency.

A. H. Sonnenschein
Director of Engineering Operations
Polarad Electronics Corp.
43-20 34th St.
Long Island City, N. Y.

"Transistor Remote Amplifier"

Editors, ELECTRONIC INDUSTRIES:

I wish to call your attention to an error in a schematic diagram on page 74 of your August 1956 issue. The top end of resistor R_3 should be connected to the other side of C_2 to furnish bias voltage to the emitter of the transistor. Resistor R_1, capacitor C, and its associated transistor in the other microphone input are connected correctly.

Gerald W. Loomis
Missile and Radar Div.
Raytheon Mfg. Co.
P. O. Box 87
Maynard, Mass.

"Cathode Follower Curves"

Editors, ELECTRONIC INDUSTRIES:

I would like to call to your attention printing errors in the otherwise excellent article, "Cathode Follower Design Curves," appearing in the September 1956 issue of your magazine.

On page 68, the equation for the gain of the cathode follower should be:

$$G = \frac{\mu R_k}{(\mu + 1) R_k + r_p}$$

and the equation for the output impedance should be:

$$Z_o = \frac{r_p R_k}{(\mu + 1) R_L + r_p}$$

Similarly, the equations in columns 2 and 3 on page 69 should be:

$$G = \frac{\mu R_k}{(\mu + 1) R_k + r_p + R_L}$$

$$G_k = \frac{\mu R_k}{(\mu + 1) R_k + r_p + R_L}$$

$$G_o = \frac{\mu R_L}{(\mu + 1) R_k + r_p + R_L}$$

Leslie R. Axelrod
Senior Engineer
Cook Research Laboratories
2700 Southport Ave.,
Chicago 14, Ill.

Thanks also to N. Lea, Research Div., Marconi's Wireless Tel. Co. Ltd., Great Baddow, Essex, England, for bringing these errors to our attention.

"New Soldering Technique"

Editors, ELECTRONIC INDUSTRIES:

The article on "New Soldering Technique" which appears on Page 98 of ELECTRONIC INDUSTRIES for April, 1956, is certainly not new insofar as soldering of aluminum is concerned. A loaded grinding wheel revolving through a bath of molten solder has been used for years in the capacitor industry and was in use prior to WW II. It is a very common method of tinning the ends of paper capacitor sections, which are rolled with aluminum foil. The operator touches the end of the capacitor roll against the revolving wheel and then immediately thereafter places the lead pigtail against the hot section.

Sidney L. Chertok
33 Concord Parkway,
Pittsfield, Mass.

For product information, use inquiry card on page 137.

(*Continued from page* 166)

copter to forward air strips and put into operation in 30 minutes.

All of the electronic equipment necessary to operate an airport is contained in the compact Set. The unit, developed and manufactured by Craig Systems, Inc., Danvers, Mass., is entirely self-contained except for electrical power source. Total weight is less than 2,500 lbs.; a special shelter construction utilizes aluminum skins bonded to a plastic foam core to provide a high strength/weight ratio and insulation factor.

Interior dimensions are 96 in. long, 76 in. wide, 54 in. high and it is 75 in. from floor to ceiling of observation dome. For lifting shelter to and from truck bodies, a mechanical lifting device of the knockdown type is available.

Dr. A. B. DuMont (l.) and David T. Schultz look over their first commercially produced 25-year-old CRO and compare it with their newest. Type 401 shown is first of 400 series.

Printed Circuit Manufacturers

In the Directory of Printed Circuit Manufacturers appearing in the October issue, two manufacturers were inadvertently omitted. The JFD Manufacturing Co., Inc., 6101 Sixteenth Avenue, Brooklyn 4, N. Y. should have been included as a manufacturer of capacitors for printed circuits, and the Allen-Bradley Company of 138 W. Greenfield Avenue, Milwaukee 4, should have been listed as a manufacturer of resistors fixed and variable for printed circuit applications.

