TELE-TECH &

ELECTRONIC INDUSTRIES

Aeronautical Electronic Conference

Dayton, May 14-16

See page 70

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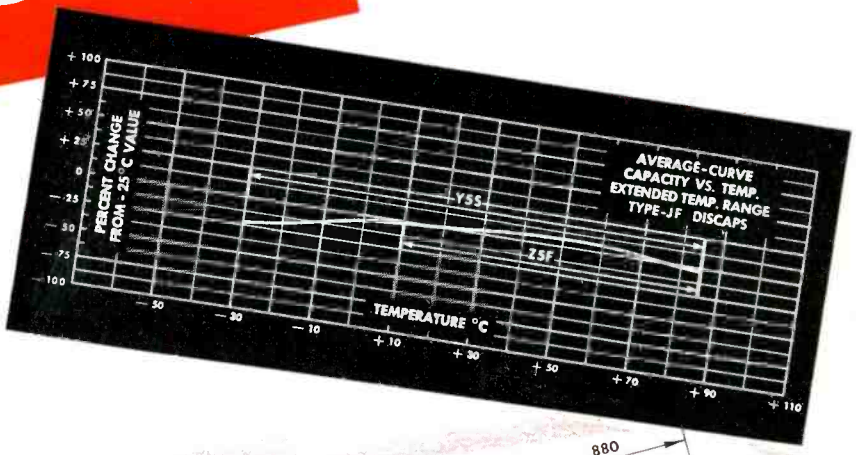
May • 1956

A Chilton Publication

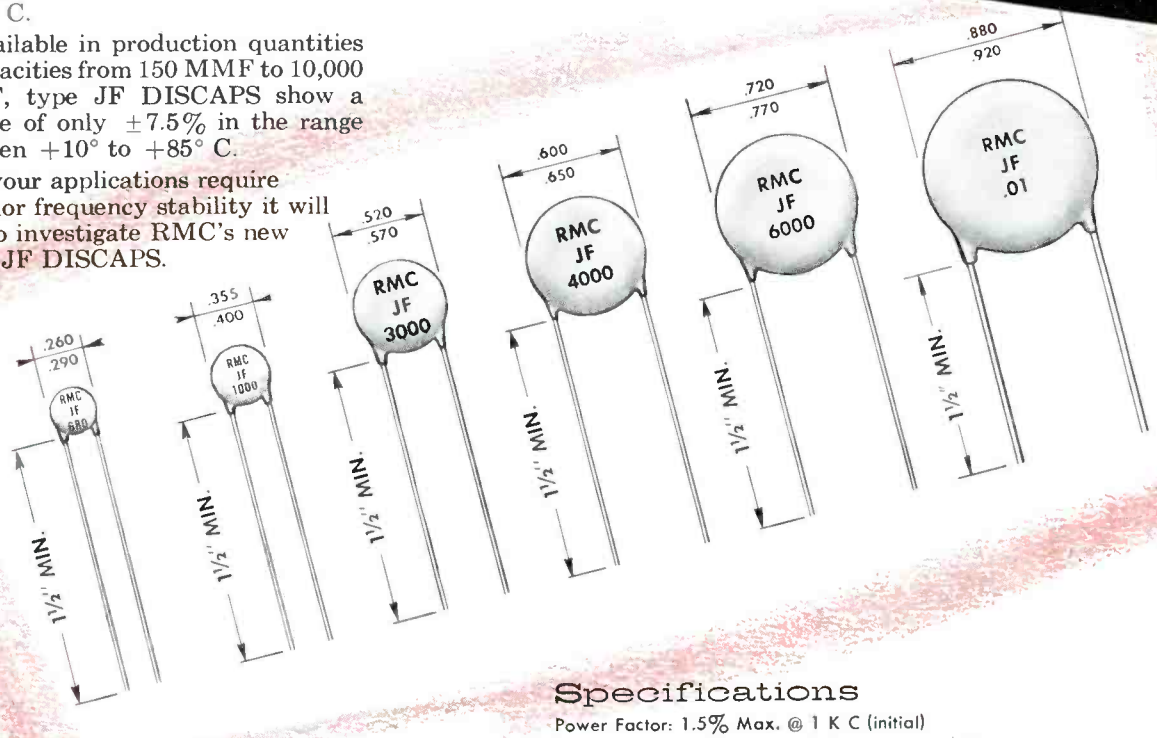
Where frequency stability is important specify RMC TYPE JF DISCAPS



Type JF DISCAPS answer the need for a ceramic capacitor with outstanding characteristics in frequency stability. This new type extends the available capacity range of the RETMA Z5F ceramic capacitor between +10° and +85° C and meet Y5S specifications between −30° and +85° C.

Available in production quantities in capacities from 150 MMF to 10,000 MMF, type JF DISCAPS show a change of only ±7.5% in the range between +10° to +85° C.

If your applications require superior frequency stability it will pay to investigate RMC's new Type JF DISCAPS.



Specifications

Power Factor: 1.5% Max. @ 1 K C (initial)
Power Factor: 2.5% Max. @ 1 K C after humidity
Working Voltage: 1000 V.D.C.
Test Voltage (Flash): 2000 V.D.C.
Leads: No. 22 tinned copper (.026 dia.)
Insulation: Durez phenolic—vacuum waxed
Initial Leakage Resistance: Guaranteed higher than 7500 megohms
After Humidity Leakage Resistance: Guaranteed higher than 1000 megohms.
Test per RETMA Specifications REC-107-A.
Capacity Tolerance: ±10% ±20% at 25° C.

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
Two RMC Plants Devoted Exclusively to Ceramic Capacitors
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

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TELE-TECH & ELECTRONIC INDUSTRIES

Vol. 15, No. 5 May, 1956

FRONT COVER: This composite picture showing Convair's new supersonic F-102A interceptor superimposed on the familiar radarscope symbolizes the role of electronics in the drive toward faster and more dependable aircraft. The spotlight is on the avionic segment of the industry this month as the 8th National Conference on Aeronautical Electronics convenes in Dayton, O. Details on the 3-day conference will be found on p. 70.

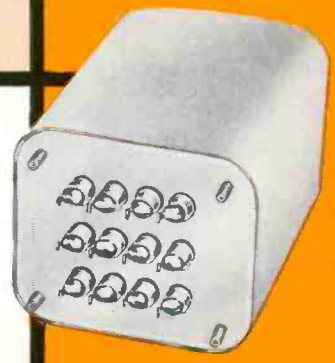
MONTHLY NEWS ROUND-UP

NEW ELECTRONIC EQUIPMENT

DEPARTMENTS

NEW HERMETIC POWER COMPONENTS

HIGHEST RELIABILITY FOR MILITARY AND INDUSTRIAL USE



Listed below are just a few of the 50 new **stock items** in the United hermetic power series. These MIL-T-27 power components add to the 200 other hermetic stock items of filter, audio, and magnetic amplifier types. Through the use of proven new materials and design concepts, an unparalleled degree of life and reliability has been attained, considerably exceeding MIL-T-27 requirements. Test proved ratings are provided, not only for military applications but for **industrial, broadcast, and test equipment service (55°C. ambient).**

For complete listing of these new items, write for Catalogue #56.

MIL-T-27 RATINGS IN REGULAR TYPE — INDUSTRIAL RATINGS IN BOLD TYPE

TYPICAL POWER TRANSFORMERS, PRI: 115V., 50-60 cycles.

Type No.	HV Sec. C.T.	Approx* DC volts	DC MA	Fil. Wdg.	Approx* DC volts	MA DC	Fil. Wdg.	MIL Case
H-81	500	L 180	65		**L 170**	**75**		
		C 265	55	6.3VCT-3A	**C 240**	**65**	**6.3VCT-3A**	HA
	550	L 200	60	5V-2A	**L 190**	**70**	**5V-2A**	
		C 300	50		**C 280**	**60**		
H-84	700	L 255	170		**L 240**	**210**		
		C 400	110	6.3V-5A	**C 360**	**150**	**6.3V-6A**	KA
	750	L 275	160	6.3V-1A	**L 260**	**200**	**6.3V-1.5A**	
		C 420	105	5V-3A	**C 380**	**140**	**5V-4A**	
H-87	730	L 245	320		**L 210**	**420**		
		C 390	210	6.3V-6A	**C 350**	**310**	**6.3V-6A**	NB
	800	L 275	300	6.3V-2A	**L 245**	**400**	**6.3V-2A**	
		C 440	200	5V-4A	**C 400**	**300**	**5V-4A**	
H-93	1000	L 370	280	6.3V-8A	**L 340**	**340**	**6.3V-10A**	OA
	1200	L 465	250	6.3V-4A	**L 455**	**300**	**6.3V-5A**	
				5V-6A			**5V-6A**	

*After appropriate H series choke. L ratings are choke input filter, C ratings are condenser input.

United "H" series power transformers are available in types suited to every electronic application. Proven ratings are listed for both high voltage outputs . . . condenser and choke input filter circuits . . . military and **industrial** applications.

United "H" series filter reactors are extremely flexible in design and rating. Listings show actual inductance at four different values of DC. Bold type listings are **industrial** application maximums.

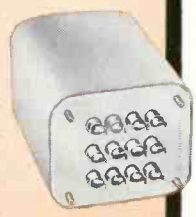
A FEW TYPICAL LISTINGS OF FILTER REACTORS.

Type No.	Ind. @ Hys.	MA DC	Ind. @ Hys.	MA DC	Ind. @ Hys.	MA DC	Ind. @ Hys.	MA DC	Res. Ohms	Max. DCV* Ch. Input	Test V. RMS	MIL Case
H-71	20	40	18.5	50	15.5	60	10	70	350	500	2500	FB
H-73	11	100	9.5	125	7.5	150	5.5	175	150	700	2500	HB
H-75	11	200	10	230	8.5	250	**6.5**	**300**	90	700	2500	KB
H-77	10	300	9	350	**8**	**390**	**6.5**	**435**	60	2000	5500	MB
H-79	7	800	6.5	900	6	1000	**5.5**	**1250**	20	3000	9000	9x7x8

*Based on maximum ripple voltage across choke in choke input filter circuit, in terms of DC output voltage.

TYPICAL FILAMENT TRANSFORMERS, PRI: 105/115/210/220V., 50-60 cycles.

Type No.	Sec. Volts	Amps. (MIL)	Amps. (Ind)	Test Volts RMS	MIL Case
H-121	2.5	10	**12**	10000	JB
H-124	5	3	**3**	2000	FB
H-127	5	20	**30**	21000	NA
H-131	6.3CT	2	**2.5**	2500	FB
H-132	6.3CT	6	**7**	2500	JA
	6.3CT	6	**7**		
H-136	14, 12, 11CT	10	**14**	2500	LA



United "H" series filament transformers have multi-tapped primaries, good regulation, and are rated for **industrial** as well as military service.

United "H" series plate transformers incorporate dual high voltage ratings and tapped primaries to provide versatile units for a wide range of military and **industrial** electronic applications. Large units have terminals opposite mounting for typical transmitter use.

TYPICAL PLATE TRANSFORMERS, PRI: 105/115/210/220V., 50-60 cycles.

No. Type	Sec. V. C.T.	Approx.* DC volts	MA DC	Choke No.	MA DC	Choke No.	Case
H-110	1050	380	275	H-75	385	H-77	MB
	1200	465	250	H-75	350	H-77	
H-113	2500	1050	280	H-77	340	H-77	5¼ x 6 x 7
	3000	1275	250	H-76	300	H-76	
H-115	3500	1500	265	H-77	350	H-77	8¾ x 6½ x 8
	4400	1900	225	H-77	300	H-77	
H-117	5000	2125	900	H-79	1100	H-79	13½ x 11 x 14½
	6000	2550	800	H-79	1000	H-79	

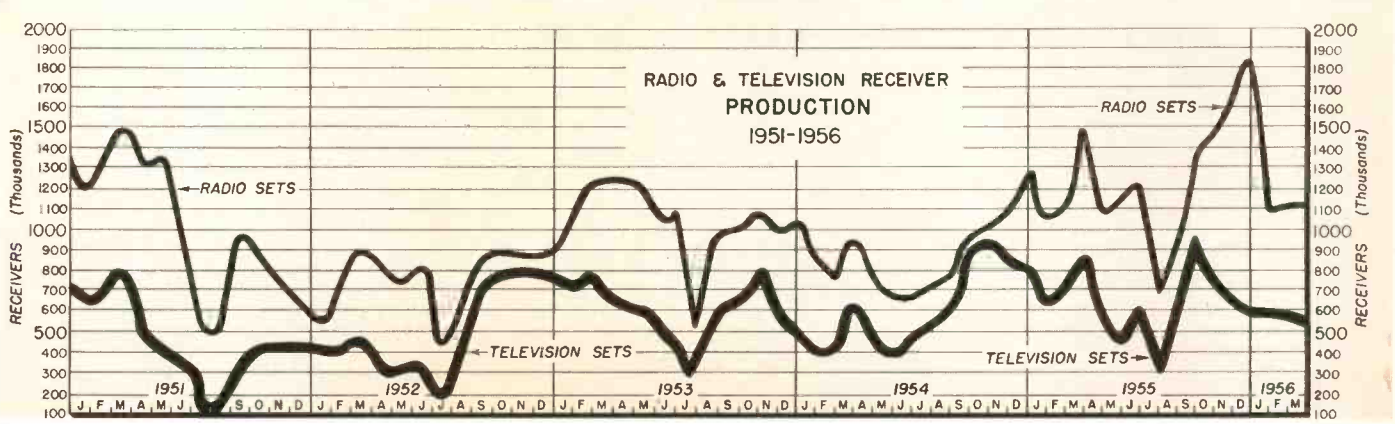
*After filter choke. All ratings are for choke input filter.

UNITED TRANSFORMER CO.

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

CABLES: "ARLAB"

TOTALS



Electronics Industry— Total Sales

($ millions)

	1955	1960	1965
Home Equip., Repairs, Svc.	4,702	6,590	9,389
Industrial & Commercial	1,186	1,974	2,830
Military	2,460	3,270	3,950
Bcst. & TV	1,435	3,430	5,460
Grand Total	9,783	15,264	21,630

These figures are from a speech delivered to the Joint Student Branch—Los Angeles Section annual meeting of IRE by H. Leslie Hoffman, president of RETMA.

Military Expenditures for Aircraft, Missiles, Electronics (000,000)

	1955 Avail. Oblig.	1955 Exp.	1956 Avail. Oblig.	1956 Exp.	1957 Avail. Oblig.	1957 Exp.
USAF						
Aircraft	$2,480	$6,295	$5,476	$5,216	$3,826	$5,041
Missiles	219	305	700	485	1,422	799
Electronics	309	450	197	494	818	511
Navy						
Aircraft	$1,918	$1,676	$ 761	$1,561	$1,489	$1,600
Missiles	126	176	238	172	354	177
Electronics	96	159	151	82	191	104
Army						
Aircraft	....	$ 67	....	$ 103	....	$ 110
Missiles	....	150	....	260	....	300
Electronics	....	28	....	95	....	130
Total Defense Dept.						
Aircraft	$4,398	$8,038	$6,237	$6,880	$5,315	$6,751
Missiles	345	569	938	917	1,776	1,276
Electronics	414	637	347	671	1,009	745

Military Electronics ($ billions)

	Total Defense	% Govt. Electronics	Value-Mil. Electronics
1955	$33.2	7.4%	$2.5
1960	$37.0	8.8%	$3.3
1965	$40.1	9.9%	$4.0

Industrial & Commercial Electronics (000,000)

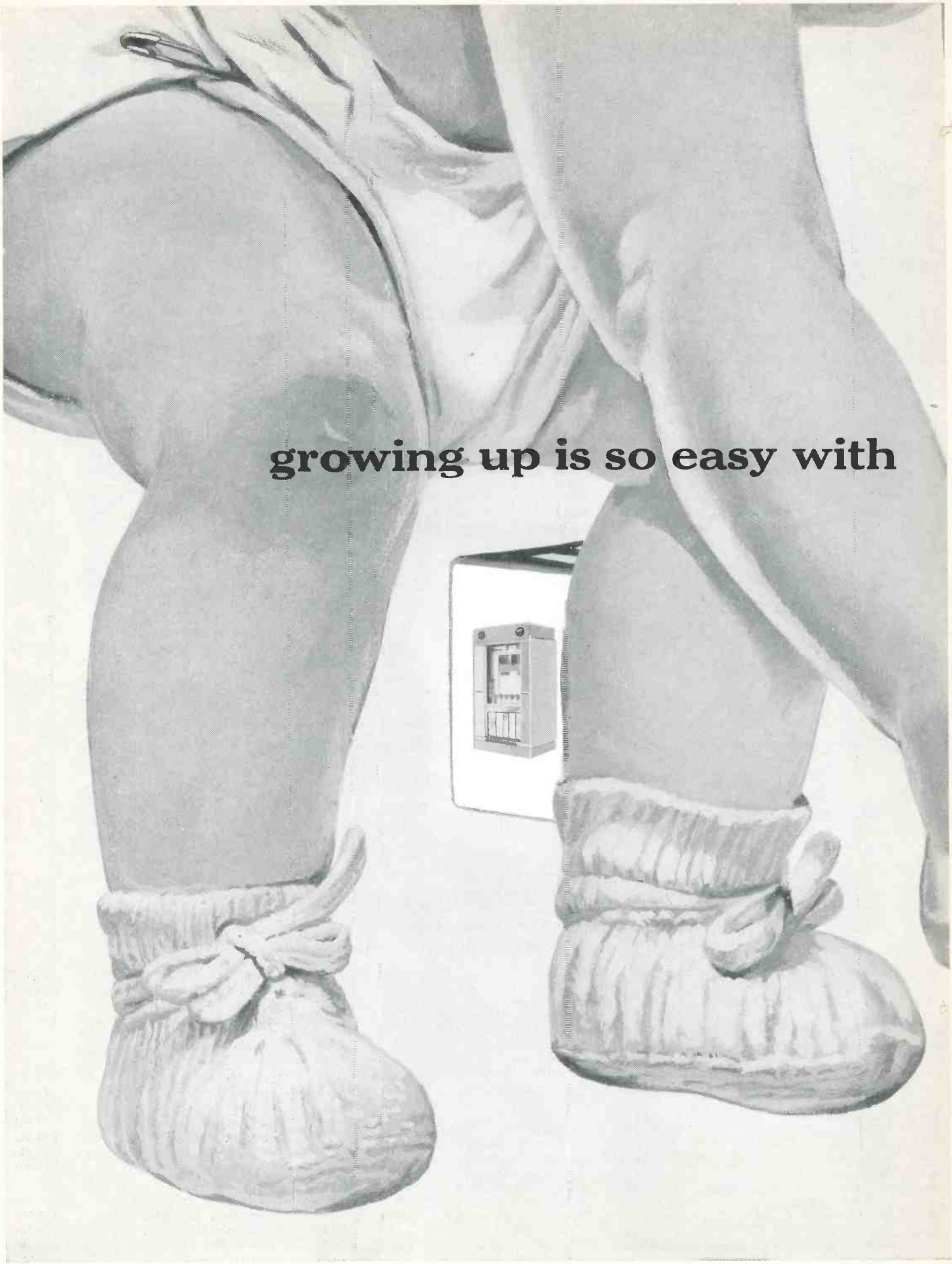
(Broadcasting equipment, computers, etc.)

	Factory Sales	Distr. Revenue	Total
1955	$ 659	$ 527	$1,186
1960	$1,014.6	$ 959	$1,973.6
1965	$1,329.6	$1,500	$2,829.6

GOVERNMENT ELECTRONIC CONTRACT AWARDS

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

Actuators	220,561	Inverters	92,045	Solenoids	32,467
Altimeters, Pressure	312,377	Lamps	79,677	Switchboards	116,004
Ammeters and Voltmeters	116,370	Microphones, Dynamic	662,093	Switches, Coaxial	38,500
Amplifiers	555,233	Motors	235,012	Switches, Pressure	366,986
Analyzers, Telegraph Distortion	48,120	Motors, Aircraft	98,824	Switches, Rotary	37,250
Antennas	318,155	Multimeters	28,733	Synchro-Receivers	34,398
Batteries	1,069,899	Oscilloscopes	239,182	Synchro Signal Amplifiers	425,852
Blocks, Terminal	135,059	Parabolas, Remote Control	52,010	Tape, Magnetic	46,328
Bombing Navigation System	10,000,000	Plotting Boards	1,111,925	Terminal Blocks	135,059
Cable	1,104,829	Radio Sets	1,562,680	Test Sets	41,681
Capacitors	32,117	Radomes	324,588	Test Sets, Meter	37,999
Cells, Battery	709,820	Receivers	1,339,845	Test Sets, Radar	683,032
Coils	52,587	Receiver-Transmitters	2,169,989	Test Sets, Synchro	36,976
Computers	516,510	Recorder-Reproducers	49,770	Test Sets, Telephone	91,843
Connectors	25,505	Regulators, Voltage	305,554	Timers, Interval	27,131
Converters, Analog-to-Digital	66,600	Relay Assemblies	85,287	Transformers	441,401
Direction Finders	226,409	Relays	203,210	Transmitters, Pressure	108,548
Discriminators	28,950	Remote Control Systems, FM Radio	65,397	Transmitter Sub Assemblies	191,264
Galvanometers	27,600	Resistors, Variable	65,013	Tubes	1,606,750
Generators	4,154,411	Servos	107,809	Vibrators	41,382
Gyro Motor Assemblies	39,803	Simulators, Range	33,617	X-Ray Apparatus	83,700
Indicators	1,884,617				



Engineering Branch Offices: WASHINGTON, D. C. • ATLANTA, GEORGIA • PREEMPTION, ILLINOIS • LOS ANGELES, CALIFORNIA

Regardless of whose equipment you are presently using,* you can boost power efficiently by adding S-E amplifiers without having to dispose of or replace any of your original units. You'll find that station growth becomes a practical, reliable and economical evolution when your equipment decision is Standard Electronics ADD-A-UNIT Amplifiers!

Now, you no longer need fuss with transmitter room layouts and "worry-through" your equipment decision when you are ready to boost power! Now, too, you can grow the easy way with completely self-contained S-E ADD-A-UNIT Amplifiers!

Gone is the problem of placement, operation and maintenance of external blowers, pumps and transformers. All components are conveniently and accessibly located entirely within the cabinet! The compact 44" wide frames fit through doorways, into elevators, thru any conventional opening or passageway. You can position ADD-A-UNIT Amplifiers in a straight line, "U", "L", or even in a split arrangement to utilize your floor and wall space most effectively. ADD-A-UNIT is right for you in any stage of your station growth.

Write for specifications, indicating your power requirements.

**Says J. D. Lawhon, WMAZ-TV: "...(Competitor) and S-E have made an ideal combination, both for simple installation and operating ease..."*

S-E add-a-unit amplifiers

standard electronics corporation

A SUBSIDIARY OF DYNAMICS CORPORATION OF AMERICA, INC.

VHF TV Transmitters	high band	500 W	10 KW	25 KW	50 KW
	low band	500 W	10 KW	25 KW	50 KW
VHF TV Amplifiers	high band		10 KW	25 KW	50 KW
	low band		10 KW	25 KW	50 KW

285-289 EMMETT STREET
NEWARK 5, NEW JERSEY

Sales Engineering Representatives: COMMERCIAL ELECTRONICS CORP., DALLAS, TEXAS • WESTINGHOUSE ELECTRIC CO., LTD., HAMILTON, ONT.

ELECTRONIC *Vignettes*

1956 is the 50th anniversary of the invention of the triode or "audion" by Dr. Lee de Forest. The biographical excerpt below from Who's Who in America should be of interest. This year some of De Forest's friends hope to have a postage stamp honoring Audion's golden jubilee issued. (See p. 63).

Biography

DE FOREST, Lee, inventor: b. Council Bluffs, Ia., Aug. 26, 1873; s. Henry Swift and Anna Margaret (Robbins) D.; grad. Mt. Hermon (Mass.) Boys' Sch., 1893; B. S. Sheffield Scientific Sch. (Yale), 1896; Ph.D., Yale, 1899, D.Sc., 1926; D.Sc., Syracuse, 1919, D. Eng., 1937; . . . . Pioneer in development of wireless telegraphy; v.p. American De Forest Wireless Telegraph Co., 1902-06; pres. Radio Telephone & Telegraph Co., De Forest Radio Telephone Co., De Forest Phonofilm Corp. (N. Y. City); v.p. Lee De Forest Laboratories (Los Angeles, Calif.). Patented in U. S. and foreign countries 300 inventions in wireless telegraphy, radio telephone, wire telephone sound-on-film talking pictures high speed facsimile and pic-

ture transmission and television, also in "radiotherapy" for physicians; the 3-electrode tube, as radio detector, radio and telephone amplifier, and as oscillator in "feed-back" or regeneration circuit . . . . Called the "Father of Radio." Awarded Gold Medal, World's Fair, St. Louis, 1904, Panama Pacific Expn., San Francisco, 1915; medal of honor Inst. of Radio Engineers; Elliot Cresson medal, Franklin Inst.; John Scott medal, City of Phila.; Prix La Tour, Inst. of France; Cross of Legion of Honor (France); Edison medal, 1946. Fellow Am. Inst. Elec. Engrs.; fellow and founder Inst. Radio Engrs.; mem. Soc. Motion Picture Engrs., Yale Engring. Soc. Sigma Xi, Tau Beta Pi, Aurelian Honor Soc. of Yale.

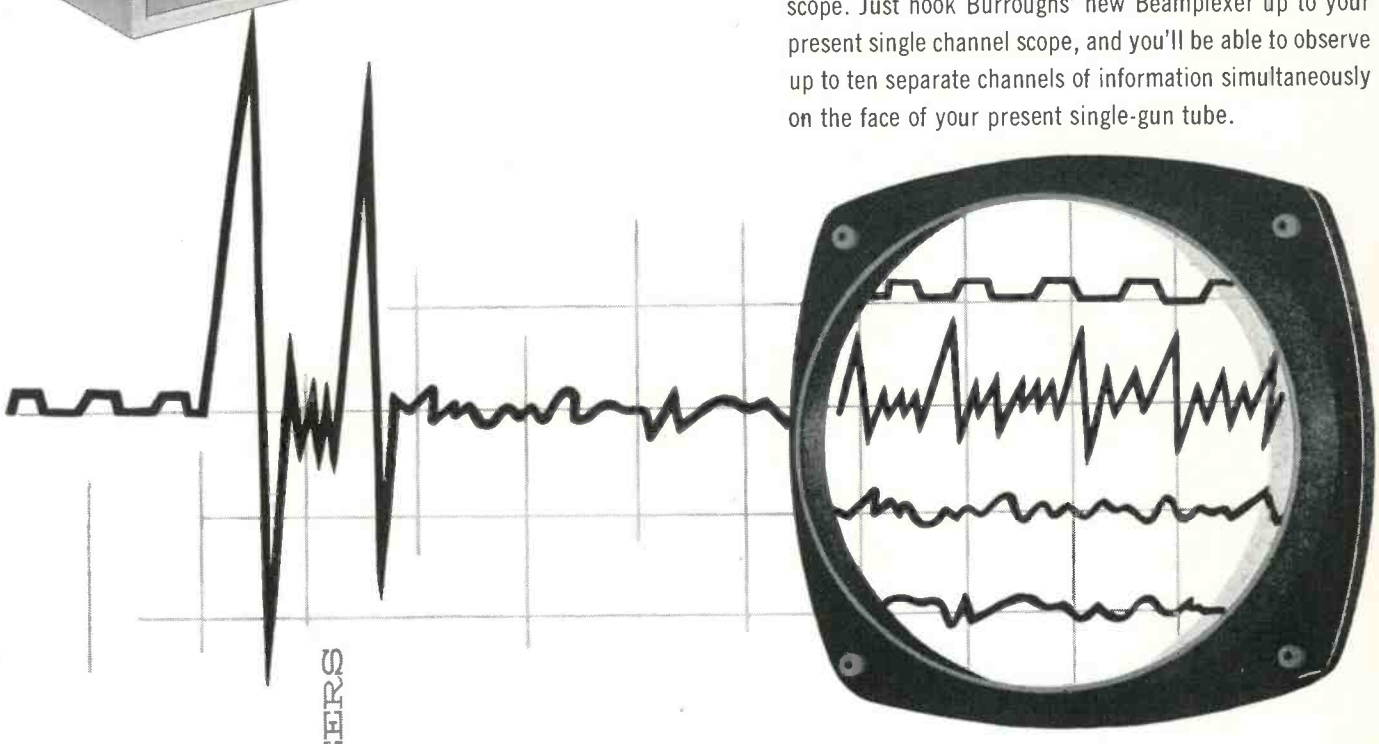
Grandson Stanton de Forest Allaben, 12, Greenwich, Conn., building his first amateur receiver. A. E. Moakler, vp, Production Engineering Corp., Thornwood, N. Y. supervises testing.

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.



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.

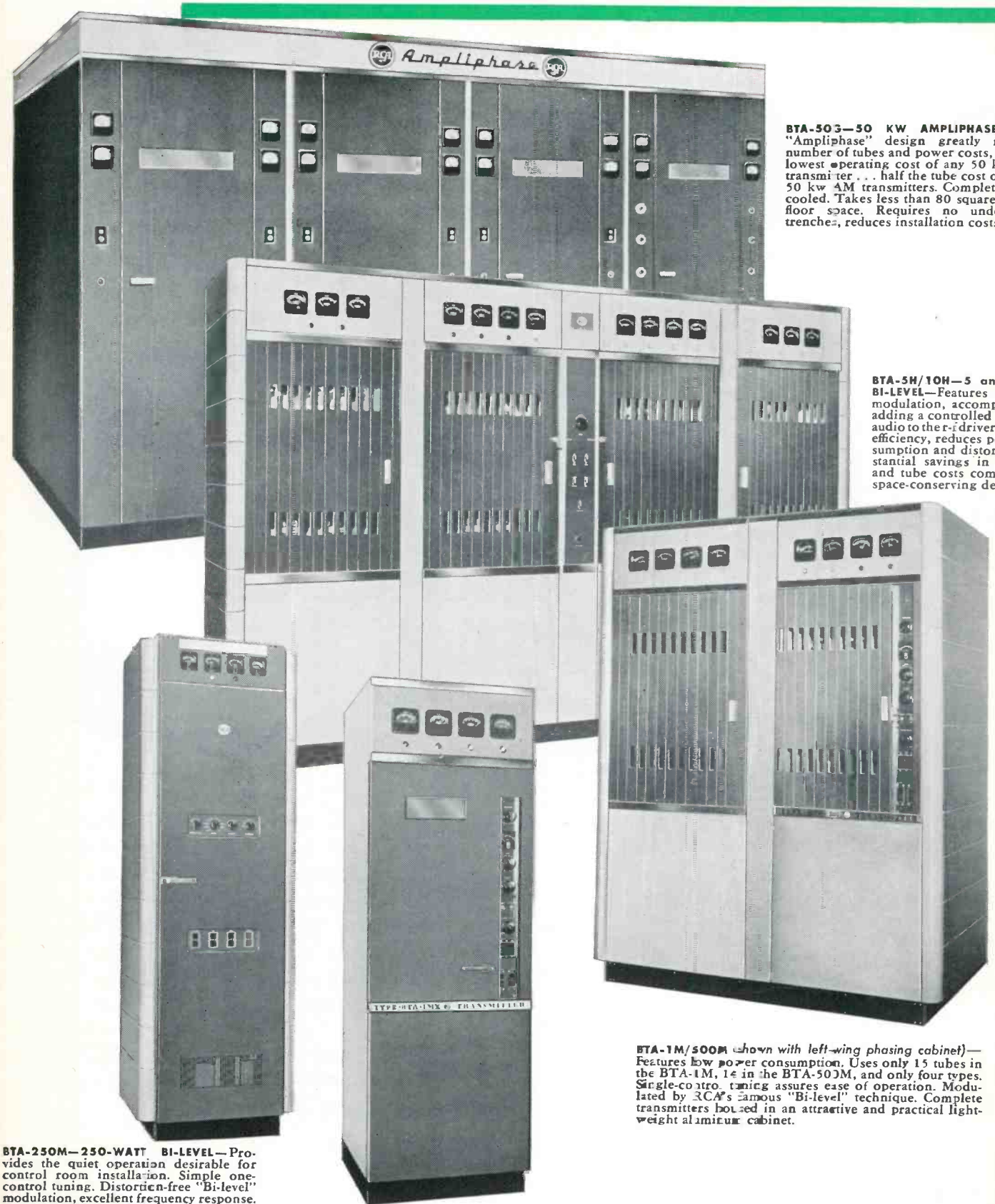
Full details on how the Beamplexer can make your scope more useful . . . make your time more efficient . . . are given in Technical Bulletin 346 available for the asking. Write for your copy.

TOOLS FOR ENGINEERS

Burroughs

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

the truth about . . .



BTA-50G—50 KW AMPLIPHASE—New "Ampliphase" design greatly reduces number of tubes and power costs, assures lowest operating cost of any 50 kw AM transmitter . . . half the tube cost of older 50 kw AM transmitters. Completely air-cooled. Takes less than 80 square feet of floor space. Requires no under-floor trenches, reduces installation costs.

BTA-5H/10H—5 and 10 KW BI-LEVEL—Features "Bi-level" modulation, accomplished by adding a controlled amount of audio to the r-f driver, increases efficiency, reduces power consumption and distortion. Substantial savings in operating and tube costs combine with space-conserving design.

BTA-1M/500M *(shown with left-wing phasing cabinet)*—Features low power consumption. Uses only 15 tubes in the BTA-1M, 14 in the BTA-500M, and only four types. Single-control tuning assures ease of operation. Modulated by RCA's famous "Bi-level" technique. Complete transmitters housed in an attractive and practical lightweight aluminum cabinet.

BTA-250M—250-WATT BI-LEVEL—Provides the quiet operation desirable for control room installation. Simple one-control tuning. Distortion-free "Bi-level" modulation, excellent frequency response. Uses only 10 tubes of three tube types. An ideal "economy package."

BTA-1MX/500MX—Designed for high-fidelity operation, transmitters BTA-1MX (1KW) and BTA-500MX (500 watts) offer single-control tuning, desirable Bi-level modulation, low power consumption, fewer tubes and fewer tube types. Minimum floor space required . . . approximately 6 square feet.

REMOTE CONTROL EQUIPMENT—RCA Remote Control Equipment provides facilities to switch program lines, adjust plate or filament voltage, operate a line variac control on emergency transmitter, control Conelrad switching, operate power contactors and reset manual overload breakers, from any desired control point, regardless of transmitter design or power.

RCA AM transmitters

FOR 25 YEARS RCA broadcast transmitters have been widely acknowledged as *the* best. During this period they have been the transmitters most often chosen by those stations which wanted, and could afford, the very best. Thus they early became, and have remained, the standard to which all others are compared.

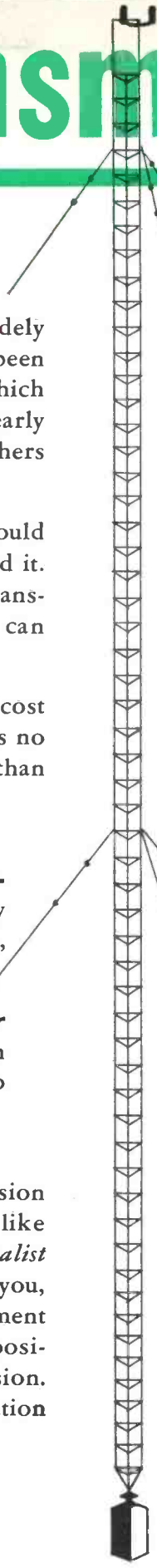
Unfortunately, some stations have believed that they could not afford such quality—no matter how much they wanted it. Today any station can "afford" one of these top-quality transmitters. In fact, it is hard for us to see how a station can afford *not* to buy one.

Why is this so? Simply because today RCA transmitters cost only a very little more than the lowest-priced (sometimes no more). And the small extra original cost (if any) is more than made up for by these two *facts:*

1. RCA transmitters are generally less expensive to operate. This is so because in almost every power class RCA transmitters either use less power, or have lower tube cost (in some cases both).

2. RCA transmitters almost always have higher resale value. This becomes very important when you go to higher power, or if you should decide to sell your station.

What is the moral? Simply this: don't jump to the conclusion you can't afford RCA. We believe you can, and we would like an opportunity to prove it. Call our nearest *AM Specialist* (see list). He will be glad to go over your situation with you, give you the benefit of his (and RCA's) broadcast equipment knowledge, and leave with you a complete and fair proposition. With such *facts* at hand you can make a correct decision. There's absolutely no obligation. You owe it to your station to find out. Act now!



Typical AM Tower

See Your Nearest Radio Broadcast Sales Representative

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522 Forsyth Bldg., Lamar 7703

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200 Berkeley Street, Hubbard 2-1700

CAMDEN 2, N.J.
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BROADCAST AND TELEVISION EQUIPMENT
CAMDEN, N. J.

A COMPLETE LINE OF DEPENDABLE ENCAPSULATED RESISTORS

PERMASEAL®

PRECISION WIREWOUND RESISTORS FOR 85C AND 125C AMBIENTS

For applications requiring accurate resistance values at 85C and 125C operating temperatures—in units of truly small physical size—select the precise resistor you want from one of the 46 standard Permaseal designs in tab or axial lead styles.

Winding forms, resistance wire and embedding material are matched and integrated, resulting in long term stability at rated wattage over the operating temperature range. The embedding material is a special plastic that extends protection well beyond the severe humidity resistance specifications of MIL-R-93A and Proposed MIL-R-9444 (USAF).

These high-accuracy units are available in close resistance tolerances down to ± 0.1%. They are carefully and properly aged by a special Sprague process so that they maintain their accuracy within the limits set by the most stringent military specifications.

SPRAGUE

FOR COMPLETE DATA WRITE FOR COPY OF SPRAGUE ENGINEERING BULLETIN NO. 122A

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

As We Go To Press...

AF Scientists Create Artificial Ionosphere

Nearly 60 mi. up over the desert sands at Holloman Air Development Center, N. M., last month an Air Force Aerobee Rocket released a quantity of nitric oxide gas into the atmosphere under high pressure. As AF scientists watched, the formation mushroomed into a great brilliant cloud of charged particles that reflected radio waves in the same manner as the Ionosphere.

Described as a major scientific "breakthrough," the discovery was part of an Air Force project designed to tap the energy chemically stored in the atmosphere by the sun.

Nitric oxide gas has the property of bringing two oxygen atoms together to form an oxygen molecule and release light.

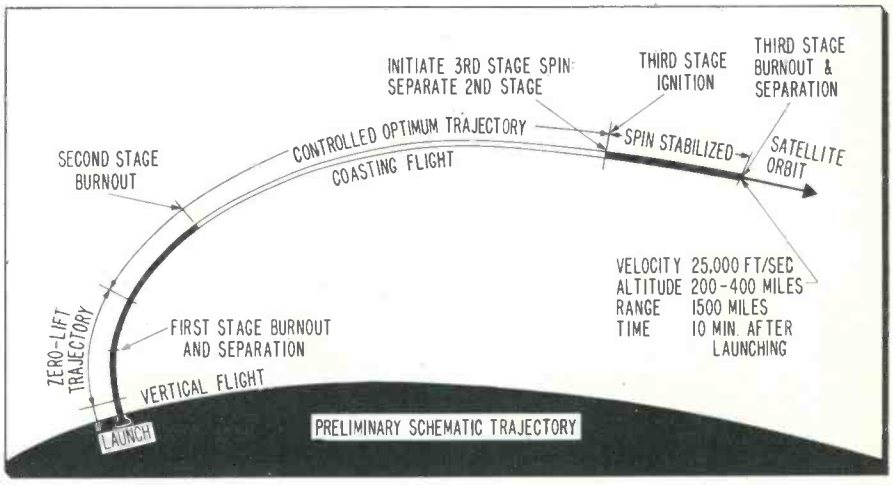
During the experiment, scientists bounced radio signals off the charged cloud. They feel that man-made Ionospheric clouds produced in a series may pave the way for increasingly effective long-range communications.

UHF'ers Unite For Last-Ditch Stand

As two more UHF operators threw in the sponge, and Congress and responsible industry officials debated methods of saving UHF-TV from extinction, the UHF operators, themselves, last month united in a last-ditch lobbying effort to stave off disaster.

Rallying behind a new Committee for Competitive Television (CCT), the operators have pledged an extensive lobbying campaign at the grass-roots level, to bring the UHF story to the Congressmen through their constituents.

Heading the new group is chairman, John J. Johnson, WTOB-TV, Winston-Salem.



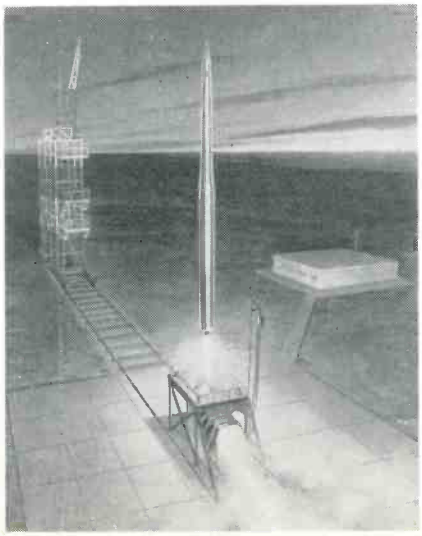
Three-section rocket will carry space satellite to its orbit

Navy, Martin Release Space Rocket Details

The U. S. Navy and the Martin Co. of Baltimore, Md., have released preliminary information on the Vanguard three-stage rocket vehicle being designed and built by Martin to place the world's first man-made satellite in its orbit.

In physical appearance, the satellite launching vehicle will resemble a giant rifle shell complete with bullet. It will be the first liquid fuel rocket designed to be controlled without the use of fins.

Artist's conception of rocket launching



The first-stage rocket is approximately 45 ft in length and resembles the Navy Martin Viking research rocket which attained an altitude of 158.4 miles.

The second stage rocket, mounted above the first stage, has a cone shaped nose section and also uses liquid propellants. The third stage rocket, with the satellite attached to its nose, will be carried completely enclosed within the second stage rocket. It uses a solid propellant because of its simplicity.

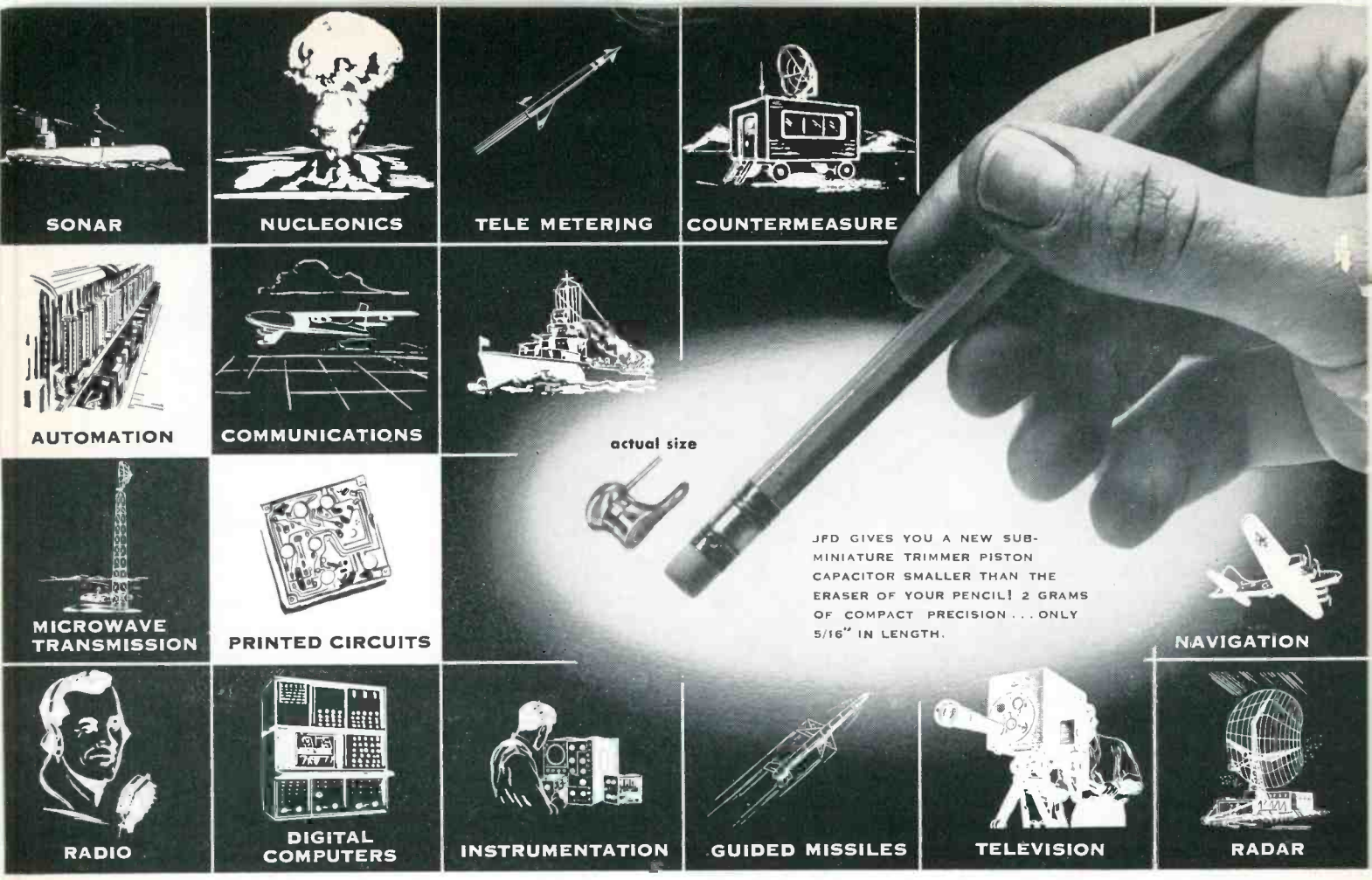
The first stage, which launches the entire assembly, will burn out its fuel at an altitude of between 30 and 40 miles. Then it will separate and drop off.

The second stage will start firing, and at a certain time during the second stage burning will jettison its nose streamlining, leaving the third stage and the satellite exposed.

The second stage rocket will tilt in the direction of the satellite's predetermined flight path. After its burnout, the second stage will continue to coast upward until it attains the satellite's intended orbital altitude.

(*Continued on page* 149)

More News on page 13



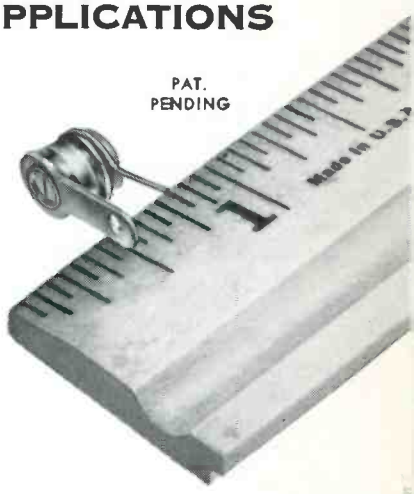
A *Giant* in Performance . . . *Sub-Miniature* in Size

JFD PISTON CAPACITORS
FOR AUTOMATION AND PRINTED CIRCUIT APPLICATIONS

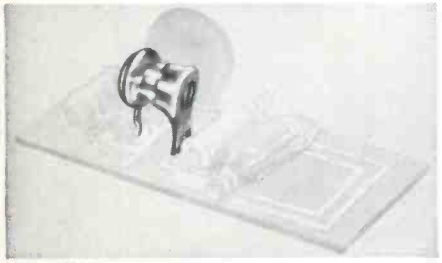
Over 1 year in development, it's here at last! The new precision sub-miniature JFD Variable Trimmer Piston Capacitor, designed expressly for use in *automation* and *printed circuitry*.

Features: Stability, approximately Zero temperature coefficient . . . End stops at either end of adjustment . . . working temperature – 55° to + 125°C . . . Anti-back lash and thread wear compensation.

These new JFD Capacitors are available in 2 models to meet your most exacting network applications:



MODEL	OVERALL LENGTH	CAPACITANCE
VC9G	9/16"	0.5 MMF. TO 8.5 MMF.
VC10G	5/16"	1 MMF. TO 4.5 MMF.



Both units feature glass dielectric and invar silver-plated rotors. Write today for Bulletin No. 106 which gives you complete electrical characteristics.

Whether you specify these new Piston Capacitors or any of the many other JFD units for your critical tuning requirements, you upgrade *efficiency and stability* of performance. A letter will bring you complete details. Write today.

JFD Electronics — OUR 26TH YEAR

GO FORWARD WITH JFD ENGINEERING!

JFD MANUFACTURING CO., INC. 6101 16TH AVENUE, BROOKLYN 4, N. Y.

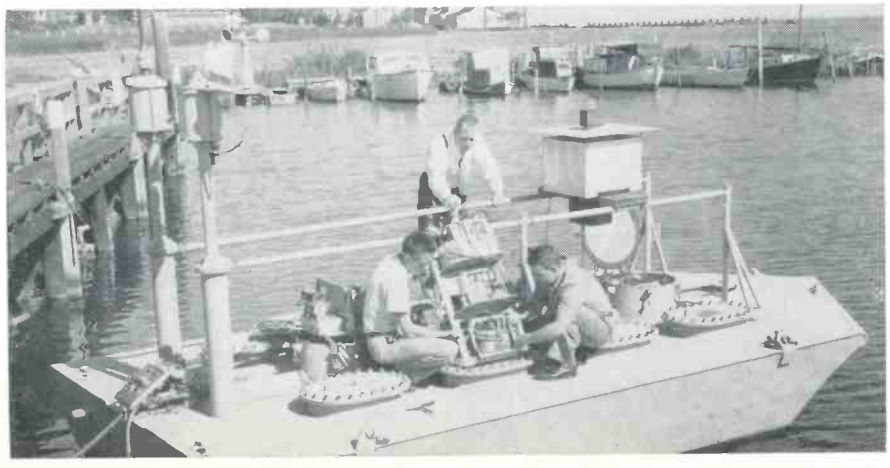
As We Go To Press . . . (Continued)

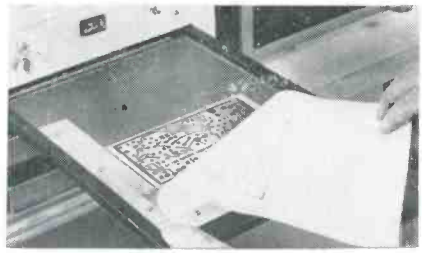
Ocean-Based Automatic NBS Weather Station

A prototype marine weather station that automatically reports local weather data by radio has been developed by the National Bureau of Standards. The unit is incorporated in a buoy that can be anchored in remote locations and left unattended for periods up to six months. At regular intervals throughout the day, the station broadcasts in code the air temperature, water temperature, barometric pressure, and wind speed and direction. Preliminary tests in Chesapeake Bay show that the station has a radio range in excess of 800 mi.

The automatic station translates information from each of five weather sensing elements into three-letter groups in continental code and transmits the coded signals on a pulse-modulated carrier frequency at about 6 MC. These signals can be received on standard communications receivers and compared with a decoding table which gives numerical values for each of the meteorological variables measured. A single transmission takes 3 min. During this interval six items of information are broadcast. The first transmission is a three-letter signal identifying the station. Coded transmissions follow containing information on (1) air temperature (2) water temperature, (3) barometric pressure, (4) wind speed, and (5) wind direction.

NBS personnel check out the new automatic weather station





Laminate is prepared for etching in 10 mins.

Printed Circuits By Xerography

Xerography is the newest technique for preparing printed electrical circuits for etching. The new process promises significant savings in time and money for model shop work, prototype circuit studies, and short production runs.

In the new application, the powder image peculiar to xerography—a dry, electrostatic method of copying, heretofore used chiefly in office and graphic arts reproduction—is transferred from a selenium plate to a sheet of transfer paper, thence to the face of a copper-clad laminate. Here the powder forms a photo-exact resist pattern impervious to chemical attack.

Since, in the etching step which follows, acid eats away all the copper unprotected by resist, the result is metal left only where specified by the original circuit drawing.