ELECTRONIC INDUSTRIES & Tele-Tech Advertisers—Nov., 1956

News of MANUFACTURERS' REPS

REPS WANTED

Manufacturer of small electric A. C. motors, propeller fans and centrifugal blowers—special application units for aircraft and electronics industries—seeks reps for Upstate New York (excluding the City of New York); Minneapolis-St. Paul; St. Louis; and Chicago. (Ask for R11-1.)

Reps for a line of amplifiers, intercoms, and home music systems are wanted to present these products to radio and TV parts distributors & electrical wholesalers in Eastern Canada. (Ask for R11-2.)

Allied Components, 3918 Harry Hines Blvd., Dallas 19, has been named rep in Texas and Oklahoma for George Stevens Mfg. Co., Chicago.

Neely Enterprises is representing Magnetic Research Corp., El Segundo, Calif., as field engineering and sales reps in California, Arizona, New Mexico and Nevada.

Two reps have been appointed by Magnetic Research Corp., El Segundo, Calif.: **Scientific Instrument Co.**, 1460 Pennsylvania St., Denver, will cover Colorado, Wyoming and Utah; the **N. R. Schultz Co.**, 619 Second Ave., Seattle, will represent Magnetic in Washington, Oregon, Idaho and Montana.

Fred L. Olson has become New England rep for **Bodine Electric Co.**, Chicago, succeeding Walter A. Black, resigned. Olson's office will be at 686 Massachusetts Ave., Cambridge 39 (ELiot 4-3442).

Pyramid Electric Co., North Bergen, N. J., has appointed two new sales reps: **Edwin A. Schulz Co.**, 721 Sherwood Drive, Indianapolis; and **Jack F. McKinney Sales Co.**, 1330 No. Industrial, Dallas. Schulz is handling jobber sales only for Indiana and Kentucky, and McKinney is taking care of both jobber and industrial sales in Texas, Ark., Okla., and La.

Mid-Lantic Chapter, "The Representatives" of Electronic Products Mfrs., Inc., has elected these officers: President, D. G. Quinlan; Vice Pres., D. G. Brown; Treas., L. Parker Maudain; and John T. Stinson, Secy.

Hale P. Faris has joined the **Fred W. Falck Co.**, electronic mfrs'. reps, Burbank, as a partner. He handles Southern California sales.

Weldmatic Div. of Unitek Corp., Pasadena, has appointed two Eastern field engineering reps: **M. P. O'Dell Co.**, Cleveland, and **Whitney A. Brown & Assoc.**, Alexandria, Va. O'Dell covers Ohio, part of Mich. and E. Pa.; Brown serves the general Southeast.

R. C. Merchant & Co., Inc., electronic mfrs.' reps, has moved to larger quarters at 18411 W. McNichols, Detroit 19. Firm also added to sales engineering staff these individuals: **R. C. Merchant, J. E. Merchant, R. A. Sanderson** and **W. A. McCall.**

The **Charles Lucas Sales Co.**, P. O. Box 8506, Dallas, has been named regional rep for Magnecord, Inc., Chicago. Lucas is covering Ark., La., Okla., Texas and the southern half of New Mexico for tape recorders.

Jack Fields Sales Co., Verona, N. J. has been named sales rep to cover electronic parts distributors in the Greater Metropolitan New York area, incl. Northern N. J., by Insuline Corp. of America, Manchester, N. H.

John R. Baker is now a Field Engineer for Koessler Sales Co., Los Angeles rep.

Gerald B. Miller Co., Hollywood, Calif., engineering reps, have been appointed tech. reps in the Western states by Computer - Measurements Corp., No. Hollywood. The Miller firm is acting in an engineering sales and service capacity for the complete CMC line.

National Electronics Corp., No. Hollywood, Calif., has appointed **Don Smith Sales Co.**, 2204 No. 45th St., Seattle 3, as sales reps for the Pacific Northwest.