The Haloid Co. of Rochester, N. Y., which is marketing the new equipment, claims that from an original opaque drawing, a copper-clad laminate serving as a printed circuit or wiring board can be prepared for etching in about 10 mins.

Closed Circuit TV Not Exempt From Tax

The Internal Revenue Service has ruled that closed-circuit television transmission of events or activities do not constitute the conduct of the business of a "broadcasting station or network" and, therefore, amounts paid to a telephone company for the lease of wires and equipment are not exempt from the tax on communications.

"New Look" for CRT's In G-E's 9-in. Tube

The 9-inch rectangular picture tube used in the personal television receiver recently announced by General Electric offers significant improvements over standard cathode ray tube design practices.

One of the more interesting features is the 1-piece funnel and face plate assembly which results in a bulb design offering minimum

GE's new personal-size 9-in. TV receiver

weight and maximum viewing area for any given diagonal. Electrical grade lead glass is used in the neck and yoke region of the tube and the anode lead is taken through the base—a procedure made possible by the relatively low design center anode voltage of 6800 volts.

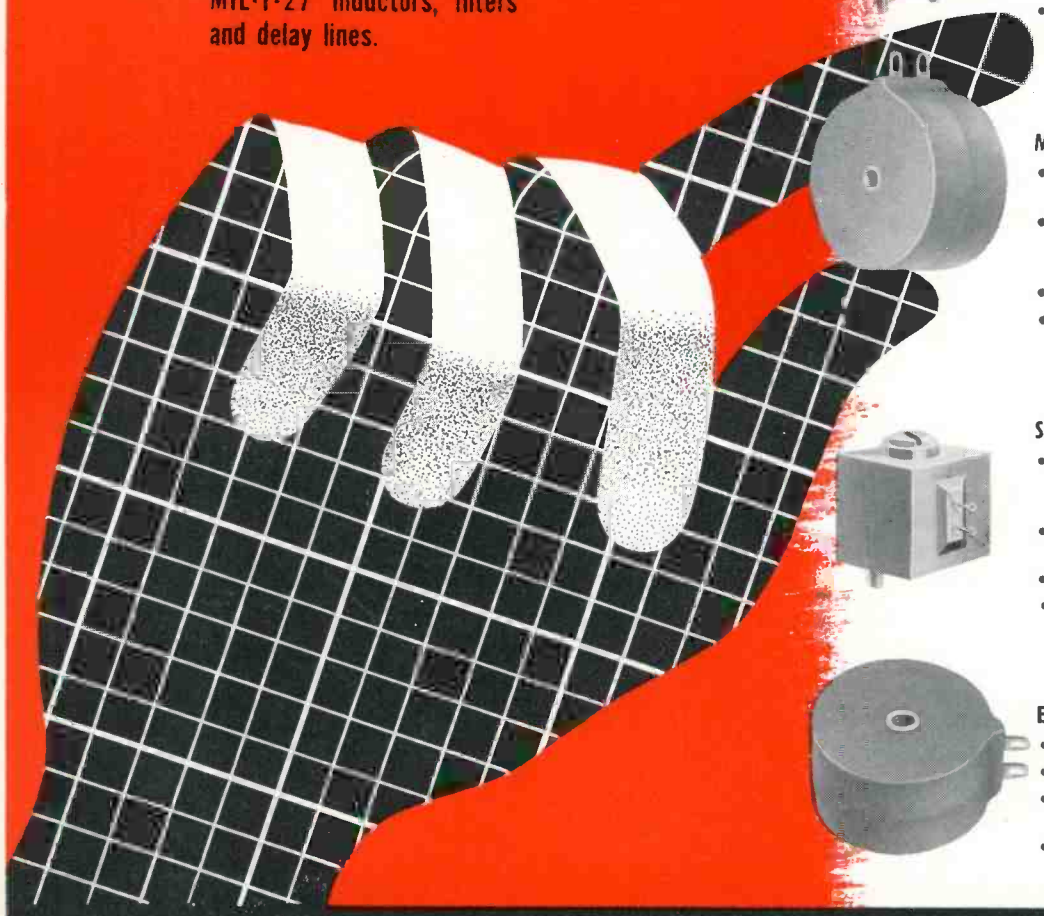
Other pertinent data on the new 9-inch tube are:

Screen size—6 in. x 7½ in.; screen area—40 sq. in. (approx.); weight—2 lbs. (approx.); overall length—13 1/16 in. (max.); deflection—magnetic; focus—electrostatic; anode voltage—6800 volts design center, 5500 volts recommended operating; and base—7-pin.

More News on page 15

BURNELL

continues to offer the most advanced line of reliable MIL-T-27 inductors, filters and delay lines.



Variable Inductors
- inductance values up to 1000 henrys
- variable over a range of ± 10%
- high Q, small size
- for low-frequency tuning applications

Molded Toroids
- inductance precision within 1%
- high Q because molded construction minimizes distributed capacity
- subminiature to standard sizes
- compact and sturdy

Subminiature Adjustoroids
- precise continuous adjustment of inductance over a 10% range
- no external control current needed
- hermetic sealing
- low cost

Encapsulated Toroids
- hermetically sealed
- high Q
- center mounting permits stacking
- miniature to standard sizes

FOR YOUR CIRCUIT NEEDS...

Crystal Filters
- nominal cost
- excellent delivery
- frequency range 50 kc to 5000 kc
- high stability

Tom Thumb Telemetering Filters
- miniaturized for guided missiles
- high temperature stability
- designed to withstand shock and vibration
- hermetically sealed

Delay Lines
- for audio and low radio frequency applications
- constancy of time delay
- flat frequency response
- low insertion loss

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PACIFIC DIVISION
720 MISSION STREET • SOUTH PASADENA, CALIFORNIA

400,000° F. Temp. Produced At AF Lab

For the first time under laboratory conditions, man has produced temperatures of well over 400,000°F and corresponding brightness 700 times greater than at the surface of the sun.

The incredible temperature and subsequent brightness were a result of investigations into the physics of high energy, high temperature gaseous discharge by scientists of the Air Research and Development Command.

Temperatures which have been measured by the laboratory are of exceedingly short duration, less than a millionth of a second, but an important outgrowth of this research was the design of equipment capable of accurately measuring the powerful and extremely fast pulsed electrical spark discharge.

The extremely high temperatures involve the release of electric energy into a very small volume of inert gas under high pressure.

A specially designed capacitor circuit is employed to store the energy and release the electric discharge. This capacitor circuit, applied to the basic gaseous discharge technique, is primarily responsible for the resultant high temperatures.

These experiments and the resulting measuring device were conducted by Dr. Heinz Fischer.

AIRPORT RADAR

Chief air route traffic controller R. Hopper plots aircraft course on new G-E radar installed at New York's Idlewild airport

More News on page 28

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period March through October, 1956 that are of special interest to electronic engineers

May 10-12: Fourth JETEC General Conference, at the Hotel Traymore, Atlantic City, N. J.

May 14-16: 8th Annual National Conference on Aeronautical Electronics, co-sponsored by the Dayton Chapter of the IRE, and the Prof. Gp. on Aeronautical and Navigational Electronics (IRE), at the Biltmore Hotel, Dayton, Ohio.

May 17-19: 30th Engineering Industries Exposition, sponsored by the N. Y. State Society of Professional Engineers in conjunction with its annual convention at the Statler Hotel, New York, N. Y.

May 21-22: RETMA Symposium on Reliable Applications of Electron Tubes, at Irvine Auditorium, University of Pennsylvania, Philadelphia, Pa.

May 21-24: 1956 Electronic Parts Distributors Show, at the Conrad Hilton Hotel. Chicago, Ill.

May 29-June 2: International Congress on Microwave Tubes, at the Conservatoire National des Arts et Metiers, Paris, France.

June 6-8: 10th Annual Convention of the American Society for Quality Control, at Le Palais du Commerce, Montreal, Canada.

June 25-27: Symposium on the methods, materials and processes involved in the uses of high temperature in science and industry, sponsored jointly by Stanford Research Institute and the Univ. of Calif., on the University's Berkeley, Calif., campus.

Aug. 15-17: The National Telemetering Conference, sponsored jointly by the IRE, the AIEE, the IAS, and the ISA, in Los Angeles, Calif.

Aug. 21-24: WESCON Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 22-Sept. 1: 23rd Annual (British) National Radio Show, sponsored by the Radio and Electronic Component Manufacturers Federation, at Earls Court, London, England.

Sept. 11-12: Second RETMA Conference on Reliable Electrical Connections, at Irvine Auditorium, University of Penn., Philadelphia, Pa.

Sept. 17-21: 11th Annual Instrument-Automation Conference and Exhibit, sponsored by the ISA, at the New York Coliseum, New York, N. Y.

Oct. 1-3: Canadian IRE Convention and Exposition, in the Automotive Bldg., Canadian National Exhibition Pk., Toronto, Canada.

Oct. 9-10: Conference on Computer Applications, sponsored by Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Oct. 16-18: Conference on Magnetism and Magnetic Materials, sponsored by the Magnetics Subcommittee of the Basic Science Committee of AIEE, at the Hotel Statler, Boston, Mass.

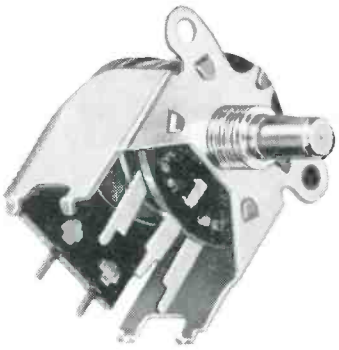
Oct. 25-26: Second Annual Technical Meeting of the IRE Prof. Gp. on Electron Devices, at the Shoreham Hotel, Washington, D. C.

Oct. 31-Nov. 2: 20th Anniversary National Time and Motion Study and Management Clinic, sponsored by the IMS, at the Sherman Hotel, Chicago, Ill.

Abbreviations:

ASTE: American Society of Tool Engineers
AIEE: American Institute of Electrical Engineers
IAS: Inst. of Aeronautical Sciences
IMS: Industrial Management Society
IRE: Institute of Radio Engineers
ISA: Instrument Society of America
JETEC: Joint Electron Tube Engineering Council
NACE: National Assoc. Corrosion Engineers
RETMA: Radio-Electronics-TV Manufacturers Assoc.

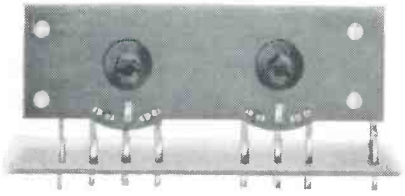
MALLORY



Especially designed for automatic assembly methods, this line of Mallory controls provides superior performance on printed circuit applications.

New Mallory Controls for Printed Circuits

ECONOMICAL STRIP TYPE CONTROLS FOR PRINTED CIRCUIT USE



This simplified series of controls, a Mallory "first", consist of resistance wafers attached directly to a phenolic panel, in single, dual and triple units. You save in installation cost, for multiple units can be mounted as easily as a conventional single. You save in component cost, too . . . for these Mallory controls give you multiple units at substantially lower price than that of a corresponding number of individual controls. Resistance values cover the range from 250 ohms to 10 megohms. Numerous adaptations available. Write to Mallory for technical data.

FOR your printed circuit designs, plan to take advantage of the simplified assembly and extra performance values offered by this new series of Mallory carbon controls.

A variety of designs is available. Included are self-supporting snap-in models for top of panel mounting . . . threaded bushing models . . . and types for mounting directly on the circuit panel. All are built with mounting lugs and terminals, precision-positioned for foolproof, fast assembly by automatic production machines. All incorporate these Mallory features:

High stability resistance element, made by special Mallory process, minimizes drift under severe humidity and temperature variations . . . gives long life.

Unusually low electrical noise.

New "floating ring" line switch, using a unique contact action, can be supplied on the new controls . . . far outlasts ordinary switches, gives clean, sharp make and break.

A complete selection of resistance values and tapers is available to match your circuit requirements. For complete data, write or call Mallory today.

Serving Industry with These Products:

Electromechanical—Resistors • Switches • Tuning Devices • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals • Welding Materials

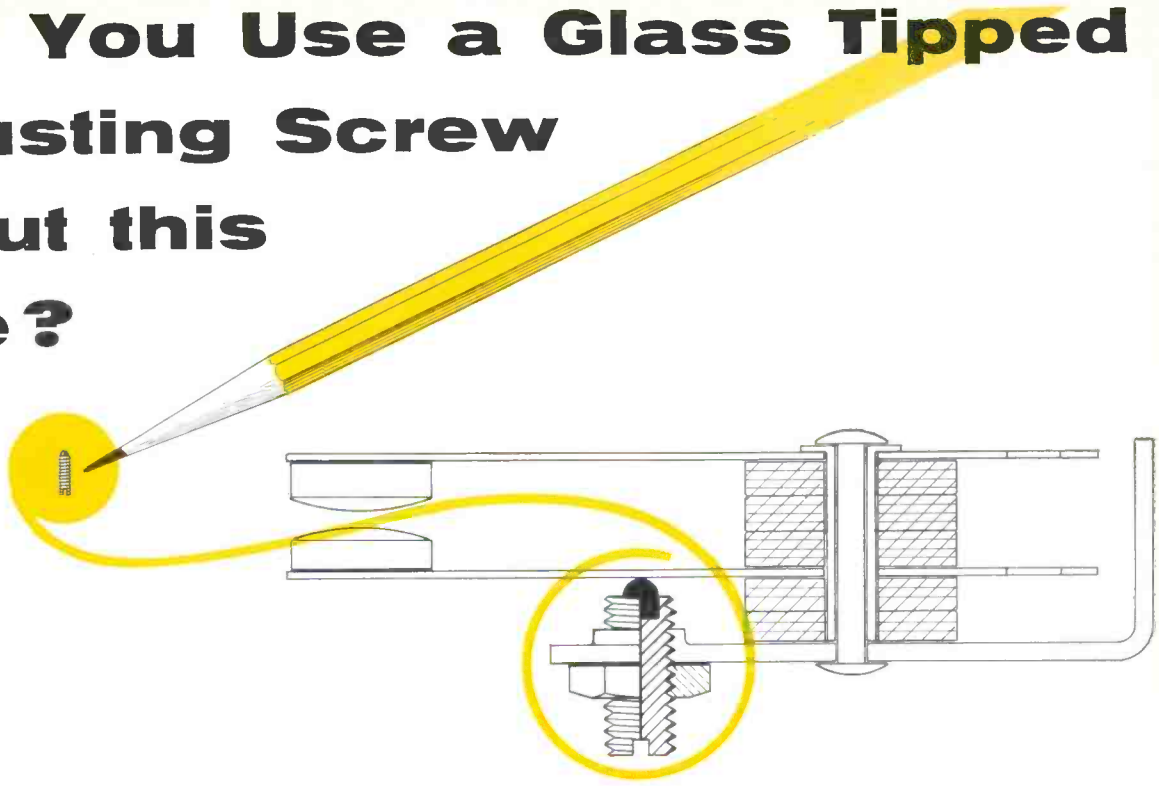
Parts distributors in all major cities stock Mallory standard components for your convenience.

Expect more . . . get more from

P. R. MALLORY & CO. Inc.
MALLORY

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

Can You Use a Glass Tipped Adjusting Screw about this Size?



If you make a relay, switch, thermostat or any component in which a metal part is adjusted by an insulated screw, please read on.

As pioneers in the field of glass-to-steel hermetic terminals, Fusite has come to grips with many problems involving the interfusion of glass with metal.

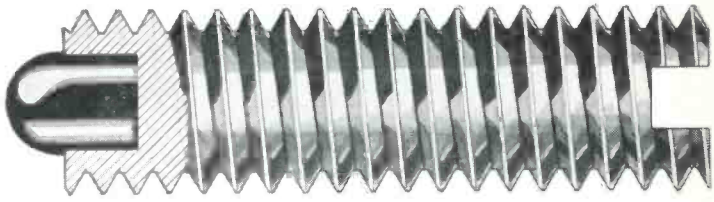
While we can only guess at the potential market for our tiny new product, we offer every assurance as to its complete practicality.

These screws, now available in standard threads one through six, have a tip of high density glass actually fused to the metal (not cemented or pressed in).

This promises perfect performance in the face of changing temperatures, humidity, friction, and corrosive chemicals.

We will be happy to send you samples without obligation.

Write Fusite Dept. U-3

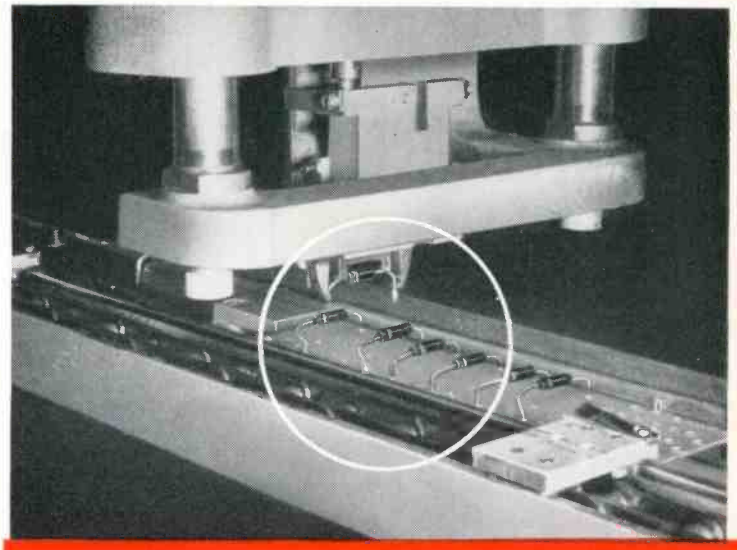


INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

THE FUSITE CORPORATION

6028 FERNVIEW AVENUE, CINCINNATI 13, OHIO

Unique method of anchoring IRC leads keeps them from being twisted or pulled out in automatic bending and insertion operations.



HOW TO BE SURE OF TERMINAL SECURITY

No matter how you assemble or solder them, IRC resistors provide the extra terminal security that prevents termination failures in the production line or in the field. Leads of IRC Type BT Resistors, for example, are uniquely anchored in the resistor body so that they won't twist or pull out. A new IRC alloy coating which overcomes copper migration also assures improved and more uniform solderability. Together, these features speed up production, cut inspection costs, and assure reliable long-range performance. For more information, send coupon today.

Why Leads Won't Come Loose

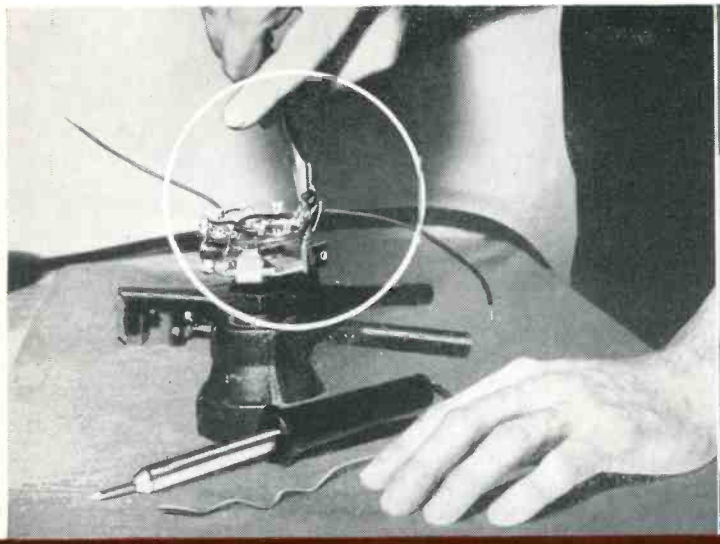
Leads of IRC Type BT Resistors are so securely joined to the element that even the unmolded assembly exceeds the standard 5-lb. pull requirement. For still greater strength, leads have a crimped collar which provides a tooth-and-notch effect when the assembly is molded as a unit.

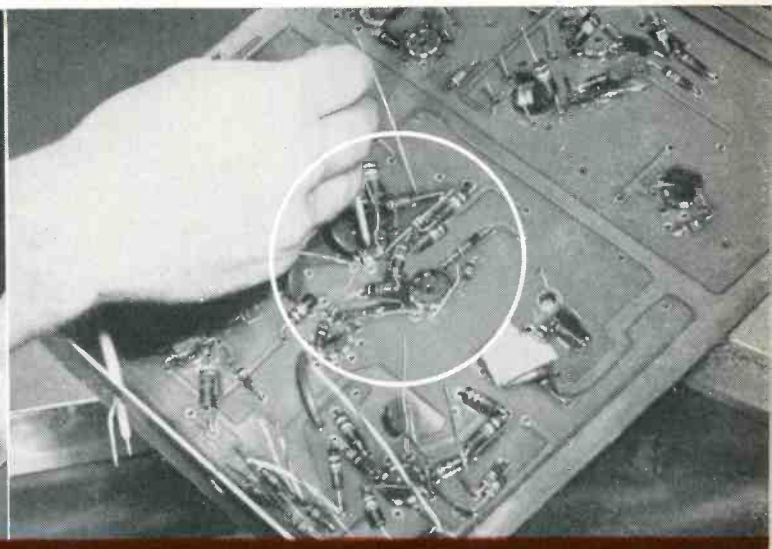
Straight Leads Speed Automation

The IRC Automation Package assures you of consistently straight leads suitable for automatic feed. This permits automatic, trouble-free feed to holding devices or into inserting heads of printed wiring lines.

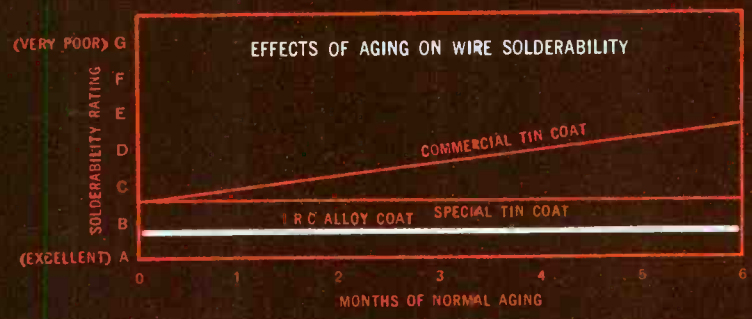
Because they can be bent up to resistor body, IRC leads solve special "fit" problems and simplify production and soldering operations.

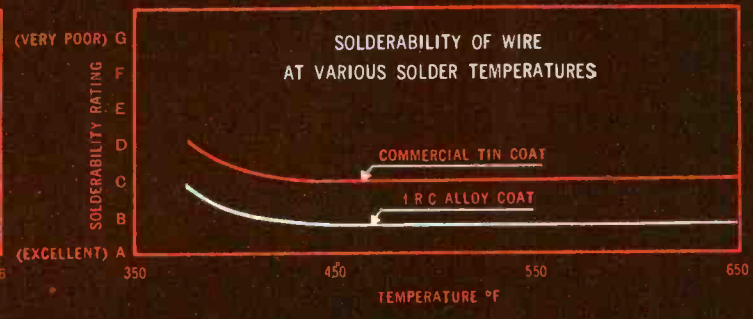
New alloy surface on leads overcomes tendency of copper to migrate toward coating. This assures superior solderability by any method, with low or varying temperatures.



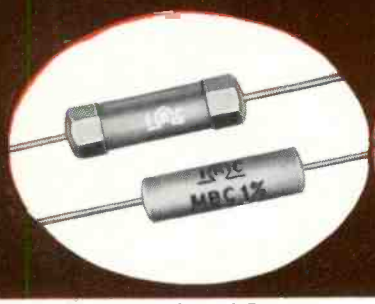


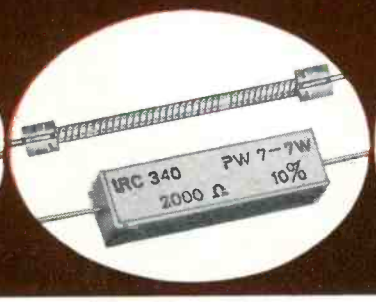
here's how much IRC's new alloy coating improves solderability

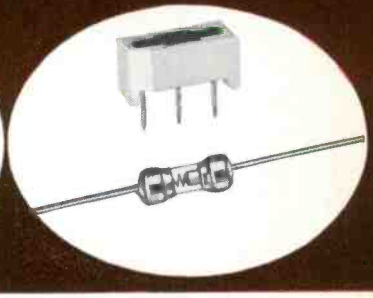




EXTRA TERMINAL SECURITY ALSO FEATURES OTHER IRC RESISTORS







Deposited and Boron-Carbon Resistors

The metal used in terminations passes ASTM tests for season cracking. In addition, terminations are automatically assembled for uniform strain strength.

Wire Wound Low Wattage Resistors

Through machine assembly, the element, terminal clips, and leads are assembled simultaneously. No other method assures such uniformly high resistance to twisting or pulling.

Wire Wound Precision and Power Resistors

Lugs can't turn or twist and break the fine resistor wire. This also eliminates any "strain gauge" effect which would change the resistance value.

Microstak Selenium Rectifiers

Miniature rectifiers and diodes with low capacitance cells as small as .060 dia. Superior characteristics and uniformity. Wide variety of types including hermetically sealed units.

Voltmeter Multipliers • Boron & Deposited Carbon Precistors • Insulated Composition Resistors • Power Resistors • Controls and Potentiometers • Low Wattage Wire Wounds • Germanium Diodes

Wherever the Circuit Says

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

IRC

HYCOR DIVISION of International Resistance Co.
Los Angeles, California and Puerto Rico
CIRCUIT INSTRUMENTS INC. (IRC Subsidiary)
St. Petersburg, Florida

INTERNATIONAL RESISTANCE CO.
Dept. 583, 401 N. Broad St., Philadelphia 8, Pa.

Send data on resistors checked:

☐ Fixed Composition Resistors ☐ Deposited and Boron-Carbon Resistors ☐ Wire Wound Power Resistors ☐ Wire Wound Precision Resistors ☐ Selenium Rectifiers

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Company_____

Address_____

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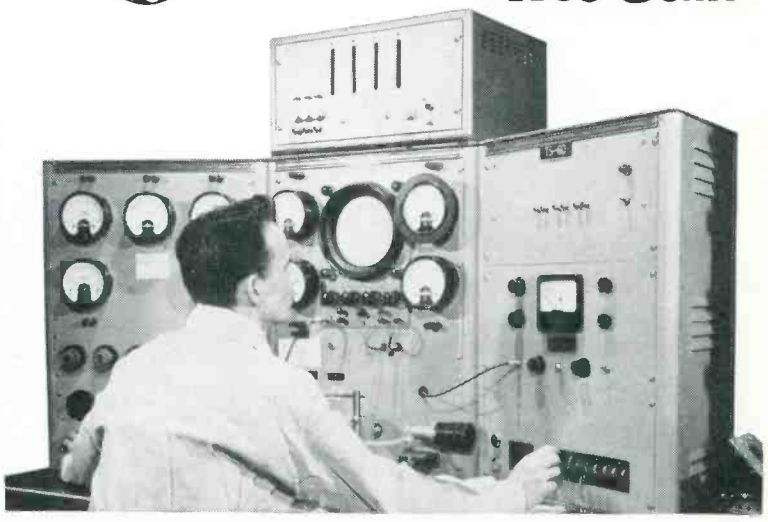
UNMATCHED MICROWAVE TUBE FACILITIES AND EXPERIENCE

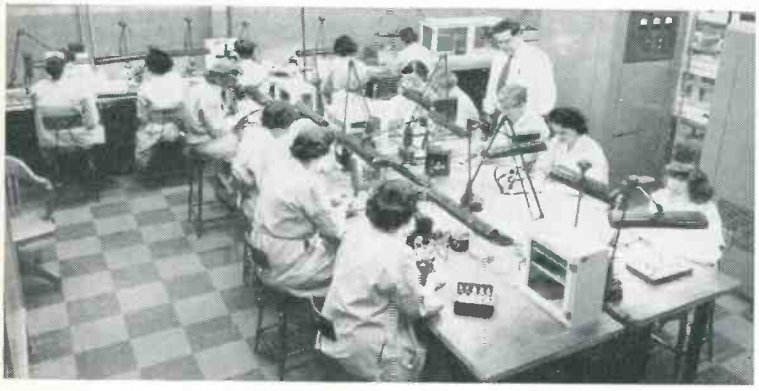
ready to go to work for you at

Bendix Red Bank

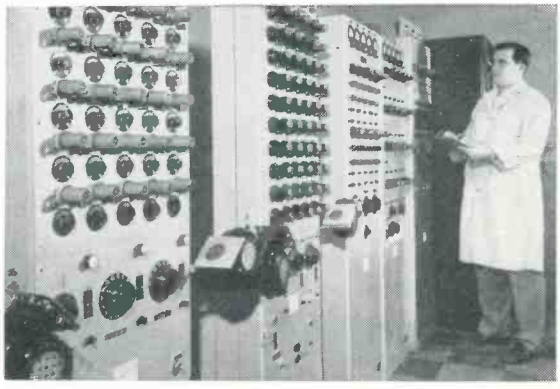
Presetting cavity resonant frequency.



All tubes get complete electrical test.



Typical klystron mount assembly line.



Aging and life testing facilities.

What do *you* need in klystron tubes?

Makes no difference how complex or unusual your microwave application is. Nor how big or little your order may be. In any case, we have the specialized equipment and know-how to turn out tubes that can do a *better* job for you.

Our microwave people have successfully designed and built klystrons of all types—thermally-tuned, external cavity, integral cavity, mechanically-tuned and ruggedized. An example of one of our latest developments is a ruggedized, mechanically-tuned, K-band reflex oscillator that utilizes the many advantages of dielectric rod tuning . . . and that can be readily scaled up or down in frequency.

If no existing tube meets your needs, we'll be glad to quote on a special tube to do the job. For information, write RED BANK DIVISION, BENDIX AVIATION CORPORATION, EATONTOWN, NEW JERSEY.

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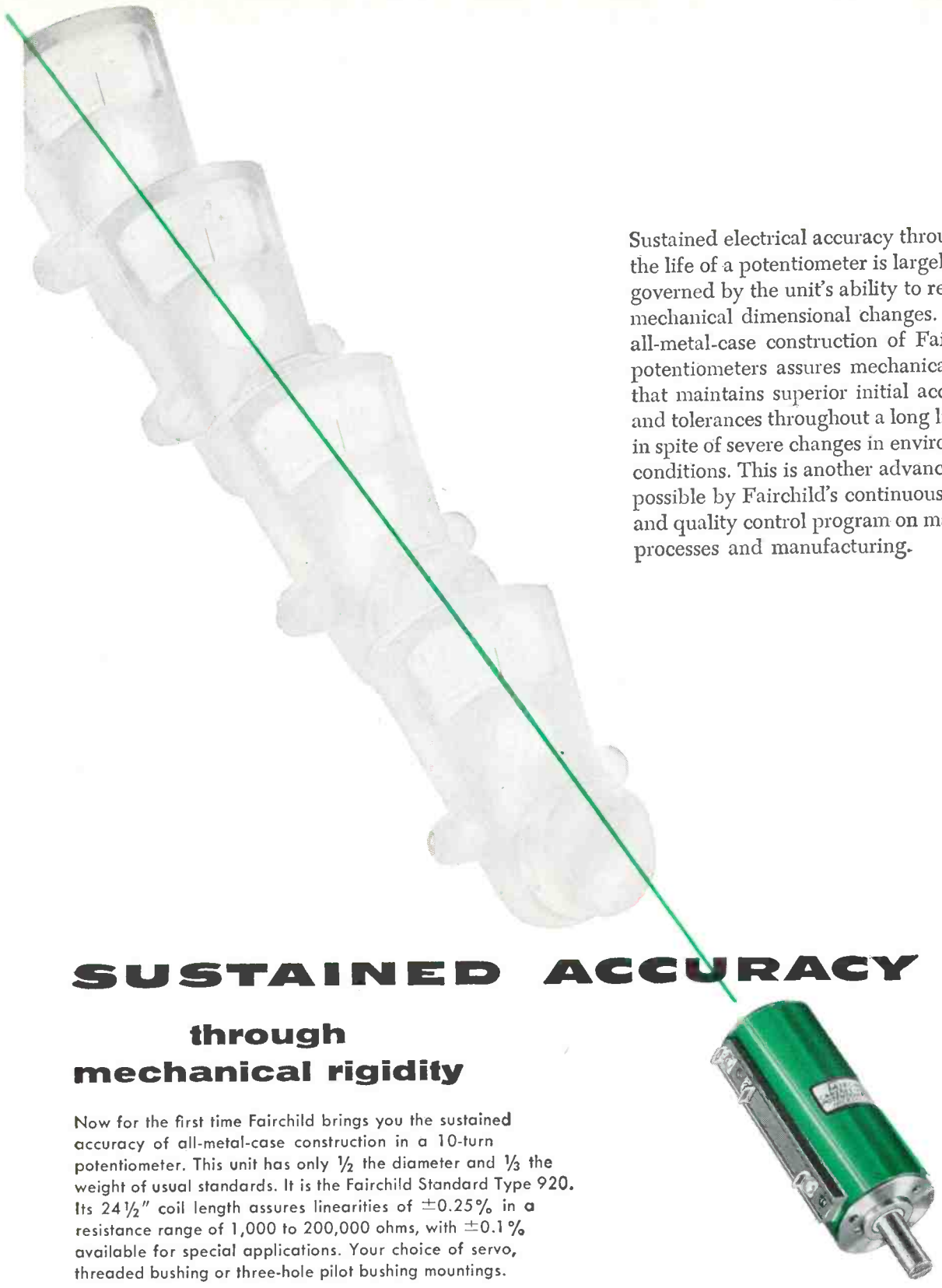
Red Bank DIVISION

Bendix AVIATION CORPORATION



Sustained electrical accuracy throughout the life of a potentiometer is largely governed by the unit's ability to resist mechanical dimensional changes. The all-metal-case construction of Fairchild potentiometers assures mechanical rigidity that maintains superior initial accuracies and tolerances throughout a long life cycle—in spite of severe changes in environmental conditions. This is another advance made possible by Fairchild's continuous research and quality control program on materials, processes and manufacturing.

SUSTAINED ACCURACY

through mechanical rigidity

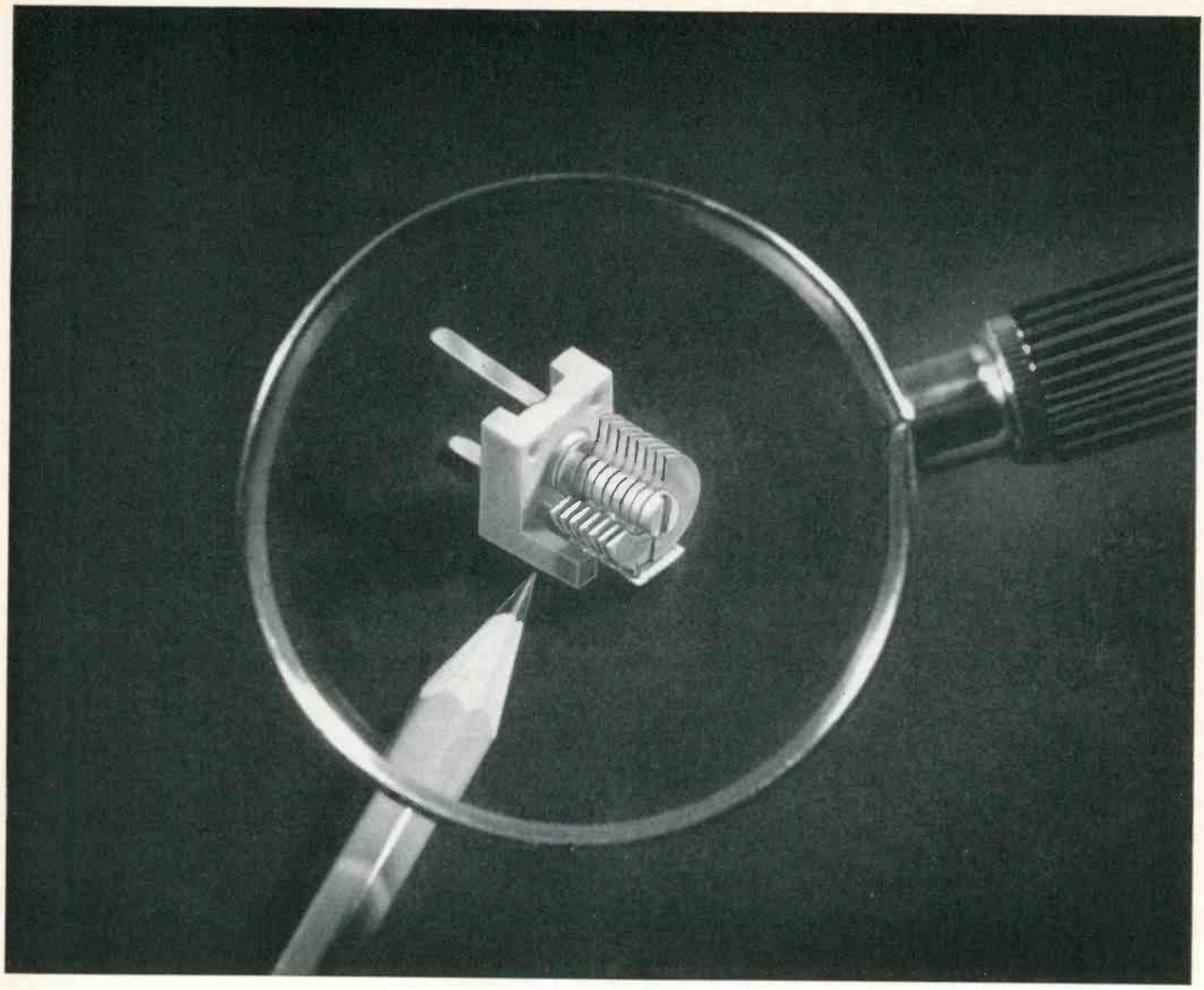
Now for the first time Fairchild brings you the sustained accuracy of all-metal-case construction in a 10-turn potentiometer. This unit has only ½ the diameter and ⅓ the weight of usual standards. It is the Fairchild Standard Type 920. Its 24½" coil length assures linearities of ±0.25% in a resistance range of 1,000 to 200,000 ohms, with ±0.1% available for special applications. Your choice of servo, threaded bushing or three-hole pilot bushing mountings.

This is another example of how Fairchild's complete line can give you the answers, no matter what factors govern your choice of precision potentiometers. Write Fairchild Controls Corp., Components Division. Dept. 140-62E2

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

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

FAIRCHILD
PRECISION POTENTIOMETERS and COMPONENTS



More than 1½ times actual size.

NOW! even smaller air trimmer capacitors

For every type of electronic equipment—printed wiring board or conventional chassis—Radio Condenser's new Series 75 trimmers mean more circuit in less space. Measuring just 25/64″ x 7/16″ x 17/32″ behind mounting surface, they're the tiniest trimmers ever made in the United States.

Three capacitance ranges are available, as tabulated below. Each is equipped with plug-in tabs for printed wiring board insertion, as well as two holes for conventional screw mounting. The sturdy low loss ceramic body, brass plates soldered and silver plated, assure a rugged unit, able to take extreme shock, vibration and temperature change. Capacitance is easily varied by means of a screwdriver slot in the rotor shaft.

Insulation resistance, "Q" and thermal stability characteristics are excellent.

Complete Engineering data and specifications for the new Series 75 Subminiature Trimmer capacitors are provided in Bulletin TR-123, available free on request. Write Radio Condenser now for your copy.

RADIO CONDENSER
MINIATURE AIR TRIMMER CAPACITORS

Type No.	Min. Cap. $\mu\mu F$	Effective Max. Cap. $\mu\mu F$	Air Gap	No. Plates
875001	1.2	5	.014	9
875002	1.2	10	.008	11
875003	1.5	15	.008	15

RADIO CONDENSER CO.

Davis & Copewood Streets • Camden 3. New Jersey
EXPORT: Radio Condenser Co., International Div., 15 Moore St., N.Y. 4, N.Y., CABLE: MINTHORNE
CANADA: Radio Condenser Co. Ltd., 6 Bermondsey Rd., Toronto. Ontario

ADVANCED DESIGN

COLOR-MONOCHROME TV TEST and BROADCAST EQUIPMENT

by TARC

Chroma-Video
DISTRIBUTION AMPLIFIER

Model DA 7126 ..... $260.

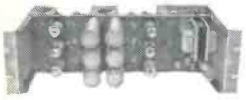
- Frequency independent of gain
- 4 individual channels, IN and OUT
- Overall size only 3½" x 19"
- 75Ω output impedance
- Extremely low differential phase and amplitude distortion

• • • • • •

MODULAR, PLUG-IN
Chroma-Video
DISTRIBUTION AMPLIFIER
Similar to Model DA 7126
Model DA 7130 ..... $460.

- 5 Channel
- Size 5¼" x 19"

Pulse
DISTRIBUTION AMPLIFIER



Model DA 7190 ..... $255.

•

- Six individual channels
- Size 5¼" x 19"
- Excellent rise time
- 75Ω output impedance
- Output tilt less than 1% for 10% input
- Individual gain controls

STABILIZING AMPLIFIER

Model SA 7410 ..... $480.

•

- Clamps on color
- Small size 5¼" x 19"
- Clips, reshapes and re-inserts sync
- Mixes Video with sync
- 75Ω picture output with an isolated monitor output

Electronically Regulated
POWER SUPPLY—750 Ma

Model PS 1536 ..... $295.

- Only 5¼" x 19"
- Very low ripple content
- Precise electronic voltage regulation
- Metering facilities
- Centering voltage available

• • • • • •

MODULAR PLUG-IN
Electronically Regulated
POWER SUPPLY—1½ AMP.
Same specifications and size as Model PS 1535
Model PS 1540 ..... $575.

AUTOMATIC CHROMA CARRIER BALANCE

Model EN 5040 ..... $325.

- Provides automatic balance for mast encoders
- Indispensable for meeting existing NTSC standards
- Easy connection to encoders

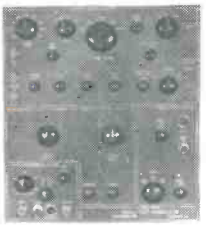
• • • • • •

WINDOW GENERATOR

Model TE 6110 ..... $475.

- Provides a signal that checks transient response and streaking for individual units and systems

VIDEO TEST GENERATOR

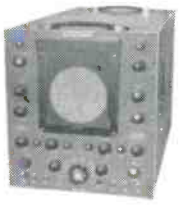


Model TE 6120 ..... $1,950.

Completely self-contained, providing:

- Variable frequency square wave generator
- Frequency sweeper . . . to 10 Mc
- Composite color signal
- Calibrated phaseable 3.58 Mc
- Measures differential phase and differential linearity

COLORSCOPE



Model TE 6000 ..... $4,800.

- 10-Function color and monochrome signal evaluator
- Vectorscope
- Wave form monitor
- Picture monitor with Pulse Cross presentation

NTSC Multi-Burst
FREQUENCY GENERATOR

Model TE 6050 ..... $1,095.

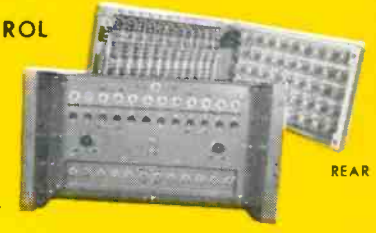
- Five calibrated variable frequency bursts and white bar
- Individual gain controls
- Variable hue color stripe
- Crystal controlled internal NTSC burst on back porch
- 75Ω source impedance
- Designed for NTSC Color System testing
- Individual gain controls for frequency bursts, color stripe, sync, and output
- 1.5V p-p output

TARC instruments now in use by networks and stations. Delivery of most items 30 to 45 days. Send for complete catalog.

TARC will modify any of its standard units, or build from "scratch", to your special requirements.

POWER CONTROL PANEL

Made to specifications of key New York City network station.



FRONT REAR

For the best in hue...

TARC ELECTRONICS, INC. • 48 Urban Avenue, Westbury, N. Y.

RCA DATA FOR

RCA BOOKLETS AVAILABLE

RCA Receiving Tubes for AM, FM, and Television Broadcast—gives characteristics and socket connections for more than 600 receiving-type tubes and TV-picture tubes. For your copy, circle 1275-G on coupon below.

RCA Photosensitive Devices and Cathode-Ray Tubes—contains physical descriptions and data: gas, vacuum, and multiplier phototubes; camera tubes; monoscopes; oscillograph tubes; and kinescopes for specialized uses. For your copy, circle CRPD-105 on coupon below.

For sales information on any of the products shown, contact your RCA Representative at the RCA District Office nearest you:

EAST: HUmboldt 5-3900
744 Broad Street
Newark 2, N. J.

CENTRAL: WHitehall 4-2900
Suite 1181
Merchandise Mart Plaza
Chicago 54, Ill.

WEST: RAymond 3-8361
6355 East Washington Blvd
Los Angeles 22, Calif.

1275-G CRPD-105

NAME_____

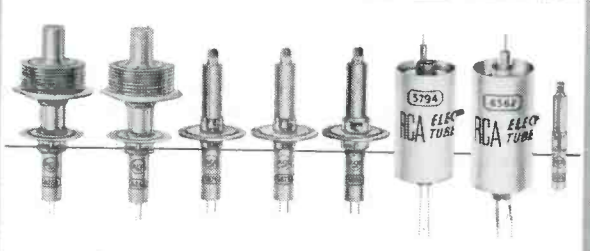
COMPANY_____ TITLE_____

ADDRESS_____

RCA MEMORY DEVICES: FERRITE CORES • TRANSFLUXOR

RCA-219M1 . . . a torroid-shaped, 0.55-ampere-turn-drive, ferrite core; **RCA-216M1** . . . a torroid-shaped, 0.95-ampere-turn-drive, ferrite core. Both types are characterized by hysterisis loops which provide reversal of magnetic-flux polarity when the correct current combination from two associated magnetized windings are coincidentally energized. These ferrite cores are primarily designed for use in matrices of the coincident-current type for applications as storage devices in digital computers.

RCA Dev. No. XF-1501 TRANSFLUXOR . . . this developmental memory device originated by RCA utilizes a ferrite core, has two apertures, and exhibits a nearly rectangular hysterisis loop. It can control the transmission of ac power according to a level established by a single setting pulse. It furnishes an output determined by the stored pulse for an indefinite length of time. Once "set" the TRANSFLUXOR does not require an input command to furnish output intelligence.



RCA "PENCIL" TUBES FOR RADIOSONDE METEOROLOGICAL SURVEY, AIRCRAFT-CONTROL EQUIPMENT, COMMUNICATIONS, AND UHF TEST APPARATUS

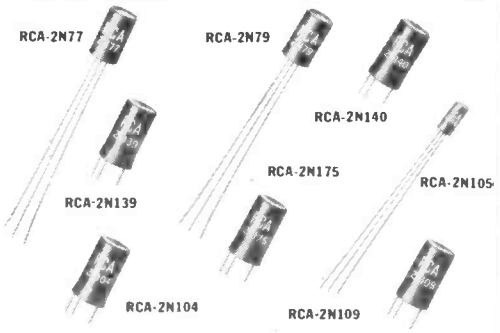
RCA-6263, -6264, -5876, -5675, -5893, -5794, -6562, and -6173 . . . among the outstanding features of these types are small size, light weight, low heater voltage, good thermal stability, minimum transit time, low lead inductance, low interelectrode capacitances, and high efficiency. Applications include oscillator, frequency multiplier, power amplifier, and pulse detection.

TINY-SIZE PHOTOCONDUCTIVE CELL

RCA-6694-A . . . head-on type cadmium-sulfide cell, features high luminous sensitivity, very low dark current, extremely low background noise. Signal output is approximately proportional to incident light intensity. Especially useful in light-controlled relay applications, and in light meters for measuring small luminous spots.

DESIGNERS

ELECTRON TUBES
SEMICONDUCTOR DEVICES
BATTERIES
TEST EQUIPMENT
ELECTRONIC COMPONENTS



RCA HIGH-QUALITY TRANSISTORS COMMERCIALLY AVAILABLE

RCA's high-quality transistors are the result of years of experience in research, development, and production of solid-state materials and devices. RCA transistors are quality-controlled for exceptional uniformity of characteristics and stability throughout long life. All are hermetically sealed, germanium-alloy junction transistors of the p-n-p type. They are useful in the follcwing services for commercial and military applications: low-power af, large-signal af, rf converter, if amplifier, and low-noise preamplifier.

RCA COMPUTER-TYPE TUBES PROVIDE CONSISTENCY OF PLATE CURRENT DURING "ON" CYCLES

Designed, manufactured, and fully tested to assure long-life and stability of operation in "on-off" control applications; all are heater-cathode types. Except for type 5915, they are primarily designed for frequency-divider circuits in electronic computers.

RCA-5915 pentagrid amplifier for "gating" c rcuits, 7-pin miniature type

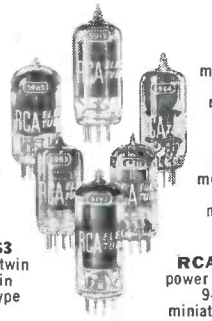
RCA-5964 medium-mu twin triode, 7-pin miniature type

RCA-5965 medium-mu twin triode, 9-pin miniature type

RCA-6211 medium-mu twin triode, 9-pin miniature type

RCA-5963 medium-mu twin triode, 9-pin miniature type

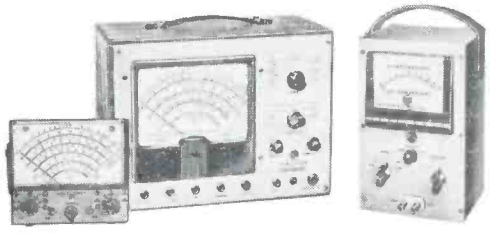
RCA-6197 power pentode, 9-pin miniature type



NEW KINESCOPES AVAILABLE FOR PORTABLE AND LIGHTWEIGHT TV SETS

RCA-8DP4 . . . has spherical Filterglass faceplate, a screen 7 3/16" x 5 3/8", and a minimum projected screen area of 35.5 sq. in. Utilizes 90° deflection, and low-voltage electrostatic focus. Short overall length: 10 3/4" and light weight: 3 pounds, make RCA-8DP4 suitable for use in portable-type designs.

RCA-14RP4 . . . has spherical Filterglass faceplate, a screen 12 1/8" x 9 5/8" and a minimum projected screen area of 108 sq. in. Utilizes 90° deflection, and low-voltage electrostatic focus. Short overall length: 14 7/8" and light weight: 8 1/2 pounds.



RCA TEST EQUIPMENT—CHOICE OF CRITICAL ENGINEERS FOR LABORATORY, PRODUCTION-LINE, FIELD USE

Senior VoltOhmyst®—RCA WV-98A . . . new addition to the well-known group of RCA Vacuum-Tube Voltmeters features large, easy-to-read wide-vision meter (6 1/2" w:), accuracy of ±3% full-scale on both ac- and dc-voltage measurements, direct peak-to-peak reading of complex waveforms. Your "work-horse," it can really take rough handling.

Master VoltOhmyst®—RCA WV-87A . . . features a 27-sq. in. meter. Has accuracy and stability necessary for many laboratory applications. Particularly useful for TV, radar, and other types of pulse work; calibrated scale reads peak-to-peak voltages directly.

Ultra-Sensitive DC Microammeter—RCA WV-84A . . . for reading extremely "feeble" currents from 0.0002 to 1000 μa. Can be used as a very-high-resistance voltmeter—up to 1005 megohms on 100-volt range. As a megohmmeter, resistances to 90,000 megohms can be measured. Well suited for use in the fields of biology, nucleonics, chemistry, electromechanics. Completely self-contained, portable.