Otto M. Lerz, Jr., has been named Vice President of the New Products Div., **M. J. Johnson Co.**, Morristown, N. J., sales engineers for aircraft and electronic products. Mr. Lerz plans to open a Long Island office to service the Metropolitan N. Y. area.

Lee Mark Associates, Kansas City mfrs.' engineering reps, have opened an office at 1500 Big Bend Blvd., St. Louis 17, with **Warren G. Seitz** as resident field engineer.

S. O. S. Cinema Supply Corp., 602 W. 52nd St., New York 19, has been appointed distributor for Synchronous Magnetic Recorders by Stancil-Hoffman Corp., Hollywood, Calif.

Foto-Video Labs, Little Falls, N. J., appointed **R. L. Ringer Co.**, Glen Rock, N. J., as exclusive sales rep in Southern N. Y. and Northern N. J.

MEMO

FROM: The Engineering Staff at N J E

TO: Electronic Design Engineers

SUBJECT: THE CONCEPT OF **TOTAL REGULATION**

JUST ONE YEAR AGO, the first of these historic "memos" appeared. It was entitled, "Why Semi-Regulated Power Supplies?", and it touched off a very satisfactory storm of interest and activity. Since then, for example, we have sold over half a million dollars worth of these tubeless, brute-force supplies.

Perhaps the most eloquent tribute to the appeal of our semi-regulated concept has been the rush of "me-too" activity on the part of our competition, much of it conservative and experienced, but some...well...a bit green and eager, to put it kindly. That kind of thing is bad for all of us, and we write this memo to clear the air.

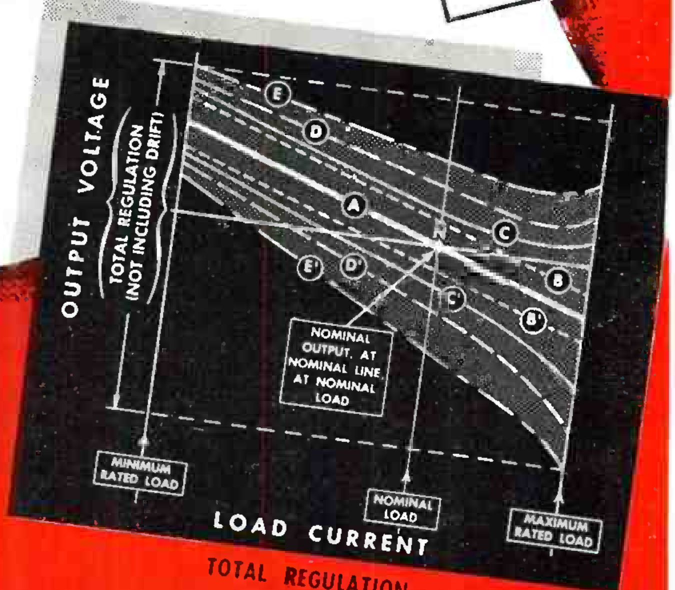
The most serious error made in specifying and designing some of the inadequate semi-regulated equipment that we see around springs from a tendency to ignore one or more of the factors which make up what we call the "total regulation" of a power supply. Perhaps the most neglected factors are line-transient and load-transient effects.

Consider the graph below. Every power supply specification should pin down all of the regulation components shown.

We would welcome correspondence from our customers (and competitors) on this method of describing power supply performance.

Incidentally, extra copies of this graph, somewhat enlarged and easier to read, are available on request.

N J E leads the power supply field.



TOTAL REGULATION

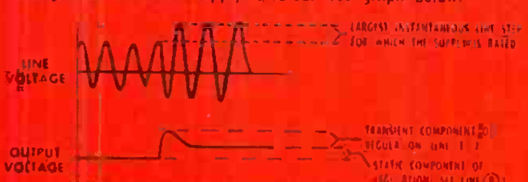
TOTAL REGULATION—Point N is rated output voltage at nominal (average, or expected average) load. N is often, but not necessarily, taken at 50% load.