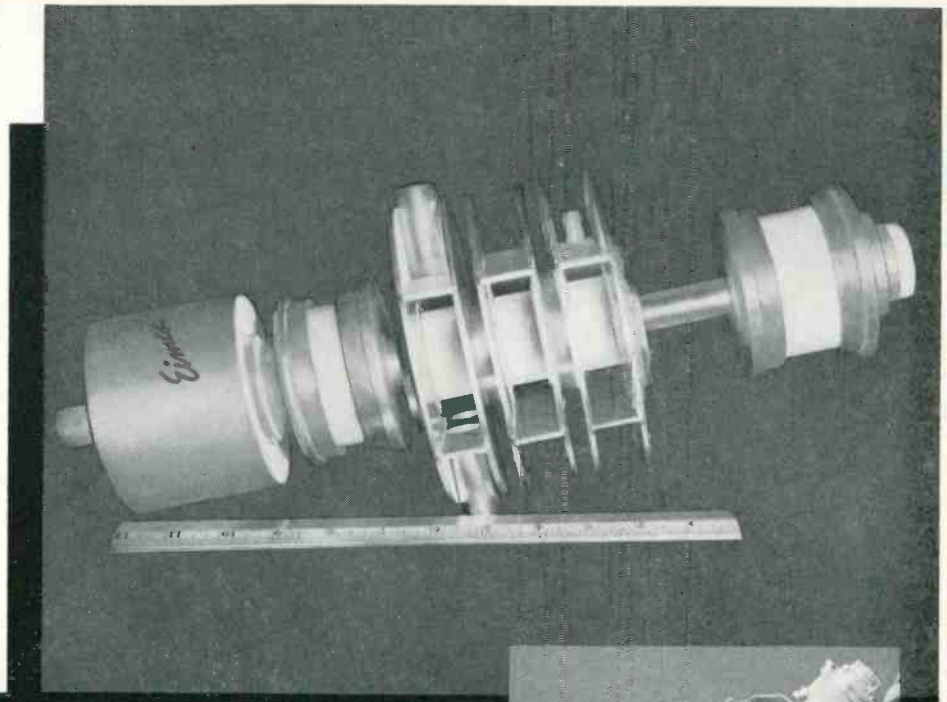
RCA TEST INSTRUMENTS ARE AVAILABLE THROUGH YOUR RCA DISTRIBUTOR

RCA®

RADIO CORPORATION of AMERICA

TUBE DIVISION SEMICONDUCTOR DIVISION

HARRISON, N. J.



A single EIMAC one kilowatt CW Klystron covers the entire 1700-2400 megacycle range

TYPICAL CW OPERATION
Eimac 3K2500SG amplifier klystron 1700-2400 mc

D-C Beam Voltage	6kv
D-C Beam Current	.472 amps
Power Output	1.0 kw
Driving Power	1.0 watt
Efficiency	35 to 40%
Power Gain	30db

One kilowatt CW power output is now commercially available with the new Eimac 3K2500SG amplifier klystron, specifically developed for reliable forward-scatter microwave systems. This three-cavity klystron operates at power gains of 1000 times and an efficiency of 35 to 40 percent.

Eimac's exclusive external resonant cavities and ceramic windows permit all critical RF tuning circuits to be placed outside the vacuum system. Two easily adjusted tuning knobs for each cavity assure the most positive and simple tuning possible.

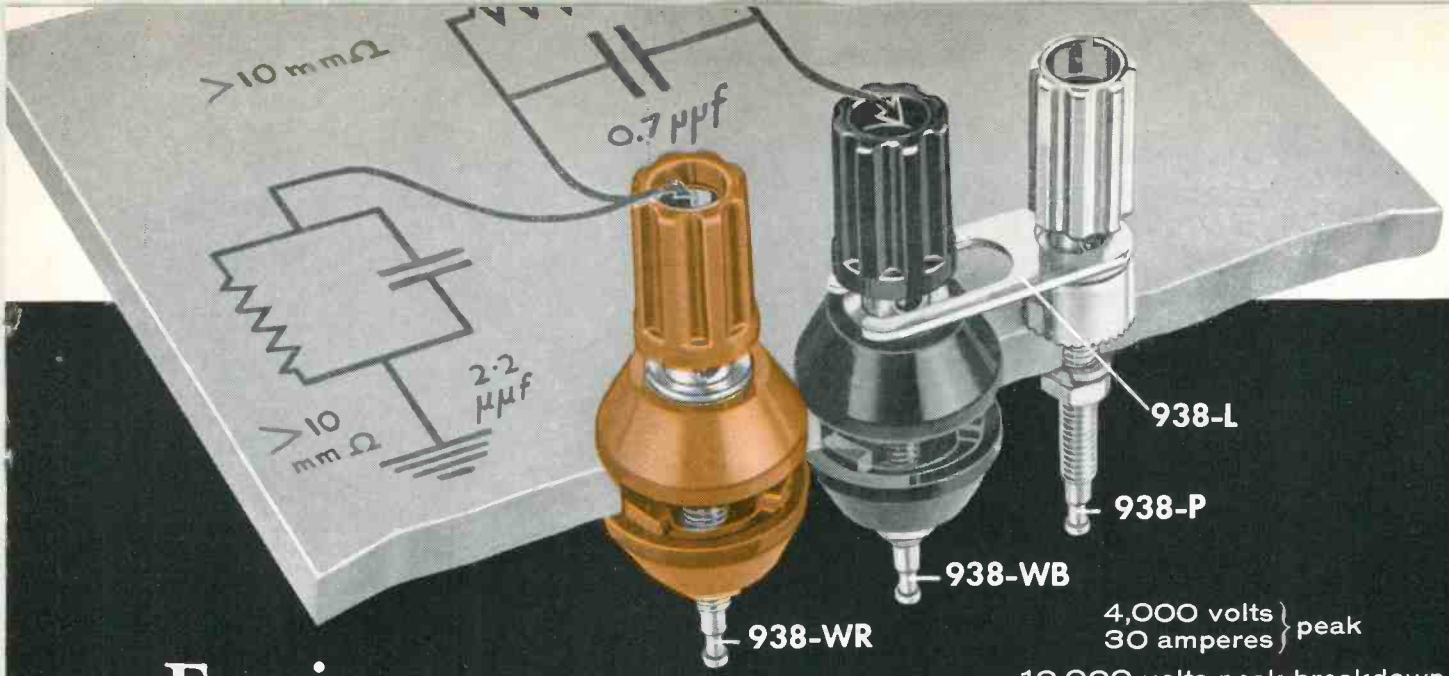
Ceramic and metal construction, a high efficiency oxide cathode, and forced air cooling give the rugged 3K2500SG the reliable, efficient, long-life service typical of all Eimac tubes.

The 3K2500SG klystron is available with resonant cavities, magnetic framework, magnetic beam control coils, output load coupler, and air system socket providing equipment manufacturers with a complete klystron amplifier circuit system.

For detailed information about Eimac tubes and their applications write our Technical Services Dept.

Eimac

EITEL-McCULLOUGH, INC.
SAN BRUNO • CALIFORNIA
The world's largest manufacturer of transmitting tubes



4,000 volts } peak
30 amperes }
10,000 volts peak breakdown
Dissipation Factor = 0.0005 at 1000 cycles

to Engineers in Search of the Best Connection

Type 938 Binding Post series is typical of G-R's extensive line of high-quality components. These posts are chosen by the leading manufacturers for their excellent electrical and mechanical characteristics and for their convenience and functional correctness.

Type	Description	Unit Prices *10-99	100-999	1000-1999	2000-9999	10,000 Up
938-P	Metal top B.P. with metal spacer	$0.38	$0.33	$0.31	$0.30	$0.29
938-WB	Black top, cone insulation	0.53	0.45	0.42	0.395	0.38
938-WR	Red top, cone insulation	0.53	0.45	0.42	0.395	0.38
938-L	Captive Shorting Link	0.10	0.09	0.085		

The basic posts, without cone insulators, are available from all of these assemblies. Cone insulators, grounding spacers and other parts are sold separately, also. Write For Prices.

*Minimum quantity sold. Prices net — no further discount.

The replacement Type 938-Z Insulators fit Type 938 Binding Posts. Older Type 139 Posts can be used as well.

FEATURES

★ Polystyrene insulation throughout — cones hollowed to minimize solid dielectric

★ Dielectric Constant and Dissipation Factor low

★ High leakage resistance

★ Minimum moisture effects

★ Banana plug fits into body of post, NOT its top

★ Tops chamfered to seat banana plugs

★ All tops captive to prevent loss

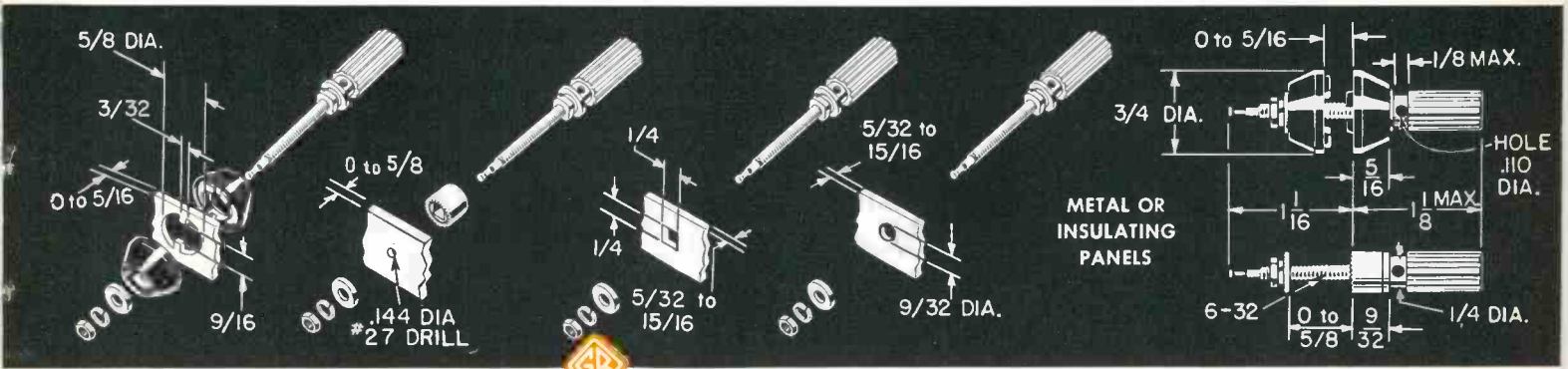
★ Solder directly to turret on mounting stud — not to lug under nut

★ Grounding post with spacer for proper height — flat knurl on bottom of spacer bites into panel and prevents rotation

★ Cross hole in top contoured for firm grip without shearing for any wire from A.W.G. No. 40 to No. 10 — tops will accommodate telephone cord tips, spade terminals, slender alligator clips etc.

★ Interlocking, anti-rotation keyed bases for any panel thickness from 0 to 5/16". If keying is not desired, 5/8" hole in panel frees key

★ Individual post-assemblies advantageous in that pairs can be mounted at any separation from the standard 3/4" to any spacing required — no special parts needed.



Mechanical details of Type 938 Binding Posts and Assemblies.
Locking keys in 5/8-inch mounting hole can be omitted if locking feature is not wanted.

GENERAL RADIO Company

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

90 West Street NEW YORK 6
8055 13th St., Silver Spring, Md. WASHINGTON, D. C.
1150 York Road, Abington, Pa. PHILADELPHIA
920 S. Michigan Ave. CHICAGO 5
1000 N. Seward St. LOS ANGELES 38

As We Go To Press (Cont.)

New Counter Measures Trainer for the AF

Thousands of dollars and thousands of man hours are expected to be saved each year by a new electronic countermeasures trainer developed for the AF's Air Research and Development Command by Melpar, Inc., Alexandria, Va.

The trainer will simulate as closely as possible all types of electronic emissions, such as various types of radar, guided missile control, micro-wave communication equipment, and commercial installations. It also provides a means of setting up various courses of flight in order to train students in several types of ECM tactical problems.

RETMA Endorses FCC's "Translator" Proposal

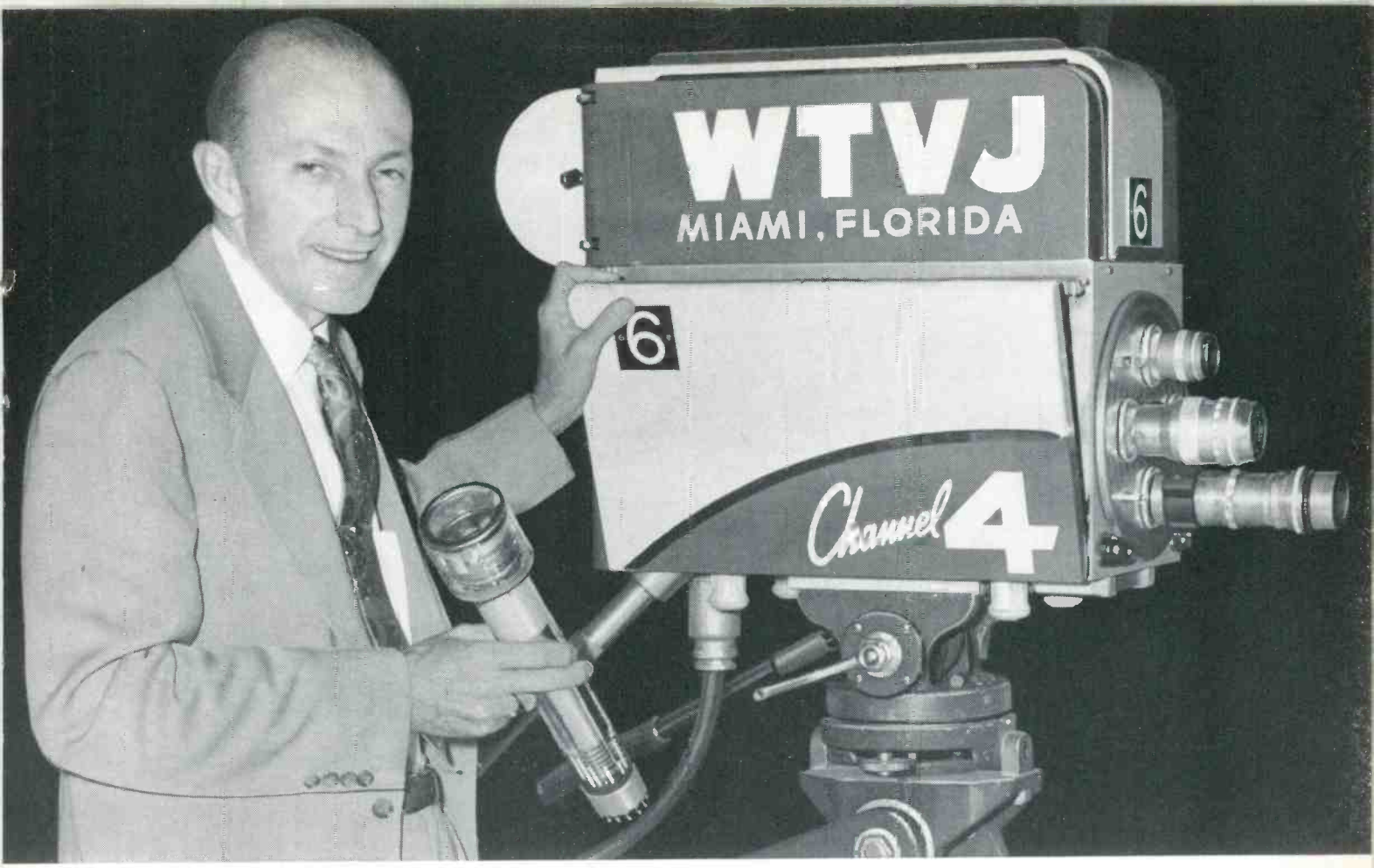
RETMA has endorsed a proposal to permit the operation of "translator" television stations in conjunction with primary TV transmitters as a means of bringing television to many of the isolated communities not now adequately served by either existing or contemplated TV stations.

Who Watches Educational TV?

The Educational Television and Radio Center, Ann Arbor, Mich., has awarded three grants-in-aid as part of a program of audience research in the educational television field.

The relation of television to in-school programming and adult or community education has been of great concern since the introduction of the medium. Now, with 20 educational stations on the air and interest in ETV rising in dozens of American communities, it is possible to begin evaluating, measuring and defining the characteristics of ETV audiences, according to President H. K. Newburn of the Center.

Center grants were received by the Univ. of North Carolina, Michigan State Univ. and the Univ. of Houston.



"Clear, sharp image reproduction...that's why we use G-E image orthicons in our own-design TV cameras!"

Says Earl Lewis, Chief Engineer, WTVJ, Miami.

"OUR purpose in developing our own studio cameras at WTVJ was to give Miami viewers a picture with the highest possible quality. Audience enthusiasm proves we came up with superior equipment.

"To get the best camera results, we specify the best components. G-E image orthicons fit our quality specifications to a 't.' Their image resolution has plenty of detail—the picture is uniform in depth and shading—tube efficiency stays high through long hours of service.

"I'm told that really big resources of skill, manpower, and equipment were drawn on by General Electric to develop their Broadcast-Designed image orthicons. The tube's fine overall performance in our studio cameras certainly bears out this information!"

* * *

Your General Electric tube distributor has Broadcast-Designed image orthicons. For top-rating picture quality, for full-measure *efficient* tube life that means replacement dollars saved . . . phone your local G-E distributor today! *Tube Department, General Electric Company, Schenectady 5, New York.*

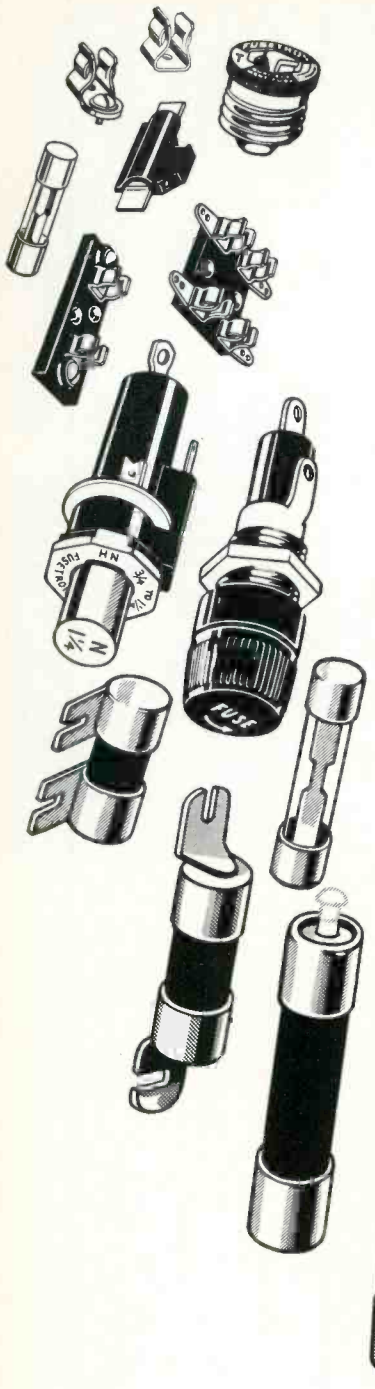
Progress Is Our Most Important Product

GENERAL ELECTRIC

161-1F2

BUSS FUSES

A complete line to meet all your fuse requirements . . .



You'll find the type and size fuse you need, quickly and easily, by turning to BUSS. The complete BUSS fuse line includes: standard, 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.

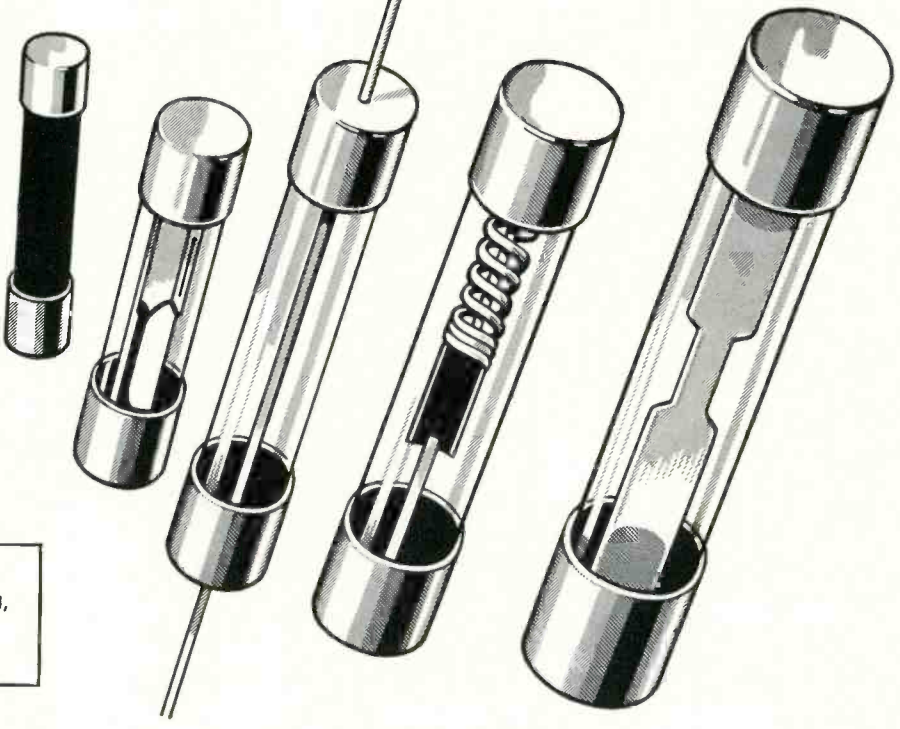
BUSS fuses are dependable and "trouble-free"

To assure you of top quality and proper operation under all service conditions — BUSS fuses are electronically tested. A sensitive device automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

That's why BUSS fuses, by their unfailing dependability, help safeguard your most valuable asset — the good name of your product. When there is trouble on the circuit, BUSS fuses open and prevent further damage — saving the users of your equipment from unnecessary repairs. And BUSS fuses won't cause irritating, useless shutdowns because . . . BUSS fuses eliminate needless blows.

Why take a chance with your product being blamed for troubles caused by poor quality fuses? It is just good business to standardize on genuine BUSS fuses.

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. (*Div. of McGraw Electric Co.*)

UNIVERSITY AT JEFFERSON, ST. LOUIS 7, MO.

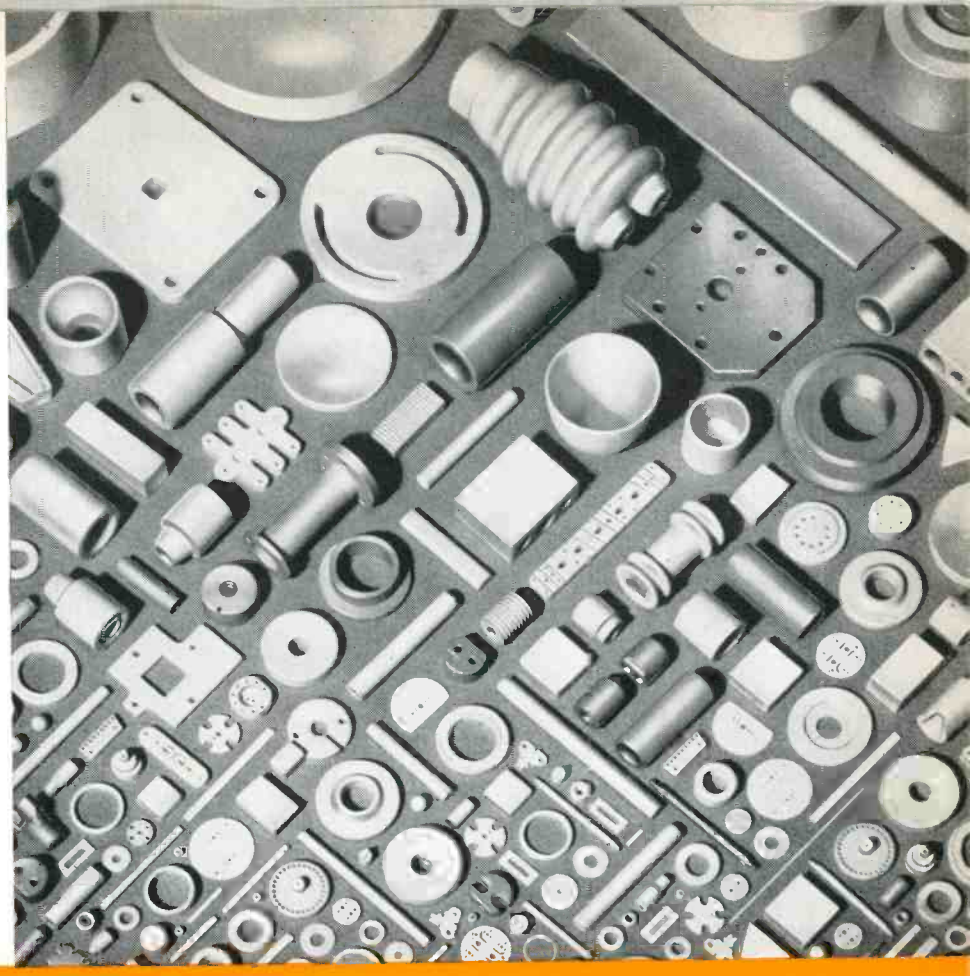
FUSETRON — TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION — BUSS

556

AlSiMag®

614

alumina ceramics



Industry Approved

Accurately Controlled

Available in Quantity

Technical ceramics perform the most difficult electrical, mechanical and chemical jobs. Where ordinary ceramics won't do, Aluminas take over. They're "Annie Oakleys" that do everything better—especially at high frequencies and temperatures or where mechanical wear is a problem.

Standout among Aluminas is AlSiMag 614—a proven success, industry tested. Available in quantity and of dependable high quality—stays uniform from piece to piece and lot to lot.

If AlSiMag 614 isn't right for your job, choose from a complete range of special characteristic Aluminas. As in regular ceramics, AlSiMag has the widest choice available from any source. Custom formulations for unusual requirements.

Large scale production facilities devoted exclusively to Aluminas . . . from raw material to high temperature, continuous firing . . . are ready to serve you NOW. Standard or custom high temperature metalizing also available.

PLANTWIDE VACATION
First two Weeks of July

Buy Alumina ceramics from this dependable source. Send blueprint or sketch for complete details. **NEW Bulletin 562 on Alumina ceramics sent on request.**

55TH YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE
A Subsidiary of
Minnesota Mining and Manufacturing Company

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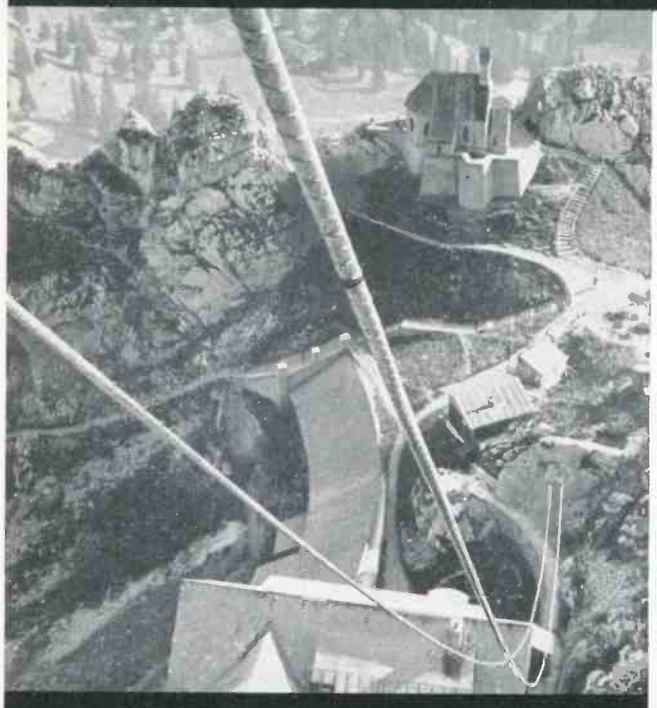
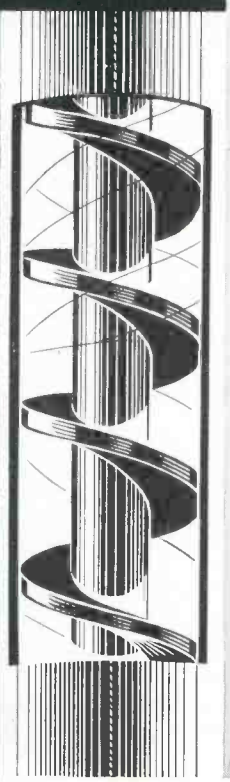
Styroflex Coaxial Cable

IS GOING PLACES—DOING THINGS in the Broadcast Field!

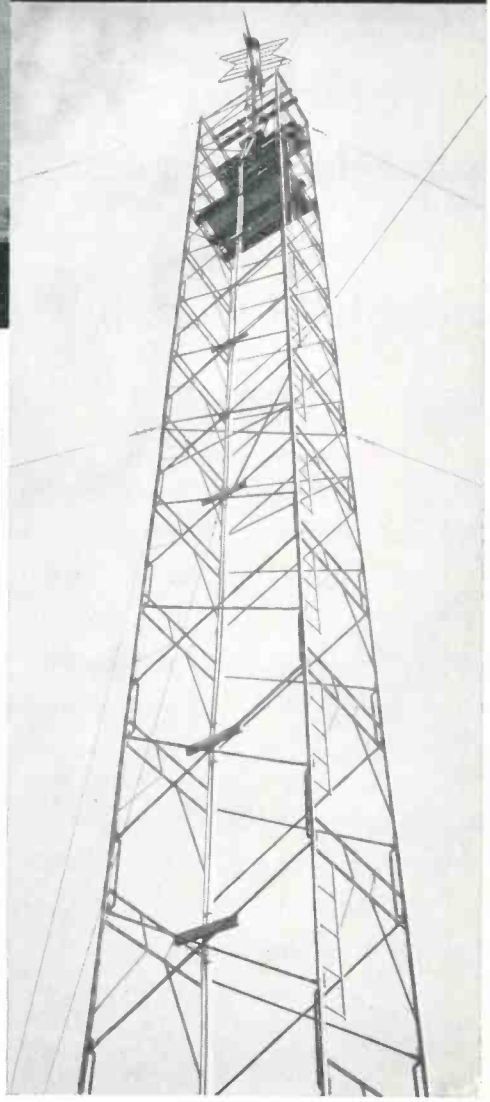
NORTH CAROLINA



SWISS ALPS



MINNESOTA



Perhaps Styroflex can answer your particular problem.
Inquiries welcomed by our engineering staff.

PHELPS DODGE COPPER PRODUCTS CORPORATION
REG. U. S. PAT. OFF.

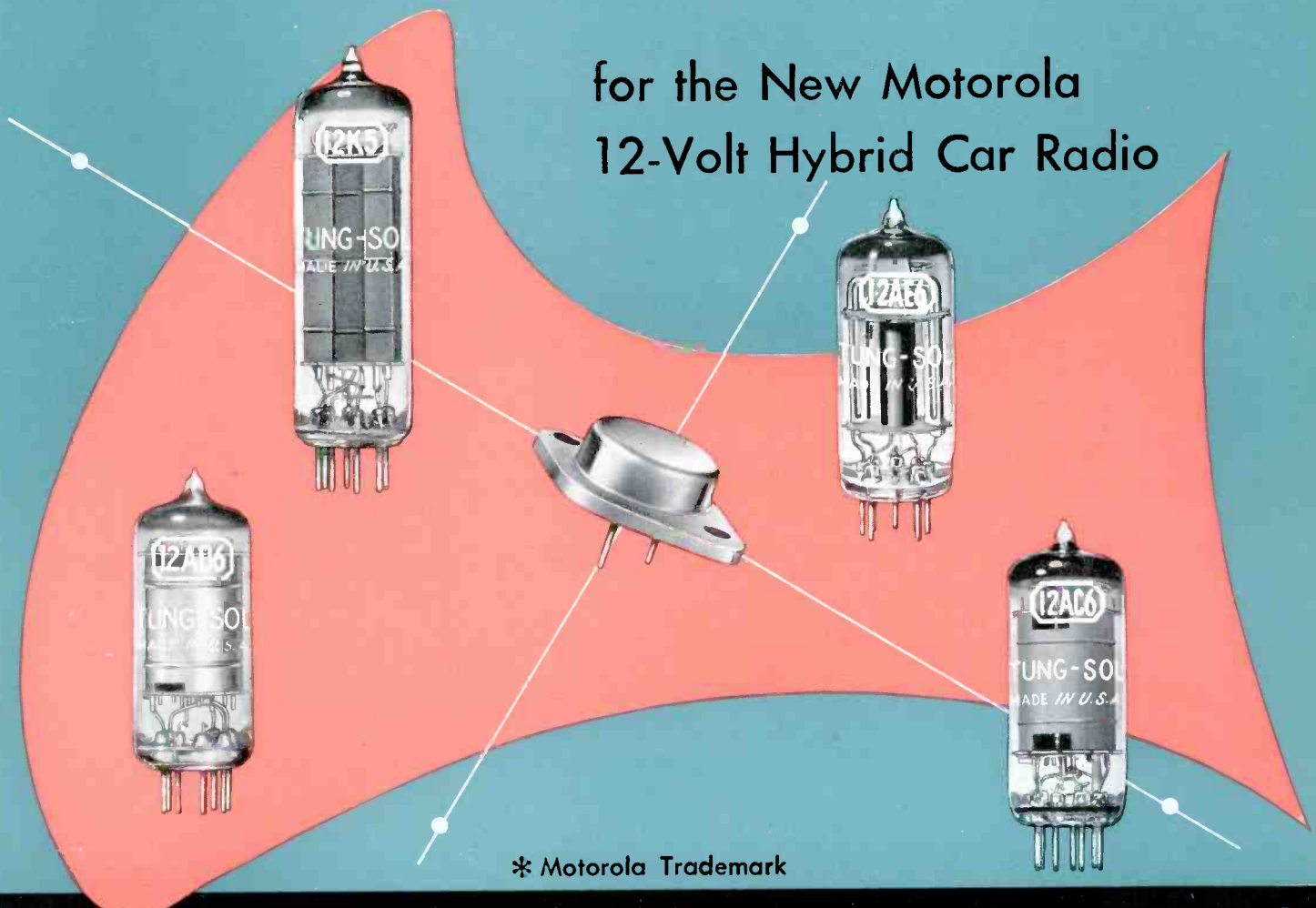
PHELPS DODGE COPPER PRODUCTS CORPORATION

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

TUNG-SOL®

Electron Tubes and "Golden Heart"* Transistor

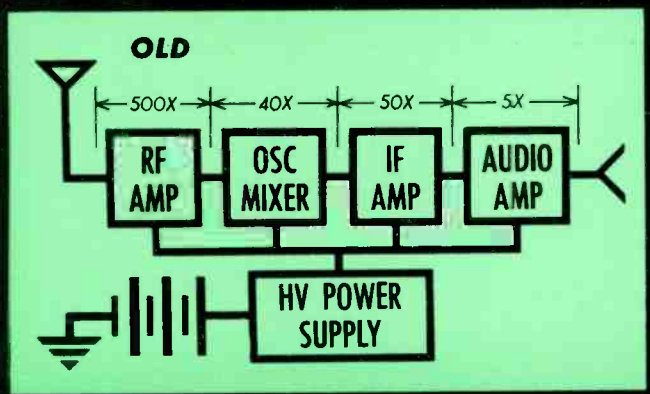
for the New Motorola
12-Volt Hybrid Car Radio

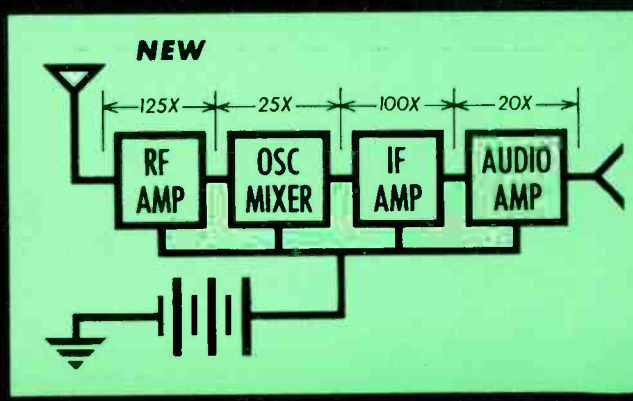


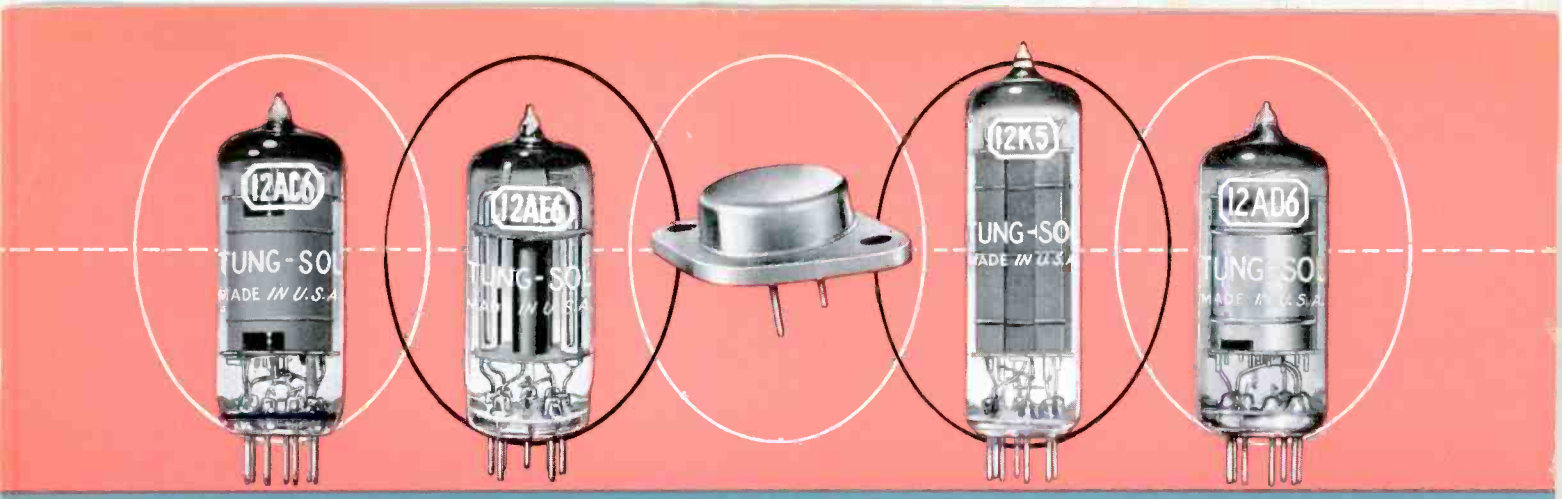
See other side for additional information

* Motorola Trademark

designed to operate directly from a 12-Volt car battery







Tung-Sol Engineering Helps Pioneer a New Concept in Motorola Car Radios...

The new Motorola hybrid car radio represents one of the most significant advancements in car radio design. Fifteen vital parts, components of the customary high power supply, have been completely eliminated. In their place—a single high power transistor plus a complement of newly engineered electron tubes developed by Tung-Sol to operate with full efficiency directly off a 12-volt plate supply source.

In addition to circuit simplification which removes many potential sources of trouble, new standards of performance are clearly indicated. Tubes operate at reduced internal temperature and dissipation. Drain on the car battery is cut almost in half.

This achievement—for many years considered impractical—is the result of Tung-Sol's intensive experience in the development of tubes for automotive applications. Thru it, Tung-Sol engineering has opened new avenues for the application of tubes to low voltage plate supply circuit designs.

As has always been the Tung-Sol policy, engineering assistance is offered impartially and all problems are treated with strictest confidence.

ELECTRON TUBE CHARACTERISTICS

TUBE TYPE	Heater Voltage	Plate Voltage	Grid #1 Voltage	Grid #2 Voltage	Grid #3 Voltage	Plate Current	Grid #1 Current	Grid #2 Current	Transconductance (Cont. Grid to plate)	Triode Ampl. Factor
12AC6	12.6 V	12.6 V	0 *V	12.6 V	Cathode	28 μa	——	28 μa	730 μmhos	——
12AD6**	12.6 V	12.6 V	1.1 V RMS	12.6 V	0	120 μa	30 μa	650 μa	100 μmhos	——
12AE6										
Triode	12.6 V	12.6 V	0	——	——	750 μa	——	——	1000 μmhos	15
Diodes	12.6 V	10 V	——	——	——	2.0 ma	——	——	——	——
12K5	12.6 V	12.6 V	12.6 V	—2.0 V	——	8.0 ma	85.0 ma	——	7000 μmhos	5.6***

*Grid #1 Resistor=2.2 Megohms **Converter Service ***Grid #2 to Plate

TRANSISTOR CHARACTERISTICS†

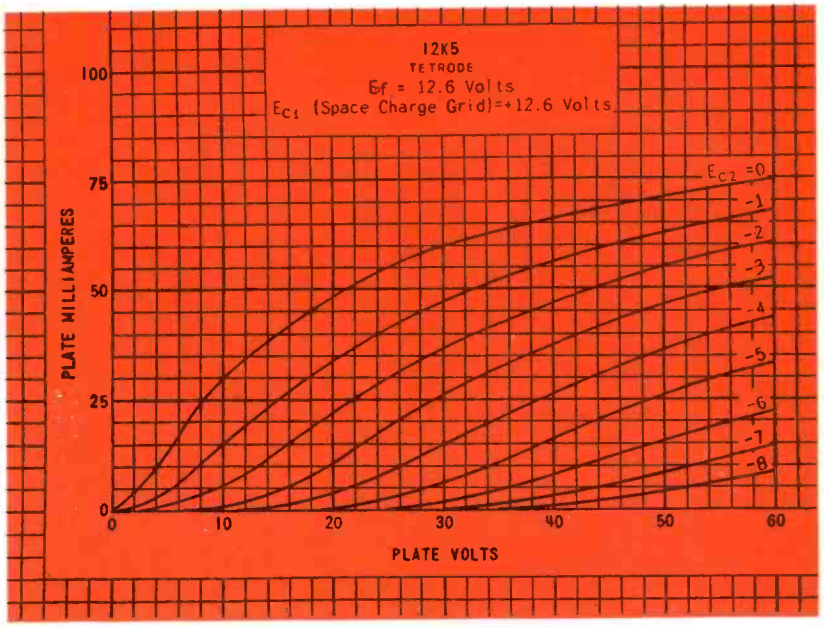
TYPE	I_z	E_z	R_L	R Source	Power Output	Power Gain	Distortion
TS-176	500 ma	—12 V	30 ohms	15 ohms	2.5 watt	30 db	8%

†With unit attached to heat sink.

MAY, 1956

12K5 Another Engineering First from Tung-Sol

The 12K5 was originally designed to fill an enormous gap in the "hybrid" auto radio complement. Before this development, no single, high-gain tube was commercially available which even approached the power sensitivity required—at 12-volts plate supply voltage—to drive a single or push-pull high power output transistor from the small signal tube amplifiers. To accomplish this, the 12K5 utilizes a unique design feature known as the "space charge grid" which effectively greatly increases the cathode area. The resulting low output impedance and high transconductance render the type extremely useful for a great many low voltage driving, switching and control applications.



12K5 POWER AMPLIFIER TETRODE

USING THE SPACE CHARGE GRID PRINCIPLE

CHARACTERISTICS

Tube Type: 12K5
Heater Voltage: 12.6V
Plate Voltage: 12.6V
Grid #1 Voltage: 12.6V
Grid #2 Voltage: —2.0V
Plate Current: 8.0ma
Transconductance:
(Cont. Grid to Plate) 7000 μmhos
Triode Ampl. Factor: 5.6*

*Grid #2 to Plate

The Tung-Sol engineering which has produced the 12K5 is constantly at work on a multitude of special electron tube developments for industry. Many exceptionally efficient general and special purpose tubes have resulted. Information about these and other types are available on request to Tung-Sol Commercial Engineering Division.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.
Sales Offices: Atlanta, Columbus, Culver City, Dallas, Denver, Detroit, Melrose Park (Ill.), Newark, Seattle.

TUNG-SOL®
ELECTRON TUBES

For product information, use inquiry card on last page.

GATES 1956 Audio's FINEST Year

What a marvelous year this will be for those lucky broadcasters who own and operate one of these two new Gates audio consoles. A year when Gates engineering . . . Gates progressive design . . . Gates workmanship have all produced in magnanimous form.

Indeed, this is a year when Gates equipment has become more economical . . . more practical . . . more generous in quality than ever before and these two 1956 Gates speech input consoles we know you will agree, make this . . . *audio's finest year.*

GATES RADIO COMPANY
Manufacturing Engineers Since 1922
QUINCY, ILLINOIS

- GATES DUALUX — big dual channel console provides more facilities than ever before offered, including inbuilt cue-intrcom system and variable equalizer. Illustrated above.

- GATESWAY — modern low and wide styling combined with functional design offers the year's finest single channel audio console, including cue-intercom and variable equalizer. Pictured below.

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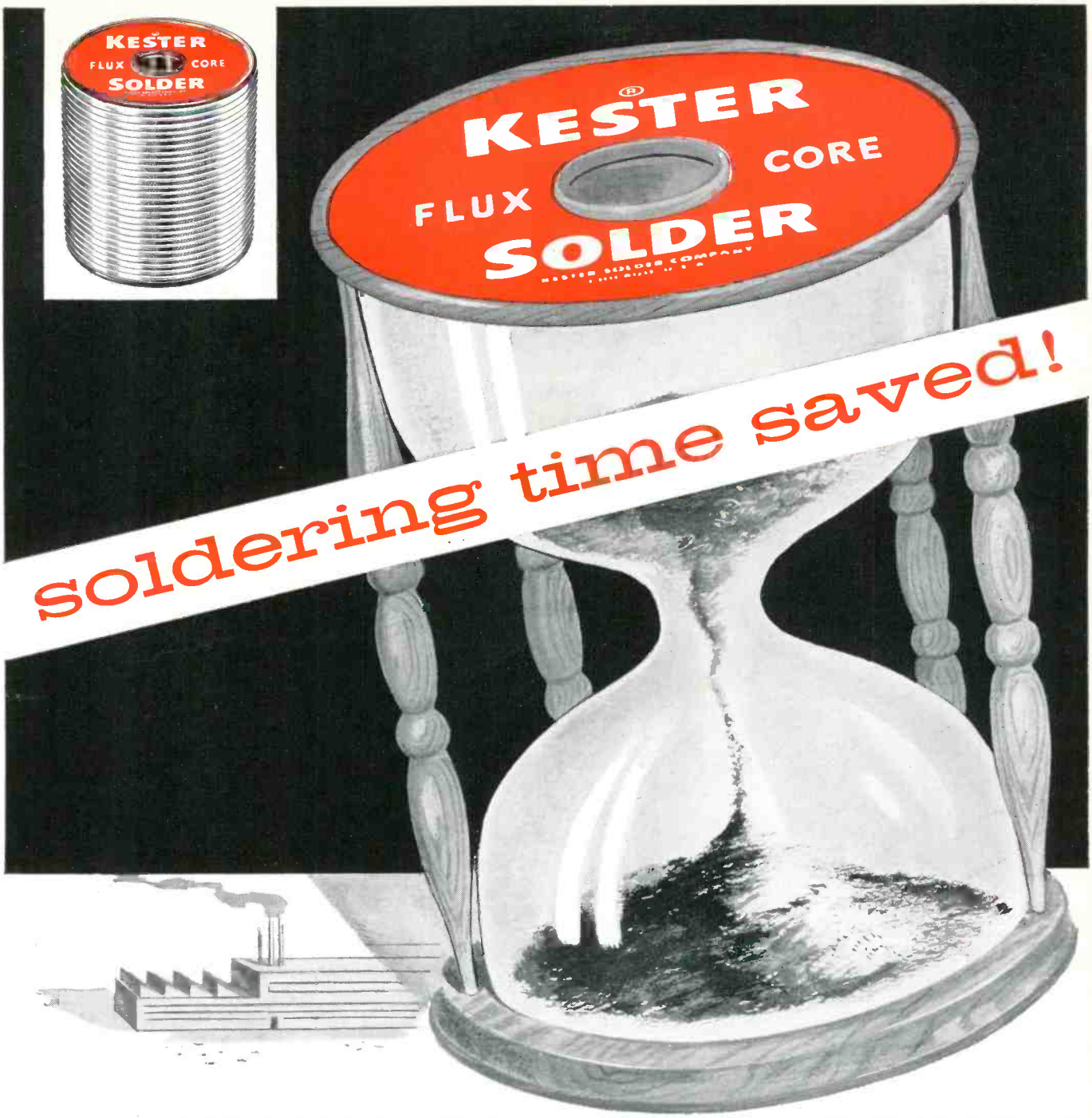

KESTER "44" RESIN, PLASTIC ROSIN AND "RESIN-FIVE" FLUX-CORE SOLDERS are tried-and-proved remedies for almost every production situation where soldering time gets out of hand. Kester's great adaptability to widely divergent soldering requirements has time and again helped so many manufacturers combat rising production costs. It could be the solution you've been looking for!

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TELE-TIPS

THE AEC estimates that 2,000-3,000 nuclear trained scientists and engineers will be needed per year over the next 20 years. Recent survey shows that industry expects to get half during the next 3-year period by hiring them rather than training them—from each other, that is.

RUSSIAN PLANTS apparently offer the engineer a good deal in the way of social activity. Travelers recently returned from the USSR describe "Recreation Palaces" equipped with swimming pools, gymnasiums and auditoriums where the workers stage ballets, operas and plays.

$8,000 TO $9,000 A YEAR could easily be the average G-E salary by 1966, said Ralph J. Cordiner, company pres.

SUBSCRIPTION TV trial run was conducted by Zenith in Chicago using scrambled picture, but normal audio. Sampling of set owners found that scrambling didn't faze them a bit; they turned down the brightness and just listened to the audio. Needless to say, the newer versions have scrambled audio, too.

ENGINEERING RECRUITMENT sales pitch put out by G-E's Utica plant opened Uticans' eyes to the attractive features in that area of their own surroundings, and earned a vote of thanks from the local paper. Booklet titled "Living to the Fourth Power" pointed out "Here in the Mohawk Valley are opportunities for city living, country living. small town living and suburban living . . ."

NEW RADIO-TV LINE, by Westinghouse, will be designed by Raymond Loewy.

TV TIME. The late shift at one large British coal mine was moved forward one hour so that workers could get home in time to catch the last hour of television. British networks normally shut down at 11 P. M.

(*Continued on page* 46)

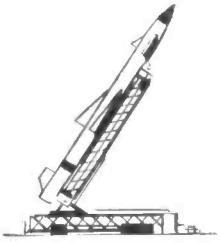
Presenting the New QWL

Bendix ELECTRICAL CONNECTOR

A HEAVY-DUTY WATERPROOF POWER AND CONTROL CONNECTOR FOR USE WITH MULTI-CONDUCTOR CABLE

OUTSTANDING FEATURES:

1. It combines the strength advantages of machined bar stock aluminum with the shock-resistant qualities of a resilient insert.
2. A modified, double stub thread provides for speed and convenience in mating and disconnecting and the special tapered cross-section thread design resists loosening under vibration. The threads can be easily hand cleaned if contaminated by a substance such as mud or sand.
3. An Alumilite 225 hard anodic finish is used which gives a case hardening to the aluminum surface. This finish offers outstanding resistance to corrosion and abrasion.
4. The cable-compressing gland used within the cable accessory accomplishes both a firm anchoring of the cable and effective waterproofing for multi-conductor cables. Neoprene sealing gaskets are used at every joint to insure a watertight connector assembly.
5. The cable accessory is designed to accommodate a Kellems stainless steel wire strain relief grip for additional cable locking.
6. A left-hand thread is used on the cable accessory to prevent inadvertent loosening.
7. High-grade copper alloy contacts are used which provide for high current capacity and low voltage drop. The famous Bendix closed entry socket is used for contacts sizes 12 and 16.



This new QWL Bendix* Electrical Connector was designed for and is being used principally on ground launching equipment for missiles and ground radar equipment.

Obviously for this important type of service only the highest standards of design and materials are acceptable.

That's why it will pay you to specify the Bendix QWL electrical connector for any job that requires exceptional performance over long periods of time.

*TRADEMARK

SCINTILLA DIVISION OF BENDIX
SIDNEY, NEW YORK

Export Sales and Service: Bendix International Division
205 East 42nd St., New York 17, N.Y.

Canadian Representatives: Aviation Electric Ltd.
200 Laurentien Blvd., St. Laurent, Montreal 9, Quebec

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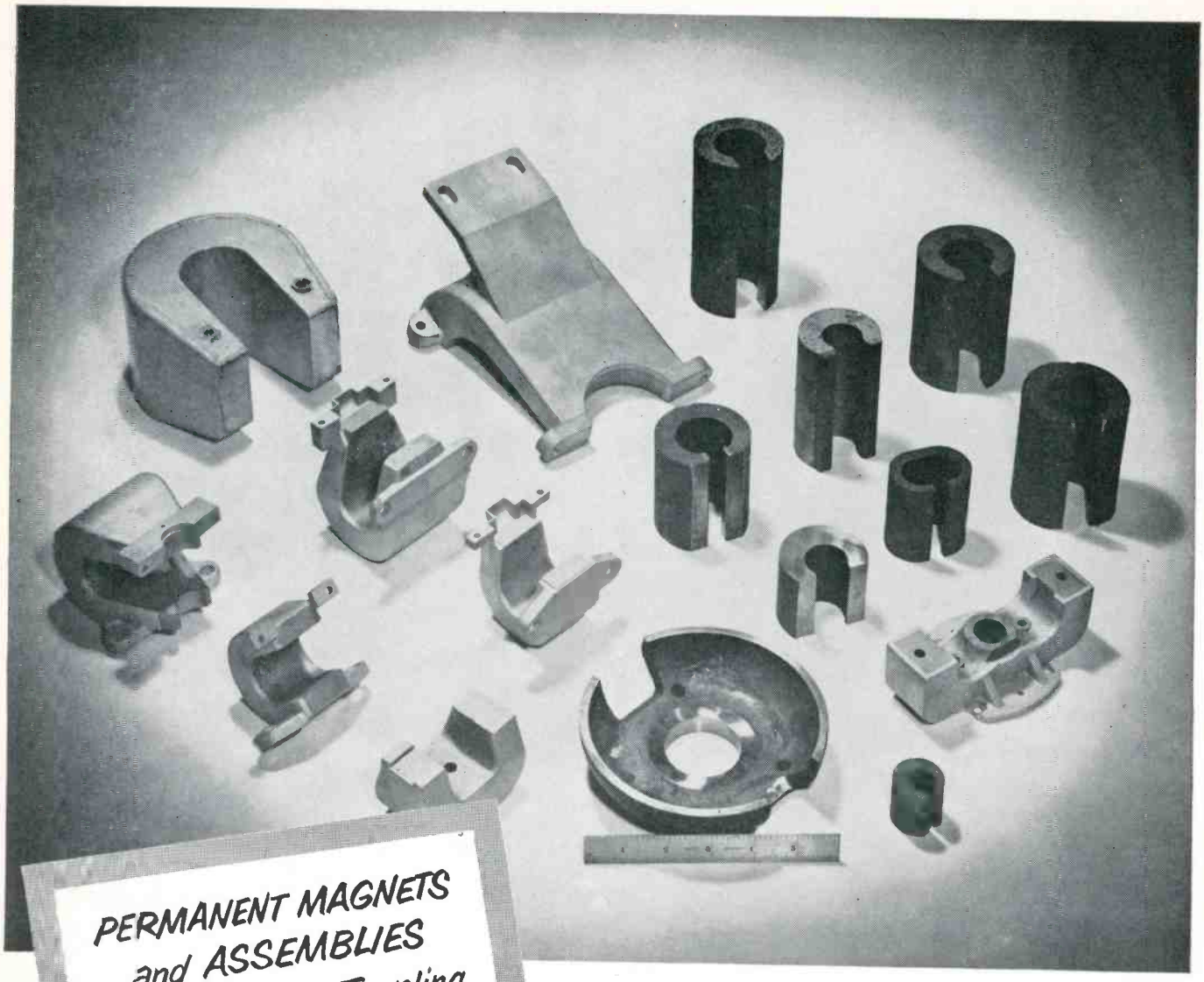
Bendix
SCINTILLA DIVISION

Bendix
AVIATION CORPORATION



PERMANENT MAGNETS and ASSEMBLIES for Wave Guides, Traveling Wave Tubes and Magnetrons

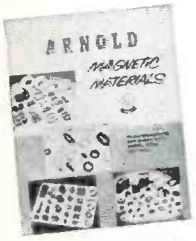
We can handle ANY requirements you have

★ Made to your specifications

★ Any size, shape or coating required

★ Send us your drawings for quotation

The group of magnets illustrated above are indicative of the great scope of Arnold production in this field. We can supply these permanent magnets in any size or shape you may need; in weights ranging from a few ounces to 75 pounds or more; and with die-cast or sand-cast aluminum jackets, Celastic covers, etc., as required. Complete assemblies may be supplied with Permendur, steel or aluminum bases, inserts and keepers as specified—magnetized and stabilized as desired. ● Let us handle your magnetron, traveling wave tube and wave guide permanent magnet requirements, *or any other magnetic material specification you may have.*



Write for your copy of Bulletin GC-106A on all Arnold Products

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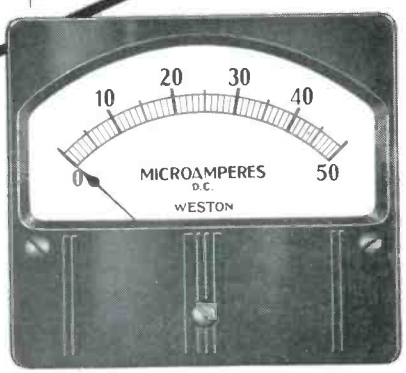
SYMBOLS OF ENGINEERING FORESIGHT



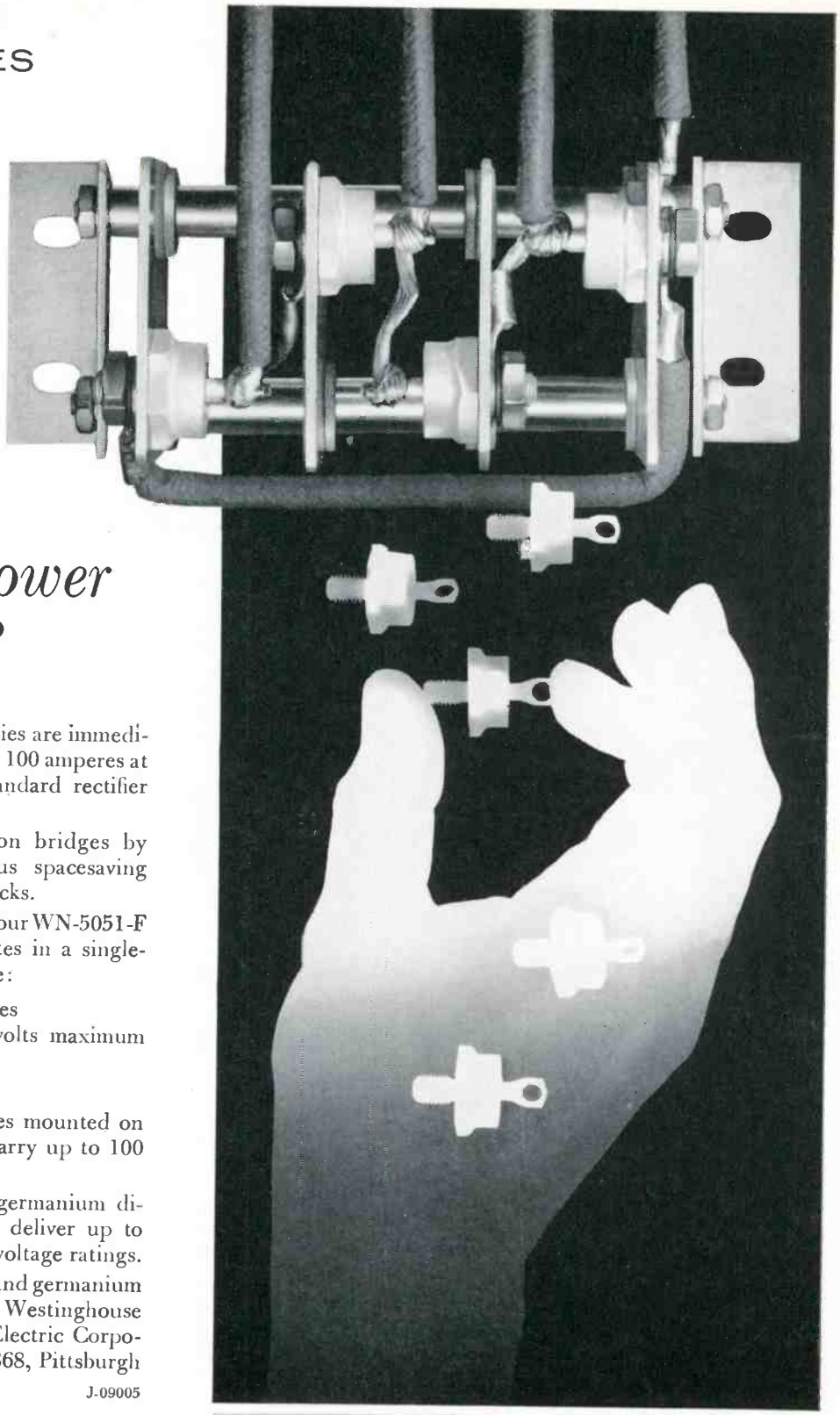
Built-in Weston dependability pays off in many ways

Two valid reasons have established WESTON instruments as the designer's choice for all "built-in" requirements. *To equipment buyers* a WESTON on the control panel instantly establishes a conviction of rigid specifications and sound engineering sense. *For equipment manufacturers* WESTON dependability continues to work after the equipment is sold. Assuring a true check on operating conditions, it protects the device itself, and the reputation of its builder.

Weston panel instruments are available in types, sizes and ranges for all electronic or electrical "built-in" needs. Also in a complete line of *ruggedized* meters for a-c and d-c requirements. For information, or engineering cooperation, consult your nearest WESTON representative or write direct. Weston Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, N. J. A subsidiary of Daystrom, Incorporated.

PANEL
INSTRUMENTS
by
WESTON

WESTINGHOUSE SILICON BRIDGES



How much power do you need?

Westinghouse silicon bridge assemblies are immediately available with outputs from 5 to 100 amperes at 50 to 300 volts peak inverse in standard rectifier circuits.

These new pre-assembled silicon bridges by Westinghouse permit a tremendous spacesaving compared to equivalent selenium stacks.

Typical performance figures using four WN-5051-F diodes on 2″ x 2″ aluminum plates in a single-phase bridge, shown at the right, are:

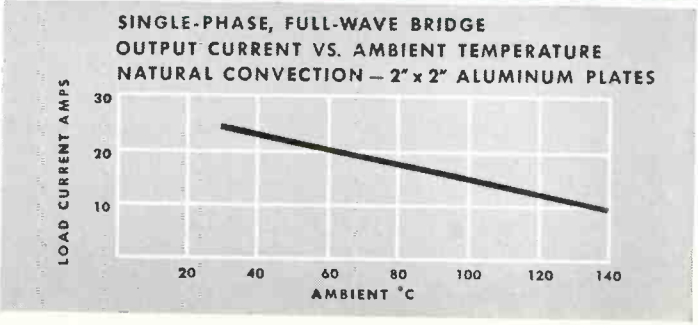
- continuous-load current 25 amperes
- leakage current <20 ma @ 300 volts maximum peak inverse
- natural convection 30° C ambient

A similar assembly with the diodes mounted on 5″ x 5″ plates with forced air can carry up to 100 amperes continuous.

Other Westinghouse silicon and germanium diodes can be mounted in bridges to deliver up to 600 amperes load current at various voltage ratings.

For detailed information on silicon and germanium bridges and diodes, contact your local Westinghouse sales office or write: Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

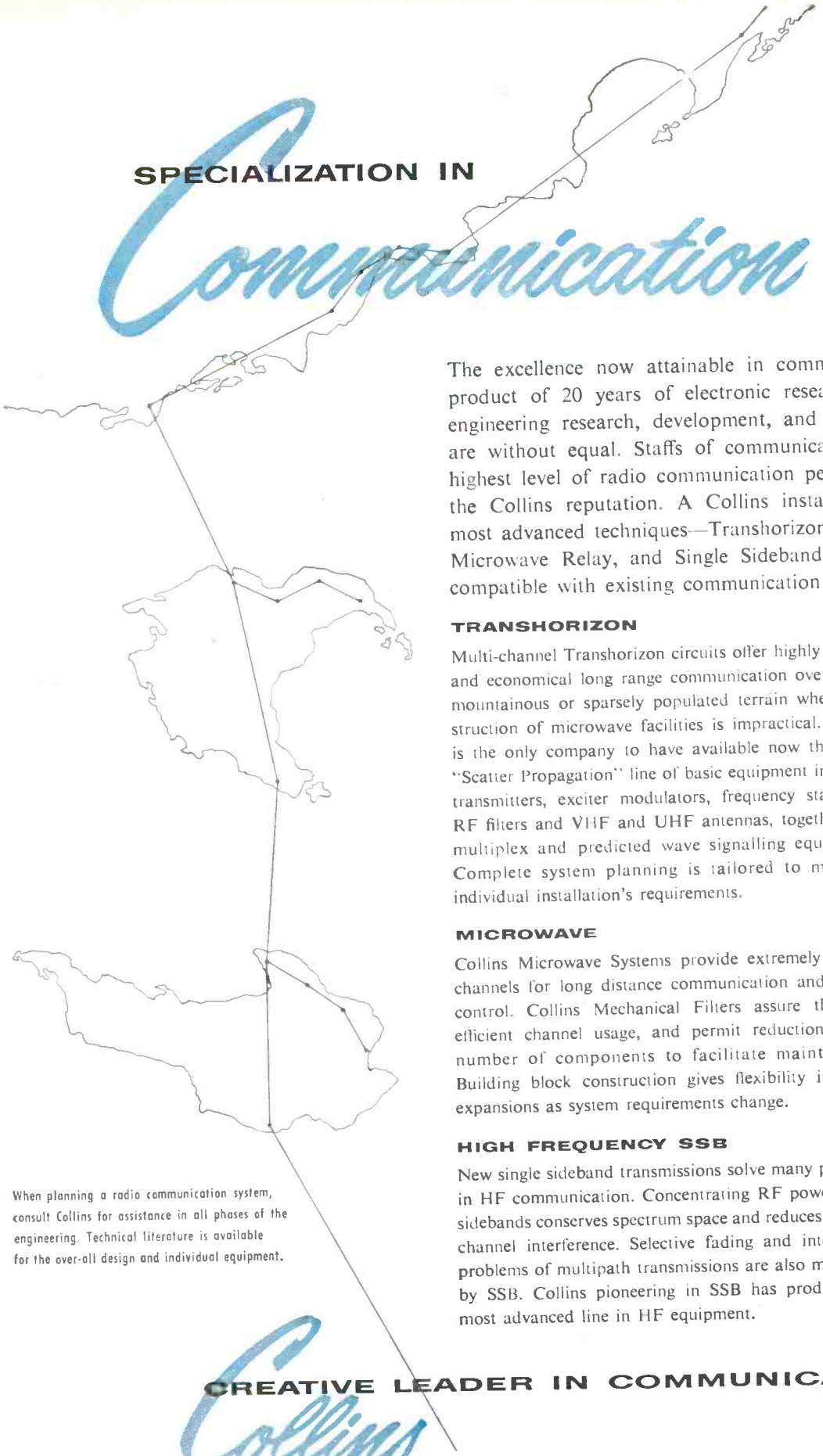
J-09005



YOU CAN BE SURE...IF IT'S

Westinghouse

SPECIALIZATION IN *Communication*



When planning a radio communication system, consult Collins for assistance in all phases of the engineering. Technical literature is available for the over-all design and individual equipment.

The excellence now attainable in communication systems is a product of 20 years of electronic research at Collins. Collins engineering research, development, and manufacturing facilities are without equal. Staffs of communication experts assure the highest level of radio communication performance, which backs the Collins reputation. A Collins installation incorporates the most advanced techniques—Transhorizon "Scatter" Propagation, Microwave Relay, and Single Sideband HF Developments—all compatible with existing communication systems.

TRANSHORIZON

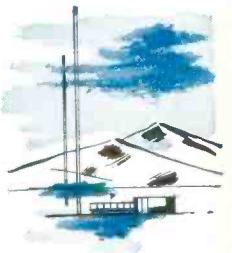
Multi-channel Transhorizon circuits offer highly reliable and economical long range communication over water, mountainous or sparsely populated terrain where construction of microwave facilities is impractical. Collins is the only company to have available now the entire "Scatter Propagation" line of basic equipment including transmitters, exciter modulators, frequency standards, RF filters and VHF and UHF antennas, together with multiplex and predicted wave signalling equipment. Complete system planning is tailored to meet the individual installation's requirements.

MICROWAVE

Collins Microwave Systems provide extremely reliable channels for long distance communication and remote control. Collins Mechanical Filters assure the most efficient channel usage, and permit reduction of the number of components to facilitate maintenance. Building block construction gives flexibility in future expansions as system requirements change.

HIGH FREQUENCY SSB

New single sideband transmissions solve many problems in HF communication. Concentrating RF power in the sidebands conserves spectrum space and reduces adjacent channel interference. Selective fading and interference problems of multipath transmissions are also minimized by SSB. Collins pioneering in SSB has produced the most advanced line in HF equipment.



CREATIVE LEADER IN COMMUNICATION

Collins

COLLINS

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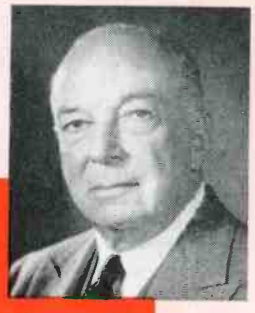

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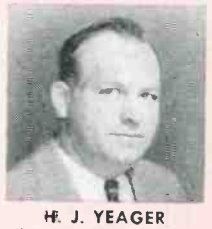

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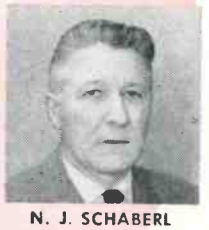

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Production Manager

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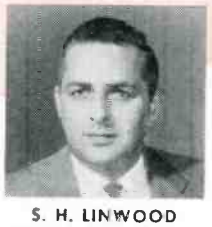
Chairman of the Board

F. S. LAMBERT
Production Supt., Electronics

C. S. ARNOLD
Supt. Kane, Pa. Plants

Here are a few of the "home plant" folks . . . 25 out of several thousand of them to be more exact . . . who *are* "Stackpole." You'll probably recognize some. Others you may not know. But each has a common objective that pertains to every user of electronic components: *To seek constant improvement, both for Stackpole products and the personalized service that is put behind them.* And, by picturing them here, we hope to help you know Stackpole better!



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Engineer, Electronics

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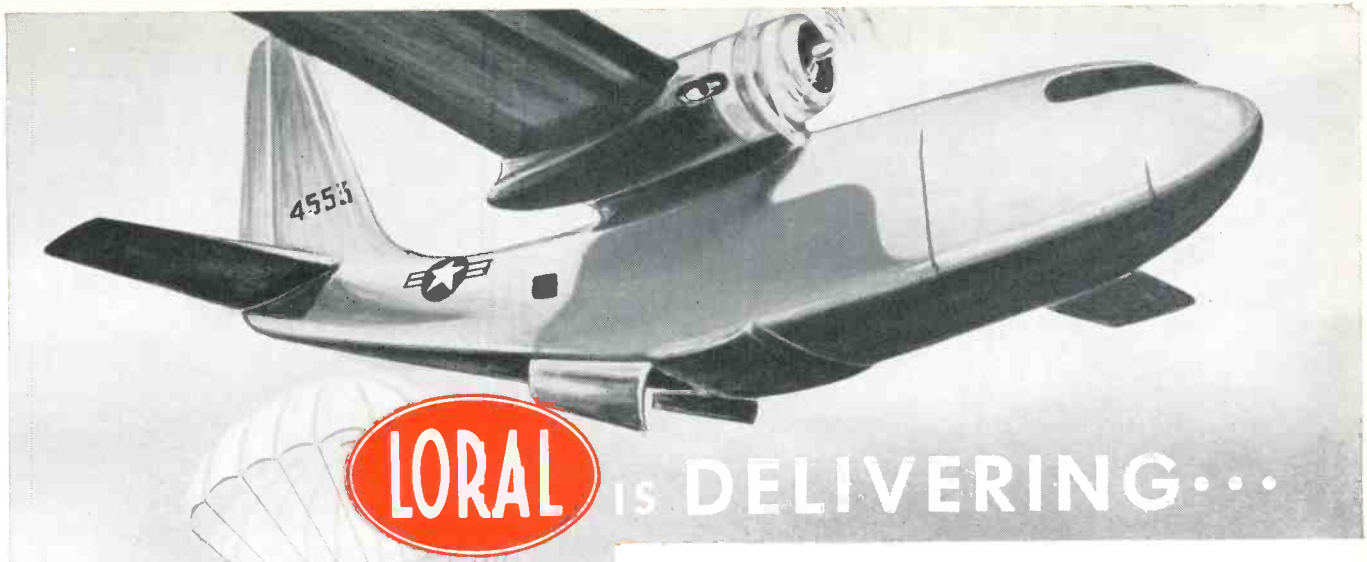

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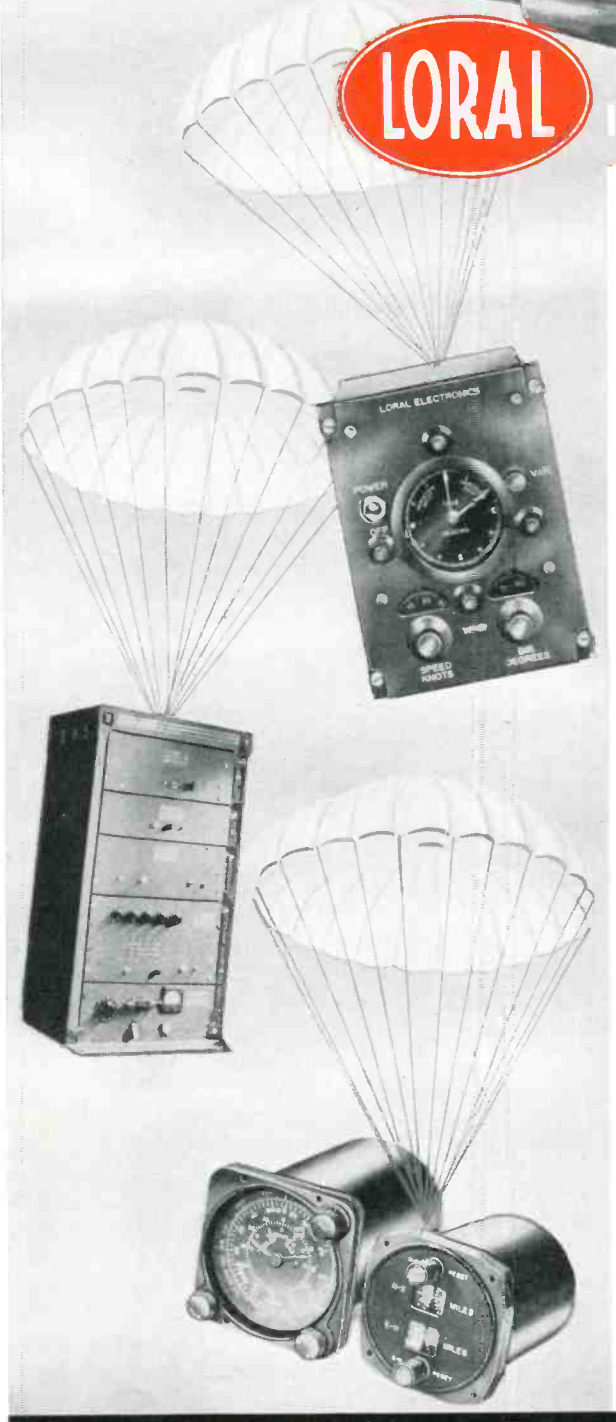

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NEW in TECHNIQUE!

NEW in DESIGN!

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Built for PRECISION, ACCURACY, and PERFORMANCE

Among recent developments are:

- the LORAL AIRBORNE NAVIGATION COMPUTER. A compact and accurate system that computes and indicates ground displacement of aircraft in rectangular coordinates, from an initial fix.
- the LORAL AUTO-CAL. A frequency calibrator which automatically calibrates and records over 1,000 frequencies per hour within an accuracy of .005%.
- the LORAL AUTOMATIC SHORT RANGE GROUND POSITION INDICATOR. An 18 pound navigational computer automatically indicating ground position — derived from airspeed, heading and wind.

Contributing to the ever-increasing use of ELECTRONICS in AIRCRAFT Instrumentation, LORAL is continuing the development and production of Airborne Equipment — new in concept, miniaturization and combined with high accuracy.

We welcome any opportunity to assist in your engineering problems related to airborne equipment.

LORAL has delivered annually many millions of dollars of ELECTRONIC EQUIPMENT

.... on time!

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LORAL ELECTRONICS CORPORATION

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

TELE-TIPS

(*Continued from page 38*)

NOTABLE CASUALTY of the IRE show was one of New York's pet myths. Local folk had long been convinced that the top of the Empire State was swaying two to three feet at the height of more severe storms. Skeptical engineers attending the show checked the building sway with an ultra-precise gyroscope in a 50 mph wind, and measured—1 inch.

DEFINITION OF ENGINEERING, offered by the AIEE, goes "Engineering is the profession in which a knowledge of the mathematical and physical sciences gained through study, practice and experience is applied with judgment to the known materials and forces of nature for the comfort, health, safety and welfare of mankind."

SPECIAL "COLOR TV" CLINIC was held in N. Y. by RCA for political candidates planning future TV appearances. Instruction covered make-up and costumes, visual aids, camera techniques and prompting devices.

SMALLEST TV STATION in Europe got a big scoop last month. Monaco's lone TV station enjoyed exclusive coverage of the Prince Rainier-Grace Kelly wedding, with the proceedings then relayed to Eurovision, the European network linking eight additional countries.

HOW MUCH does society get back for its investment in research? Raymond Ewell of the National Science Foundation provides this astonishing answer: 100 to 200% over the last 25 years. In other words, $2,500 to $5,000 for every $100 spent on research and development.

NO OUTSIDE TV ANTENNAS for Bermuda, ruled the little island's governing body. (They must have seen some of our apartment house roof tops.)

PERSONAL

Philip S. Hessinger has been appointed Research and Development Engineer of Mycalex Corporation of America. He will assume responsibility for new product development and research at the Clifton, N. J., plant of the corporation.

John A. Rado has been appointed Chief Engineer of the Electronics Department, Diamond Power Specialty Corp., Lancaster, Ohio.

John A. Rado

Frank J. Skwarek

The Board of Directors of Polarad Electronics Corp., Long Island City, N. Y., has elected **Frank J. Skwarek** as a vice-president of the corporation.

Fred Shimabukuro has joined the technical staff of the Systems Laboratory, Hughes Aircraft Company, Culver City, Calif. The company has also announced the additions of **Neil A. Holmberg** to the technical staff of the Guided Missiles Division, **Howard E. Britton** to the Ground Systems Laboratory, and **Robert F. Reich** to the technical staff of the Systems Division.

Fenimore Fisher has been promoted to the position of Chief Engineer of the Motor and Generator Division of Infra Electronic Corporation, Roseland, N. J.

Dr. Leonard Reiffel has been promoted to manager of the physics research department at Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.

Dr. Lewis M. Branscomb, a specialist in atomic physics research, has been appointed Chief of the Atomic Physics Section at the National Bureau of Standards, Washington, D. C.

C. D. W. Thornton has been appointed to head the Atomic Energy activities of The Farnsworth Electronics Company of Fort Wayne, Ind.

Electronic Industries News Briefs

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

EAST

ATOMIC INSTRUMENT CO. and BAIRD ASSOCIATES, INC., Cambridge, Mass., representatives have agreed on terms for the merger of the two companies. Agreement is subject to formal action on detail plans by the respective boards of directors and to approval of stockholders of each company.

BART MANUFACTURING CORP. and BART LABORATORIES CO., INC., both of Belleville, N. J., have been consolidated to form one corporation with Bart Laboratories as a separate division of Bart Manufacturing.

BRIDGEPORT THERMOSTAT DIVISION of Robertshaw-Fulton Controls Co. has completed the move to its newly-constructed plant in Milford, Conn.

DUNLAP and ASSOCIATES, INC., will hold its fourth annual Human Engineering Institute in Stamford, Conn., June 18-22. This will be an advanced course built around the newest concepts in the design of equipments, consumer products, and workplaces.

ERIE RESISTOR CORP., Erie, Pa., has announced that the Jeffers Div. of the Speer Carbon Co. will manufacture Erie's Packaged Assembly Circuit, known as "PAC"", under license agreement.

GENERAL TRANSISTOR CORP. has opened its new plant and offices at 130-11 90th Ave., Richmond Hill, N. Y.

LAS-LAB, INC., Baltimore, Md., has introduced a product design and development service built around an integrated group of scientists, engineers, accountants and technicians.

ARTHUR D. LITTLE, INC., Cambridge, Mass., has completed arrangements for the acquisition of The Miner Laboratories, Chicago, Ill.

LOCKHEED AIRCRAFT CORP. announces that contracts have been let for development of preliminary plans for an advanced design engineering office building and supporting research laboratories to be constructed at the Georgia Division in Marietta.

MACK ELECTRONICS DIVISION, INC., is the new name for White Industries, Plainfield, N. J., wholly-owned subsidiary of Mack Trucks, Inc. No management or personnel changes are contemplated in connection with the name change.

THE W. L. MAXSON CORP., and Roger White have announced the acquisition, by Maxson, of a substantial interest in Roger White Electron Devices, Inc., of Ramsey, N. J.

NATIONAL BUREAU OF STANDARDS, Atomic and Radiation Physics Division, Washington, D. C., has announced the establishment of a new Subcommittee on "Protection from High Energy Electrons."

RCA TUBE DIVISION has announced plans for the establishment of an Advanced Development Laboratory by RCA in Needham, Mass.

SEMIMETALS, INC., 15 E. 48th St., New York, N. Y., is a new firm which will produce and sell, among other items, germanium and silicon crystal growing and refining equipment.

STROMBERG-CARLSON, Rochester, N. Y., a division of General Dynamics Corp., has formed a Nucleonics Research Section in its Research Department.

STURRUP, INC., Middletown, Conn., announces a special coil winding and coil form service to supply small lots of intricate, close tolerance coils.

SYLVANIA ELECTRIC PRODUCTS, INC., Parts Division, is planning a new 110,000 sq. ft. plastics plant to be erected in Warren, Pa. Completion is scheduled for Dec. 15, 1956.

UNION ELECTRONICS & MACHINE CORP., Georgetown, Mass., active management has been taken over by Andrew A. Cirolia and Percy E. Goodwin, executives and principals of Defiance Engineering & Microwave Corp.

U. S. HOFFMAN MACHINERY CORP. has entered into the atomic energy field through the purchase of a majority interest in Anton Electronic Laboratories, Inc., Brooklyn, N. Y.

GARY WELLS COMPANY, 149 B'way., New York, N. Y., is a new company which will act as exclusive importers of selected electronic devices and parts.

MID-WEST

BATTELLE INSTITUTE has established an Electronic Reliability Division at its Columbus, Ohio, laboratories.

ELGIN NATIONAL WATCH COMPANY, Elgin, Ill., is greatly expanding its product development facilities in a bid to apply high-precision watch manufacturing techniques to a wide variety of commercial and military products. The program will be centered in a new Micronics division which is absorbing personnel and functions of the former Ordnance division.

ESCO ELECTRONICS, INC., Chicago, Ill., has purchased the electronics division of Mitchell Manufacturing Company, Chicago, Ill.

MUELLER ELECTRIC COMPANY, 1583 E. 31st St., Cleveland, Ohio, has broken ground for an additional 6000 sq. ft. of production floor space.

WEST

BRUBAKER ELECTRONICS, INC., Culver City, Calif., has made available, on a contract-service basis, environmental test facilities to Southern California aircraft, missile and electronics firms.

CALBEST ELECTRONICS COMPANY, Los Angeles, Calif., has begun construction of new research laboratories and offices providing an additional working area of over 10,000 sq. ft.

CONSOLIDATED ELECTRODYNAMICS CORPORATION, Pasadena, Calif., directors have instructed company officers to vote the firm's 325,000 shares of common stock of ElectroData Corp. in favor of the proposed combination of the latter company and the Burroughs Corporation.

FRANK R. COOK CO., Denver, Colo., has been awarded a contract by the Sperry Gyroscope Company to design and manufacture 15 instant-activated batteries for use in the Sparrow II, an air-to-air guided missile which Sperry will produce for the U. S. Navy.

ELECTRONICS EQUIPMENT ENGINEERING, INC., Dallas, Tex., has announced the sale of the Type 200 stainless steel VHF antennas to Riddle Airlines of Miami, Fla.

FEDERAL TELECOMMUNICATION LABORATORIES, Nutley, N. J., a division of IT&T, has established a California branch in the San Fernando Valley. The new laboratories are situated at Bledsoe St. and San Fernando Rd., Los Angeles.

HYCOR DIVISION of INTERNATIONAL RESISTANCE COMPANY has opened a new, larger, air-conditioned plant at 12970 Bradley Ave., Sylmar, Calif.

THE LIQUIDOMETER CORP., Long Island City, N. Y., announces that construction is scheduled to start this month on a new engineering and sales office at Santa Monica Blvd. and Harper Ave., Los Angeles, Calif.

SORENSEN & COMPANY, INC., Stamford, Conn., have opened a new sales office to service the West Coast area at 1548 N. Highland Ave., Hollywood, Calif.

VARIAN ASSOCIATES, Palo Alto, Calif., has approved a master building plan to more than treble the company's floor space over the next few years. As part of the program, the company has extended its lease in the Stanford Industrial Park to a new total of 33 acres.

FOREIGN

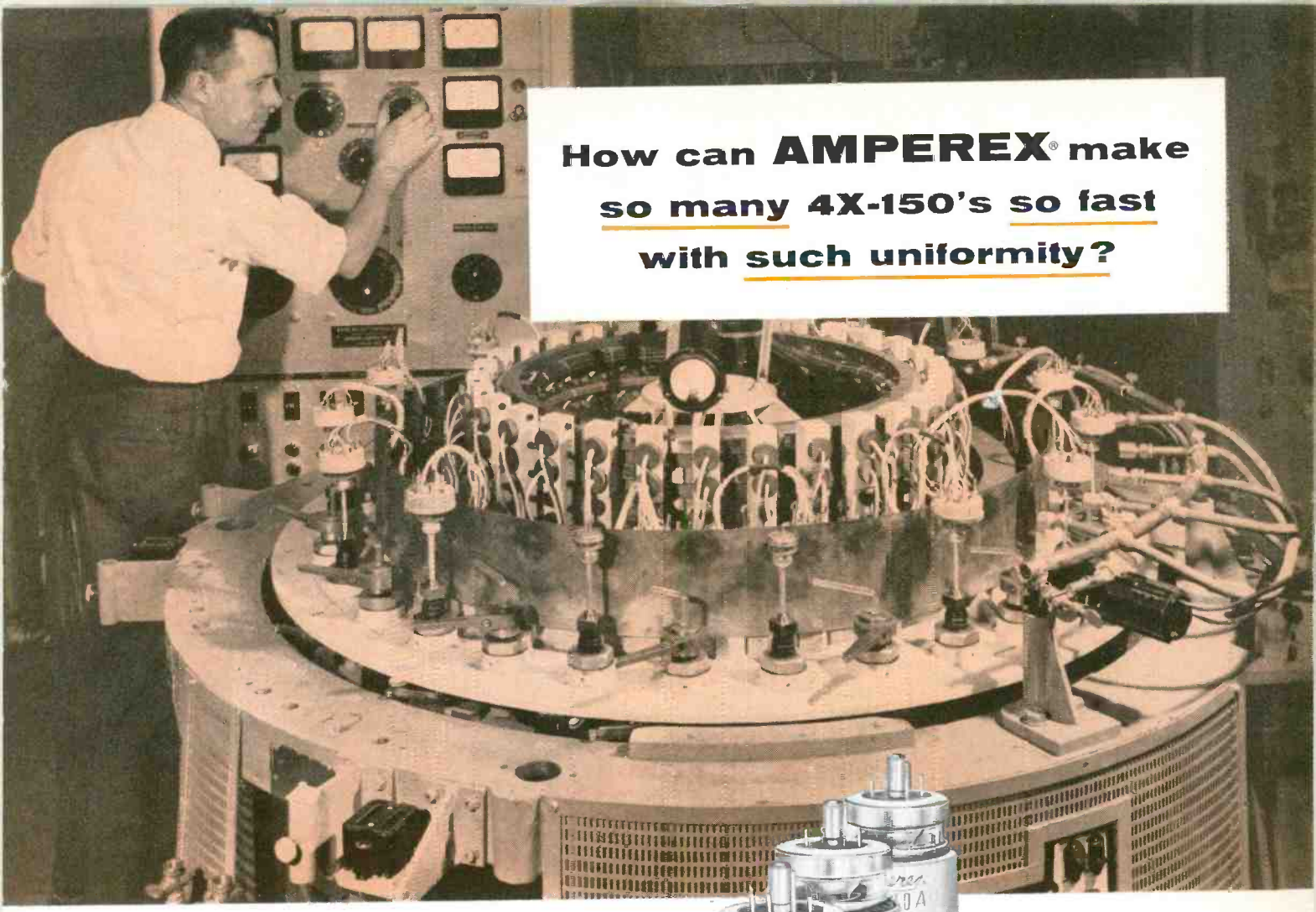
CANADIAN AVIATION ELECTRONICS LIMITED, Ville St. Laurent, P.Q., Canada, has announced the appointment of R. C. Ludlow as Secretary-Treasurer of CAE.

THE COMPAGNIE GENERALE de TELEGRAPHIE SANS FIL and its group (CSF) of Paris, France, and Airborne Instruments Laboratory, Inc. (AIL), Mineola, N. Y., have announced the formation of an American company, called the Intercontinental Electronics Corporation, aimed at manufacturing and marketing in this country electronic products developed in France.

GENERAL ELECTRIC RESEARCH LABORATORY'S new European office is now permanently located at Pelikanstrasse 37, Zurich 1, Switzerland.

NARDA CORPORATION, Mineola, N. Y., has appointed Regulation-Mesure, Brussels, Belgium, and Elektronik-bolaget AB, Stockholm, Sweden, exclusive reps for the company's line of microwave and UHF test equipment.

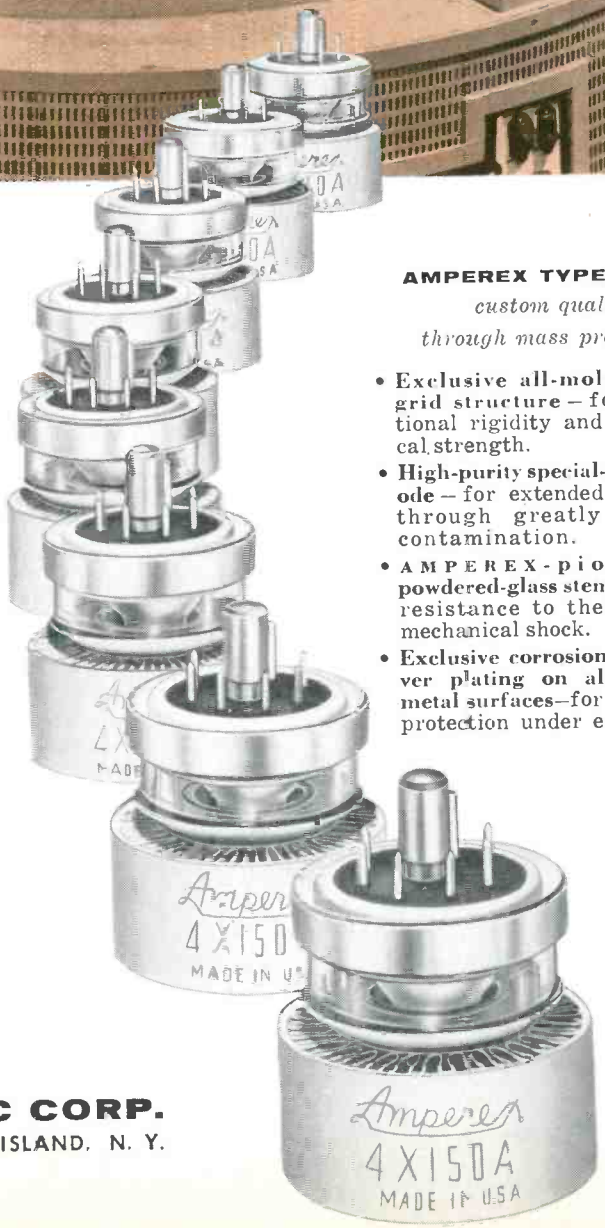
THE OSAKA TV CORPORATION of Osaka, Japan, has ordered two complete CineScanner Television Studio Systems from Philco Corporation's Government and Industrial Division.



How can AMPEREX® make so many 4X-150's so fast with such uniformity?

PRECISION AUTOMATION is the answer!

The sensational automatic exhaust machine recently developed by AMPEREX speeds up production of JAN approved 4X-type RF power amplifier tetrodes by a factor of four . . . helps achieve unprecedentedly uniform emission and life characteristics . . . yet leaves time for individual testing of each tube *beyond* JAN specifications! Precision automation at AMPEREX means higher performance and more rigid quality control *because of*, not in spite of, mass production. Any AMPEREX 4X-150 will perform exactly like its many hundreds of mates produced the same day . . . exactly like the many thousands produced the same week.



AMPEREX TYPE 4X-150

custom quality

through mass production

- **Exclusive all-molybdenum grid structure** – for exceptional rigidity and mechanical strength.
- **High-purity special-alloy cathode** – for extended tube life through greatly reduced contamination.
- **AMPEREX-pioneered powdered-glass stem**—for high resistance to thermal and mechanical shock.
- **Exclusive corrosion-proof silver plating on all external metal surfaces**—for maximum protection under exposure.

If not available from your favorite Electronic Parts Distributor, write to:

Amperex ELECTRONIC CORP.

230 DUFFY AVENUE, HICKSVILLE, LONG ISLAND, N. Y.

James E. Herbert has been appointed vice-president in charge of sales for Hoffman Electronics Corp., Los Angeles, Calif. **John Chadwell,** sales manager of the Hoffman Sales Divisions, has been appointed general manager of the Hoffman Sales Division, San Francisco, Calif.

Appointment of **Arthur C. Treece** to the position of General Manager of the General Electric Company's Plastic Dept. has been announced. Headquarters for the department has been moved from Pittsfield, Mass., to Decatur, Ill.

W. Ropp Triplett, general manager of the Triplett Electrical Instrument Co. of Bluffton, Ohio, has been named president of the company. **Ray L. Triplett,** founder and president of the concern for many years, has resigned his position to become chairman of the board of directors.

Appointment of **Edward J. Hart** as Manager, RCA Microwave Equipment Sales and the realignment of the microwave field sales organization were announced by the Communications Products Dept., RCA, Camden, N. J.

Robert M. Fichter has been appointed Manager, Product Development Dept., Television-Radio Div., Westinghouse Electric Corp., Metuchen, N. J. **Russell W. Johnson** has been named Advertising and Sales Promotion Manager of the division.

Electro-Voice, Inc., Buchanan, Mich., has announced the appointments of **Jay Carver** to handle wood product sales, **Frank Stroempl** to the position of assistant manager of the distributor sales division, and **Jim Johnson** to the post of assistant manager, manufacturers' sales division.

Arthur H. Jones has been named Director of Engineering, National Defense Dept., Motorola Communications & Electronics, Inc., Chicago, Ill.

Appointment of **Donald Inman** as Broadcasting Sales Manager of the Rust Industrial Co., Inc., Manchester, N. H., has been announced.

George Wunderlich, Vice-President and General Manager of Eitel-McCullough, Inc., San Bruno, Calif., has been named to fill the newly-created position of Vice-President of Manufacturing. **E. E. McClaran** has become Vice-President of Finance; **Frank Mansur** will head a new Mar-

(*Continued on page* 56)

New, convenient, compact
High accuracy expanded scale
Ideal for industrial use

-hp- 500B FREQUENCY METER—$285.00

Here's a list of the many industrial and laboratory jobs the new -*hp*- 500B Frequency Meter can do for you quickly, easily and without elaborate setup:

Count sine waves, square waves and pulses. Indicate average frequency of random events. Measure beat frequency between rf signals. Determine oscillator stability. Measure crystal frequency deviation. Measure temperature, pressure, weight and other physical quantities which can be converted to frequency.

This versatile instrument also serves as a convenient automatic motor speed control, overspeed and underspeed control and makes possible a permanent record of frequency or speed as a function of time. And, it may be used for automatic control of quartz crystal etching.

-*hp*- 500B covers the range 1 cps to 100 KC and provides direct readings of high accuracy. Readings are not affected by either signal or line voltage variations. An expanded scale permits any 10% or 30% segment to be viewed over the full meter range, making possible highly accurate measurements of differential frequency. A pulse output is provided to sync a stroboscope and continuous recordings of readings may be made on an Esterline-Angus recorder.

Model 500B is extremely compact, light, easy to use and of quality construction throughout. It is also available as Model 500C, calibrated in RPM.

BRIEF SPECIFICATIONS

Freqency Range:	1 cps to 100 KC. 9 ranges.
Input Voltage:	0.2 v sensitivity (sine waves) 1.0 v min. (pulses) 250 v peak max.
Input Impedance:	Approx. 1 megohm shunted by 40 $\mu\mu$f.
Accuracy:	Better than $\pm$ 2% full scale.
Self Check:	Convenient calibration based on line voltage frequency.
Recorder Output:	Panel jack for 1 ma, 1,400 ohm Esterline-Angus Automatic Recorder.
Pulse Output:	To trigger strobe, etc., in sync. with input.
Photocell Input:	Panel jack with bias for 1P41 phototube, 40 $\mu\mu$f shunt.
Power:	115/230 v $\pm$ 10%, 50/1,000 cps, 110 watts.
Size:	7⅜" x 11½" x 12¼". Wt. 17 lbs.
Price:	-*hp*- 500B or 500C: $285.00.

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

SEE YOUR -hp- REPRESENTATIVE OR WRITE DIRECT FOR DETAILS

HEWLETT-PACKARD COMPANY
3506T PAGE MILL ROAD • PALO ALTO, CALIFORNIA, U.S.A.
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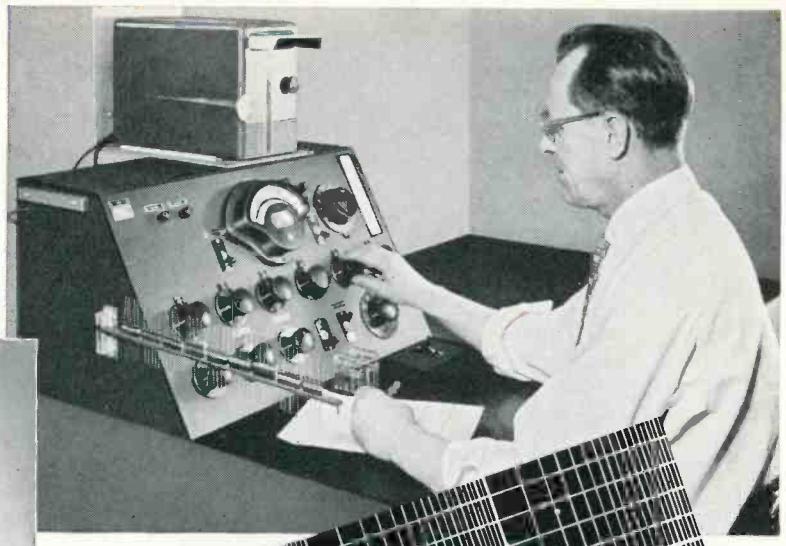
Field representatives in all principal cities

ELECTRONIC MEASURING INSTRUMENTS

Right—Testing the resistance change of Allen-Bradley fixed resistors after 113 hour, 95% humidity test. The results are then plotted on the graph shown below.

Below—Allen-Bradley fixed molded resistors are available in 4 sizes—1/10-watt, 1/2-watt, 1-watt, and 2-watt. In all standard RETMA resistance values.



Graph showing the consistency of resistance change in 2-watt resistors in all resistance values from 10 ohms to 100 megohms.

A-B Quality

UNIFORMITY OF ALLEN-BRADLEY RESISTORS IS THE KEYNOTE OF THEIR QUALITY

Allen-Bradley resistors have the greatest *uniformity* in mechanical size, shape, and electrical characteristics of any electronic component manufactured.

As a function of Quality Control, Allen-Bradley continuously samples its resistor production, running tests on each characteristic to verify *uniformity* and *consistency* of the production.

Graph shows production sampling of over 100 million resistors showing the small deviation in the resistance change characteristic in a humidity test conducted at 95%, 55°C for 113 hours. Such a *phenominally low deviation* over such a *large quantity of production* is the reason that Allen-Bradley fixed resistors are the *standard* of the electronic industry—where quality counts!

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

In Canada—
Allen-Bradley Canada Ltd., Galt, Ont.

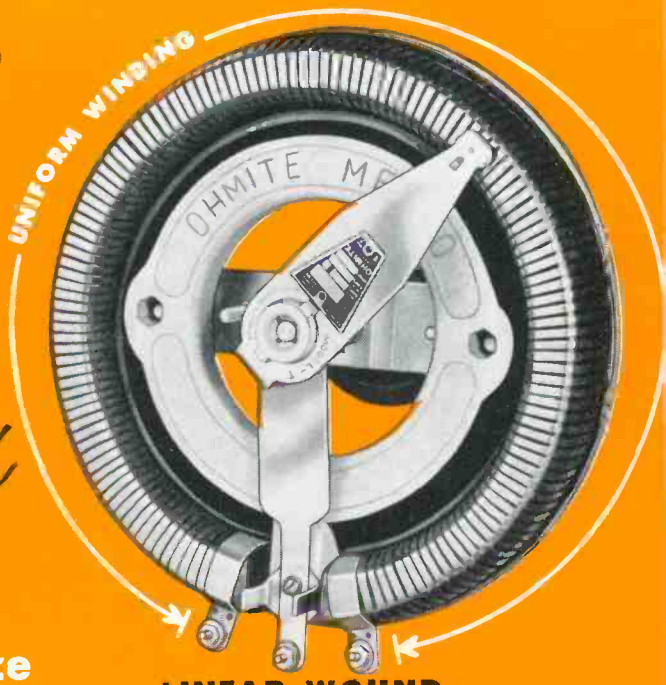
ALLEN-BRADLEY

RADIO, ELECTRONIC AND TELEVISION COMPONENTS

OHMITE®

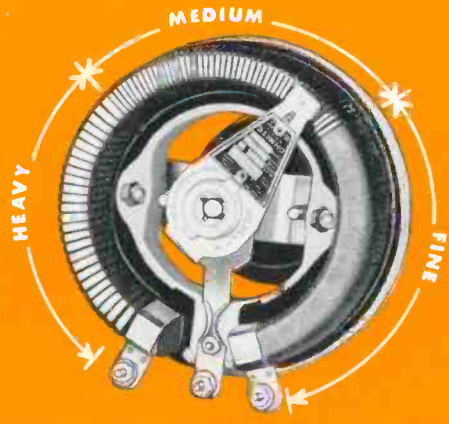
taper-wound RHEOSTATS

reduce rheostat size required



LINEAR-WOUND

Tapering the wire size to match the current carried permits greater capacity in a smaller unit!



EQUIVALENT TAPER-WOUND

A smaller rheostat may often be used for a given load by having the rheostat windings tapered or wound in two or more sections of diminishing wire sizes. This can be done because only the first turn of the winding carries the maximum current . . . succeeding turns carry reduced amounts. This makes possible great savings in control-panel space, making Ohmite taper-wound rheostats particularly useful in portable equipment. Ohmite taper-wound rheostats are also very durable because they use the largest wire sizes practical for the current to be carried.

MORE UNIFORM CONTROL—For a given application, the tapered winding also provides more uniform control. Because a linear-wound rheostat adds a constant number of ohms per degree of rotation to a constantly increasing number of ohms, the current changes more slowly as the resistance is increased. A tapered winding, by increasing the number of ohms per degree of rotation as the total ohms in circuit increases, makes the current curve more nearly linear.

Ohmite has an extensive line of standard tapered rheostats, or will design special tapered windings to suit individual needs.