Slope of Line (A) describes static (slow) load regulation at fixed (nominal) line input.

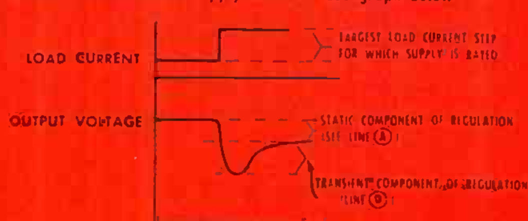
Lines (B) and (B') indicate, by their spacing from Line (A), the static (slow) line regulation at all loads within rating.

Line (C) superimposes on Line (B) the peak ripple excursion in one direction, at each load current. Similarly, Line (C') represents the opposite polarity of peak ripple.

Lines (E) and (E') add the transient line regulation components (only) which result from the largest instantaneous line voltage changes for which the supply is rated. See graph below:



Lines (D) and (D') add the transient load regulation components (only) which result from the largest instantaneous load change for which the supply is rated. See graph below



NOTES:

1. Lines on this chart are not necessarily straight, parallel, or equidistant.
2. Drift, manifested by a gradual vertical shift in the entire pattern as a result of temperature changes, aging of components, or reference instability is not included.
3. Line frequency and/or waveform changes, if present, will add additional regulation components.
4. Shaded area is locus of all possible output voltage-current conditions which can occur . . . unless transient load or line steps can overlap additively with previous load or line steps, before recovery curve is substantially complete.

N J E CORPORATION • 335 Carnegie Avenue, Kenilworth, New Jersey

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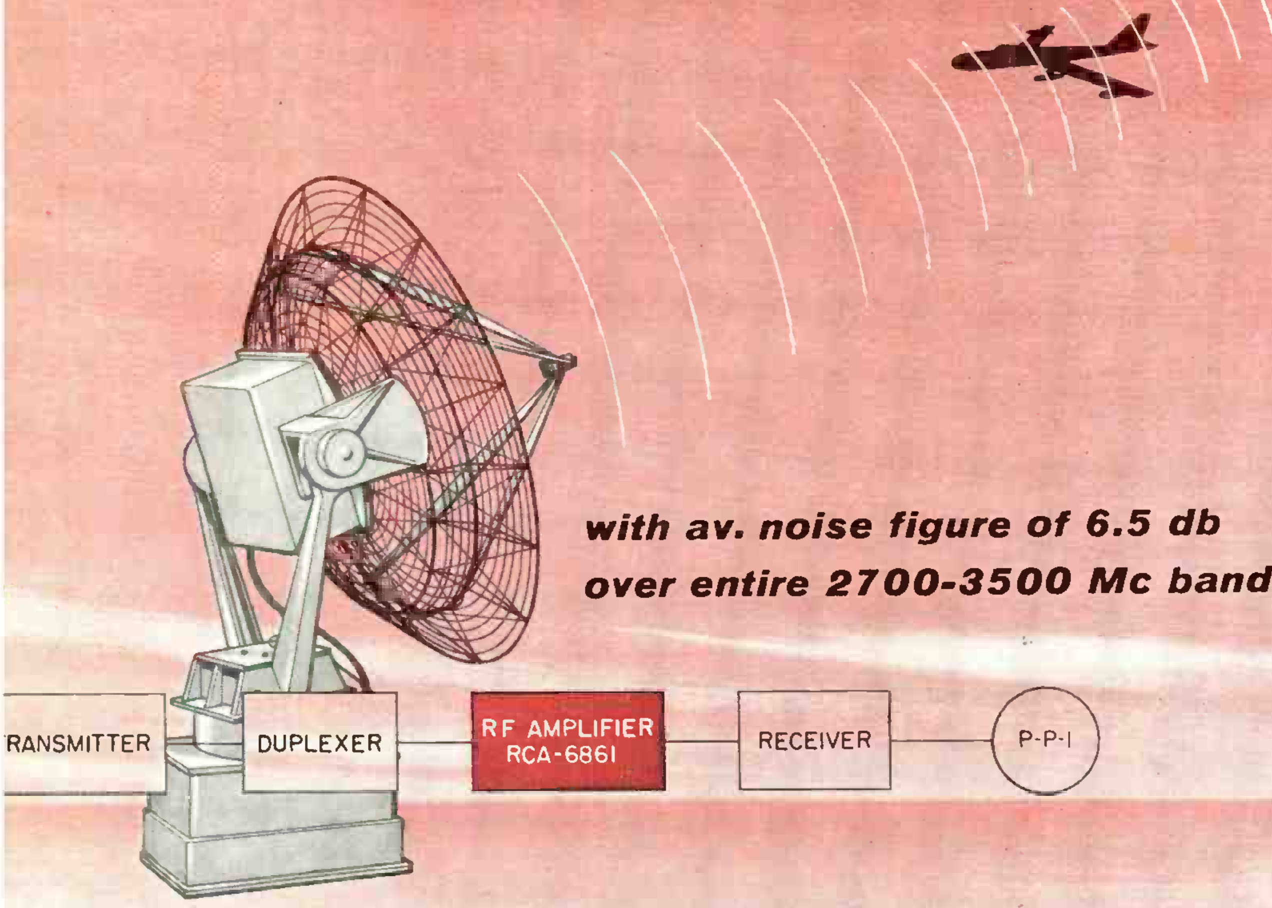
OW-NOISE
'RAVELING-WAVE TUBE