Write on company letterhead for Catalog and Engineering Manual No. 40.

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

MORE OHMITE RHEOSTATS SOLD THAN ALL OTHER MAKES COMBINED

Be Right with

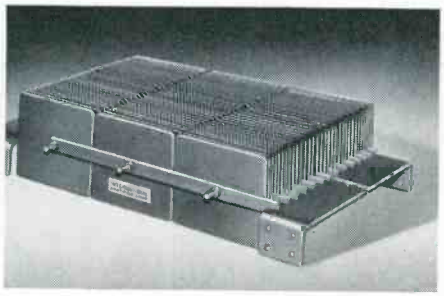
OHMITE®

RHEOSTATS • RESISTORS • RELAYS • TAP SWITCHES

International Rectifier
Selenium and Germanium Rectifiers

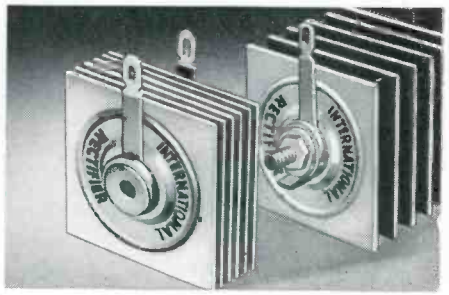
International Selenium Products

Pressed powder or vacuum process used as determined by our Applications Engineering Dept. The most widely used Industrial Power Rectifiers in Industry today!



INDUSTRIAL POWER RECTIFIERS

For all DC power needs from microwatts to kilowatts. Features: long life; compact, light weight and low initial cost. Ratings: to 250 KW, 50 ma to 2,300 amperes and up. 6 volts to 30,000 volts and up. Efficiency to 87%. Power factor to 95%. **Bulletin C-349**

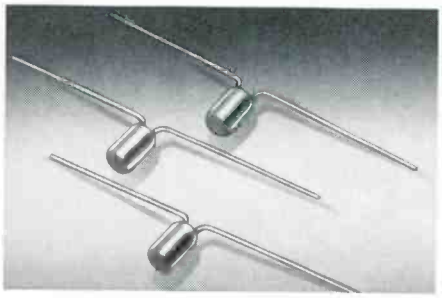


TV AND RADIO RECTIFIERS

The widest range in the industry! Designed for Radio, Television, TV booster, UHF converter and experimental applications. Input ratings from 25 to 195 volts AC and up. DC output current 10 to 1,200 MA. Write for application information. **Bulletin ER-178-A**

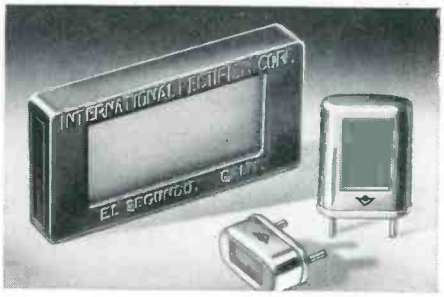
HIGH VOLTAGE CARTRIDGE RECTIFIERS

Designed for long life and reliability in Half-Wave, Voltage Doubler, Bridge, Center-Tap Circuits, and 3-Phase Circuit Types. Phenolic Cartridge and Hermetically Sealed types available. Operating temperature range: −65°C to +100°C. Specify **Bulletin H-2**



SUB-MINIATURE SELENIUM DIODES

Developed for use in limited space at ambient temperatures ranging from −50°C to +100°C. Encapsulated to resist adverse environmental conditions. Output voltages from 20 to 160 volts; output currents of 100 microamperes to 11 MA. **Bulletin SD-1B**



PHOTOELECTRIC CELLS

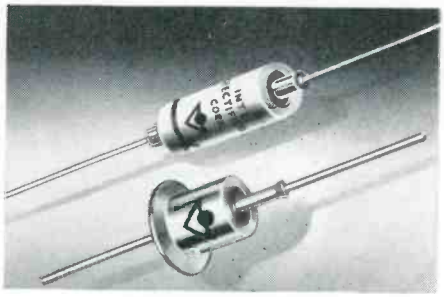
Self-generating photocells available in standard or custom sizes, mounted or unmounted. Optimum load resistance range: 10 to 10,000 ohms. Output from .2 MA to 60 MA in ave. sunlight. Ambient temperature range: −65°C to +100°C. **Bulletin PC 649**

International Germanium Products

High quality units of improved design are the results of years of experience in the production of exceptionally fine germanium crystals plus extensive research, development and field performance testing!

GERMANIUM POWER RECTIFIERS

This new line features: High efficiency—up to 97%, Lowest forward drop, High reverse to forward current ratio, unlimited life expectancy. No reforming required after storage. Ratings: 26 to 66 AC input v. per junction: 150 to 100,000 amps DC output. Operating temperature range: −55°C to +75°C. In three styles. **Bulletin GPR-1**



GERMANIUM DIODES

POINT CONTACT. High quality crystals—long reliable life—superior resistance to humidity, shock, temp.-cycling. **Bulletin GD-2**
JUNCTION POWER. Hermetically sealed—welded construction. Available in Standard JETEC 1N91, 1N92, 1N93 types. For diodes to meet your specific requirements, consult our Semiconductor Division.

a world of difference through research!

For bulletins on products described WRITE ON YOUR LETTERHEAD *to our* PRODUCT INFORMATION DEPARTMENT

International Rectifier
CORPORATION

EXECUTIVE OFFICES: 1521 E. GRAND AVE., EL SEGUNDO, CALIFORNIA • PHONE OREGON 8-6281

WORLD'S LARGEST SUPPLIER OF INDUSTRIAL METALLIC RECTIFIERS

Raytheon — World's Largest Manufacturer of Magnetrons and Klystrons

PHILCO
Famous for
QUALITY
the World Over

HEWLETT-PACKARD COMPANY

MOTOROLA

GCA RADAR AND ELECTRONICS
Gilfillan
LOS ANGELES
GCA
AROUND THE WORLD

WHY LEADING MANUFACTURERS USE RAYTHEON MAGNETRONS AND KLYSTRONS

A good test of any product is the company it keeps. The famous trademarks above belong to only four of the many distinguished companies which use Raytheon magnetrons and klystrons in their microwave equipments.

Manufactured under precision controls by skilled men and women, Raytheon microwave tubes give you the utmost in first-rate performance, long life, and continuous duty under demanding conditions.

Excellence in Electronics

RAYTHEON

RAYTHEON MAKES:

Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Transistors

RAYTHEON MANUFACTURING COMPANY
Microwave and Power Tube Operations, Sec. PT-70
Waltham 54, Mass.

(*Continued from page 50*)

keting Dept.; **John S. McCullough** has been appointed Director of Research; and **Fred A. Speaks** has been named Assistant Director of Research.

Promotion of **Stanley E. Rendell**, a twenty-year veteran, to the post of Factory Engineering Manager, has been announced by Raytheon Manufacturing Co., Television and Radio Operations, Chicago, Ill.

James H. Brewster, III has been appointed Director of Customer Relations of the Electronic Systems Div. of Sylvania Electric Products, Inc., Waltham, Mass.

Melvin B. Kline has been promoted to Manager of the Missile Engineering Dept. of Allen B. Du Mont Laboratories, Inc., Clifton, N. J.

Austin E. Rankin has been appointed manager of klystron and traveling wave tube product engineering for the General Electric Power Tube Sub-Department, Schenectady, N. Y.

International Business Machines Corp. has announced the appointment of **Charles J. Lawson, Jr.**, as general manager of the company's Rochester, Minn., manufacturing plant.

K. L. Bishop is now president and general manager of Bell Sound Systems, Inc., Columbus, Ohio, subsidiary of the Electronics Div. of Thompson Products, Inc.

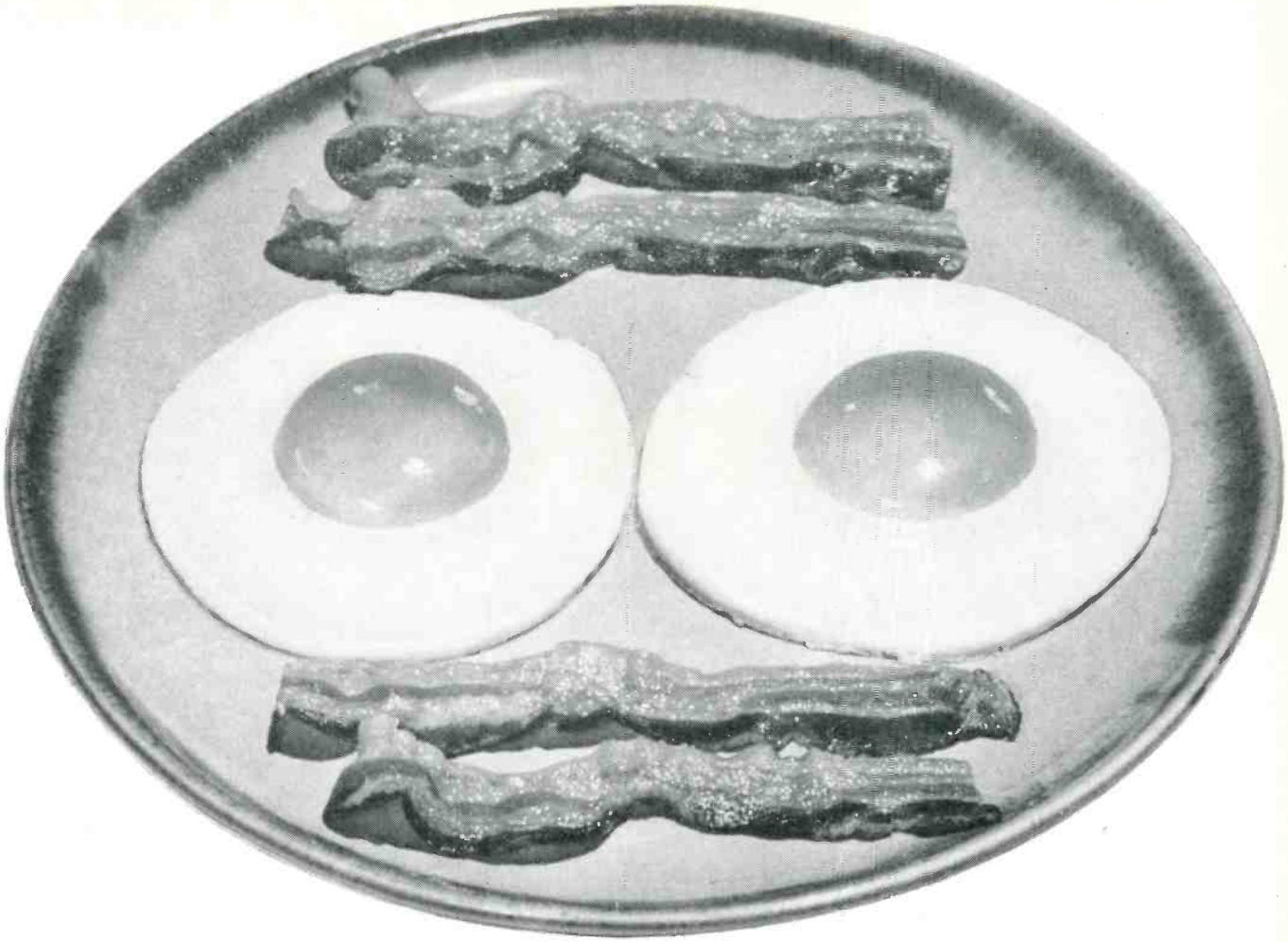
Henry W. Harding has been elected president of Laboratory for Electronics, Inc., electronic development company of Boston, Mass.

Craig Lawrence, Director of Station Administration, has been appointed Vice-President in Charge of CBS Television-Owned Stations. He will also be in charge of CBS Television Spot Sales.

At a stockholders' meeting of Magnecord, Inc., Chicago, Ill., **Bruce Payne, William R. Swett, and Damon Van Utt** were elected directors. **Arthur S. Brown** was elected Vice-President and General Manager at a previous Board of Directors' meeting.

Dr. Louis Ten Eyck Thompson has been elected Vice-President for Research of Norden-Ketay Corporation, Milford, Conn.

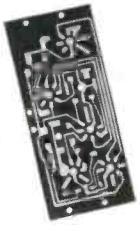
James E. Patas has been appointed to the new post of Director of Merchandising of Charles Bruning Co., Inc., Chicago, Ill.



. . . a combination that's hard to beat!

Laminated plastics . . . for a combination of properties that *can't* be beat

SYNTHANE is a favorite material among engineers, designers, and product-conscious executives because it possesses a combination of many properties. It is light in weight, strong; has high dimensional stability, excellent electrical properties and chemical resistance. It's also easy to fabricate.



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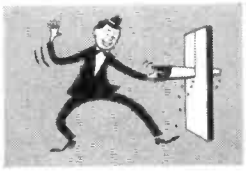

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BOOKS

Reliability Factors for Ground Electronic Equipment

Keith Henney, Editor in Chief. Published 1956 by McGraw-Hill Book Co., Inc., 330 West 42nd St., N. Y. 36, N. Y. 288 pages; price $7.50.

During the past few years, a number of agencies, both private and governmental, have developed workable criteria for the aid of the equipment designer in overcoming the problem of reliability. This book offers this concrete material in practical form.

Starting with reliability concepts and the causes of reliability, it covers fundamentals of statistical methods, electrical and mechanical engineering problems, the human engineering side of reliability, some broad principles governing the selection and use of components and tubes, and some comments on maintenance.

The causes of unreliability in military electronic equipment are discussed in some detail. Among these causes are unrealistic specifications, poor engineering practice, complexity of equipment, "overuniversality," and production methods that are influenced by low bidder tactics. Circuit and component applications are discussed, with some examples of misapplications given.

Although this work is aimed primarily at the designer of military ground equipment, the problems and most of the solutions are of a general nature, and the techniques indicated are applicable to industry.

Electronics

By A. W. Keen. Published 1956 by The Philosophical Library, Inc., 15 East 40th St., N. Y. 16, N. Y. 265 pages, price $7.50.

Executives, salesmen, and other non-technical personnel interested in obtaining an introductory knowledge of modern electronics will find this book quite useful. It is written so that anyone with a basic knowledge of electricity and magnetism will be able to obtain a clear idea of the nature and scope of the subject. The treatment is entirely descriptive.

Beginning with an explanation of circuit elements and processes, the book goes on to give an up-to-date and comprehensive account of electronic devices and their applications. Schematic diagrams are used quite freely to illustrate circuit operation.

Transistors, magnetic amplifiers, and color TV are described, as are recent developments in such fields as electronic controls in industry, computers and counting, radio communication, sound recording and reproducing, and radio navigational aids. A great many illustrations and photographs aid in the presentation of the material.

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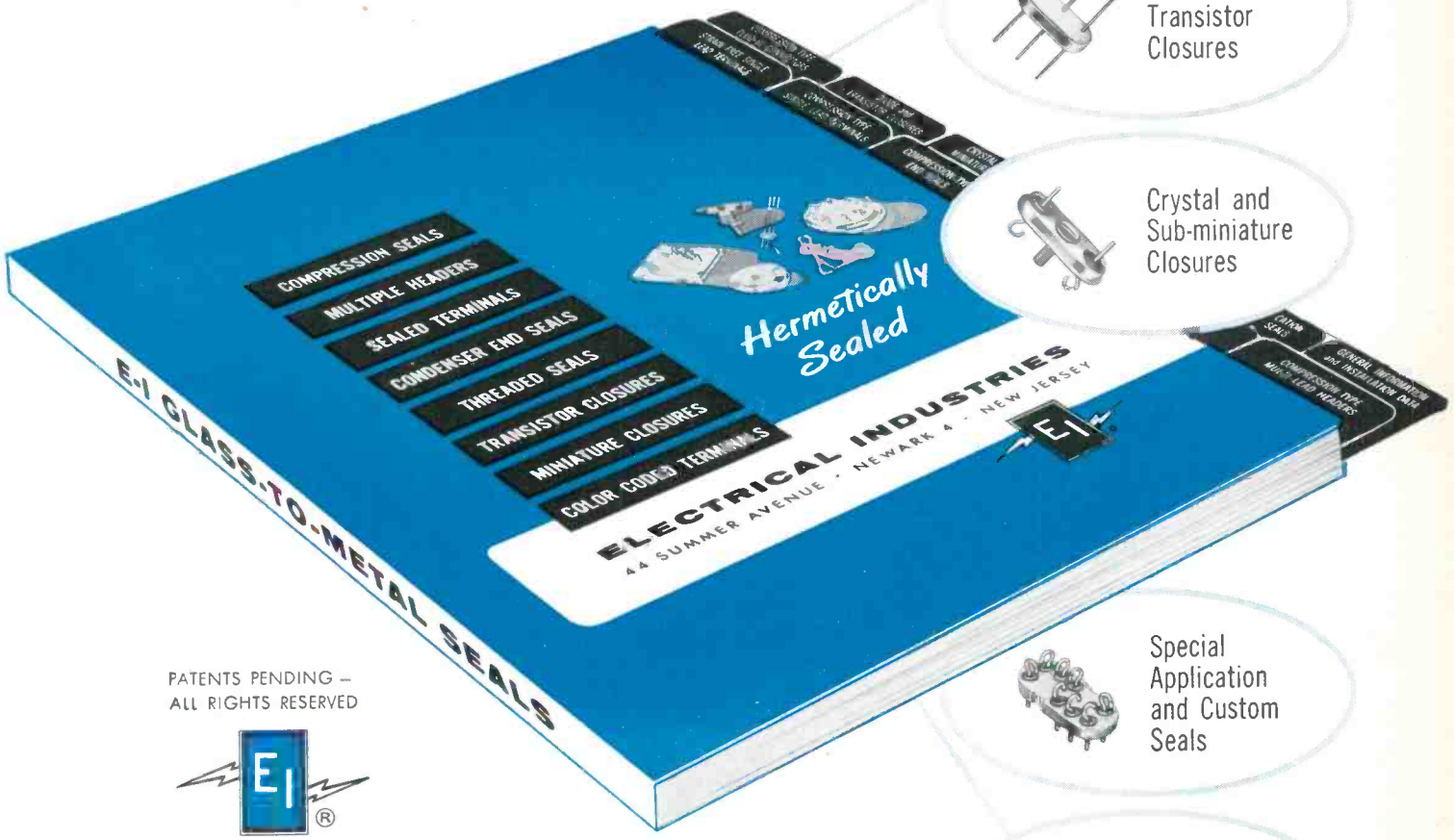


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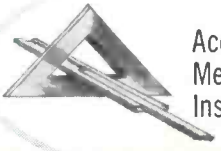
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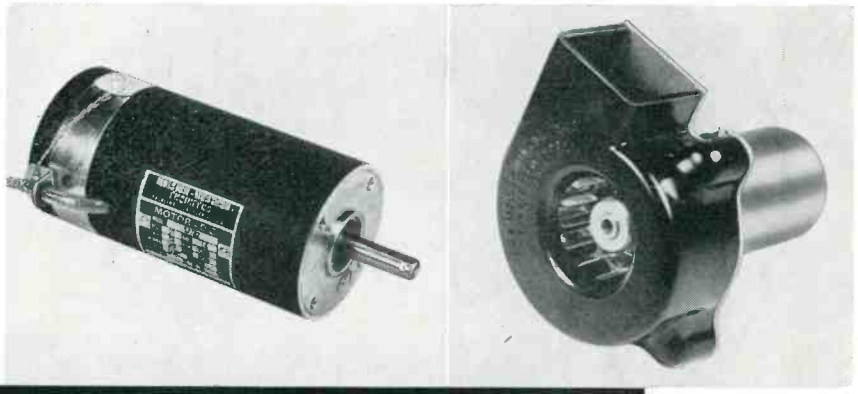

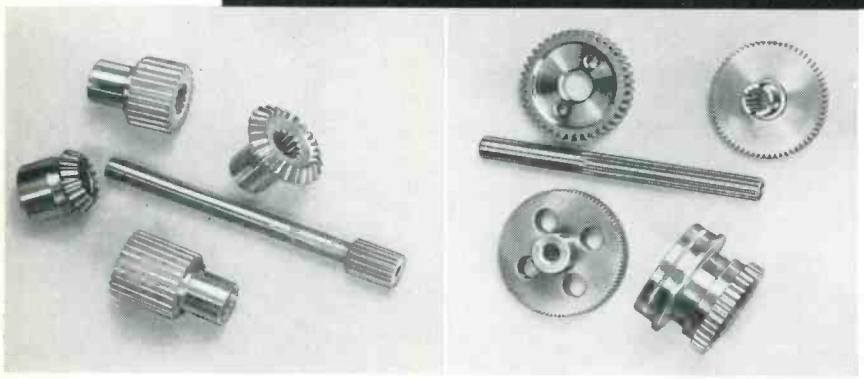

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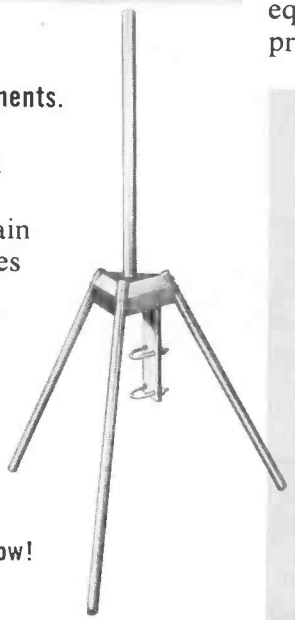

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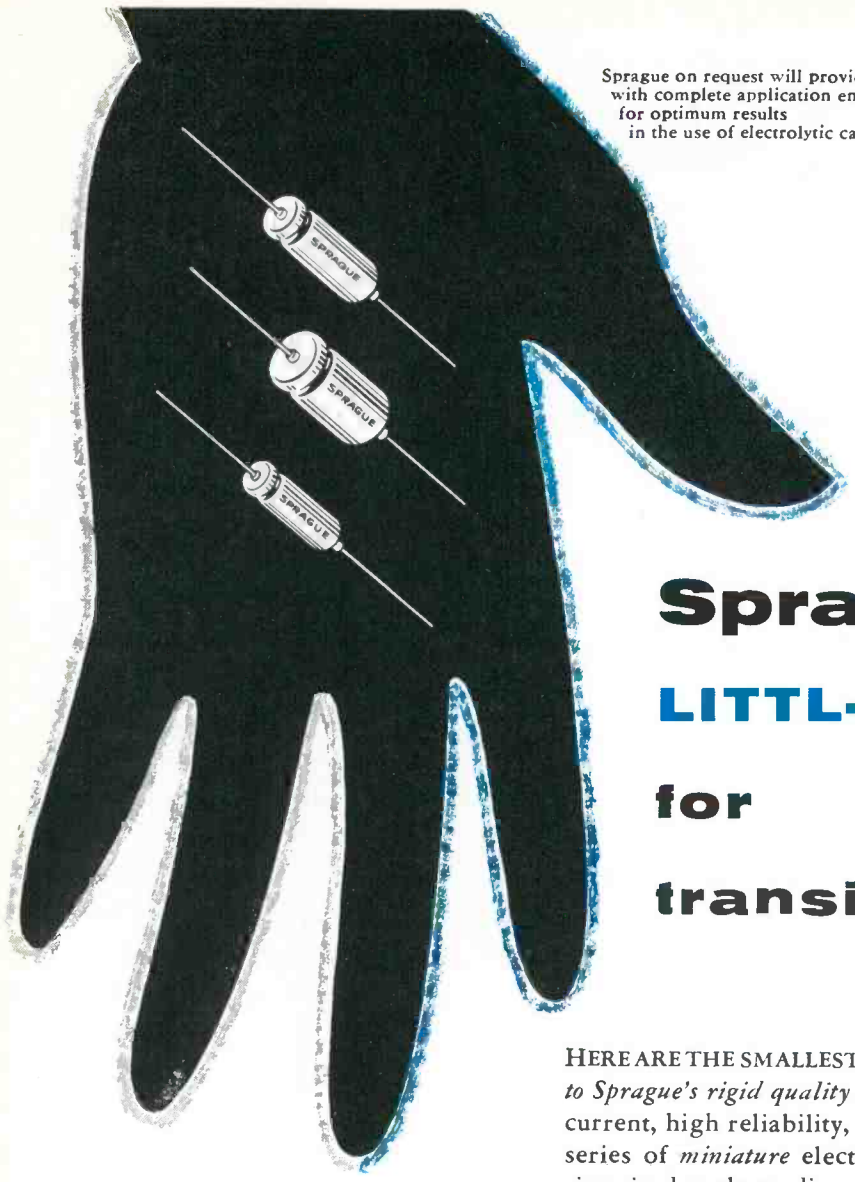

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M. CLEMENTS, Publisher ★ O. H. CALDWELL, Editorial Consultant ★ B. F. OSBAHR, Editor

For the Avionic Industry

ONE of the most important electronic events taking place this month will be the 8th National Conference on Aeronautical Electronics. This annual event is sponsored jointly by the Dayton Section of IRE and the Professional Group on Aeronautical and Navigational Electronics. Over the years we have watched the growth of this conference with interest and we are happy to especially salute the event at this time.

In a recent speech H. Leslie Hoffman, president of Hoffman Electronics Corp. and president of RETMA, provided some interesting data on the dollar volume of military avionics over a three-year period, 1955-1957. Some of his figures are reproduced on page 3 in this issue. It is interesting to note that at least one-third of the aircraft dollar goes for electronic gear and that approximately 50% of the missile dollar is so involved.

On page 70 we have reviewed the program for this year's event and on page 71 we offer some previews of new avionic items that will be on display. See you at the show!

Engineering Conference Days

DURING the recent IRE convention the Raytheon Manufacturing Company came up with an idea that might merit some consideration on the part of feature show exhibitors. In addition to maintaining a booth at the show and a customary hospitality suite, Raytheon set up an "Engineering Conference Day." This was held in a suite at one of the downtown hotels during the middle of the convention. Operating on the theory that the show is crowded and that interested booth visitors might not get all the technical data that they wanted; that the hospitality suite was largely social and just not the place for a concentrated engineering discussion, an Engineering Conference Day appeared to be a desirable solution. Accordingly, on this day Raytheon brought in their senior engineers from the plants and had them available to discuss the application engineering of their respective products to all comers.

We visited the suite on this day and judging from the many small groups gathered at the tables; the notebooks, papers and moving pencils; and the general tenor of things, we'd say it was a complete success. Other organizations have become aware of the idea so it's likely we should be seeing more of such programs at future conventions.

Audion's Golden Jubilee

1956 marks the 50th anniversary of the invention of the triode vacuum tube by Dr. Lee de Forest. Ellery W. Stone, President of the American Cable & Radio Corp. and President of The De Forest Pioneers, has kindly forwarded a facsimile of the letter sent by President Eisenhower to Dr. de Forest in commemoration of the occasion. We believe our readers would be interested in reading this letter too, and accordingly have reproduced it below. (See p. 6 for additional data on Dr. Lee de Forest.)

THE WHITE HOUSE
WASHINGTON

March 16, 1956

Dear Dr. de Forest:

In this fiftieth anniversary year of a great invention, I congratulate you on your many contributions to scientific progress. Through your long and distinguished career you must have experienced many moments of pride that your imagination and talent furthered the development of modern radio, television and radar. You must also feel great satisfaction in remembering your past decades of service and in anticipating future achievements that your handiwork has made possible.

May you enjoy many more years in which to witness the fruit of your labors.

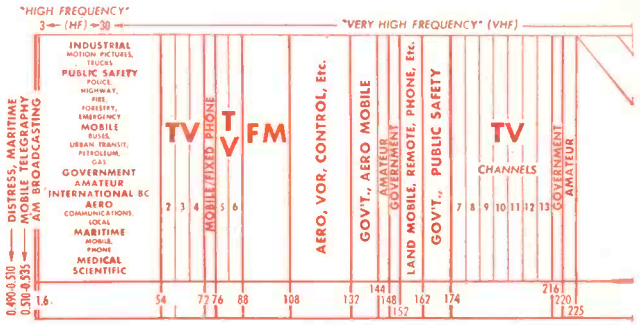
Sincerely,

Dwight D. Eisenhower

Dr. Lee de Forest
c/o Rear Admiral Ellery W. Stone, USNR
American Cable & Radio Corporation
67 Broad Street
New York 4, N. Y.

RADARSCOPE

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

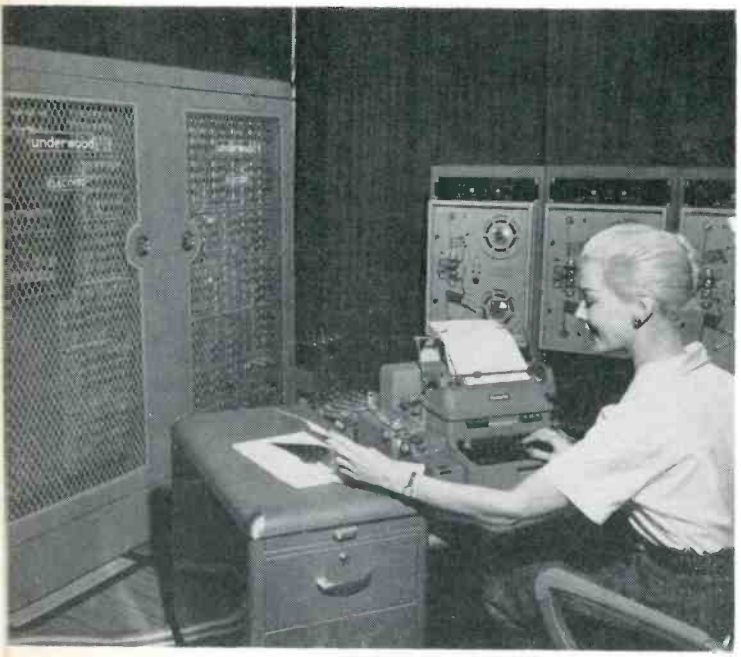


NEW APPROACH to electronic reliability, being pushed by the military, recommends use of redundant circuits. Reasoning is that electronic equipments are often unreliable because of the large number of parts which may fail. One means of countering this effect of increasing equipment complexity is by introducing even more tubes and components as redundant circuitry. Requirements are that circuits be designed so that as parts fail, their failure will not cause others to fail.

INITIAL PLANS to hire foreign engineers is running into trouble. The red tape involved is tying up applications for periods of 12 to 16 months. As a result, firms now are concentrating only on high level personnel that warrant the time and expense involved.

"NO COMMENT." Top TV equipment firm won't discuss rumor that they are developing a tiny transistorized TV camera built around a miniature (less than ½-in.) camera tube imported from Germany.

Electronic "Memory"



Newest in the line of electronic office equipment is this Underwood "ELECOM" File processor which reduces the contents of 1600 conventional file cabinet drawers to less than 3 cu. ft. of space. The unit also feeds desired information via tape to a companion computer.

SMALL NECK PICTURE tubes were prominent at the IRE show. By increasing the proximity of the deflection yoke and the electron beam manufacturers hope to cut needs for present high deflection voltages. Emphasis in the future will be on 110° CRT's.

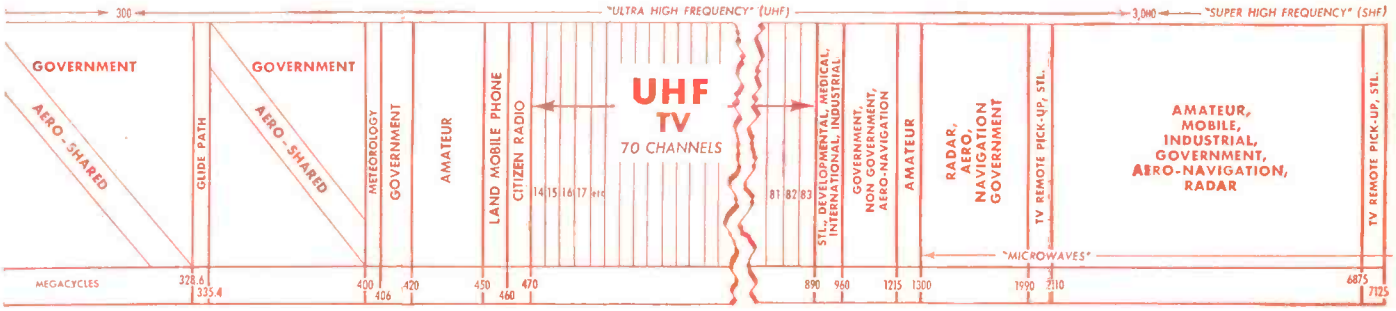
THAT TRANSISTORIZED TV SET is out of the planning stage, and on the drawing boards, according to reliable information. Major breakthrough was announced just recently in the development of a radio frequency transistor operating at usable power levels to over 100 MC, and capable of oscillating at over 250 MC.

NEW ELECTRICAL INSULATION, with greater tolerance for heat, has been developed by exposing specially formulated plastic to a beam of electrons. The new material will find extensive application as jacketing in such high temperature environments as jet, airborne and various electronic components. The specially formulated polyethylene is being marketed under the trade name "Hyrad," by Sequoia Process Corp. Stamford Research Inst. was the developer.

RESTRICTION ON OUTER SPACE travel will receive the attention of aviation circles. None of the present rules which furnish legal guidance to states on problems of air sovereignty apply to trips into outer space. How far into space this sovereignty applies will be thrashed out, probably, at the meeting of the Assembly of the International Civil Aviation Organization in Caracas, Venezuela this June.

AUTOMATIC AERIAL CAMERAS that will spot routes for new roads and help survey the rights of way will be an important aid in highway construction and operation. Also envisioned for the future: remote radio controlled lighted signs to warn motorists of sun, ice, fog and such hazards.

IMPROVED SELENIUM RECTIFIER, a German import, will soon hit the market. Prime advantages are much smaller dimensions without sacrificing the current carrying capacity, and a longer life than present American rectifiers. Saving in selenium is estimated at 30 to 50%.



MILITARY PROCUREMENT PRACTICES will get increased attention, particularly in the direction of attracting and holding experienced procurement personnel. Turnover in military procurement personnel is much too rapid, and costly. More freedom for each individual officer is the immediate goal, and plans call for more reliance on personal negotiation, rather than advertised bids so that the special knowledge of the procurement personnel can be better utilized.

INCREASED RELIABILITY is promised by new silver zinc batteries introduced by American Machine and Foundry Company for rocket and transistor applications. Miniaturized unit employs pile type construction and features a dry shelf life of 5 years.

INCREASING CONCERN over electronic reliability. In recent talk Dudley C. Sharpe, Assistant Air Force Security (Materiel) lamented that "three hours of maintenance are needed for every hour in the air." He added, "We are fast approaching the time when we must procure electronic equipment as much for reliability, simplicity and maintainability as for performance."

NEWEST ADDITION to the missile field is Chrysler Corp. Under new Army-Navy contract Chrysler becomes responsible for the engineering and development of a system for a proposed ship-launched ballistic missile.

TRANSISTOR PRODUCTION is being expedited by latest automation methods. Problems in yield are being attacked through unique sensing units that permit rigid control of crystal growing.

ONE SOLUTION to the engineer shortage which is gaining increasing support is to reduce the present four year "bachelor" curriculum to two years of concentrated study. As pointed out by one educator curriculum offered by many of the present four year schools represents no more than two years study, anyway. Added weight is offered by the Government which last month expressed concern about the trend toward higher educational requirements in many professional fields.

LOOK FOR increased use of aluminum wiring in electrical equipment. New process of anodizing aluminum wire gives it a ductile oxide coating which in effect becomes electrical insulation.

Materials

RHENIUM—A NEW METAL just now being introduced will find many uses in the electronic industry. Electron tube filaments made of rhenium exhibit great resistance to transfer by the "water-cycle," the phenomenon which occurs with tungsten, blackens the walls of vacuum tubes and light bulbs, and shortens their lives. Rhenium is useful, too, in contact points, particularly where salt water corrosion is found. Thermocouples of rhenium alloy have high thermal emf, stability in reducing atmospheres, high melting points, and low vapor pressures. The metal's exceptional wear-resistance can also make it valuable in phono needles. Rhenium prices, though not yet finalized, are expected to approach those of platinum.

Missile Masters

Electronic consoles, similar to these radar entry consoles in the system at Ft. Geo. G. Meade, Md., are heart of the new Martin "Missile Master" system which controls and coordinates NIKE antiaircraft missile batteries. Systems will be located at key antiaircraft installations throughout the country.

"Airline" Approach To Electronic Reliability

(Photo Courtesy of Lockheed Aircraft Corp.)

In contrast to the military, which snaps up new design techniques, the airlines are interested primarily in tried-and-proven methods that will ensure, first, reliability, and second, minimum maintenance

By S. B. PORITZKY

AIRBORNE electronic equipment for the commercial air carriers presents different problems to the designer than equipment intended for military use. The airline approach to electronics equipment reliability is this:

Give the equipment designers realistic operational and performance requirements; give them the benefit of the consumer's specialized experience on the new radio's environment and carefully gathered past performance data, add competition—then leave them alone to design the equipment, and a reliable radio will result. This is the essence of the Airlines Electronic Engineering Committee's recently published Report Number 403, "Guidance for Designers of Airborne Electronic Equipment." With the airlines approaching 10 hr.-per-day utilization time on every aircraft, they are exceptionally well qualified to speak on the will o' the wisp of reliability.

Aeronautical Radio, Inc.'s, Report Number 403 is yet another in

S. B. PORITZKY
Airlines Electronic Engineering Committee, Aeronautical Radio, Inc.
1700 K St., N.W.
Washington, D. C.

the myriad reports and technical papers on reliability of electronic equipment, but it provides a unique approach to this vexing problem. The ARINC sponsored Airlines Electronic Engineering Committee (AEEC), composed of a number of commercial air carrier technical representatives, represents, in the aggregate, a highly qualified industry consensus of the most elusive and vexing of all the engineering problems — that of long-term, satisfactory performance of electronic equipment. The Report represents the Committee's views, and thus the view of the airline industry on the most important points of equipment design and maintenance practice.

Unique Viewpoints

A number of unique and yet perhaps surprising viewpoints on design practice are expressed. The Committee, while certainly mindful of the need for small and light-weight equipment in an ever more crowded radio compartment, looks with a jaundiced eye upon subminiature tubes, and printed circuits. It urges caution, perhaps to the point of discouragement at this time, in the use of the very newest semiconductor devices. It discourages the use of potted assemblies, printed components, hermetically sealed component groups, sealed instruments, and sealed relays. On the other hand the Committee encourages the use of removable subassemblies, does away with the need for most high-voltage interlocks, and eliminates the oldest bromide of them all—the requirement for a solid mechanical joint in addition to a good solder joint.

Coordination Process

The release of this Report by

AEEC represents the completion of only one step in the continuing coordination of equipment design practices with the airlines, the airframe manufacturers and the electronic equipment designers. The first industry work on the subject was done as early as 1939 by the publication of an Airlines Electrical and Mechanical Requirements Specification. This specification was probably based on and resembles even earlier work done by the CAA's predecessor, the Bureau of Air Commerce. The primary difference between the older specifications and the new report, aside from bringing the technical material up-to-date, marks a point of departure from the time-honored art of specification writing. The report is done entirely in the form of guidance material, without a single "shall" or "must." There are no arbitrary requirements, and each point or desired practice is explained in terms of the need and the probable effect on equipment performance.

Reliability Studies

The many studies of equipment performance all point up that reliability begins with common sense. Many of the seemingly obvious rules of good practice, such as operating components below their ratings and preventing soldering iron burns on components when removing other components, are so elementary as to almost insult the experienced designer's intelligence. Yet the fact must be faced that each new radio suffers from some elementary faults which become immediately obvious when a group of sets is placed into service. The often stated and rather pat admonition to the designer to exercise extreme care in his design, his choice of components and tubes, placement of parts, ventilation, ambient temperatures, power supply variations and the many other considerations has become routine even though it is still entirely valid.

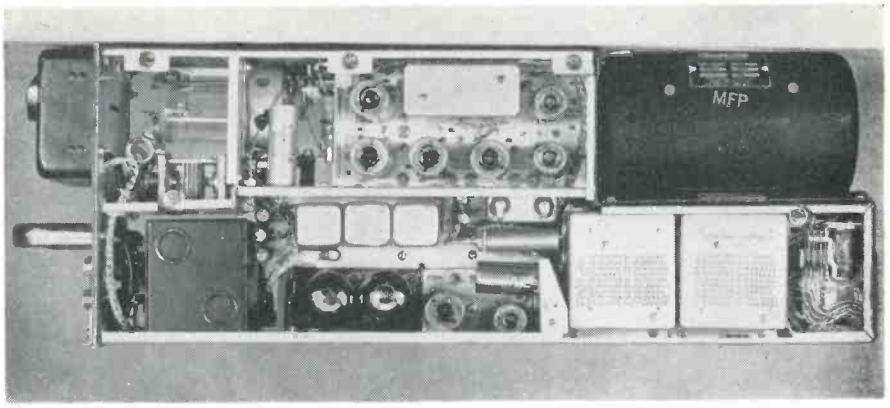


Fig. 1: Side view of Bendix Radio's 360-channel VHF transmitter

The Airlines' Attitude

Report 403 attempts to recognize that it is an extremely difficult and probably impossible task to make rules which can be applied to every situation. It is the airlines' wish to be as unrestrictive as possible. It is well recognized that a particular practice might be extremely undesirable in one application, and perfectly satisfactory in another. For this reason the airlines' approach is to state, as clearly and concisely as possible (Brevity is important, for one can lead a horse to water, but . . .), the facts about the equipment's environment, the way it is used, and the general airline philosophy of testing and maintenance. The general attitude toward new practices and new components is also outlined to give the designer insight to the user's problems.

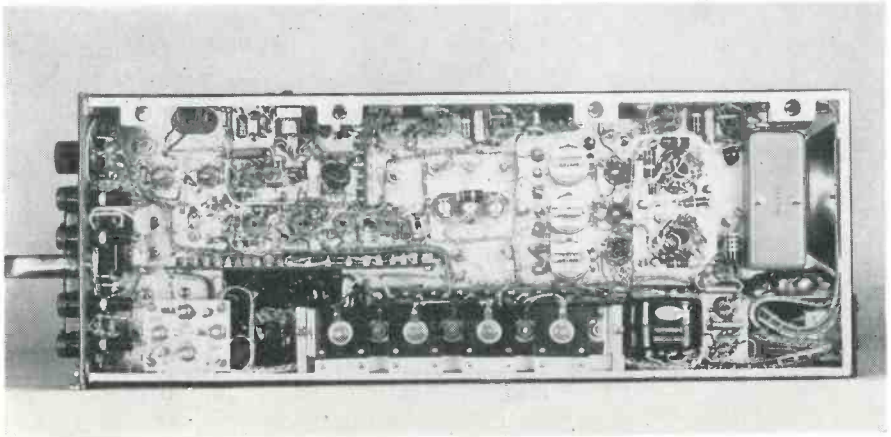
In reviewing the airlines' attitude toward "building reliability" into its airborne electronic equipment it is natural to compare their work with the vast efforts put into the improvement and reliabilization of military equipment. A great deal of the military work is used to good advantage in both military and civil equipment and everybody benefits when the military work is universally applicable. In the case of airline equipment, however, the key is not in the use of military specifications or specific applications of military findings, but rather in the different approach to the overall methods of specification, purchasing, and the relationship with the contractor and his designers.

Military Approach

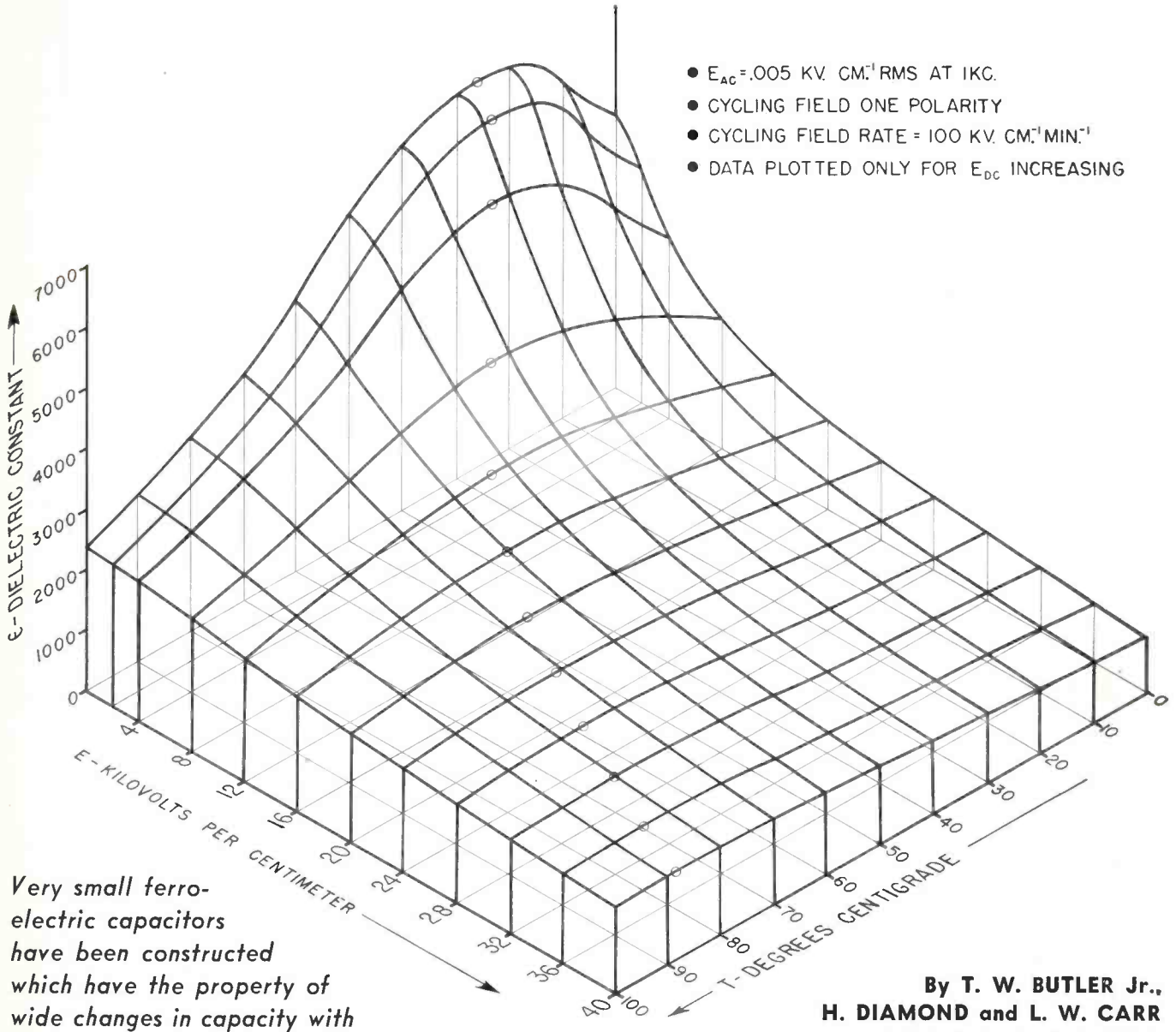
Because of the vastness of the military establishment, the process of specification writing, development contracts, the bidding for quantity procurement, and the operating relationship between cognizant agency and the contractor is highly impersonal during most of the procurement period. The potential contractor-bidder often has only an equipment specification and a group of standard "Mil. Specs." The military services have done wonderful work in preparing guidance

(*Continued on page* 90)

Fig. 2: Bendix Weather Radar Synchronizer unit in long ½ ATR case



Non-Linear DC-Tuned Capacitors



ϵ-T-E SURFACE

Fig. 1: Small signal dielectric constant as a function of temperature and biasing field

Very small ferroelectric capacitors have been constructed which have the property of wide changes in capacity with applied dc voltage.

By T. W. BUTLER Jr., H. DIAMOND and L. W. CARR

Univ. of Mich., Engineering Research Inst., Electronic Defense Gp., Ann Arbor, Mich.

FERROELECTRIC materials may be used as electrically variable capacitors in tuned circuits up to 400 MC. The special techniques for making suitable capacitors with low loss at very high frequencies are described in detail below. Electric tuning is accomplished in a manner similar to magnetic tuning. In the latter, the permeability of a magnetic core is varied by a dc control current, thus changing the inductance of the signal winding. In the former, the dielectric constant of a sample is varied by applying a dc voltage to the electrodes, thus producing an electrically variable capacitor.

Of the various ferroelectric materials presently available, we will confine our attention here to the barium-strontium titanate ceramics which are commonly found in many commercial ceramic capacitors. The relative dielectric constant of these materials is in the range of 10^3 to 10^4.

The desirable material properties for voltage tuning are: 1. A large change in dielectric constant with applied electric field. 2. Small variation of dielectric constant with temperature. 3. Low dielectric loss. 4.

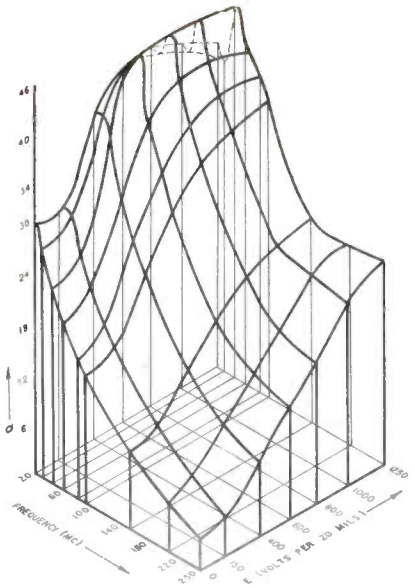


Fig. 2: Q as function of field and freq.

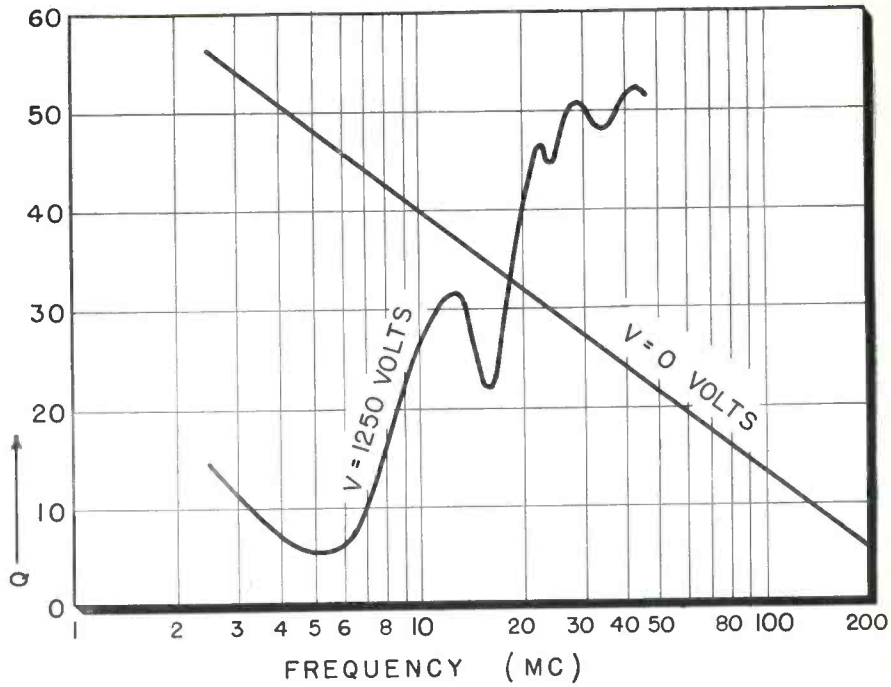


Fig. 3: Q vs. freq. Dip at 5 MC is harmonic of resonant freq.

Freedom from voltage breakdown with large dc fields.

Fig. 1 shows the small signal dielectric constant as a function of both temperature and biasing field for a typical commercial ferroelectric ceramic. The data are shown in 3 dimensions as a convenient means of presenting the temperature-field behavior. Note that the material is very temperature sensitive at low biasing fields and that the peak dielectric constant shifts to higher temperatures as a biasing field is applied.

The dielectric constant of this material has its maximum value near room temperature. This peak may occur either above or below room temperature depending on the composition of the ceramic. This particular material has been applied to electrically-tunable devices operating at room temperatures without special thermostating arrangements, and the results have been surprisingly good. Compensating or thermostating techniques are required for applications where large temperature variations are expected.

Measurements have also been made of the small-signal dielectric losses as a function of both frequency and biasing field. Fig. 2 shows the Q, which is the inverse of the loss tangent, plotted as a function of applied field and frequency. The frequency range considered here is from 25 to 250 MC while the biasing field varies from zero to about 70 v./mil. In this frequency range, the Q increases with an increasing biasing field. As will be shown later, this is not necessarily the case at lower frequencies. The lowest Q is found at the high frequency-low field corner of the diagram (Fig. 2) where the Q drops to a comparatively low value of about 5.

In a tuned tank circuit, using voltage sensitive capacitors, the frequency increases with increasing bias field. Thus, the path traced on the QEF surface in such a case runs diagonally from the low frequency-low field region to the high frequency-high field region. In this manner a reasonable Q is maintained over this frequency range.

(*Continued on page* 130)

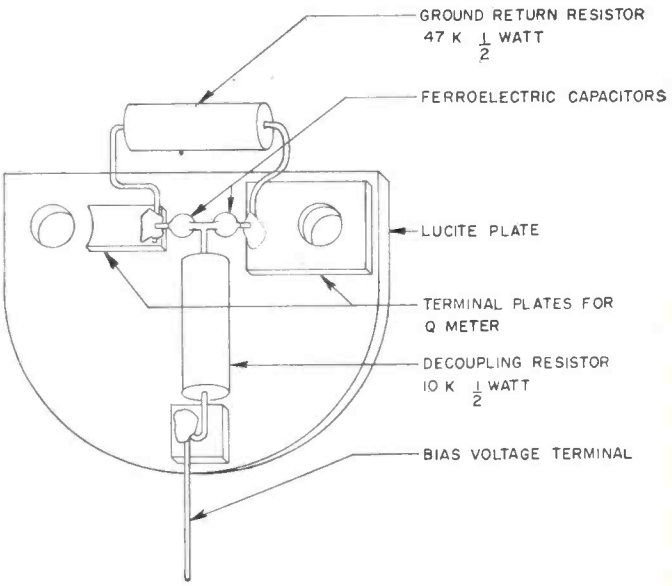
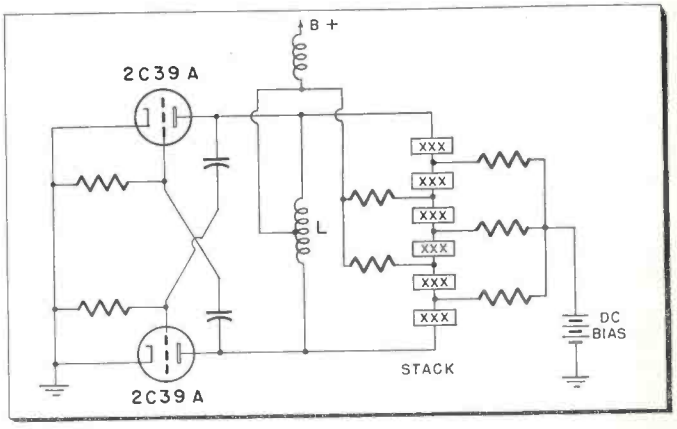


Fig. 4: Test plate for high frequency Q measurement

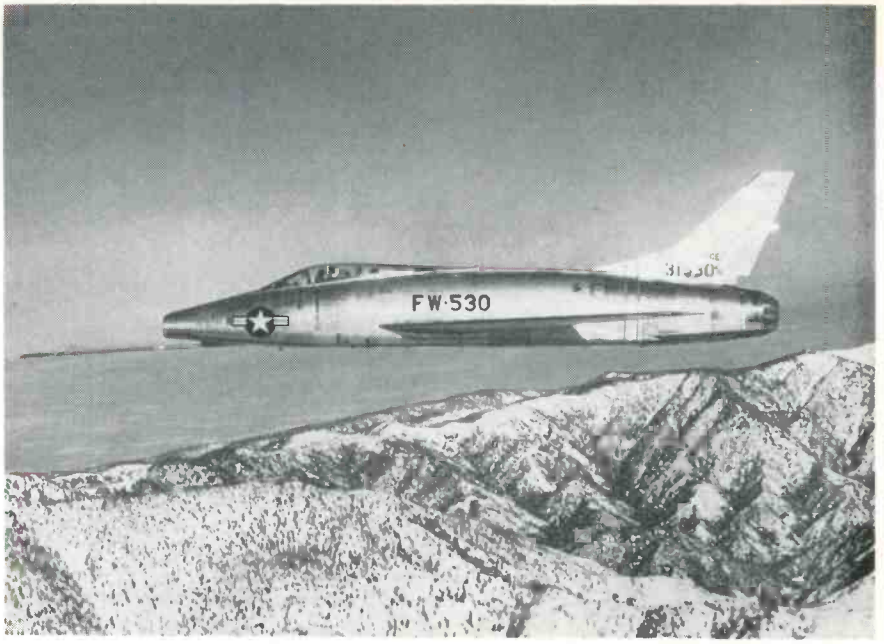
Fig. 5: Voltage tunable power oscillators



8th National Conference On Aeronautical Electronics

May 14-15-16

Biltmore Hotel Dayton Ohio



Air Force's North American F-100 Super Sabre jet joins in salute to Avionics

ON May 14, 15 and 16 Dayton, O. will play host to the 1956 National Conference on Aeronautical Electronics. The conference will be sponsored jointly by the Professional Group on Aeronautical and Navigational Electronics and the Dayton Section of IRE.

A broad program of technical papers is planned. The keynote is the "how to do it" approach.

The welcome address will be made by the Conference president, Richard J. Framme, Chief of the Product Control Office, Directorate of Laboratories, Wright Air Development Center.

Highlight of the program will be an open forum on the subject, "How to Accelerate Research & Development of Aeronautical Electronics."

PROGRAM

Monday Morning

MAGNETICS I

Moderator: D. A. Ramey, Westinghouse Electric Corp.

9:00—"New Type Miniaturized Power Transformers for High Temperature Airborne Applications," H. S. Feder and A. B. Haines, Bell Telephone Labs.

9:30—"High Performance Magnetic Amplifier Type Regulator-Exciter for AC Generator," H. S. Sechrist and H. G. Carlson, General Electric Co.

10:30—"Core Volume Derivation for Magnetic Pulse Modulators," J. E. Sunderlin, Westinghouse Electric Corp.

11:00—"Use of Constant Current Flux Reset Testing in the Design of Self-Saturating Magnetic Amplifiers," Harvey D. Faram, Emerson Television & Radio.

COMPONENTS I

Moderator: F. E. Wenger, Air Research & Development Command

9:00—"Hermetic Sealed Composition Resistors," A. C. Pfister, Allen-Bradley Co.

9:30—"Application and Selection of Accurate Film Type Resistors," Paul Nuyl, International Resistance Co.

10:30—"Application and Selection of Power Resistors," George M. Stapleton, Ward Leonard Electric Company.

11:00—"The Use of Magnetic Clutches and Precision Potentiometers in Strain Gauge Measurements," Leo Woerner, International Resistance Co.

SEMI-CONDUCTORS

Moderator: Dr. John S. Saby, General Electric Company

9:00—"The Microwave Diode, C. T. McCoy, Philco Corporation.

9:30—"Investigation of Power Gain and Transistor Parameters as Functions of Both Temperature and Frequency," Dr. A. B. Glenn and I. Joffe, Radio Corporation of America.

10:00—"High-Power Switching Characteristics of Conjugate Emitter Transistors," J. J. Suran, General Electric Company.

10:30—"Characteristics of Silicon P-N-P Junction Transistors," J. Spanos, A. Caggiano and R. D. Greene, Raytheon Mfg. Co.

11:30—"Silicon Tetrode Transistors for the 5 to 40 MC Region," Roger R. Webster, Texas Instrument, Inc.

CIRCUITS

Moderator: F. C. Collings, Radio Corporation of America

9:00—"PCM Frame Synchronization," Pierre J. Tapernoux, Stromberg-Carlson Company.

9:30—"The Neon Tube Switch as a New Method of Highspeed Multiplexing," R. C. Givens, Radio Corporation of America.

10:00—"Crystal Controlled Pulse Generators," David C. Howard, Radiation, Inc.

Three-day conference will feature the theme "How to Accelerate Research & Development of Aeronautical Electronics." Avionic products will be exhibited by more than 70 manufacturers

10:30—"A Precision Memory Delay Generator," Harvey Bush, Radiation, Inc.

11:00—"Low Level Detection in the UHF Region," Elisabeth M. Philipp Rutz, Emerson Television & Radio.

Monday Afternoon

MANAGEMENT

Moderator: George Rappaport, Wright Air Development Center

2:00—"Management of Research & Development," Paul Clark, Radio Corporation of America.

2:30—"Management of a Development Engineering Enterprise," O. H. Wing, General Electric Co.

3:00—"Managing an Engineering Research Center," R. L. Shetler, General Electric Company.

4:00—"The Role of the Design Engineer in the Field Support of Complex Airborne Electronic Equipment," H. W. Brown, Radio Corporation of America.

4:30—"The Questions Are Easy," Donald Friedman, Avion Division of ACF Industries.

4:45—"Skull to Skull Communication of Technical Ideas," Philip Klass, Aviation Week.

ENVIRONMENT

Moderator: J. R. Grimm, Wright Air Development Center

2:00—"The Problem of Electronic Components in Nuclear Power Plants," Dr. R. D. Shelton, Admiral Corporation.

2:30—"Direct and Indirect Forced Air Cooling Teechniques for Electronic Equipment," Dr. Melvin Mark and M. Stephenson, Jr., Raytheon Mfg. Company.

3:00—"A Fusion Type Seal for Large Repairable Airborne Electronic Equipment," Robert Einfeldt and F. J. Biltz, Remington Rand.

4:00—"A Note on Forced Convection Tube Cooling with Chimneys," Dr. Melvin Mark, Raytheon Mfg. Company.

4:30—"Evaluation of Hermetic Sealing Terminals," G. A. Forster, Armour Research Foundation.

ELECTRON TUBES I

Moderator: Walter Greer, Navy BuShips

2:00—"Receiving Tube Reliability Studies," G. H. Gage, General Electric Co.

2:30—"Display Tubes," Dr. Jenny Bramley, Allen B. DuMont Lab., Inc.

3:00—"Traveling-Wave Tubes: Applications and Application Considerations," F. R. Arams, Radio Corporation of America.

3:30—"Beam Switching Tube Circuit Design in Aircraft Applications," Rudolph Cola, Haydu Brothers of N. J.

4:00—"Using Viewing Storage Tubes in Aircraft Indicators," H. O. Hook, Radio Corporation of America.

4:30—"Reduction of Vibration Output in Miniature Tubes," Melvin Levine and D. O. Holland, Raytheon Mfg. Co.

TESTING AND TEST EQUIPMENT

Moderator: George G. Brown, Inland Testing Laboratories

2:00—"New Testing Concepts for the Advancement of Electro-Mechanical Component Reliability," W. H. Grument, Rototest Laboratories.

2:30—"Automatic Testing of Fire Control Systems," Allen Borck, Emerson Television & Radio.

3:00—"A Dielectrometer for Millimeter Wavelengths," Morris J. Ehrlich, Microwave Radiation Co.

3:30—"The Design and Development of Precision Signal Generators in the VHF and UHF Regions," A. DiNardo and E. Fuller, Sperry Gyroscope Co.

3:45—"High Voltage RF Generator," J. O. Stenoien, Boeing Airplane Co.

4:00—"New Developments in Liquid Loads for Use in Waveguide and Coaxial Systems," Samuel Freedman, Chemalloy-Electronics Corp.

4:30—"The Discovery of a Realistic Dynamotor Brush Test," Lawrence V. McNamara, Wright Air Development Center.

Tuesday Morning

COMPUTERS I

Moderator: Lewis Imm, Librascope

9:00—"Redundancy in Complex Computers," M. Cohn, Remington Rand.

9:30—"A High Accuracy, High Speed Shaft Position to Digital Converter," George W. Oberle, Glenn L. Martin Company.

10:00—"An Analog-to-Digital Converter with Decimal Output," Robert P. Bishop, Radiation, Inc.

10:30—"A High Speed Digital Translating-Recording System," George F. Anderson, Radiation, Inc.

11:00—"A Multipurpose Electronic Switch or Analog Simulation and Auto-correlation Applications," N. D. Diamantides, Goodyear Aircraft Corp.

COMPONENTS II

Moderator: James T. Brothers, Philco Corporation

9:00—"Ceramic Capacitors and Their Applications," Nello Coda, Erie Resistor Corporation.

9:30—"Typical Expected Performance Characteristics of Extreme Temperature Rang Tantalum Capacitors," J. W. Maxwell, P. R. Mallory & Co., Inc.

10:00—"Tantalum Solid Electrolytic Capacitors," D. A. McLean, Bell Telephone Labs., Inc.

10:30—"Time Delay Relay Applications," John J. Dietz, Thomas A. Edison, Inc.

11:00—"Fluxless and Corrosionless Soldering of Aluminum and Attachment of Copper Thereto," Samuel Freedman, Chemalloy-Electronics Corp.

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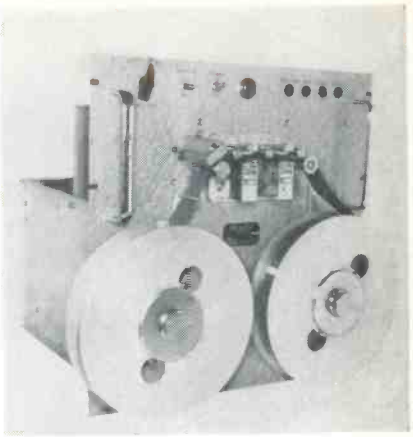
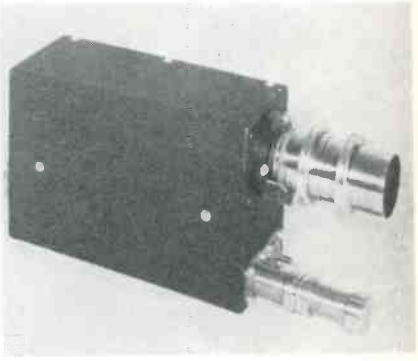
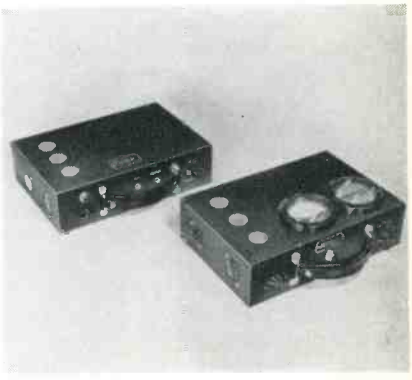


Six-speed rack mounting tape transport. Push-button controlled. Davies Labs.

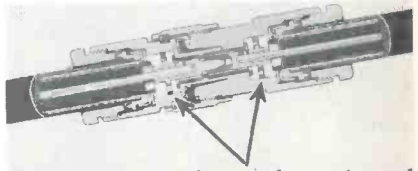


Ruggedized, closed-circuit TV camera for airborne use. General Precision Labs.

Portable 400 cps power supply for testing and servicing aircraft instruments. Avien Inc.



New r-f connector for use under conditions of extreme temp. variations. Amphenol.



Cross-section of mated captivated contact RF connectors. Contacts remain in fixed position when extreme temperature changes may cause cable shrinkage.

Fig. 1: Reflectometer system contains oscillator, 2 directional couplers, 2 detectors, a ratio meter, and a means of visual data presentation.

By N. L. PAPPAS

Measuring Microwave Impedance

N. L. Pappas

THE measurement of impedance at microwave frequencies has been made primarily by slotted line techniques up to the present time. A load (impedance) on the end of a r-f line whose value differs from the characteristic impedance of the line does not absorb all of the power incident upon it. This means that some of the power is reflected back towards the source. Therefore there is a set of incident and reflected waves in the transmission system. The summation of these waves establishes a standing wave which is measured with the use of slotted lines. The ratio of the reflected to the incident wave is also related to the impedance. The desired separation of the reflected and incident waves, and the formation of the ratio, is accomplished by a microwave reflectometer system. The measurement of impedance by this method is not an everyday experience, not for lack of motivation to use this more fundamental approach, but because of the lack of practical equipment. This lack of practical equipment has been eliminated by recent developments.

A reflectometer permits measurement of the magnitude of the reflection coefficient over bandwidths limited only by the bandwidths of its components. The system presents the data as a continuous function of frequency. For example, this feature makes the investigation of resonances a simple task. The use of a swept frequency oscillator permits rapid assimilation of data as a function of frequency. The data may be presented on an oscilloscope, or recorded. The accuracy of the system is as good, if not better, than the best of slotted lines. Such a reflectometer is now a reality.

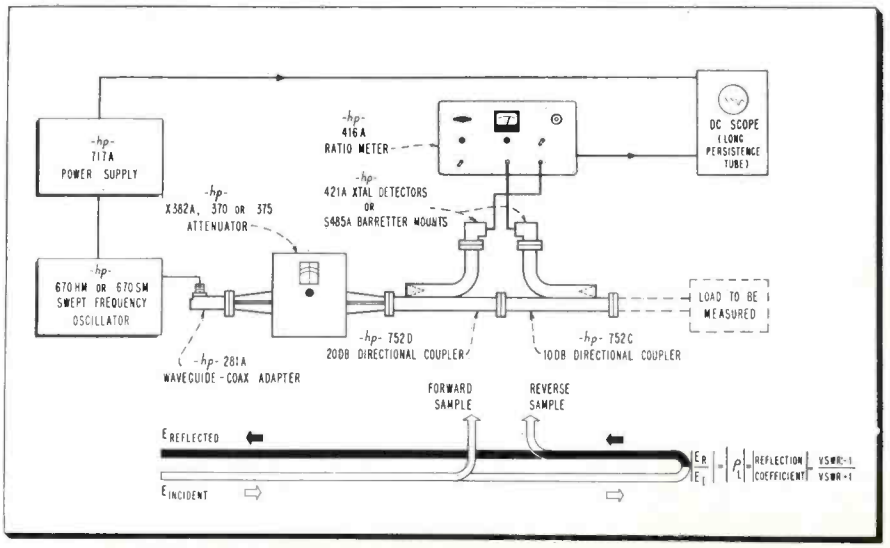
N. L. PAPPAS, Consulting Engineer, 25981 Vinedo Lane, Los Altos, Calif. (Formerly with the Hewlett-Packard Co., Palo Alto, Calif.)

Principle of Operation

The reflectometer basically performs two functions; the separation of incident and reflected waves, and the formation of the ratio of the reflected to the incident waves. A reflectometer system may contain an oscillator, two directional couplers, two detectors, a ratio-meter and a means of visual data presentation. The components are assembled as shown in Figs. 1 and 2.

The modulated r-f power leaves the oscillator and propagates down the line towards the load. The first (incident) directional coupler has the property of sampling power in the main line and hence some of the incident power enters the secondary arm, subsequently reaching the first square law (incident) detector. The square law detector characteristic is not necessary for this system. Practical linear detectors, though desirable, are not available at microwave frequencies. The detector output is a voltage at the modulation frequency which has an amplitude proportional to the incident r-f power. The incident power passes the second (reflected) coupler and the sampled power is absorbed by

Fig. 2: Block diagram showing component arrangement of microwave reflectometer



Practical reflectometer permits rapid measurements of reflection coefficient of r-f lines by separation of incident and reflected waves and formation of their ratio. Bandwidth is limited only by bandwidth of its components. Sweep frequency oscillator permits rapid assimilation of data as a function of frequency

With the Reflectometer

the perfect load in the secondary arm. Assuming that the line load is not matched, some of the incident power is reflected back towards the source. The reflected power is sampled by the reflected coupler and the sample flows into the reflected square law detector. The detector output is a voltage at the modulation frequency. The amplitude of this voltage is proportional to the reflected power. The reflected power passes the first (reflected) coupler and the sampled power is absorbed by the perfect load in the secondary arm. Assuming that the source is not matched to the line, some of this power is reflected back into the line. This power is now considered as incident power. The ratio-meter forms the ratio of the two detectors' output voltages.

Requirements

The practical reflectometer should be able to measure reflections of magnitudes in a range from 0.01 (1.02 SWR) to 1.00 (infinite SWR). The measurement of 0.01 reflections implies that the couplers should have directivities greater than 40 db. In addition, sufficient r-f power should be available at the source in order to have a good signal to noise ratio in the reflected channel.

The measurement of 1.00 reflections (infinite SWR) requires that the reflected detector mismatch be small.

The range of reflections to be measured is 100:1. This means that the detector law be accurate over a 40 db input r-f power range.

Components

The existence of commercially available directional couplers, in which directivity is greater than 40 db, permits accurate separation of incident and reflected waves. This means, for example, that less than 1% of the incident power sampled by the reflected coupler enters the reflected detector (Fig. 7, path R_1). The coupling law of the couplers varies by less than 1 db over their 50% bandwidth. Even this variation is unimportant because it is the ratio of the reflected and incident coupler's samples that should be independent of frequency. This ratio varies by less than ½ db over the coupler's bandwidth.

METHOD OF MEASUREMENT	LOAD REFLECTION COEFFICIENT OR V S W R		
	$0<P_L<0.2$ $1<\sigma_L<1.5$	$0.2<P_L<0.5$ $1.5<\sigma_L<3$	$0.5<P_L$ $3<\sigma_L$
Slotted Section	1.02	1.02	1.02
Reflectometer Fixed Frequency Fixed Short	1.03	1.05	1.10
Reflectometer Fixed Frequency Sliding Short	1.02	1.04	1.07
Reflectometer Fixed Frequency Sliding Short, Sliding Load & SST	1.005	1.04	1.05

Fig. 3: Major cases, summarized in terms of residual SWR.

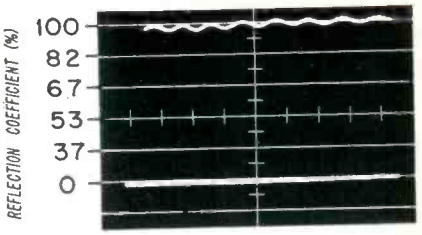


Fig. 4: Scope pattern obtained when calibrating reflectometer with a short (100% reflection)

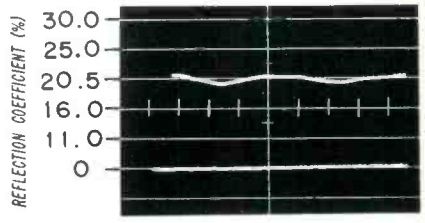
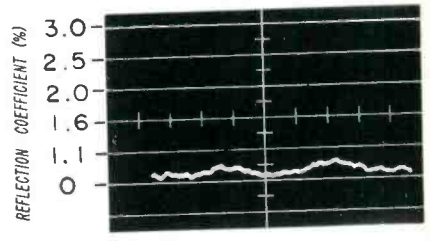


Fig. 5: Pattern obtained using Model X916E Series Standard Reflection of 20%

Fig. 6: Reflection of less than ½%. Spurious signals and detector mismatch cause fluctuations



The formation of a ratio at audio frequencies is, intuitively, more practical than an attempt to do this at microwave frequencies. Therefore the r-f source is modulated and subsequently demodulated by detectors. The detectors may be crystal detectors or barretters. These two types of detectors have almost a square law characteristic over the range of r-f powers occurring in practical systems. Practical detectors are available in which the square law characteristic varies by less than ± ½ db over a 40 db dynamic range. This is achieved by proper video loading of the crystals (Fig. 8). The detector's output signal to noise ratio is sufficient to permit measurement of the reflected channel output when very low reflections are being measured. The ratio of the rectification efficiencies of the two detectors is essentially independent of frequency as is shown in Fig. 4. The reflected detector mismatch (less than 1.5 SWR) is the source of the beats in the figure. Fig. 7, path R_3 illustrates this phenomenon.

The outputs of the two detectors are voltages at the modulation frequency which are in phase (1,000

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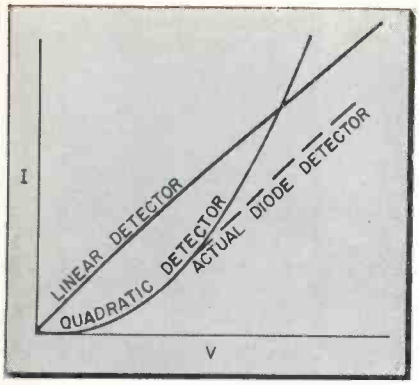
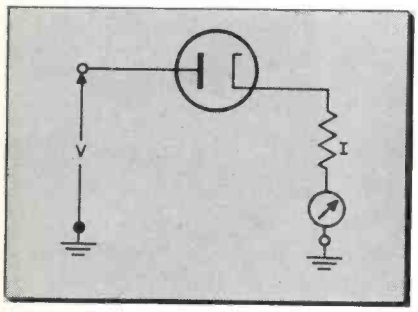


Fig. 1a: Diode output compared with linear and quadratic detector output

Signal-to-noise ratio is determined using an r-f signal generator, the receiver, and a pencil and paper calculation involving solution of a cubic equation

Calculating Noise Level In Radar Receivers

Fig. 1b: Diode circuit for curves above



By D. W. HANEY

IN radar research it is frequently necessary to specify the exact ratio of signal power to noise power as received. This signal-to-noise ratio is very important in all kinds of radar equipment and in radio communication. There are several good methods of measuring signal power, but up to now it has been difficult to measure noise power or equivalent noise voltage input to the receiver. Noise power measurement is easy for radar receivers having quadratic elements as second detectors, but most radar receivers lack quardratic second detectors.

The actual detection characteristic of a vacuum tube diode (e.g. a 6H6) is asymptotically linear but starts out approximately quadratic. (See Fig. 1 and 2.)

This article describes an accurate method for determining the noise level in a radar receiver using an r-f signal generator, the receiver, and a pencil and paper calculation involving solution of a cubic equation.

The conventional methods of noise evaluation should require either substitution of a quadratic detector for the second detector in the receiver or comparison of the output of the i-f strip with the output of a noise diode suitably amplified.

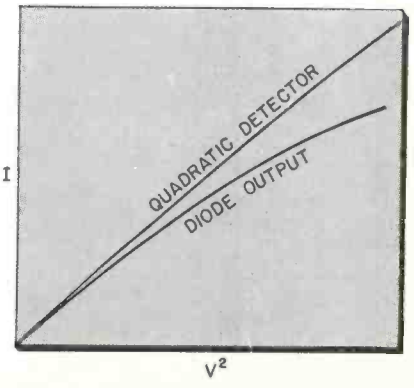
Determination with a Quadratic Second Detector

For determination of receiver noise level when the receiver has a quadratic second detector, the equipment may be connected as shown in Fig. 3. After the equipment is warmed up, the second detector output is measured for zero signal in. Then the output of the signal generator (which doubles the milliameter reading) is equal to the noise level in the receiver when this noise level is referred to the input.

The Method

First, the second detector output of the receiver is measured for calibrated r-f signal inputs to the receiver. The output is in μa., the input in μv.; the amplitude of the output has a distribution described by the incomplete Toronto function which can be calculated as shown by Rice[1] and Marcum[2]. The output y of the second detector is plotted as a function of Z and the square of the input voltage measured in

Fig. 2: Diode output vs. quadratic detector output (quadratic plot)



D. W. HANEY, engineer, The Martin Co., Baltimore, Md.

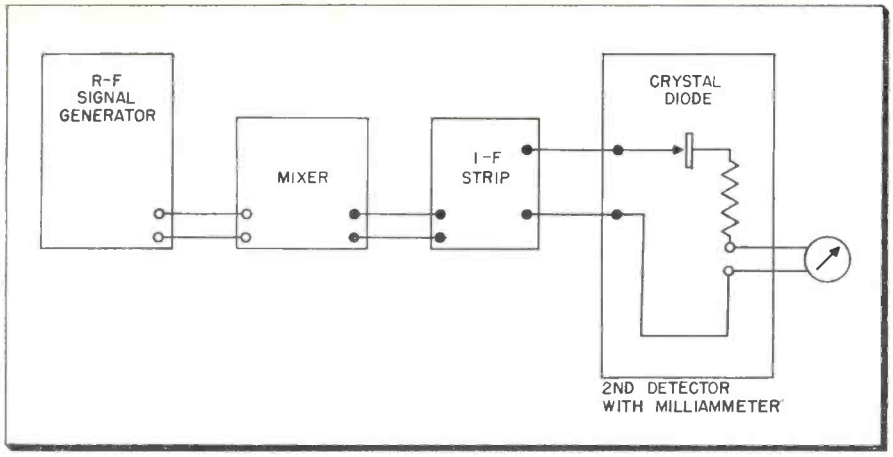


Fig. 3. Noise measurement on a superhetrodyne receiver

μv. The approximate function

$$y = \alpha_0 + \alpha_2 Z + \alpha_4 Z^2 + \alpha_6 Z^3 \qquad (1)$$

is determined from the graph.

The noise amplitude μ is then determined from the following equation to be derived in the following pages:

$$6\alpha_6\mu^6 - 2\alpha_4\mu^4 + \alpha_2\mu^2 - (\alpha_0 - a_0) = 0 \qquad (2)$$

where a_0 is the unexcited output of the second detector, and μ=rms noise level of receiver in units of equivalent input voltage. Obviously the accuracy depends on the calibration of the signal generator.

Mathematical Justification

The method of noise measurement described will be justified from a consideration of the mathematics of detected signal-with-noise, and the experimentally determined characteristics of the second detector diode.

To derive the noise formula from operating diode characteristics, it is assumed that the second detector characteristics, output current y vs. diode input voltage V is shown by Eq. 3. (For convenience V is to be computed in terms of the equivalent receiver input voltage.)

$$y = \beta_0 + \beta_2 V^2 + \beta_4 V^4 + \beta_6 V^6 \qquad (3)$$

The input voltage can be considered as a modulated sine wave of angular frequency ω of amplitude R which varies with time. Hence,

$$V = R \sin \omega t$$

and by substituting V=R sin ωt we may arrive at the fact that the "dc" or low frequency output of the detector as a function of R is as follows:

$$y = \beta_0 + \tfrac{1}{2}\beta_2 R^2 + \tfrac{3}{8}\beta_4 R^4 + \tfrac{5}{16}\beta_6 R^6 \qquad (4)$$

Let

$$\beta_0 = a_0;\ \tfrac{1}{2}\beta_2 = a_2;\ \tfrac{3}{8}\beta_4 = a_4;\ \tfrac{5}{16}\beta_6 = a_6$$

$$y = a_0 + a_2 R^2 + a_4 R^4 + a_6 R^6 \qquad (5)$$

If R varies with time, so does y and time average y (=$\bar{y}$) will vary as a function of the average moments of R ($\bar{R^2}$, $\bar{R^4}$, $\bar{R^6}$) as follows:

$$\bar{Y} = a_0 + a_2\bar{R^2} + a_4\bar{R^4} + a_6\bar{R^6} \qquad (6)$$

From Rice's formula

$$\bar{R^n} = (2)^{\frac{n}{2}}\mu^n\left(\frac{n}{2}\right)!\,{}_1F_1\left(-\frac{n}{2},\ 1,\ -x\right) \qquad (7)$$

we have

$$\bar{R^2} = 2\mu^2(1 + x) \qquad (8)$$

$$\bar{R^4} = 2^2\mu^4 2!\left(1 + 2x + \frac{x^2}{2}\right) \qquad (9)$$

$$= 4\mu^4(2 + 4x + x^2)$$

$$\bar{R^6} = 2^3\mu^6 3!\left(1 + 3x + \frac{3.2\,x^2}{(2!)^2} + \frac{x^3}{3!}\right) \qquad (10)$$

$$= 2^3\mu^6(6 + 18x + 9x^2 + x^3)$$

Note: $x = \dfrac{Z}{\mu^2}$

$$\bar{Y} = a_0 + 2a_2\mu^2 + 8a_4\mu^4 + 48a_6\mu^6 \qquad (11)$$
$$+ (2a_2 + 16a_4\mu^2 + 144a_6\mu^4)Z$$
$$+ (4a_4 + 72a_6\mu^2)Z^2$$
$$+ 8a_6Z^3$$

Now by matching coefficients

$$8a_6 = \alpha_6$$
$$4a_4 + 72\mu^2 a_6 = \alpha_4$$
$$2a_2 + 16\mu^2 a_4 + 144\mu^4 a_6 = \alpha_2 \qquad (12)$$
$$a_0 + 2\mu^2 a_2 + 8\mu^4 a_4 + 48\mu^6 a_6 = \alpha_0$$

These 4 equations suffice to determine a_2, a_4, a_6 and μ^2 providing a_0 is known. However, it is easiest to solve first for μ^2 without explicitly evaluating a_2, a_4, and a_6. The above equations reduce to

$$6\alpha_6\mu^6 - 2\alpha_4\mu^4 + \alpha_2\mu^2 - (\alpha_0 - a_0) = 0 \qquad (13)$$

One may solve this equation directly for μ^2.

It may be argued that the diode characteristic is approximately linear and that therefore the preceding derivation does not apply, because it is incorrect to approximate a linear function with a nonlinear polynomial in voltage with a finite number of terms.

However, the particular operating conditions of the second detector may be used to justify the utility of the mathematical derivation. The input to the second detector is limited by the output capabilities of the last tube in the i-f strip. Therefore, within the operating limits of radar receivers it is safe to approximate the diode characteristic as follows.

$$y = a_0 \qquad R = 0$$
$$y = a_0 + a_2R^2 + a_4R^4 + a_6R^6$$
$$0 \le R \le R_0 \qquad (14)$$
$$y = a_0 + a_2R_0^2 + a_4R_0^4 + a_6R_0^6$$
$$R_0 \le R \le \infty$$

The statistical distribution of R has been calculated by Rice and has the normalized probability density function

$$P(R) = \frac{R}{\mu^2}\,e^{\frac{-R^2+2Z}{2\mu^2}}\,I_0\left(\frac{\sqrt{2Z}\,R}{\mu^2}\right) \qquad R > 0 \qquad (15)$$

$$P(R) = 0 \qquad R \le 0$$

(*Continued on page* 120)

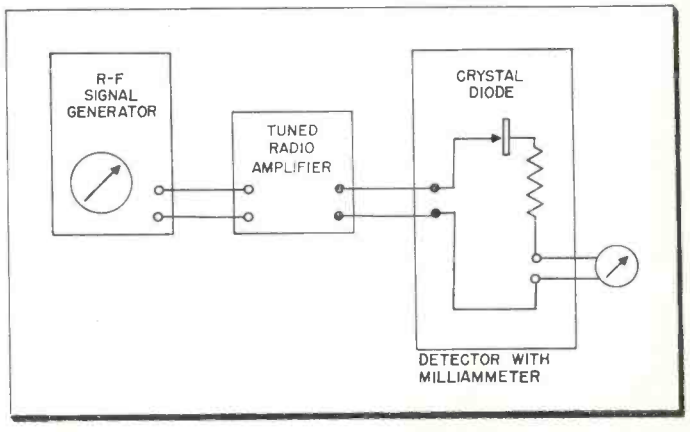


Fig. 4: Noise measurement on a tuned-radio-frequency receiver

Micro-Power Operation of Silicon Transistors

By E. KEONJIAN

Electronics Lab.,
General Electric Co.,
Syracuse, N. Y.

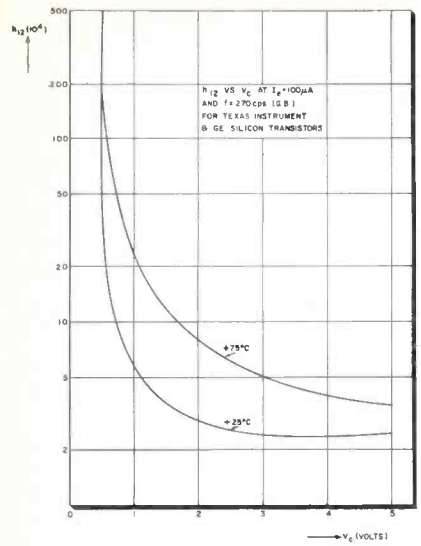
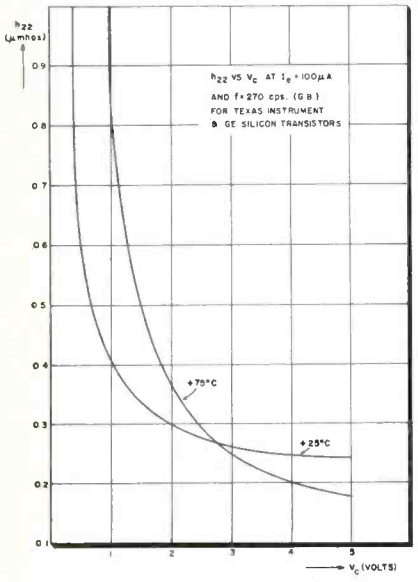


Fig. 1: Change in the h_{12} parameter as function of the collector voltage

Fig. 2: Output admittance is an inverse function of the collector voltage



IT is well known that one valuable attribute of transistor circuitry is the lower supply power requirement as compared with vacuum tubes. Nevertheless, present day transistors still consume too much power for some applications which require continuous operation over a long period of time without replacement of batteries. Consequently, further reduction of present day power requirements is very desirable, since it would enable the design of subminiature equipments using self contained batteries, and operating for several years without maintenance. It would also make the satisfactory operation of equipments from miniature solar energy converters possible.

One of the chief difficulties of realization of micro-power operation is the temperature variation of the transistor parameters. Due to this fact, germanium transistors with their relatively large values of I_{co} (which can be of the same order of magnitude as the collector current I_c required for micro-power operation) are less suitable for low level applications than silicon transistors. Another difficulty lies in the fact that the properties of transistors at low levels have not been studied thoroughly since accurate measurements are difficult in this region.

This article contains the results of an investigation of the parameters of few commercially available and some experimental silicon transistors in the micro-power region and in the temerature range from $-25°C$ to $+75°C$.

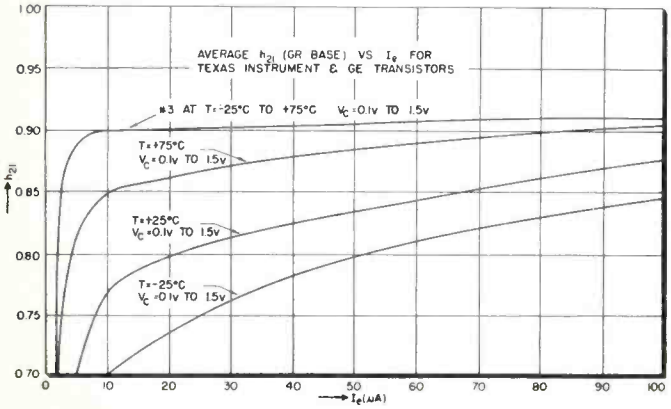
As a result of this study, an experimental two stage micro-power audio amplifier was designed and tested to demonstrate the practical use of silicon transistors at very low power levels.

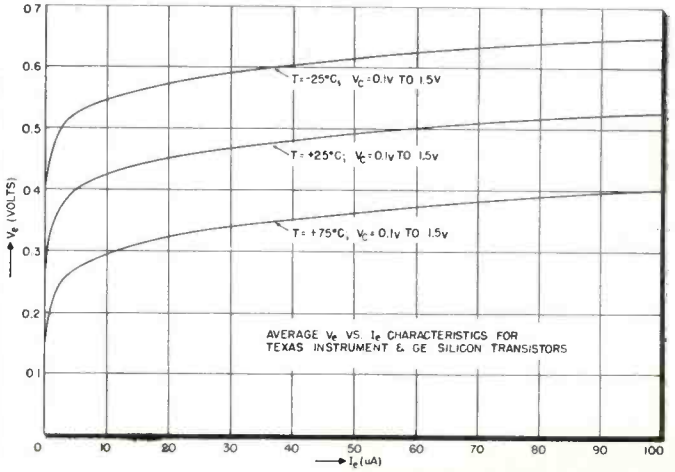
Ranges of Measurement

For the purpose of this work, the following transistors were

Fig. 3: (below) Variation of h_{21} with emitter current

Fig. 4: (r) Average input curve for grounded base configuration





Self-contained equipment that is to function for years without maintenance should consume very small amounts of power. Silicon transistors, because they are not so sensitive to temperature variations, offer a promising approach. The results of an investigation of silicon transistor parameters in the micro-power region and in the temp. range from —25°C. to +75°C. are described here.

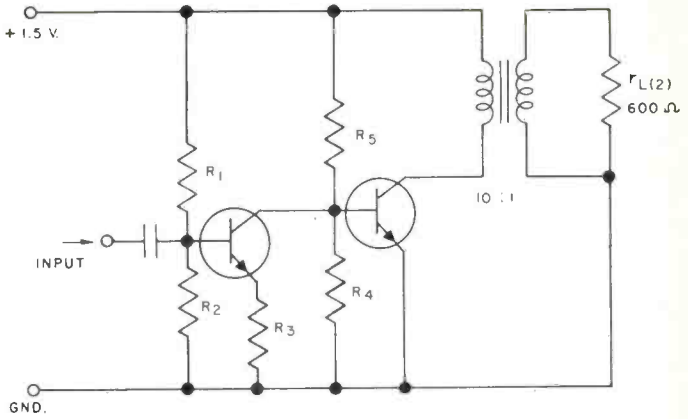


Fig. 6: Two-stage grounded emitter amplifier

used: Texas Instrument silicon, grown-junction transistors, types 904, 904A, and 905 and G.E. experimental silicon transistors. The ac parameters h_{11}, h_{12} and h_{22} of the grounded base transistors were measured at a frequency of 270 CPS, at $I_e = 100\mu a$ and for three collector voltages: $V_c = 0.5$; 1.0 and 5 v. Due to limitations of the measuring instruments, it was difficult to obtain accurate data for the current amplification h_{21}; therefore the dc characteristics were taken and h_{21} was determined from the slope of the input curve. The parameters were measured at three temperatures: —25°C, +25°C and +75°C, except ac parameters h_{12} and h_{22} which were taken only at +25°C and +75°C.

Discussion of AC Parameters

A. h_{11} vs. V_c

According to the measurements, at $I_e = 100$ μa, the parameter h_{11} was almost independent of the collector voltage and temperature. For most of the transistors its value was approximately 450 ohms.

B. h_{12} vs. V_c

In Fig. 1, the change in h_{12} is shown as a function of collector voltage. We see that h_{12} increases markedly below a value of V_c=1.5 v. With a change in temperature from +25 to +75°C, the value of h_{12} increases only 40% at V_c=5 v. while there is 400% change for the same temperature range at V_c= 1 v.

C. h_{22} vs. V_c

As can be seen from Fig. 2, the output admittance also increases with decreasing collector voltage.

D. h_{21} vs. I_e

Shown in Fig. 3 is the variation of h_{21} (grounded base) vs. emitter current as derived from the dc input curves. The curve shows h_{21} as a function of I_e for collector voltages of 0.1 to 1.5 v. at —25°, +25°, and +75°C.

The bottom three curves represent the average of the units tested while the top curve was obtained for a single sample type 905 silicon transistor. This transistor exhibits an almost ideal characteristic for micro-power applications. The current amplification remains constant at a high value down to currents of 10 μa before decreasing.

DC Characteristics

By using a Mosely Automatic Recorder, a series of accurate dc characteristics were obtained which permitted making some useful observations.

A. V_e vs. I_e.

The average input curve for the grounded base configuration is shown in Fig. 4 for temperatures of —25°, +25°, and +75°C and $V_c = 0.1$ v. to 1.5 v. Since the slope of the input curve indicates input resistance, we see that the input resistance of the transistor shows a gradual increase as I_e decreases, until it is reduced to approximately

Fig. 5: Average output characteristics of the silicon transistors

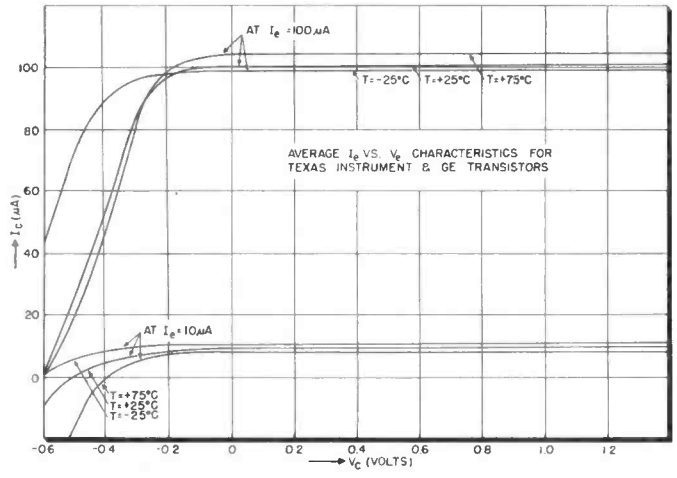
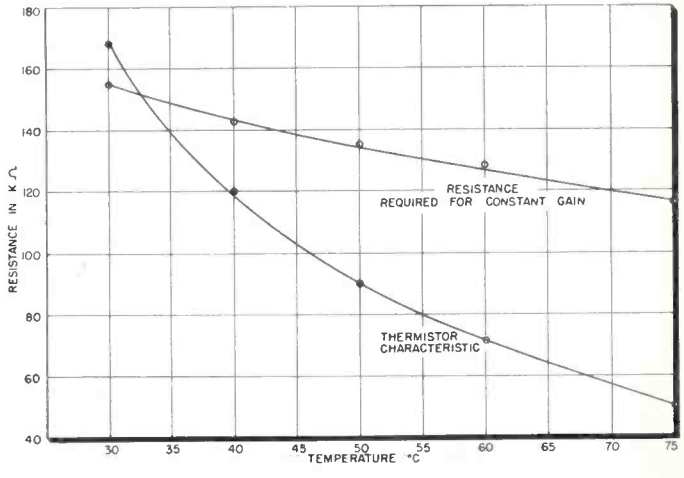


Fig. 7: Resistance needed to obtain a constant gain



Silicon Transistors (Cont.)

10 μa. Below this current, the input resistance increases very sharply. We also see that for the silicon transistor the input resistance and the point of inflection of the I_c—V_e curve is practically independent of temperature and collector voltage. The input curves of the silicon transistor show a constant shift in the direction of decreasing emitter to base voltage as the temperature increases.

B. I_c vs. V_c.

The average output characteristics of the silicon transistors are shown in Fig. 5 for $I_e = 10$ μa and 100 μa. The collector current is constant with V_c and shows no tendency to decrease until V_c is made negative. There is little shifting of the curves with temperature, due to the very small value of I_{co}. The chief effect of temperature upon the output characteristics of the silicon transistors is a shift of the point of inflection of the curves toward the current axis from the negative collector voltage region.

C. V_e vs. V_c.

It was found that a plot of V_e vs. V_c was a straight line parallel to the collector voltage axis for emitter currents as low as 2 μa. As the temperature increased, the curves shifted in the direction of decreasing emitter voltage.

Determination of the Minimum Power Levels

It is known that a variation of the transistor parameters causes a change in power gain.

The maximum power gain of a transistor in terms of the h parameters is:

$$G_{max} = \frac{h_{21}^2}{\left(\sqrt{h_{11}h_{22} - h_{12}h_{21}} + \sqrt{h_{11}h_{22}}\right)^2}$$

From this we see that to obtain a maximum power gain, h_{21} must be large and the product $h_{11}h_{22}$ must be small. As to the parameter h_{12}, it seems from the equation that for the grounded emitter configuration (h_{21} positive) power gain should increase as h_{12} increases. From Fig. 1, we see that h_{12} is large at lower values of V_c; however, h_{22} (Fig. 2) also is large at low values of V_c, and consequently the power gain will not increase as the product $h_{11}h_{22}$ increases. The net effect of this is a reduced gain at low values of collector voltage which is in full agreement with experimental results.

For micro-power application it is imperative to keep the dc power consumption as small as possible which suggests the use of minimum emitter currents and collector voltages. From Fig. 3 we see that h_{21} decreases sharply for all transistors below $I_e = 10$ μa. Thus 10 μa should be considered as the minimum allowable value of emitter current. From Figs. 1 and 2 can also be seen that in order to keep the product of $h_{11}h_{22}$ small, the collector voltage must be at least 1.5 v.

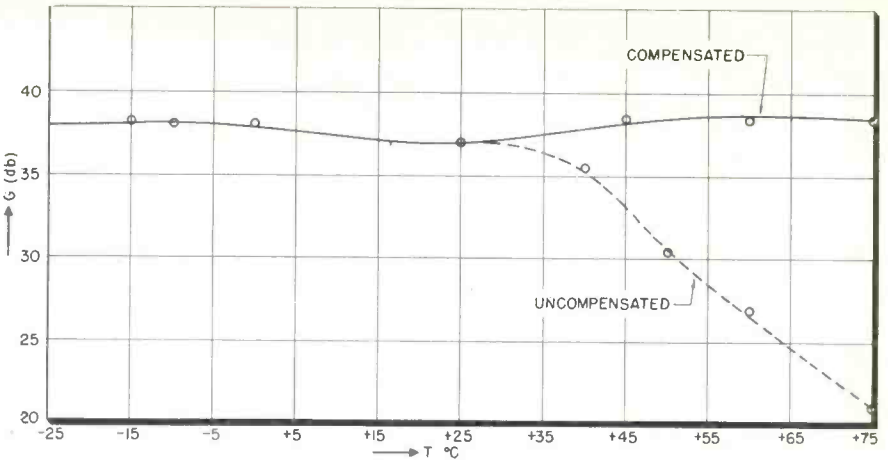


Fig. 8: Results of temperature tests on compensated and uncompensated amplifier.

Micro-power Audio Amplifier

A general purpose two-stage audio amplifier was chosen as the first experimental circuit to be designed for micro-power operation.

The output impedance of the amplifier was set at 600 ohms so that it can be connected to the standard 600 ohm telephone line. The input impedance was chosen relatively high (30 KΩ) for it is assumed the amplifier will be driven by a high impedance microphone. The only frequency specifica-

(*Continued on page* 138)

Fig. 9: Frequency characteristic of the silicon transistor amplifier.

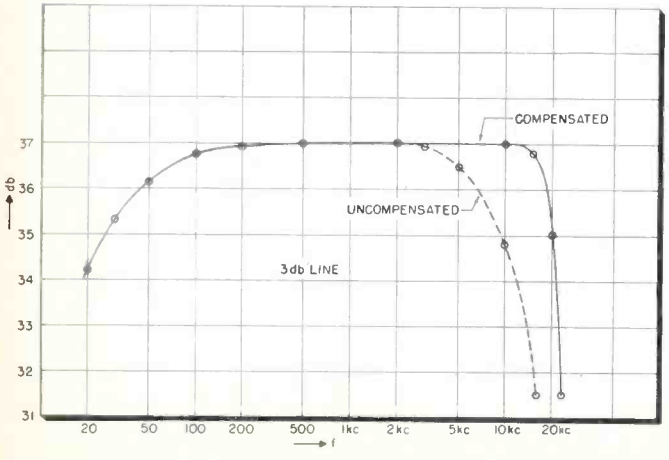
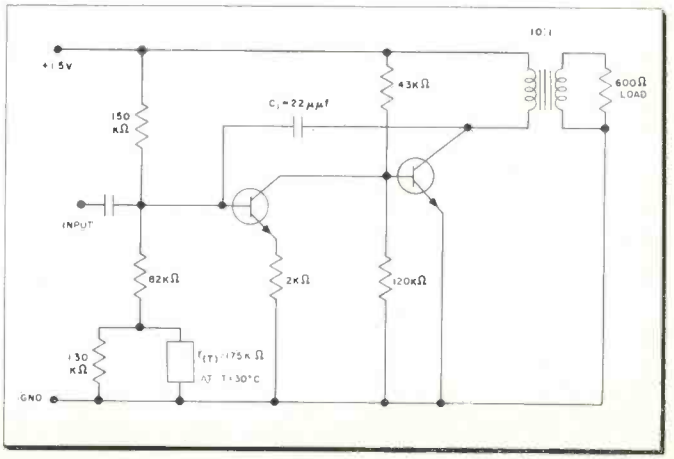


Fig. 10: Schematic diagram of transistor amplifier.