with av. noise figure of 6.5 db over entire 2700-3500 Mc band

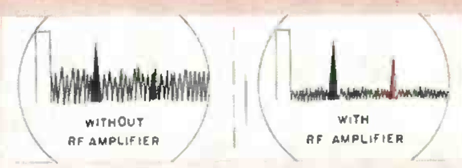
ıncreases S-band receiver sensitivity

eliminates crystal "burnouts"

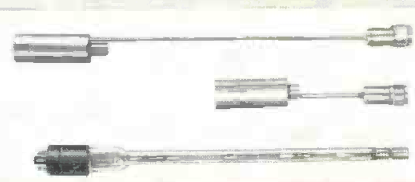
ow in production, RCA-6861 is a ajor advance in electron-tube de-gn for microwave receivers. It en-bles—for the first time—the practical pplication of low-level rf-amplifier ages in radar, scatter-propagation, id other microwave receivers, and -amplifier stages for millimeter-ave receivers.

The unusually low noise figure of 5 db is obtained by the use of an CA-designed special type of electron un which deamplifies noise gener-ted in the electron beam.

ales information on sample units or uantity deliveries is available. Con-ict your RCA Representative at the CA District Office nearest you.



Patterns show signal-to-noise ratio at input to S-band receiver's crystal detector with and without a stage of rf amplification. Utilizing RCA-designed-and-developed type 6861 Traveling-Wave Tube, high signal-to-noise ratio and extended range are obtained. In addition, crystal "burnouts" caused by TR-tube leakage are eliminated by the isolation afforded by the rf stage.



Glass portion of RCA-6861 is enclosed with rf-input and rf-output transducers in tubular metal capsule. Transducers are factory-set for optimum tube performance; require no adjustment in the field. Capsule has terminals which fit the standard octal socket.

RCA-6861 DATA	
Heater Voltage	5.0 ±5% volts
Collector Voltage	400 volts
Collector Current	150 μa max.
Magnetic Field*	525 gausses
Noise Figure	6.5 db
Gain	25 db
Frequency Range	2700 to 3500 Mc

*field supplied by RCA solenoid Dev. No. J-2006, or equivalent

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6355 East Washington Boulevard
Los Angeles 22, Calif.

For technical data on RCA-.8 ı. write RCA. Commercial Engineering. Section K50Q, Harrison, N. J

RADIO CORPORATION of AMERICA

TUBE DIVISION ***HARRISON, N.J.***