Bandwidth Requirements Of FM/FM Telemetering

Best signal-to-noise ratio is achieved when the frequency spectrum of the transmitted signal completely fills, but does not exceed the bandwidth of reception. This article describes the widest and narrowest bandwidths permissible in a FM/FM telemetering system

By J. C. CARPENTER, Jr.

THE efficient use of a FM/FM telemeter system is primarily limited by the bandwidths of the signal reception. The best signal to noise ratio is achieved when the frequency spectrum of the transmitted signal completely fills, but does not exceed, the bandwidth of reception. It follows that if the signal exceeds the bandwidth of reception, accuracy of reproduction of the signal suffers. This is true because signal components beyond the bandwidth of reception are attenuated and the reproduced signal is not a faithful representation of the original signal.

It is assumed that the FM/FM system is linear. That is, the spectrum of the signal appearing on the output of a component does not contain frequency components that do not appear in the spectrum of the signal on the input of that component. This is a valid assumption only when the distortion introduced by the component is a practical minimum. In this case, practical minimum is defined as the maximum distortion introduced in the signal by the component as limited by the manufacturer of that component. In cases where the component does not and cannot meet the manufacturer's specification, allowances must be made. For example, a manufacturer of a crystal controlled FM transmitter states that the distortion introduced by the transmitter is a maximum of 1% total harmonic distortion for a modulation index of four (4).

Take a modulating frequency of 70 KC and calculate the allowable deviation with a modulation index of 4

$$\text{Index} = \frac{\text{deviation}}{\text{modulation frequency}}$$

$$\text{Deviation} = 4 \times 70 \text{ KC} = 280 \text{ KC}$$

However, in spite of the manufacturers claim, experience has demonstrated that the distortion introduced into a modulating signal by this transmitter becomes appreciable above 80 KC deviation and this, therefore, limits the maximum deviation if we are to continue to evaluate the system on a linear basis. In fact, other system considerations may limit the maximum signal deviation to somewhat less than this figure. For example, noise of an FM nature, is generated in some transmitters when those transmitters are subjected to vibration or high sound level environments. This noise adds to the signal and can cause significant signal side band power to appear beyond the limits of the reception bandwidth.

Bandwidths

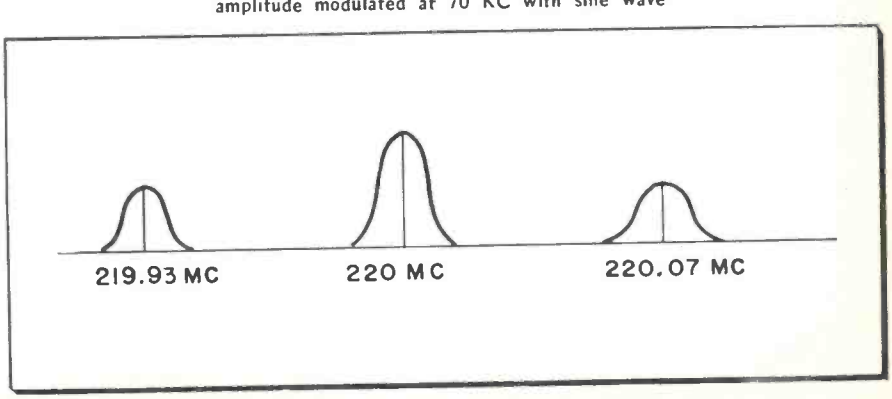
Every signal transforming component in the FM/FM system has a bandwidth. Even a simple R-C network has a frequency response characteristic. A statement of frequency response is essentially a statement of bandwidth and the terms are synonymous.

This discussion will start with the widest bandwidths within the system and conclude with the narrowest.

A. RF Receiver Bandwidth. Consideration of the IF bandwidth of the telemetering receiver in present day systems is essential. The RF bandwidth is wide enough in present day receivers to present no limiting problem. At least two different IF bandwidths are available

(*Continued on page* 142)

Fig. 1: Spectrum analysis of 220 MC transmitter amplitude modulated at 70 KC with sine wave



J. C. CARPENTER, Jr., prepared for the Missile Instrumentation Group at Radioplane Company, 8000 Woodley Ave., Van Nuys, Calif.

Magnetron beam switching tube is used to simulate action of a 10-contact single channel switch. Sampled voltages are mixed in the common cathode using unique gating circuit.

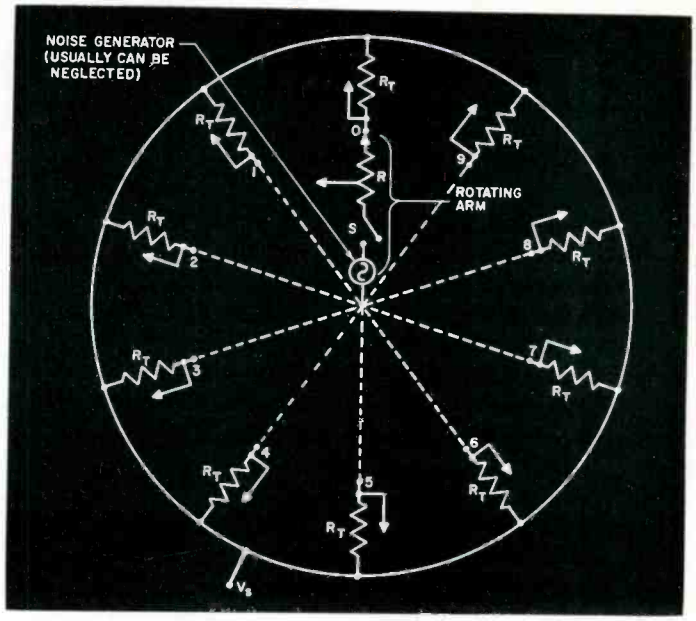


Fig. 1: Equivalent circuit of beam switching tube and circuitry

10-Ch. Time Division Multiplexer

By Dr. H. MOSS and S. KUCHINSKY

Dr. H. Moss

S. Kuchinsky

THE MBS tube which is the essentially new element of the system to be described has already been discussed fairly fully.[1, 2] The reader must consult at least one of these references to gain a proper understanding of the present article. The physics of this device is quite complicated but for many purposes it is sufficient to consider it in the terms of its equivalent circuit which may be roughly represented by Fig. 1. This shows a 10 contact single channel switch which we suppose to be driven by a slipping clutch mechanism and controlled in its rest position by means of a series of pins which act as stops for the arm. In the actual tube, the operation simulating the removal of a pin, i.e., the movement of the switch arm from contact to contact, is represented by making the appropriate switching grid sufficiently negative. The fly-over time between the contacts in the actual tube is controlled essentially by the beam current/capacitance ratio and this is such as to result in switching times of the order of 1/5 μs. The resistor R in Fig. 1 simulates the beam resistance in the tube while the generator simulates the noise source due to turbulent electron flow in these magnetron devices.

Dr. H. Moss, Dept. Mgr., Tubes, Circuits and Components, Burroughs Research Center, Paoli, Pa. and S. Kuchinsky, Mgr. Applications Engrg. Dept. Haydu Bros. of N. J., a Burroughs subsidiary.

Signal Injection

The most obvious way in which the various signals might be mixed would be to insert them in series with each switch contact position and extract the time sequence of signals from the common switch arm connection. We now show, however, that this method is unsatisfactory, a fact which indicates that the model of Fig. 1 is not a very accurate simulation of the actual device. Fig. 2 shows a cross-section of the MBS tube. Suppose we attempt to modulate the beam from each separate signal source by varying the corresponding spade potential and deriving the multiplexed output from the common cathode connection. Fig. 3 shows the consequence of this type of operation. This shows typical holding and leading spade characteristics and indicates that for stable operation there is a range of input spade voltage lying between about 75 and 125 v. Projection of the intersections of these two limit load lines (connected by the shaded area) on to the cathode current characteristic reveals that the range of cathode current variation is comparatively small so that the modulation depth is very limited. This would not necessarily be important were it not for the presence of the noise generator in the switch arm. This latter means that at such low modulation depths the signal-to-noise ratio may become rather poor. Perhaps this defect might be avoided by some sophisticated method of pulse code modulation but, for the moment, we are not going to pursue this possibility and are considering that the tube is being used in some normal variable amplitude system.

These considerations dictate the necessity of using the MBS tube indirectly in conjunction with

some gating system. There are a number of ways in which this can be accomplished and, as usual, a compromise has to be reached between performance and complexity.

The output pulse from the MBS tube is negative. This indicates two general methods of attack. If we are going to use a separate tube passing the signal information, and "open" it by grid switching, we shall require a positive pulse so that an inverter is called for. Alternatively, pulses might open a gate by direct injection of the negative output of the MBS tube into a cathode so eliminating the inverter. This is the system adopted in the instrument described—for reasons of simplicity. Fig. 4 shows the basic circuit adopted. The diode D_1 serves to clamp the cathode potential of the signal passing tube V_1 at a defined potential, regardless of variations in the different target characteristics of the MBS tube. However, it also serves a much more important function; namely, that of providing a virtual short circuit on the noise generator in the MBS tube. The remainder of the circuit of Fig. 4 is self-explanatory and calls for little comment. The dc level of the output is set by the potentiometer R_1 and the signal amplitude by R_2. The resistor R_3 serves to cut-off the signal passing triode V_1 in the absence of a pulse from the MBS tube. Fig. 5 shows photographs of the complete instrument incorporating 10 channels each similar to that drawn in Fig. 4. The switching of the MBS tube from contact to contact is controlled by a Schmidt trigger driving a bi-stable flip-flop having two outputs to which the grids are connected in alternate pairs. DC triggering of the MBS tube is thus achieved at high sensitivity. These circuits are entirely conventional and call for no comment. Fig. 6 shows a frequency response curve for each of the triode gate systems shown in Fig. 4. It should be noted that the measured equivalent noise input, almost entirely due to magnetron beam turbulence, is approximately 15 mv. This limits the maximum signal input to give a satisfactory signal-noise ratio to around 0.5 v. Fig. 7 shows 10 separate traces on a cathode-ray tube produced by this device. Trigger fly-back pulses from the oscillograph are used to trigger the MBS tube between each line. Signal information is being applied to 4 channels only to make the picture clearer. Particular note should be taken of the lack of cross modulation between the traces.

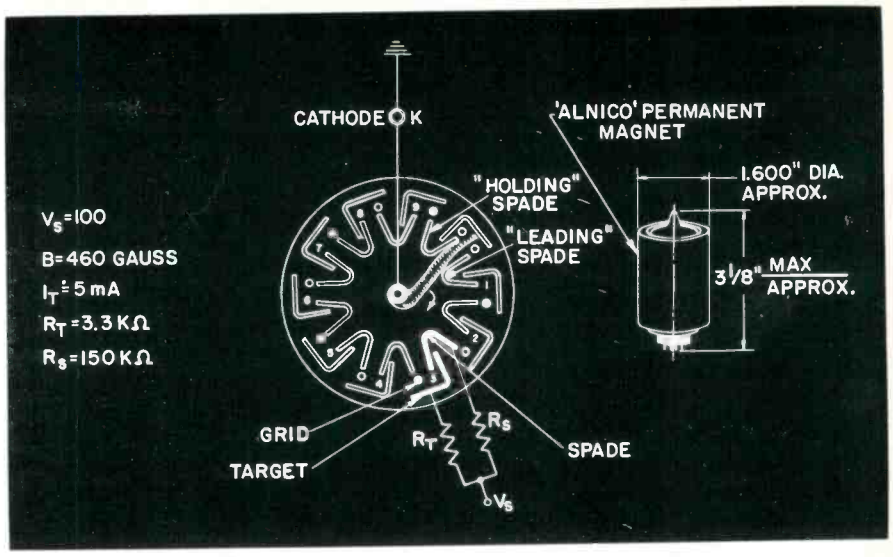


Fig. 2: Cross-section of "Beamplexer" tube used for multiplex operation

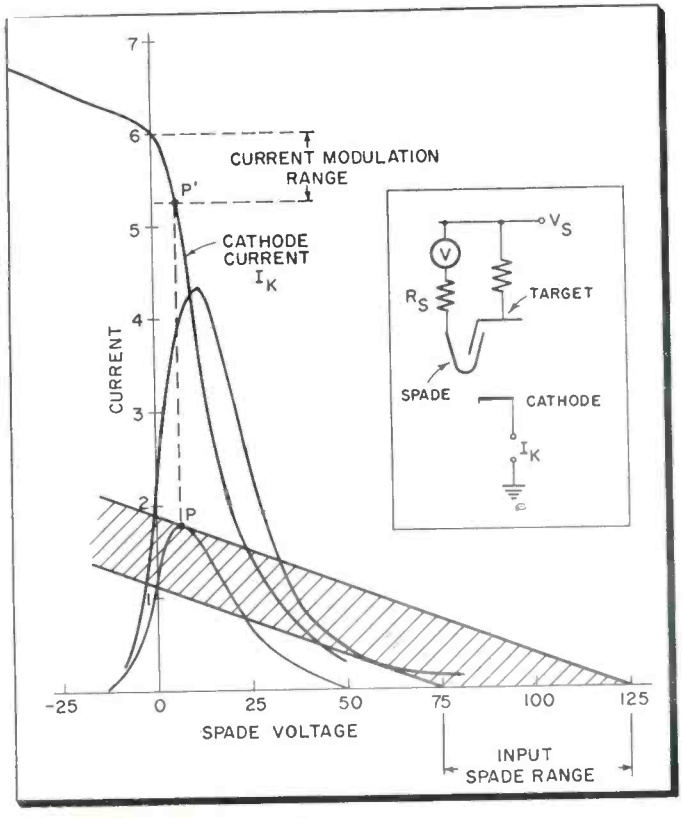
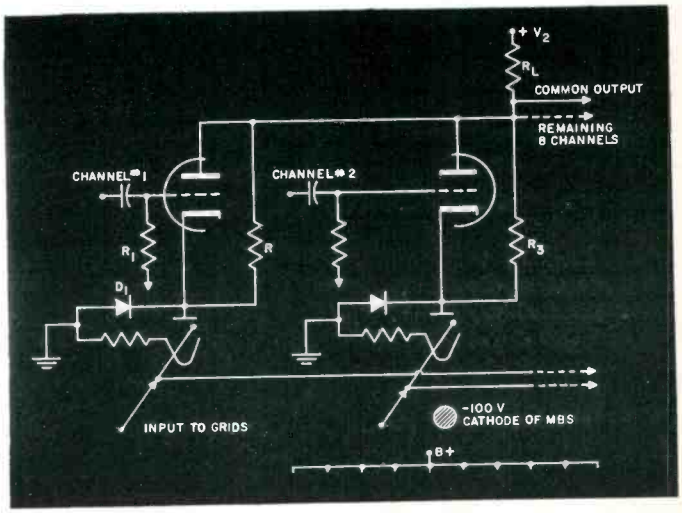


Fig. 3: Holding and leading spade characteristics

Fig. 4: Output pulses are injected directly into cathode



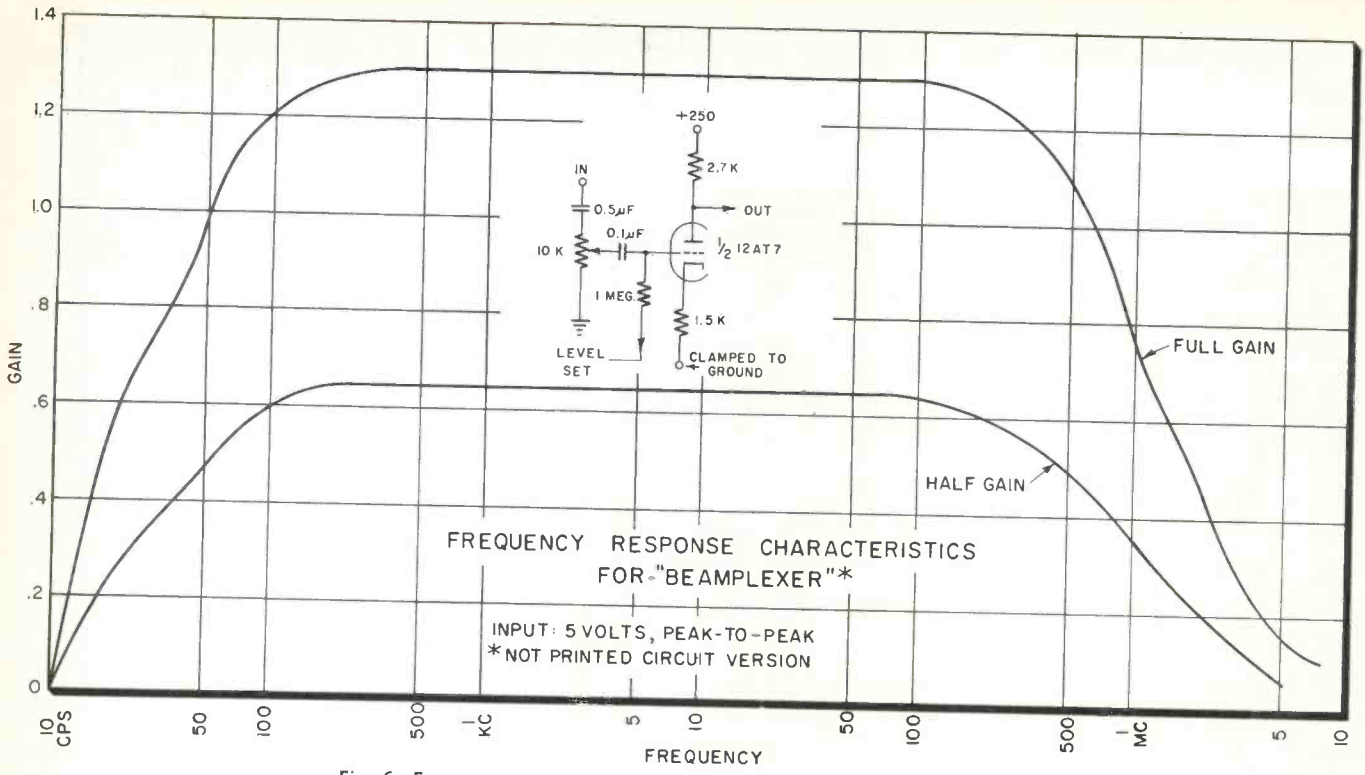


Fig. 6: Frequency response curves for each of the triode gate systems

Multiplexer *(continued)*

Analysis of the System

1. Commutation Noise. Fig. 8 is a diagram illustrating the concept of commutation noise in a time division multiplexing system. The resistors r represent the dynamic resistance of the gating tubes shown in Fig. 4 and it is supposed that these resistors are modulated in value by the signals which are being examined. The output is taken from the common load R_L in the manner shown in Fig. 4. C represents the stray capacitance associated with the anodes of the gating tubes.

We now suppose that in Fig 8(a) the switch takes a finite time Δt to move from contact to contact. Fig. 8(b) then indicates diagrammatically the wave shape which would be observed at the output point of Fig. 8(a). It will be noted that the generated wave is an exponential rise, terminated by an exponential fall starting at the instant the switch re-closes in the next position. Obviously, this pulse is of an interfering nature and can be eliminated only if the fly-over time between the contacts is zero. In Fig. 8(b) the dc levels of the several outputs are shown to be the same because in the diagram from which it is derived, all gate tubes are supposed to have the same resistance. In practice, of course, this would not usually be the case since the resistor R_1 shown in Fig. 4 would normally be set so that the dc levels for each channel were different. Here essentially the same result applies as shown in Fig. 8(b) except that the dc levels instead of being connected by vertical lines to form infinitely steep steps are joined by a pair of exponentials.

The actual situation so far as commutation pulse interference is concerned is somewhat more complicated than that indicated in the simplified circuit of Fig. 8(a) since another time constant, namely, that associated with the cathode capacitance of the tube in Fig. 4 is involved. However, the basic principles are unchanged and indicate the necessity for the fastest possible fly-over time in the basic switching element, i.e. in this case, the MBS tube. This is of the order of 1/5th of a μs, but the duration of the pulse disturbance arising therefrom is very considerably longer since the various time constants involved with it in the gating system act as

(*Continued on page* 149)

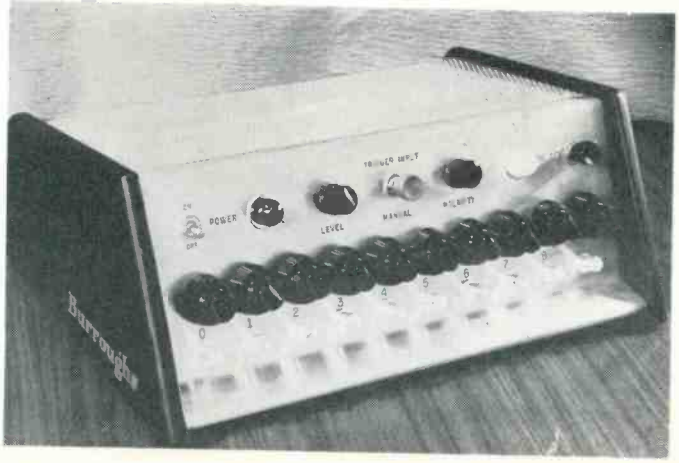


Fig. 5: Complete instrument. Incorporates 10 channels similar to that shown in Fig. 4

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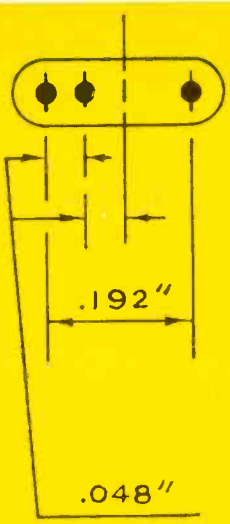

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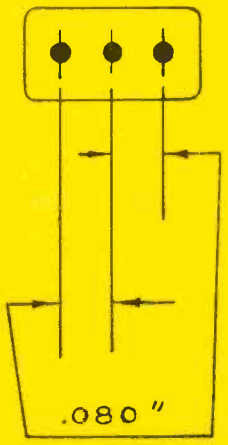

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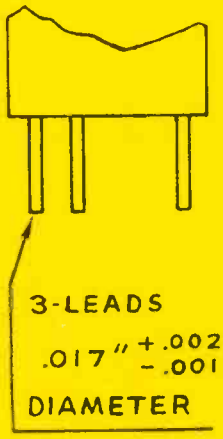

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These sockets (above) are five contact printed wire subminiature sockets having .040" centers.

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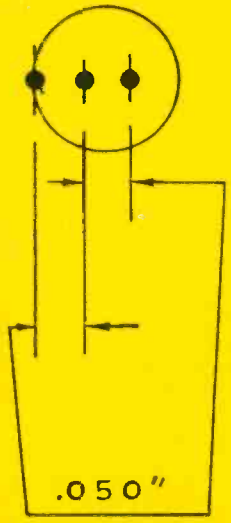
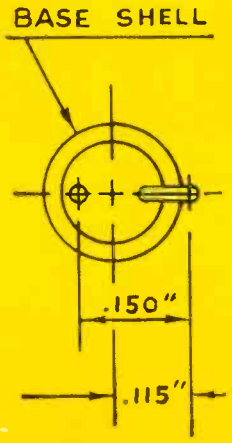


54A 17431

54A 16995

(Left) Four contact subminiature socket having .048" centers.



FOR PRINTED WIRE APPLICATIONS:

46P 22485

46A 22452

54A 14273

54A 14148

Also EXP 9402, Printed wire right angle socket (Not shown above)

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

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Cinch ELECTRONIC COMPONENTS

CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

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

Centrally located plants at Chicago, Pasadena, Shelbyville and St. Louis

Survey of Industrial TV

Part Two

System manufacturers are looking to '56 as the first "boom" year in the industrial TV field. 5,000 installations are visualized by year's end. Reviewed here are the major systems presently offered.

Kay Lab Model 1985 TV camera

KAY LAB

Industrial Television System, Model 1985A

Specifications

Bandwidth: 8 MC video amplifiers throughout.
Horizontal Resolution: 600 lines.
Sensitivity: 1-volt video output across 75 Ω at 25 ft. candles. Minimum light level—1 to 2 ft. candles.
Dynamic Range: Output signals to 2 v. will not cause compression.
Compensation: The camera control video amplifier includes aperture correction and high peaker.
Scanning: Standard 525 line, 2:1 interlace.
Sync Generator: Full prime number count down (5:7:5:3), 60 cycle line locked, Phontastron sync generator.
Linearity: Better than ±2%.
Mechanical Features: Plug-in removable subassemblies.
Power Requirement: 100 to 130 v., single phase, 60 cycle.
Current Required: 3 a. (Camera and Camera Control).

TV Camera, Model 1985

Specifications

Video Frequency Response: In excess of 8 megacycles.
Lens Mount: 16 mm, Type C.
Output Connector: Cannon, Type FK-24-32S.
Net Weight: 6 lbs.
Power Required: Furnished by Camera Control.

Camera Control, Model 1985A

Specifications

Video Compensation: High peaking and aperture correction.
Video Output: 1-v. negative video; 0.4-v. sync.
Scanning: Standard 525 lines, 2:1 interlace.
Line Frequency (horizontal): 15,750 cps.
Frame Frequency (vertical): 60 cps.
Driving Pulse Output: —4 v.
Horizontal Pulse Width: 10 micro seconds.
Vertical Pulse Width: 1000 micro seconds.
AFC: Sync generator locked to the 60 cycle line frequency.
Line Voltage: System operates over voltage range of 100 to 130 v., 60 cycle, single phase.
Line Current: 3 amps.
Dimensions: For standard 19-in. rack mount, 19 x 8¾ x 15 in.
Net Weight: 40 lbs.
Shipping Weight: 60 lbs.

Kay Lab Model 1985 camera control and monitor

Remote Monitors, Model Arm-1,-2,-3

Specifications

Video Termination: 75Ω, switch in or out.
Input Power: 110 v., 60 cycles ac, 250 w.

	Model ARM-1 (10-in.)	Model ARM-2 (17-in.)	Model ARM-3 (21-in.)
Dimensions:			
Height	12¼	14	19
Width	19	19	21¾
Depth	19	23	20⅝
Net Weight (lbs.)	50	79	95

CAPEHART-FARNSWORTH

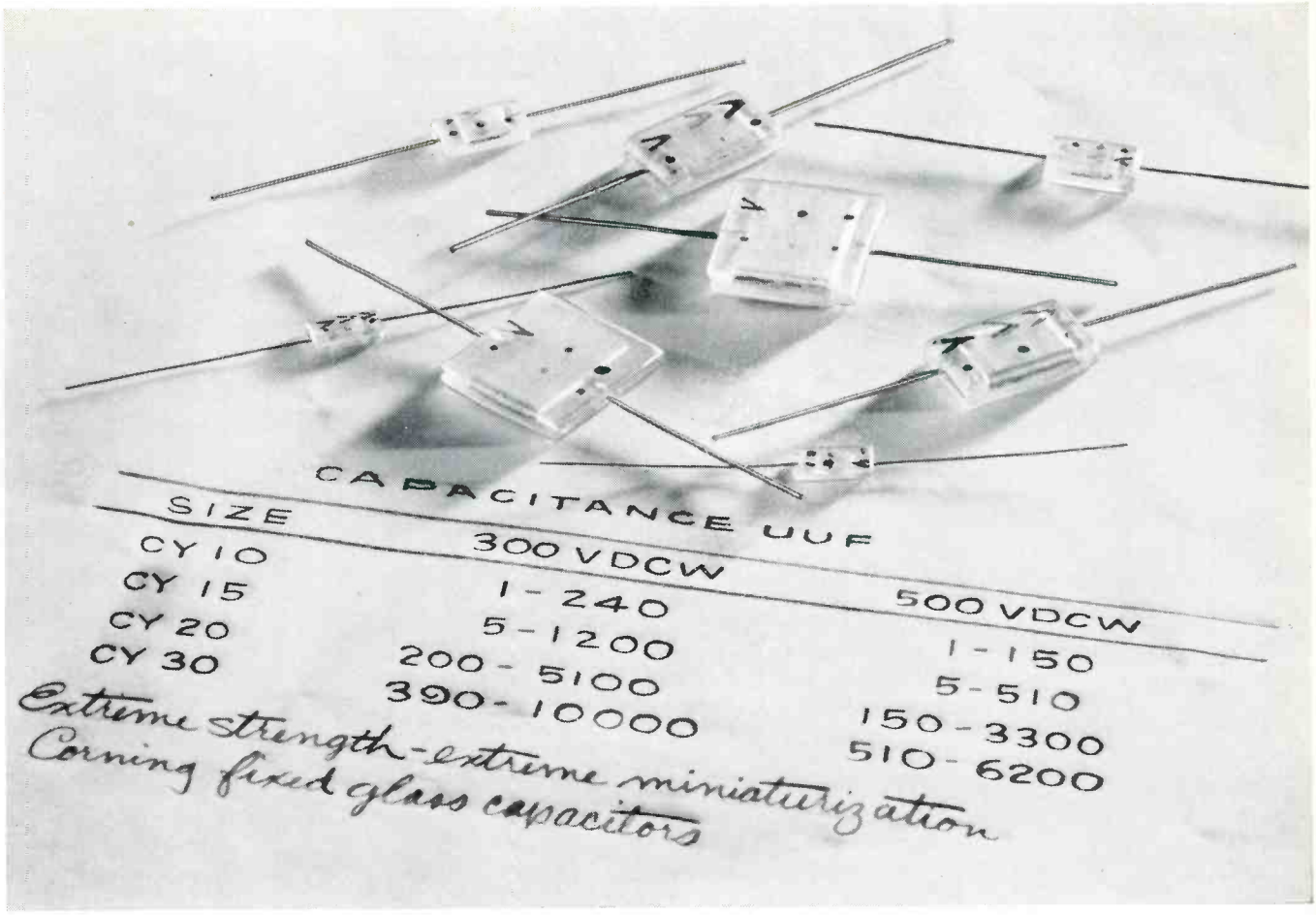
Industrial Television System, Model 600A

Specifications

Scanning Frequencies: Standard RETMA interlaced scan; 525 lines, 60 fields, 30 frames per second horizontal frequency 15750, (vertical 60, synchronous with power line frequency).
Scanning Linearities: Maximum deviation of ±2% of picture width.
Monitor Picture Tube: 8½ x 6⅜ in. scanned area.
Illumination Levels: Approximately 30 to 50 ft.-candles of average scene illumination for a 10 to 1 signal-to-noise ratio. Satisfactory pictures obtained with scene illuminations of from 5 to 10 ft.-candles.
Resolution: Horizontal: 600 television lines at 5 to 10% modulation. Horizontal with aperture correction: 600 television lines at 100% modulation.
Vertical: 400 television lines.
Video: Video Bandwidth (System) 7.5 MC +0, —3db. Video Voltage Gain: Camera, 30. Monitor, 2700. Maximum high-frequency gain with full aperture correction: 40,000,000. Video Output: 1.4 v. composite.
R-F Transmitter: 12 MC double-sideband transmission. Center frequency tunable from 50 MC to 88 MC (covering channels 2 through 6). R-F output 0.1 v. into 72 ohms. Modulation up to 90% with the modulation characteristic linear within 10%. Frequency stability adequate for commercial television receiver operation.

(*Continued on page* 88)

Units of Capehart-Farnsworth's TV system



You'd have to smash a Corning Capacitor before you could alter its values by mechanical shock

That's how rugged these miniature fixed glass capacitors are. ("Miniature" means about one-third smaller than other kinds of equal capacitance.)

Their strength comes from the way we make them. Layers of conductor and dielectric are sealed together under heat and pressure into a monolithic structure. No mechanical shock short of shattering the seal alters the value. Speaking of values, the table illustrated above shows them.

Because everything is sealed in the same material as the dielectric, nothing outside can get inside.

You can use these capacitors to temperatures of 125° C. and higher with proper voltage derating. Even after repeated temperature cycling, the TC remains the same. And TC stays within close limits over a wide temperature range, varies little between capacitors. Capacitance drift is so close to zero that it's generally less than the error of measurement.

We can make capacitors to your electrical and physical specifications over an unusually varied range. Single, self-supported units can be designed for high voltages or high capacitances. Series parallel combinations still further extend the range.

Circle the reader service of this publication, or write direct for more information about Corning Fixed Glass Capacitors, prices and samples.

Ask for information on these other Corning Capacitors:

Medium Power Transmitting—CY-60 and CY70. Ideal for mobile RF transmitters.

Canned High Capacitance—provide the advantages of rugged glass design to your specifications.

Subminiature Tab-Lead—up to 90% less volume compared to pigtail types. To your specifications.

Special Combinations—the performance and benefits of glass in infinite shapes, sizes and leads. To custom order.

Other electronic products by Corning Components Department:

Fixed Glass Capacitors*, Transmitting Capacitors, Canned High-Capacitance Capacitors, Subminiature Tab-Lead Capacitors, Special Combination Capacitors, Direct-Traverse and Midget-Rotary Capacitors*, Metallized Glass Inductances, Resistors.

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RESPONSE, RUGGEDNESS and VERSATILITY

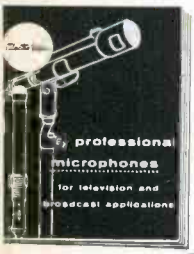
Engineers and Management both want

E-V DYNAMIC MICROPHONES for TV and BC

Serving Stations Coast to Coast
DAY-IN AND DAY-OUT

You're ahead in every feature when you use Electro-Voice Microphones. *For the engineer*...this means easier, better set-ups; high sensitivity; high signal-to-noise ratio; stable, wide-range reproduction; trouble-free operation; utmost versatility and convenience. *For management*...this means positive performance; more in-service, less out-of-service time; greater economy.

All models have the exclusive E-V indestructible Acoustalloy diaphragm. Slim-Trim models also have integral blast and wind shield. No closely associated auxiliary amplifier equipment is required. Each microphone is guaranteed to be within its very close tolerance specifications. In addition, E-V manufactures a full line of accessory microphones for intercom, paging and utility applications.



New Catalog 120 gives complete information on E-V professional microphones for TV and BC.

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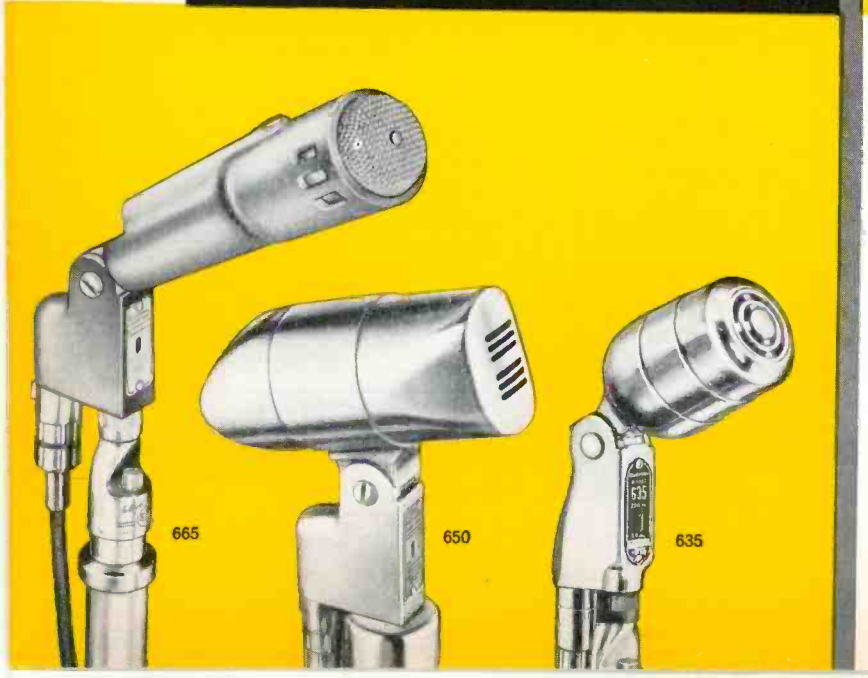

Model 666. Variable D* Cardioid. Response 40 to 15,000 cps. Output level -55 db. Provides high front-to-back discrimination. No proximity effects. TV gray. Weighs only 11 oz. **List Price**.....$245.

Model 655C. New Slim-Trim. Response 40 to 20,000 cps. Output level -55 db. Omnidirectional. Easily concealed in studio props. TV gray. 1-in. diam. **List Price**.....$200.

Model 654. Slim-Trim. Response 50 to 15,000 cps. Output level -55 db. Omnidirectional. Impedance selector. TV gray. 1-in. diam. **List Price**.....$95.

Model 646. Lavalier-type. Response 40 to 10,000 cps. Adjustable for chest use. Output level -55 db. Omnidirectional. TV gray. 1-in. diam. Weighs only 7 oz. **List Price**.....$140.

Model 649. New extra-small lavalier. For chest, desk or hand. ¾-in. diam. 2¾-in. long. Omnidirectional. Output —62 db. Response 70 to 13,000 cps. Wt. 2 oz. TV gray. **List**.....$115.

Model 665. Variable D* Cardioid. Response 50 to 14,000 cps. Output level -55 db. Unidirectional. Impedance selector. TV gray. **List Price**.....$130.

Model 650. Response 40 to 15,000 cps. Output level -48 db. Omnidirectional. Dual-type external shock mount. Impedance selector. TV gray or satin chrome. **List Price**.....$150.

Model 635. "Workhorse" of the industry. Omnidirectional. Response 60 to 13,000 cps. Output level -55 db. Impedance selector. TV gray or satin chrome. **List Price**.....$75.

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captured with stark realism on COOK records

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With the newly expanded line of Audiotape, this unsurpassed recording quality is now available to every tape recordist — professional and amateur alike. Five different types of Audiotape provide the base materials and recording times to meet every recording requirement to *best advantage*. For complete information on the entire Audiotape line, send for a copy of Bulletin 250.

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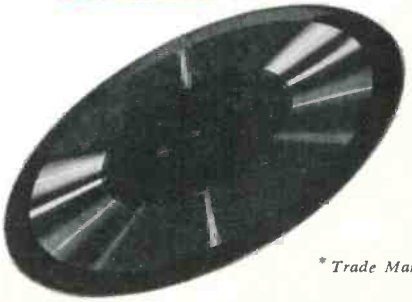
audiotape*

...master recordings on
audiodiscs*



* *Trade Mark*

Survey of Industrial TV

(*Continued from page* 84)

Timer: Will stay locked in with line frequency variations from 55 to 65 cps. Will pull into synchronization with the power lines at frequencies from 57 to 63 cps.
Temperature: Continuous Rating

	Camera
Range	−40°C to 40°C
Rise	20°C
Cooling	Convection
	Monitor
Range	−40°C to 50°C
Rise	20°C
Cooling	Forced Air Filtered

Power:

	Volts	*Watts*	*Frequency*
Input	105-125	550	60 cps

Physical

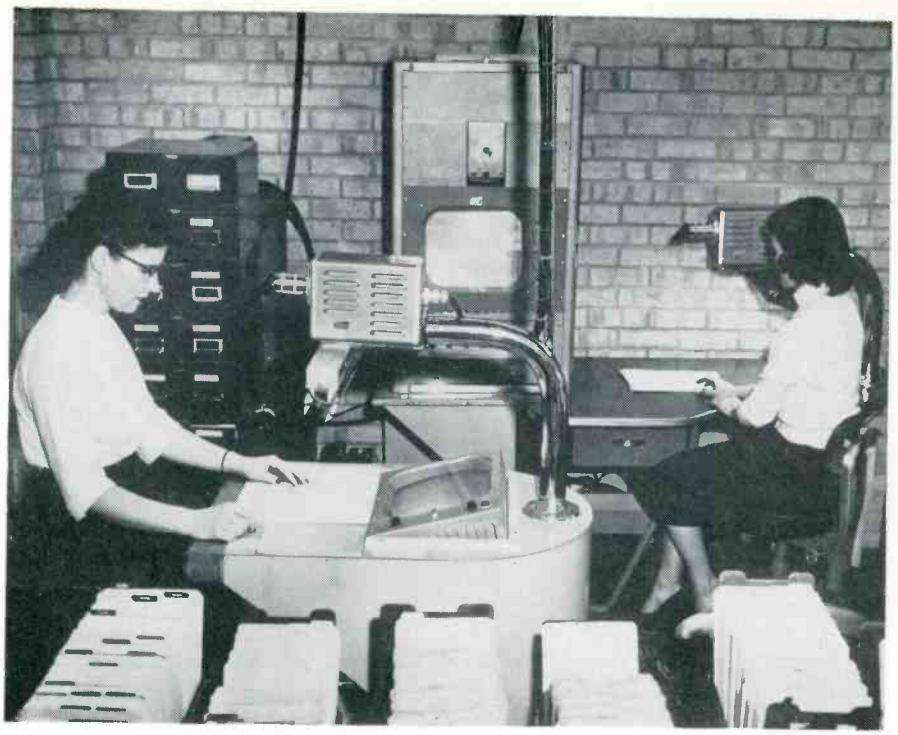
		Weight
Camera	4½ x 7 x 11 in.	9½ lbs.
Monitor 13	x 20 x 25 in.	134 lbs.
50 ft. of Cable with connectors		22 lbs.

DAGE TV

Industrial TV Camera, Model 60B

Electrical

Output: 100,000 μv, 1 v. flat neg.
Power: 115 v. −45 watts.
Scanning: Vertical 60 CPS, locked to line. Horizontal, 15,750. Random interlace; full interlace optional at extra cost.



Scooter-mounted Dage TV camera and monitor speeds bank record keeping

Optical

Light required: To less than 10 ft.-candles.

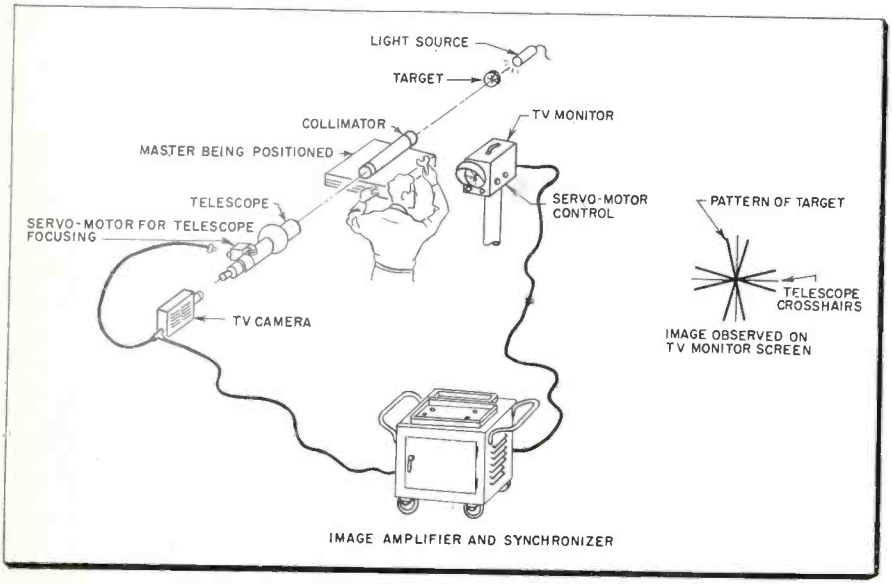
Mechanical

Dimensions: 6¾ x 5⅛ x 11 3/16 in.
Weight: 10 lbs.
Resolution: Better than 400 lines.
Camera-to-monitor: Up to 1,500 ft. without line amp.
Camera delivers video signal and r-f signal simultaneously.

Video Monitor, Model 602-A

Video Input: .1 v., p-p, minimum; 4 v. max.
Sync In (when used) — negative; min. .1 v., max. 4 v.
Contrast control range: 30 db min.
Input impedance is for high impedance bridging, but can be terminated.
Uses 14QP4 kinescope.
Frequency Response: To 8 mc on wideband; to 4 mc on narrow band.
Video Gain: 47 db on wideband, 57 db on narrow band, ±3 db.
Line voltage: 117 v., ±7 v., on 50 or 60 cps.
Weight: 53 lbs.

TELECHROME INC.



Closed-circuit TV system for application to optical tooling. High-quality system providing minimum 600 line resolution. Pickup tube is 6326; interlace is 2/1. Camera-to-console—50 ft (can be increased to 1,000 ft.).

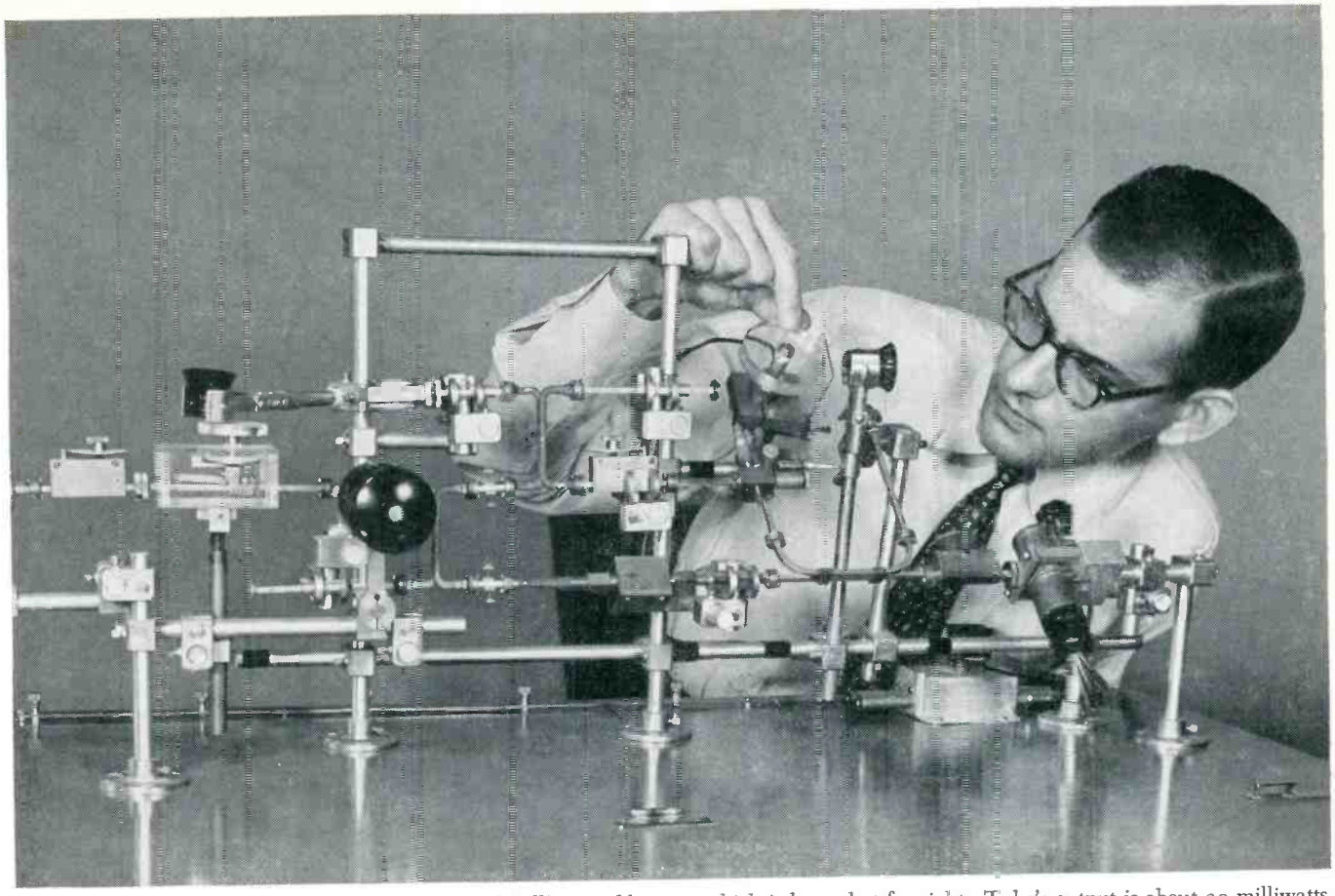
Color TV Film Camera, Model 360A

Output to 51.5 ohms.
Light Required: 30 ft. candles, measured at field relay lens.
Dimensions: 16½ x 8½ x 23⅛.
Weight: 37 lbs.

Color TV Monitor, Model 650A

Signal requirement: .5 v., p-p.
Sync.: composite, neg., 4 v., p-p nominal.
Pix tube: 15GP22, or equiv.
Resolution: 450 lines.
Power: 117 v., 60 cps, 280 watts.
Dimensions: 19 x 17 x 23.

In addition to the basic units described here, most of these manufacturers also produce special equipment tailored to fit specific applications, such as high ambient conditions or exceptional accuracy. A firm which services this custom field, only, is Telechrome Inc., of Amityville, N. Y. A typical application of their equipment is seen in the accompanying photo.



Physicist G. K. Farney checks the frequency of Bell's new klystron, which is located at far right. Tube's output is about 20 milliwatts.

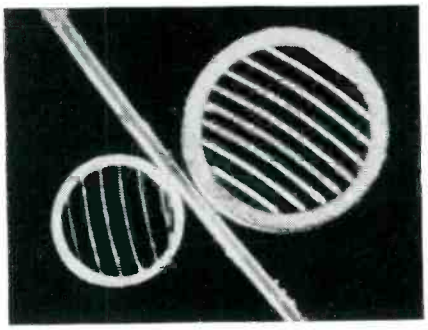
Sixty billion vibrations per second

A great new giant of communications—a waveguide system for carrying hundreds of thousands of voices at once, as well as television programs—is being investigated at Bell Telephone Laboratories.

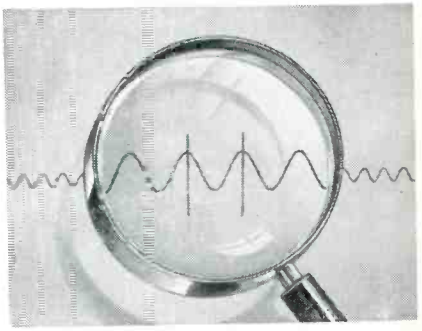
Such a revolutionary system calls for frequencies much higher than any now used in communications. These are provided by a reflex klystron tube that oscillates at 60,000 megacycles, and produces waves only 5 mm. long.

The resonant cavity that determines the frequency is smaller than a pinhead. The grid through which the energizing electron beam is projected is only seven times as wide as a human hair, and the grid "wires" are of tungsten ribbon 3/10,000 inch in width.

G. K. Farney, University of Kentucky Ph. D. in nuclear physics, is one of the men who successfully executed the development of the klystron. Dr. Farney is a member of a team of Bell scientists whose exciting goal is to harness the immense bandwidth that is available with millimeter waves . . . and to make certain that your telephone system remains the best in the world.



Grids in new tube, enlarged 30 times, with human hair for comparison. Electronic beam passes through smaller, then larger, grid.



Wavelengths produced by the klystron tube are only .2 inch long—1/15 that of the transcontinental radio relay system.

BELL TELEPHONE LABORATORIES

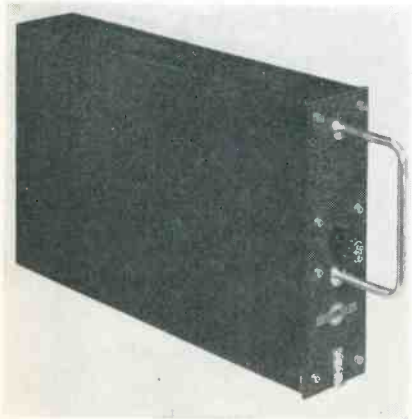
WORLD CENTER OF COMMUNICATIONS RESEARCH

Electronic Reliability

(*Continued from page* 67)

material and in stating the operating problems; yet at the crucial time of bidding and costing the job, primarily the written "shall's" and "must's" of the contract are seriously considered in a competitive bid proceeding for production equipment. A successful bidder cannot be confident that he will get more orders for the same product in the next bidding process, or even that more of the same black boxes will be bought by the military agency. Thus, the important incentive, that a first-rate job will get additional orders, is absent. This same situation, coupled with frequent lack of feedback of field performance data, may easily leave the manufacturer without the desire to improve the product as the production moves forward. The result of this is to place an especially heavy burden on the military specification writer who faces the impossible task of foreseeing all possible eventualities, and who must attempt to make rules on reliability where no rules have been invented. The project engineer and the equipment inspector must often start from scratch to give the successful "qualified" low bidder all the necessary guidance on the actual job to be done. They must also act the policeman, to assure that all the many rules are followed, and the judge, to assure that the rules fit the game. The Government must use legal authority to protect itself from the incompetent and negligent contractor. The result is often undesirable restriction of the vast majority of well-qualified and highly conscientious manufacturers.

Fig. 3: Collins short ¼ ATR Interphone and isolation amp is typical of new form



The problem is made all the more difficult because it is the military agencies, particularly those concerned with aircraft, who must pioneer the new techniques, the innovations, and the magic of putting a cubic foot of electronics into a few cubic inches, with combat readiness and reliability a constant must.

The Airlines' Approach

By comparison, the airlines' approach to new equipment and the reliabilization of production equipment is by its very nature far more simple and direct. The commercial user can be far more independent as to rules and regulations, and because the scope is smaller, can achieve a very intimate relationship with the potential manufacturers.

Fig. 4: Airline radio operator's position

The airlines, on beginning work on a new equipment, normally set up a Subcommittee of the Airlines Electronics Engineering Committee to prepare the Equipment Characteristic. Recognizing that only the items on which complete agreement can be reached can go into the Characteristic, the meetings of the Subcommittee are nearly always completely open. The interested manufacturers are free and extremely welcome to attend and participate in the discussions. In the free and competitive atmosphere of an airline meeting the proximity of sellers to potential customers provides an excellent foundation for the exchange of ideas and possibilities. It permits the equipment designer to get a "feel" for the airline problem and to influence the writing of the Characteristic by the contribution of technical information and logical argument. The manufacturers know that their success depends not upon the first sale, but entirely upon the worth of the product to bring in new business when the airline buys a new group of airplanes or when other airlines start to buy equipment. Because maintenance is done at one or only a few central bases in each airline, the maintenance records and thus performance "feedback" are usually good. The manufacturers as well as the other potential customers hear very quickly if a new equipment is falling on its face in service.

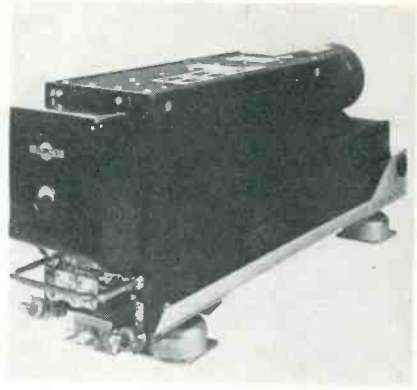


Fig. 5: Collins 25-watt, 360-channel VHF transmitter in long ½ ATR case

Development

The development of new airline equipment is done almost entirely on the manufacturer's initiative and at his own expense; thus the incentive to determine the exact needs and the desire to build exactly what the customer wants is very strong. Usually at least two manufacturers develop and offer new equipment to the airlines to meet an Equipment Characteristic. Since the Characteristic is not binding on anyone and merely represents the industry opinion without obligations attached, the

(*Continued on Page* 123)

Now Available...

FIRST HF TRANSISTORS

now in production, meeting

Army Signal Corps Standards

A wide variety of military equipment, once impossible to transistorize due to frequency limitations of available transistors, is now being developed with Philco Surface Barrier Transistors.

PHILCO SBT

SURFACE BARRIER TRANSISTORS

(Type 2N128 and 2N129)

Meet MIL-T-12679A Military requirements

Check These Features

- High frequency performance
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- Rigid quality control
- Minimum battery drain
- Low leakage currents
- Low operating voltage
- Absolute hermetic seal
- Meet MIL-T-12679A Military requirements

Now available for large volume military and industrial applications . . . the high frequency Philco Surface Barrier Transistors that were developed for the Army Signal Corps to meet the stringent requirements of field use in military electronics equipment. Advanced precision techniques used in fabricating the Philco Surface Barrier Transistors make possible rigidly controlled automatic manufacture with its resultant uniformity, reliability and high volume production. These reliable transistors point the way to new fields in transistorization. Make these reliable high frequency Philco Surface Barrier Transistors part of your forward looking plans.

For complete technical information on these High Frequency transistors write Dept. TT-3 LANSDALE TUBE CO., Lansdale, Pa. A DIVISION OF PHILCO CORP.

PHILCO CORPORATION

LANSDALE TUBE COMPANY DIVISION

LANSDALE, PENNSYLVANIA

	Dayton Biltmore Hotel		Engineers Club	
	Main Ballroom	*English Room*	*Auditorium*	*Italian Room*
Monday May 14, 1956 9:00-11:30	Magnetics I	Components I	Semi-Conductors	Circuits
Monday May 14, 1956 2:00-5:00	Management	Environment	Electron Tubes I	Testing and Test Equipment
Tuesday May 15, 1956 9:00-11:30	Computers I	Components II	Semi-Conductor Circuits I	Antennas I
Tuesday May 15, 1956 2:00-5:00			FORUM	Human Engineering
Wednesday May 16, 1956 9:00-11:30	Magnetics II	Radio Interference & RF Cables	Semi-Conductor Circuits II	Antennas II
Wednesday May 16, 1956 2:00-5:00	Computers II	Analysis Techniques	Electron Tubes II	Equipment

Technical program for the three-day engineering conference

Aeronautical Electronics Conference (*Continued from page 71*)

SEMI-CONDUCTOR CIRCUITS I

Moderator: Dan Noble, Motorola

9:00—"Communication Circuits Using Germanium Transistors," Robert E. Wilson, Radio Corp. of America.

9:30—"Low Level Transistor Amplifiers," P. L. Putzrath, Radio Corporation of America.

10:0 —"A Transistorized Automatic Gain Control for Variable Gain AC Servos," Ralph Gittleman, W. L. Maxson Corporation.

11:0 —"A Transistor Demodulator Limiter," N. L. Johanson, Boeing Airplane Company.

ANTENNAS I

Moderator: L. E. Rayburn, Crosley Div., AVCO

9:00—"Study of Feasibility of HF Airborne Direction-Finding Antenna Systems," Philip S. Carter, Jr., Stanford Research Institute.

9:30—"The Collins 37X-1 Marker Beacon Receiving Antenna," J. P. Shanklin, Collins Radio Company.

10:00—"Pattern Shaping with Surface Wave Antennas," Robert S. Elliot, Hughes Aircraft Company.

10:30—"Shunt-Fed and Notch-Fed Aircraft H-F Antennas," Robert L. Tanner, Stanford Research Institute.

Tuesday Afternoon

FORUM

Moderator: James W. McRae, President, Sandia Corporation

"How to Accelerate Research and Development of Aeronautical Electronics,"—Brigadier General Thomas L. Bryan, Jr., Commander, Wright Air Development Center; Dr. Douglas H. Ewing, Vice-President, David Sarnoff Labs.; Karl H. Martinez, Boeing Airplane Co.; Thomas Meloy, President, Melpar, Inc.; Julian Sprague, President, Sprague Electric Co.; Robert J. Shank, Vice-President, Hughes Aircraft Co.

HUMAN ENGINEERING

Moderator: J. M. Christensen, Wright Air Development Center

2:00—"The Use of Mock-Ups in Airborne Equipment Designing," George W. Michalec, General Precision Lab.

2:30—"Integrated Cockpit Presentation," T. J. Thomas Kearfott Co., Inc.

3:00—"New Engineering Techniques in Flight Display Evaluation," Frank Klimowski, Jr., Stavid Engineering, Inc.

3:30—"Collapsing Loss in Airborne Radar Displays," L. E. Mertens, P. N. Nesbeda and J. P. Mayberry, Radio Corp. of America.

4:00—"The PPI Display as a Linear Filter," Dr. Daniel Levine, Goodyear Aircraft Corporation.

4:30—"On Flight Instrument Quantization," L. J. Fogel and D. Jagerman, Stavid Engineering, Inc.

Wednesday Morning

MAGNETICS II

Moderator: Dr. Paul Russell, General Electric Company

9:00—"Design for Magnetic Switch," Norman Rubenfeld, W. L. Maxson Corporation.

9:30—"Design Techniques for Extremely High Powered Broad Band Ferrite Isolators from 3,000 to 36,000 MC," Tore N. Anderson, Airtron, Inc.

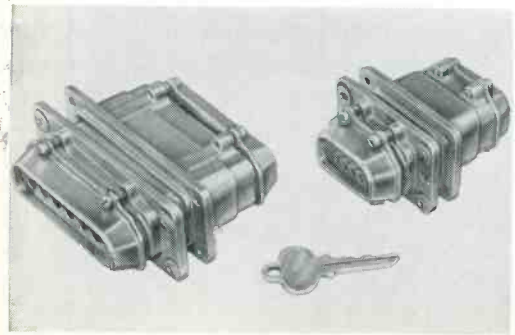
10:00—"An Amplitude Regulator for Microwave Signal Sources," Philip Fire and Perry Vartanian, Electronic Defense Lab of Sylvania.

11:00—"The Development of a 36 Kmc High Power Rotational Ferrite Duplexer-Switch Isolator for Radar Services," Tore N. Anderson, Airtron, Inc.

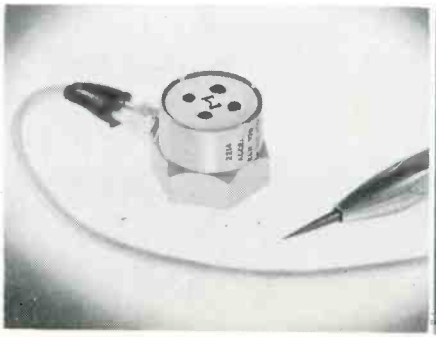
RADIO INTERFERENCE and R. F. CABLES

Moderator: Robert Lewis, Consulting Engineer (*Continued on page 116*)

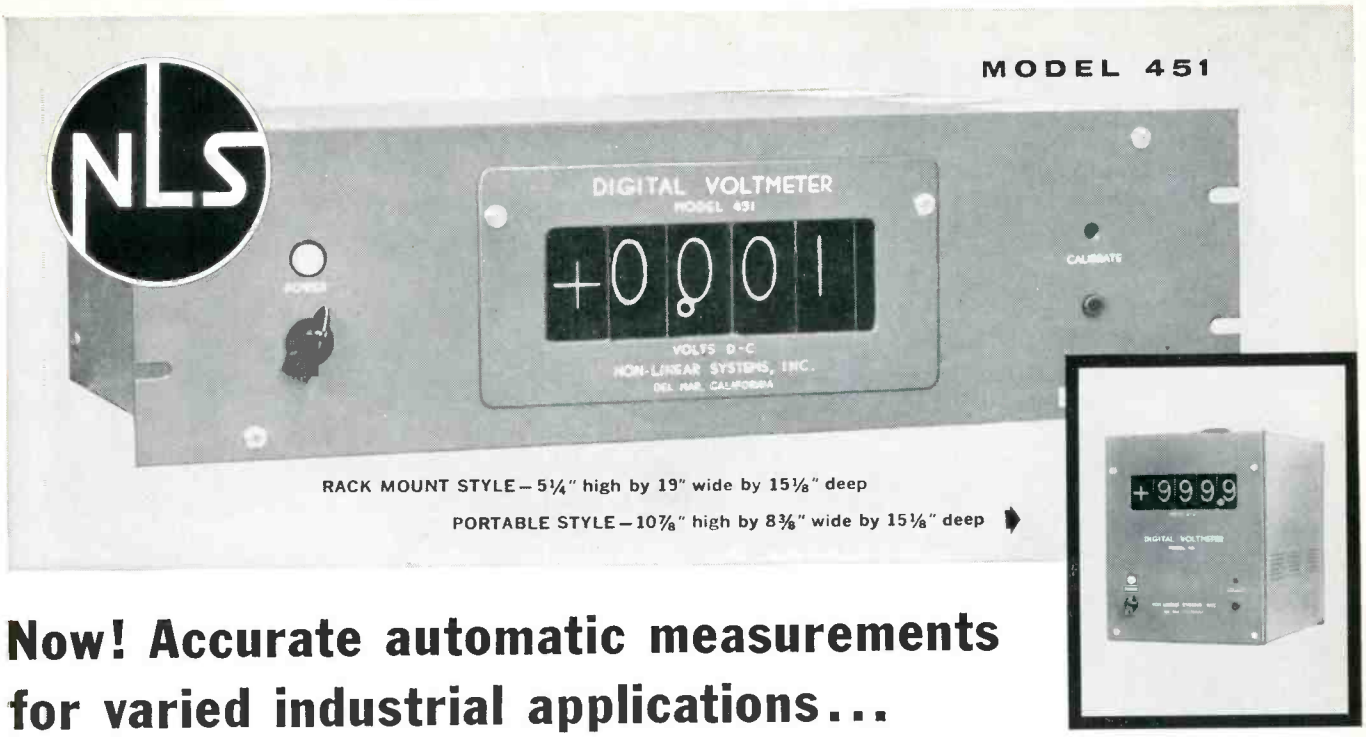
Cannon Electric DPS connector



High "G" accelerometer—Endevco Corp.



Cubic Corp.'s portable VSWR computer



RACK MOUNT STYLE – 5¼" high by 19" wide by 15⅛" deep

PORTABLE STYLE – 10⅞" high by 8⅜" wide by 15⅛" deep

Now! Accurate automatic measurements for varied industrial applications...

NOW EVERY FEATURE you want in a precise, automatic Digital Voltmeter is available in these new Non-Linear Systems models. Their *performance* features automatic measurement from zero to ± 999.9 volts DC with high accuracy and resolution. *Fast readings* are presented in a brilliant, in-line luminous numerical display. *Automatic features* simplify operation, enable you to use non-technical employes. Assured *long life* results from exclusive NLS *oil-sealed* stepping switch system, plus top-quality components. Thorough *quality control* ensures reliable operation. And unitized construction means *simplified maintenance*, saving you time and money.

Yet NLS Model 451 Digital Voltmeters are priced far below instruments offering only a fraction of these advantages! These low costs are possible because NLS, as originators of the Digital Voltmeter, has the advantage of pioneering design and production techniques. Furthermore, NLS quantity production results in additional savings.

You can save time and money, and assure automatic accuracy in precision measuring, with an NLS Digital Voltmeter. Mail coupon today for more information on how these quality instruments can assist your operations.

YOU GAIN THESE ADVANTAGES

Automatic operation — Simple operation plus brilliant numerical readout and recording allows use of non-technical personnel.

Exhaustive quality control — Sustained accuracy assured by systematic testing procedure throughout all engineering, production phases.

Unitized, standardized construction — Each instrument can be quickly disassembled into three functioning subassemblies.

Quality components, including mercury-cell reference standard, stepping switches built to NLS specifications, precision resistors and other high standard components.

Oil-sealed stepping switch subassembly cuts maintenance, boosts switch life, ensures reliability under all operating conditions.

Long-life stepping switches — Life tests corresponding to 21,000,000 readings completed, with switches still operating!

Simplified maintenance, resulting from unitized construction, saves you time and money.

No-lost-time service — Interchangeable subassemblies and complete instruments available promptly.

Automatic recording by electric typewriter, printer, summary punch.

Low initial cost, based on NLS integrated, efficient production methods, and on advanced engineering developments.

New! Automatically-standardized reference power supply eliminates manual adjustment; available instead of internally-mounted mercury-cell battery pack.

APPLICATIONS

Automatic measurement, digital display and recording of DC voltages for:

Manufacturing — Development, production and process control testing.

Laboratories — Precision standardization procedures.

Special test equipment — Analog computers, missile components, control systems.

Many more! Our application engineers are available to work with you.

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New Avionic Products

SERVO MOTOR

New high speed high temp. servo motor tachometer generator, Type MG-3088, has a no load speed of 19,600 RPM and continuous operation at 140°C ambient temp. In-

ertia is 2.85 gm.-cm². The device consists of a size 11 2-phase 2-pole servo motor and a drag cup type tachometer integrated into a single compact homogeneous unit 1.03 in. max. dia. by 2.156 in. long and weighing 4.6 oz. Motor portion has 26v. 400 cycle input, .26 oz.-in. stall torque min., and 12.5 w. stall wattage. **John Oster Manufacturing Co., Racine, Wis.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 5-1)

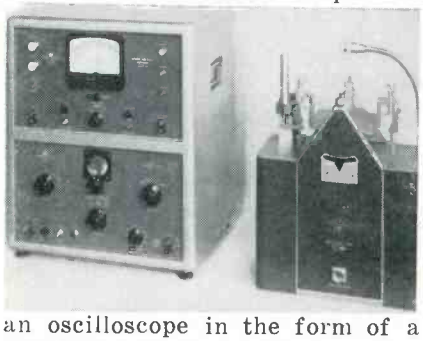
DUAL CONTROL PANEL

For remote control and sensing of the operation of radar air pressurizing equipment in aircraft the Dual Control Panel is used in conjunction with Model RR-15020-A Dual Pressurizing unit. Panel consists of air pressure gages, electrical switches and two panels. The toggle switches override the pressure switches in the Model

RR-15020-A Dual Pressurizing unit so that the radar system can be checked on the ground. **Lear-Romec Division Lear, Inc., Elyria, Ohio.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 5-15)

SIMULATION TABLE

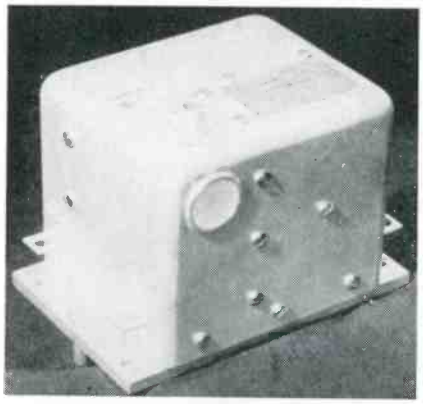
Frequency response and threshold characteristics of gyros and low range accelerometers are determined by displaying table position and instrument output on



an oscilloscope in the form of a Lissajou pattern or by recording these quantities on a recorder. The table with its associated amplifier is a high performance servo system with a natural frequency in excess of 15 cps and a threshold of less than 5 microradians. Damping ratio is adjustable from approximately 0.1 to 1.0. Max. angular displacement is ±10°. **Micro Gee Products, Inc., Box 1005, 6100 W. Slauson Ave., Culver City, Calif.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 5-13)

PDM-FM TRANSMITTER

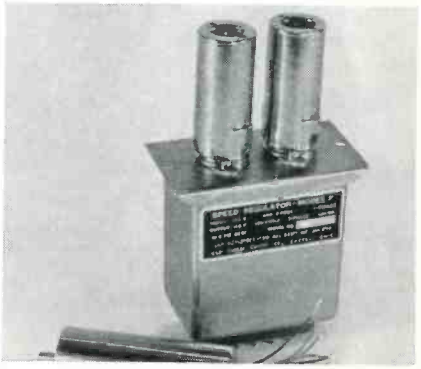
Model 1463-A VHF-FM Transmitter is a miniature unit capable of supplying 20 w. min. of rf power into a 50 ohm load over the frequency range of 215-235 MC. Unit is designed for FM modulation and will produce a deviation of ±125 KC at the output frequency. The transmitter is completely self-



contained except for power supply and cooling air supply. It is designed for bulkhead mounting. **Telechrome, Inc., 632 Merrick Rd., Amityville, N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES 5-16.

ADJUSTABLE DRIVE

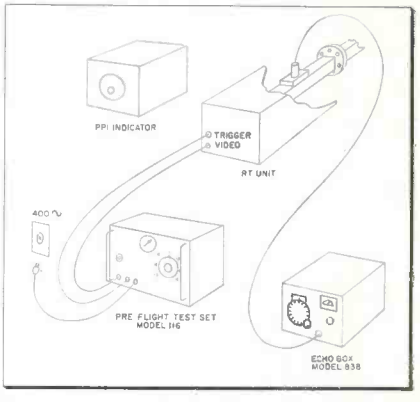
This 400 cycle adjustable speed drive provides infinite speed adjustability with close speed regulation over a range as high as 100:1. Regulated full load speeds



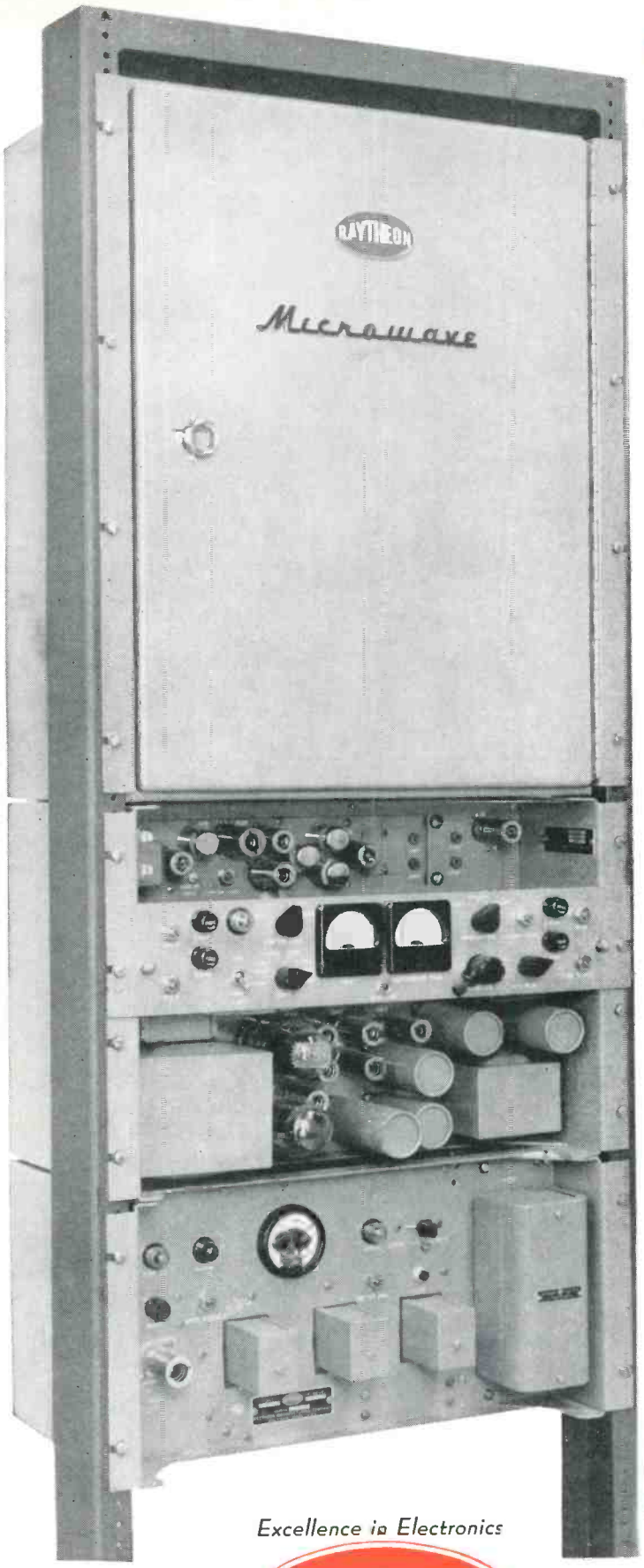
as high as 18,000 RPM are available for 400 cycle applications, and such speeds may be steplessly reduced to less than 200 RPM without reducing the load torque. The absence of brushes or slip rings reduces radio interference and renders suppressors unnecessary. **WacLine, Inc., 35 South St. Clair St., Dayton 2, Ohio.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 5-22)

PRE-FLIGHT TEST SET

In less than a minute, an accurate test of overall performance of airborne weather radar can be made by means of a new Pre-Flight Test Set. Small, light, and rugged for convenience and dependability, the Test Set operates from the 400 cycle power available in the aircraft. It is used in conjunction with the Narda 833



Echo Box, a high Q resonant cavity tuned to the radar frequency. **Narda Corporation, Mineola, L. I., N. Y.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 5-3)



NOW AVAILABLE

RAYTHEON KTR SERIES TV MICROWAVE LINKS FOR RACK MOUNTING

To meet your need for permanent TV relay installations, Raytheon now provides its famous KTR series links for fixed as well as portable use. Retaining all of their fine performance features, the KTR-100 and KTR-1000 (100 mw and one watt) are now available rack mounted for the 6000 and 7000 mc bands.

A new accessory system offers remote control of important transmitter and receiver functions and also includes an alarm circuit. Both rack-mounted and portable units can be operated with waveguide extensions. A ferrite isolator eliminates long-line effects, thus permitting indoor operation and maintenance of the entire equipment, with the antenna system separated from the radio equipment by as much as 100 feet.

In nearly 200 television stations*, Raytheon KTR links provide monochrome or color with simultaneous program audio transmission at lowest cost with greatest reliability. With the addition of rack mounted units, Raytheon now serves you with the most complete line in the industry.

PORTABLE KTR UNITS FOR REMOTE PICK-UPS

The ultimate in simplicity and portability, Raytheon KTR equipment for portable use consists of only four compact units with a total weight of 162 lbs. Portable units are available for all bands—color or monochrome with audio channel—if desired.

Names on request.

For complete information, please write Dept. 6120.

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RAYTHEON

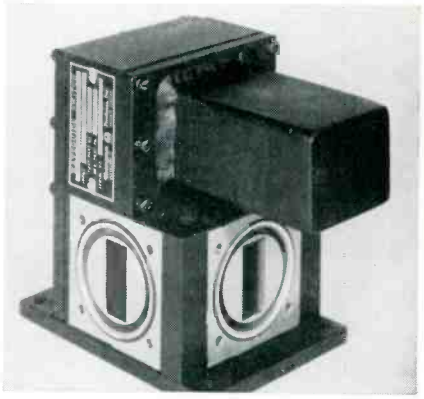
RAYTHEON MANUFACTURING COMPANY

Equipment Marketing Department, Waltham 54, Mass.

A-3012

WAVEGUIDE SWITCH

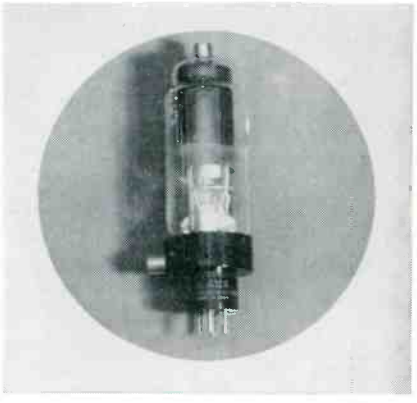
The Electronics Division of Thompson Products, Inc. has available for the microwave field a compact, airborne waveguide switch ¾ x 1½ in. guide size



with the following features: VSWR-1.05 max. in position, 1.15 max. during switching; crosstalk 45 db down; actuator 28 v dc; actuation time 0.5 sec. max.; pressurization 45 psig max.; power handling ability — approx. 0.35 megawatts cw. **Thompson Products, Inc., 2196 Clarkwood Rd., Cleveland 3, Ohio Electronics Div., Dept. H.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 5-106)

THYRATRON

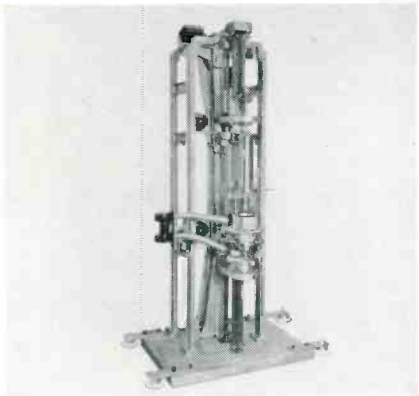
New 2.5 a. dc thyratron, designated as the NL-632B, is a mercury vapor shield grid tube, designed and specially tested for use in frequency-changer type resistance welders. Ratings are: Filament—5 v. at 4.6 a.; peak anode current—30 a., peak inverse and forward volts—1500; and maximum averaging time—15 seconds.



Shield grid construction and mercury vapor filling give stable operation even with high impedance grid supplies. **National Electronics, Inc., Geneva, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 5-24)

RATE-GROWING UNIT

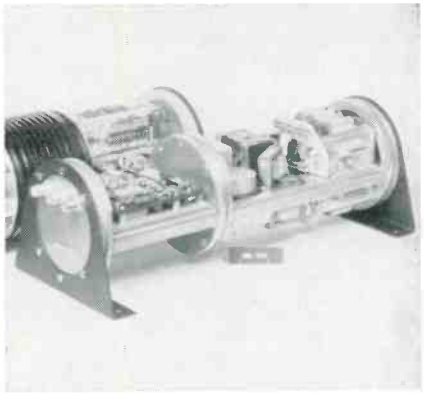
This high precision rate-growing machine is designed for faster and more uniform production of germanium or silicon single-crystal ingots. The process is



based on the insertion of a germanium or silicon seed into a similar molten metal, forming single crystals by the rate-growing process. Machines can be supplied in all sizes and types and with or without automatic programming. **Kahle Engineering Co., 1300 Seventh St., North Bergen, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 5-20)

MULTICODERS

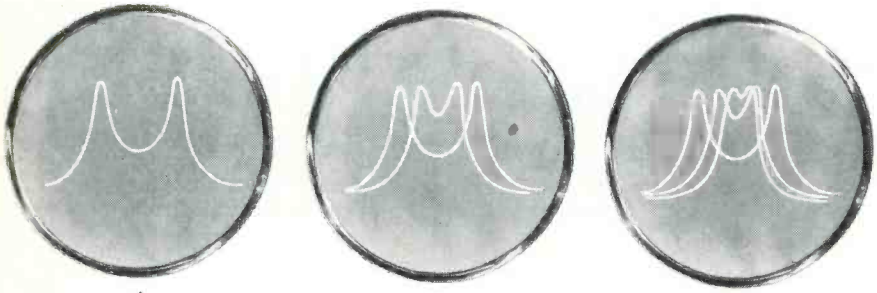
Line of functional units operate collectively as a low level Pulse-Width Multicoder. Its function is to accept output voltage signals in the low millivolt range from 43 or 88 transducers or reference sources, sample these signals in time sequence, code the data samples in pulse width form, and provide an output of pulse-width signals for operating Ampex Series 800 airborne tape recorders or



similar devices. Sampling rates of 2, 5, 10, or 20 RPS and inputs of 15 mv or 30 mv are available. **Applied Science Corp. of Princeton, P. O. Box 44, Princeton, N. J.** Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 5-11)

HUGHES MEMOTRON

A NEW TYPE OF CATHODE RAY TUBE



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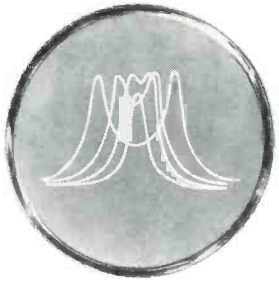


4

MAINTAINS brilliant traces indefinitely.

Now you can examine nonrecurrent phenomena without resorting to photography. The Memotron, a direct display cathode ray storage tube, retains transients—permits leisurely examination on the tube face itself.

There is no blooming or fading. And the high tube brilliance permits its use without a hood, even in well-lighted surroundings.

DISPLAYS successive transient writings.

Even the most complex patterns can be superimposed or shifted in position. The Memotron tube thereby enables you to make convenient comparisons and analyses.

INSURES superior file records.

When a file record is needed, photography is greatly simplified because all displays occur at a constant, uniform brightness regardless of differences in writing speeds. Therefore, a single camera exposure setting is sufficient.

FUNCTIONS as curve plotter.

An oscillograph equipped with a Memotron combines, into one instrument, pen-recorder performance at low frequencies and oscillograph performance at high frequencies. Successive writings may be stored to produce a family of curves.

TYPICAL APPLICATIONS: As a read-out device for the display of solutions produced by an analog computer . . . for recording shock transients during shock testing . . . in medicine for electro-cardiography and vector-cardiography. Illustrated: a technique for plotting a family of curves, representing a coupled circuit with varied parameters.

GENERAL SPECIFICATIONS

RESOLUTION . . . 50 to 60 written lines per inch.
WRITING SPEED . . . 0 to at least 100,000 inches/second (selected tubes in excess of 100,000 ips).
BRIGHTNESS . . . 50 foot-lamberts.
USABLE SCREEN DIAMETER . . . 4 inches, maximum.
DIMENSIONS . . .
Over-all length: 18 1/2 inches, ± 1/2-inch.
Bulb diameter: 5 5/8 inches, maximum.
Neck diameter: 2 1/4 inches, ± 3/32-inch.

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

For descriptive literature, please write:

HUGHES PRODUCTS
ELECTRON TUBES
11220 South Hindry Street
Los Angeles 45, California

MAY 1956

ABSTRACTS & REVIEWS of WORLDWIDE ELECTRONIC ENGINEERING

TELE-TECH & ELECTRONIC INDUSTRIES

International ELECTRONIC SOURCES

PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name
Arc. El. Uber.	Archiv der elektrischen Uber-tragung
Auto. Con.	Automatic Control
Bell J.	Bell System Technical Journal
Comp.	Computers and Automation
Con. Eng.	Control Engineering
El.	Electronics
El. Des.	Electronic Design
El. Eng.	Electronic Engineering
El. Eq.	Electronic Equipment
El. Mfg.	Electrical Manufacturing
El. Rund.	Electronische Rundschau
Elek.	Elektrichestvo (USSR)
Freq.	Frequenz
Insul.	Insulation
Nach. Z.	Nachrichtentechnische Zeitschrift
Onde	L'Onde Electrique
Phil. Tech.	Philips Technical Review
Proc. IRE	Proceedings of the Institute of Radio Engineers
Rev. Sci.	Review of Scientific Instruments
Rev. Tech.	Revue Technique, Co. Francaise Thomson-Houston
Tele-Tech	Tele-Tech & ELECTRONIC INDUSTRIES
Télonde	Télonde
Vak. Tech.	Vakuum-Technik
Vestnik	Vestnik Svyazy (USSR)

Also see government reports and patents under "U.S. Government."

ANTENNAS, PROPAGATION

Parabolic Horn Antenna for Wide-Band Directional Radio Installations, by H. Laub and W. Stoehr. "Freq." Feb. 1956. 11 pp. Structure and performance of a parabolic horn antenna designed for a FM system are discussed. Gain, radiation pattern, and band width are considered. Source 5/6-1

Interference Spectra and Antenna Filters. A Contribution to the Question of the Simultaneous Operation of Directional Arrays with Pulse Modulation, by A. Kaech. "Nach. Z." Feb. 1956. 7 pp. Pulse modulation spectra are very wide and unsymmetrical, requiring special filters. Suitable multi-stage continuously-tunable filters (1800 to 2200Mc) are described. The transmitter filter comprises four transmission line coupled resonators, the receiver filter three resonators coupled by common holes in the resonator walls. Source 5/6-3

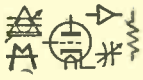
AUDIO

Contribution to the History of HF Magnetization, by J. Roemer. "El Rund." March 1956. 1 p. This is a short survey of the history, and in particular of the patent literature, of using a superposed HF-magnetizing field to improve the quality of magneting recording systems. Source 5/6-4

The Noise of an Amplifier Stage with Voltage Feedback, by H. Nottebohn. "El Rund." March 1956. 6 pp. The contributions of several noise sources in a voltage-controlled feedback stage are computed. Design considerations for magnetic tape recorder amplifiers are suggested intended to minimize the noise originating in such a stage. Source 5/6-5

Signalling Arrangement for Speed Control of Motor-Generators In Tonal Telegraphy Apparatus, by M. Ritsland and I. Kalinichenko. "Vestnik." Jan. 1956. 1 p. The article describes a signalling unit and its associated detector circuit, which controls the speed of the motor-generators (and therefore the carrier frequencies) in tonal telegraphy units. It responds to a ± 2% speed deviation, to individual speed pulses and to a cessation of electrical supply to the motor-generator rack. Source 5/6-6

A Metering Rack for Tonal Telegraphy Apparatus, by Y. Alterman, G. Demyanko, G. Parr and M. Tarakanova. "Vestnik." Feb. 1956. Article describes a complex of instruments assembled on a special rack for operative metering of the apparatus and channels of tonal telegraphy in the frequency spectrum 300-7000 cps. Circuit diagrams of the metering generator, level indicator, frequency meter and control panel are analyzed. Source 5/6-7



CIRCUITS

Basic Principles for the Design of Modern Filter Networks Having No Attenuation Pole Except at Infinity, by E. Henze. "El Rund." Mar. 1956. 5 pp. A survey of the comutations available on filter networks comprising a sequence of stages tuned to the same resonance frequency. The expressions for the selectivities for periodic, critical and aperiodic damping involve Tschebyscheff's polynominals. Two- and three-stage filters are discussed in detail. Source 5/6-8

Energy Considerations of the Transient Phenomena in a Simple Resonant Circuit, by G. Cremosnik. "Arc. El. Uber." Feb. 1956. 8 pp. The electric energy, the magnetic energy and the heat dissipated in the resistor are evaluated. Their values during the transient period are compared and it is shown that the energy may be used as the time dependent variable. Source 5/6-9

The Geometrical Most Elementary Representation of Loss-Less Linear Four-Terminal Networks, by J. de Buhr. "Nach. Z." Feb. 1956. 5 pp. A geometrical method using mirror images to present impedance transformations is presented permitting the unified treatment of elliptical, hyperbolical and parabolical four-terminal networks. Source 5/6-10

Optimum Phase-Shift Oscillator Design, by D. Waidelich. "El. Eq." Apr. 1956. 5 pp. Method for determination of phase-shift networks for all types of phase-shift oscillators is given. Source 5/6-11

Study of the States of Stable Equilibrium of a Bi-Stable Flip-Flop Circuit with a View to Stability and Reliability of Operation, by M. Bataille. "Onde." Feb. 1956. 10 pp. The effect of variations in the values of all pertinent components of a flip-flop circuit are studied. Conditions that must be met to make parts interchangeable and to account for aging are specified. Considerations in selecting the power supply are presented. Source 5/6-12

Signal-Triggered Sweep Magnifies Pulse Widths, by R. Kuehn. "El." Apr. 1956. 2 pp. CRO automatic sweep control circuit initiates horizontal sweep cycle for each pulse edge at vertical input terminals. Increasing sweep frequency expands signal pulse display. Source 5/6-13

Permanent-Writing Cathode-Ray Recorder, by L. Hetnick, R. Wohl, and D. Andrews. "El." Apr. 1956. 2 pp. Description of inertialess electron beam recorder which writes directly

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, Tele-Tech & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N. Y. 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."

on electrographic paper. Beam of modified CR tube sweeps 26 in-line targets. Source 5/6-14

Noise, Part 2. Equipment for Generating Noise, by W. Bennett. "El." Apr. 1956. 4 pp. Frequency characteristics and performance of hot cathode arcs in gas discharge tubes, noise diodes, photoelectron multipliers, glow discharge noise souces and similar devices. Source 5/6-15

The RC Resonance Amplifier, by H. Voelz. "El. Rund." Mar. 1956. 2 pp. The operation of an RC-coupled amplifier having an RC feedback network is studied and pertinent vector diagrams are shown. Advantages of the double-T network for single-tube amplifiers are pointed out. Source 5/6-16

Increasing the Reliability of Electronic Equipment by the Use of Redundant Circuits, by C. Creveling. "Proc. IRE." Apr. 1956. 7 pp. Equations relating reliability to the number of circuit elements in the redundant and nonredundant cases are derived and applied to examples which show the degree of improvement which can be expected. Source 5/6-17

A Systems Approach to Electronic Reliability, by W. Luebbert. "Proc. IRE." Apr. 1956. 6 pp. Review of the general principles of reliability. A check list for developing system reliability is given. Source 5/6-18

A Magnetic Thyratron Grid Control Circuit, by J. Burnett. "Proc. IRE." Apr. 1956. 4 pp. New grid circuit provides rapid rate of rise of thyratron firing voltage, wide control range, and high voltage amplification. It eliminates from the grid circuit most of the usual noise pick-up and interference. Source 5/6-19

Analysis of a Regenerative Amplifier with Distributed Amplification, by B. Golosman. "Proc. IRE." Apr. 1956. 6 pp. Regenerative circuits of the discontinuous output type, such as the monostable multivibrator, do not have their high speed performance improved by the use of distributed amplification in the amplifier portion. Source 5/6-20

Fundamentals of the Construction of Magnetic Amplifiers with a Low Sensitivity Threshold, by M. Rosenblatt. "Avto. i Tel." Jan. 1956. 11 pp. The article compares the lower sensitivity threshold of various types of magnetic amplifiers. Various approaches toward raising null-stability are examined. Results are given for the measurement of magnetic noise in amplifiers with cores of several different magnetic alloys, when operating on the frequency-doubler principle. Source 5/6-21

Design of Magnetic Push-Pull Power Amplifiers, by N. Vasileva. "Avto. i Tel." Jan. 1956. 14 pp. Article analyzes design of push-pull magnetic amplifiers on the basis of curves for the specific volume of steel plotted as a function of control-field intensity. Amplifiers with and without feedback are considered. This method permits determination of all parameters for minimum amplifier weight or dimensions, if load power and gain for a maximum signal are given. Source 5/6-22

Design Computing of Complex Nonlinear Electrical and Magnetic Branch Networks, by L. Bessonov. "Elek." Dec. 1955. 4 pp. General method for designing branch circuits is given. Volt-ampere characteristics are constructed for 3 and 4 pole networks. Numerical examples and practical applications are illustrated. Source 5/6-23

Two Trigger Circuits Useful as Sources of Rectangular Pulses, by G. Low. "El. Eng." Apr. 1956. 2 pp. The first circuit is similar to the Eccles-Jordan trigger circuit but has the advantage of a comparatively low output impedance. The second circuit provides a simple method of generating high voltage positive pulses. Source 5/6-24

Tolerance Limits in Matching, by W. Alexander. "El. Eng." Apr. 1956. 3 pp. Consideration of the level of power transfer attained for various degrees of mismatch. General curves are given for both resistive and reactive mismatch. Source 5/6-25

Band-Pass Characteristics of Low Asymmetry, by B. Easter. "El. Eng." Apr. 1956. 3 pp. The nature of the asymmetry of conventional bandpass filters is considered using the complex frequency plane. An empirical rule is stated for designing characteristics of much reduced asymmetry. Method is compared to the conventional bandpass design method. Source 5/6-26

A Detailed Analysis of Beam Formation with Electron Guns of the Pierce Type, by W. Danielson, J. Rosenfeld, and J. Saloom. "Bell J." Mar. 1956. 46 pp. The theory of Cutler and Hines is extended to permit an analysis of beam spreading in electron guns of high convergence. Gun design charts are presented which can be used in choosing design parameters to produce a prescribed beam. Source 5/6-27

"Airline" Approach to Electronic Reliability, by S. Poritzky. "Tele-Tech" May 1956. 4 pp. In contrast to the military which snaps up new design techniques, the airlines are interested primarily in tried and proven methods that will insure, first, reliability, and second, minimum maintenance. Source 5/6-203

COMMUNICATIONS

Bandwidth Requirements of FM/FM Telemetering, by J. Carpenter, Jr. "Tele-Tech" May 1956. 3 pp. Best signal-to-noise ratio is achieved when the frequency spectrum of the transmitted signal completely fills, but does not exceed, the bandwidth of reception. This article describes the widest and narrowest bandwidths permissible in a FM/FM telemetering system. Source 5/6-206

The Control of the Waiting Period in Manually-Operated Communication Systems, by H. Stroemer. "Arc. El. Uber." Feb. 1956. 7 pp. The investigation is concerned with the waiting period of a telephone subscriber for the telephone operator in a manually-operated system. The statistics (1) for a system limiting the number of waiting calls by a busy signal for any call arriving at the time the limiting number is calling and (2) for a system limiting the waiting period by a busy signal after the limiting waiting period has elapsed are derived. Source 5/6-28

Telemetering, Electronic Data Transmission, by A. McKenzie and H. Manoogian. "El." Apr. 1956. 28 pp. Comprehensive review of the techniques and components used in electronic data transmission. Glossary of telemetering terms and complete bibliography is included. Source 5/6-29

The "Stabilidyne," by M. Colas. "Onde." Feb. 1956. 11 pp. The Stabilidyne is a receiver designed to compensate for the frequency fluctuations of the local oscillator. For this purpose two superheterodyne channels are provided, one channel for mixing the local oscillator output with a quartz-stabilized frequency, and one channel for mixing the local oscillator output with the received signal. Mixing of these channels results in a signal equivalent to the difference of the originally received signal and the quartz-stabilized frequency. Source 5/6-30

Multiplex Equipment for Position-Modulated Pulses, by J. Chaumeron. "Rev. Tech." Dec. 1955. 22 pp. The general principles are explained and a stationary and a mobile unit, both operating between 1,700 and 2,400 Mc, are described. Source 5/6-31

Electro-Acoustic Problems in Intercommunication Technique, by W. Langsdorff. "Nach. Z." Feb. 1956. 6 pp. The electric and acoustic feedback conditions in simultaneous two-way, two-wire intercommunication systems using loudspeakers are studied. Test equipment used is described and results are plotted. It is suggested that if these systems are wired into the telephone net, speech-controlled amplification be used. Source 5/6-32

On Observations and Experiences with the TOM-Equipment (Teletype on Multiplex) on Short-Wave Links, by the Federal German Post Office, Frankfourt/Main, by F. Corsepius and K. Vogt. "Nach. Z." Feb. 1956. 5 pp. The 4-channel teleprinter system using time-multiplex modulation was tested. The error compensation was found to improve the system from satisfactory operation for 1 mistake in 1000 (uncompensated) to 150 mistakes in 1000 (compensated) received marks. Source 5/6-33

Microwave Detector, by J. Mendel. "Proc. IRE." Apr. 1956. 6 pp. Wide band microwave detector, free from power limitations, operates on the electron beam of a traveling wave tube as a velocity sorter by utilizing the stop-band phenomenon of a periodic magnetic focusing system. Several related devices, including a high level mixer, are discussed. Source 5/6-34

An Experimental Remote Controlled Line Concentrator, by A. Joel, Jr. "Bell J." Mar. 1956. 45 pp. Concentration, which is the process of connecting a number of telephone lines to a smaller number of switching paths, is performed by 3 new models which function remotely from the central office. Philosophy, devices, and techniques are discussed. Source 5/6-35

COMPONENTS

Non-Linear Capacitor Tuning Devices, by T. Butler, Jr., H. Diamond, and L. Orr. "Tele-Tech" May 1956. 3 pp. Very small ferroelectric capacitors having relatively low losses up to a few hundred Mc are discussed which have the property of wide changes in capacity with applied voltage. Described are special techniques developed for the construction of these capacitors to reduce high frequency losses and prevent voltage breakdown. Source 5/6-200

Applying Tape Resistors in Design, by H. Hansen. "El. Des." Mar. 15, 1956. 4 pp. Application of tape resistors to printed wiring boards, and comparison of these resistors to MIL-R-11A resistors. Limitations are discussed. Source 5/6-36

Power Transformer Design Charts, by R. Lee and N. Mullinix. "El." Apr. 1956. 2 pp. Use of charts based on specific core series under typical operating conditions reduces design time for 2 winding, 60 cps power transformers. Source 5/6-37

Revised MIL "Spec" for Transformers, by E. Wiler. "El. Mfg." Apr. 1956. 4 pp. Discussion of MIL-T-27A which sets up revised, realistic requirements based on changes in service needs and on availability of new materials and manufacturing techniques. Source 5/6-38

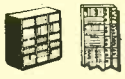
Pyrolytic-Carbon Resistors: A Comparison of Three Types (Part I), by C. Wellard. "El. Eq." Apr. 1956. 4 pp. Discussion of the differences between deposited-carbon, boron-carbon, and carbon-alloy resistors. Characteristics are discussed with relation to MIL Specs. Source 5/6-39

Eddy-Current Losses In Transformer Windings Carrying Nonsinusoidal Currents, by E. A. Mankin. "Elek." Dec. 1955. 5 pp. Thorough analytical derivation of formulas for eddy-current losses in transformer coils carrying nonsinusoidal currents. Wave shape is broken down by method of harmonic components. Rectifier transformers are discussed in detail.

Practical factors are considered; accuracy of method is verified by experimental results. Source 5/6-40

A Chart for the Evaluation of Crystal Rectifier Constants, by I. Templeton. "El. Eng." Apr. 1956. 1 p. Using the method described, with the universal chart, makes it possible to evaluate α, I_0, and r for a given crystal rectifier to within a few percent, in about 10 minutes. Source 5/6-41

Subminiature Transformers and Transductors, by E. Dunkin and D. Johnston. "El. Eng." Apr. 1956. 7 pp. Features of subminiature design are described and technical limitations of small size discussed in relation to audio and control frequency transformers and transductors. A miniature toroidal shell construction is suggested. Source 5/6-42



COMPUTERS

The Organization of a Program Library for a Digital Computer, by W. Frank. "Comp." Mar. 1956. 3 pp. Description of a technique for classifying and labeling routines used in operating a digital computer. Source 5/6-43

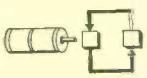
Publications for Business on Automatic Computers: Reference Listing. (Part 1), by N. Chapin. "Comp." Mar. 1956. 4 pp. This reference listing of publications for business on automatic computers is in addition to the "Basic Listing" and the "Supplemental Listing" that appeared in the Sept. 1955 and Feb. 1956 issues of "Computers and Automation." Source 5/6-45

How Computers Do Arithmetic, by J. Blankenbaker. "Con. Eng." Apr. 1956. 7 pp. Discussion of binary and decimal systems and how familiar problems in arithmetic are reduced to sequences of logical problems. Source 5/6-46

The Cryotron—A Superconductive Computer Element, by D. Buck. "Proc. IRE." Apr. 1956. 12 pp. Theory and application of the cryotron, a straight piece of wire about 1 in. long with a single-layer control winding over it. Current in the control winding creates a magnetic field which causes the central wire to change from its superconducting state to its normal state. Source 5/6-47

Project Design and Construction of Small Automatic Computers with Program Control In the Dresden Technical College, by I. Lemann. "Avto. i Tel." Jan. 1956. 18 pp. The article develops the principles of constructing a small automatic computer with program control, designed for small mathematical institutes. Memory system based on tape-recorder principle, single-address control system, electronic dual-system arithmetic element. High efficiency at minimum cost and maximum convenience. Source 5/6-48

The Gas Filled Diode as a Digital Storage Element, by B. Taylor and R. Bird. "El. Eng." Apr. 1956. 5 pp. An outline of 2 schemes for the use of gas-filled diodes; one in a computer input buffer store, the other in a parallel access store. Source 5/6-49



CONTROLS

Tracing an Electronic Contouring System from Idea to Application, by A. Jeudon. "Con. Eng." Apr. 1956. 8 pp. Machine and control system design are coordinated to apply a contouring system to a vertical lathe. A specific electronic contouring system is considered. Source 5/6-50

Nonlinearity in Control Systems, Part 3—Deliberately Nonlinear Systems, by T. Stout. "Con. Eng." Apr. 1956. 9 pp. Nonlinear elements may be deliberately introduced into control systems to make the system smaller, simpler, or less expensive, or to compensate for inherent nonlinearities. Second and third order systems are covered. Source 5/6-51

Visualizing Resolver Circuits, by J. Kadish. "Con. Eng." Apr. 1956. 6 pp. A vector diagram approach to designing resolver computers is given, and applications discussed. Source 5/6-52

Simplification of Control Circuits, by W. Holden. "El. Mfg." Apr. 1956. 7 pp. Five circuit problems are considered, including: use of rectifiers to replace less reliable relay contacts; reliability obtained at the expense of increase in circuit complexity; and selection of the right relay to improve reliability of circuits with ac plate supply. Source 5/6-53

Linear Approach to Servo Analysis, by I. Ritow. "El. Mfg." Apr. 1956. 10 pp. Methods of analysis which permit the designer to increase gain to the limit without entering the region of instability. Source 5/6-54

Packaged Programmer Features Drum-Type Memory. "El. Mfg." Apr. 1956. 6 pp. Design and operation of a packaged programming attachment which prepares a machine tool for automatic control. Source 5/6-55

A New Electronic Simulating Apparatus by the Institute of Automation and Remote Control, Academy of Sciences USSR, by B. Kogan, A. Talantsev, V. Trapeznikov and V. Gurov. "Avto. i Tel." Jan. 1956. 16 pp. Brief description of new small simulator developed in 1954. Article analyzes operation of determinative amplifiers which operate with an economical output stage. Nonlinear blocks with potential-grounded diodes, multiplying-dividing system, establishment of initial conditions, transfer coefficients and overload indications are analized. Source 5/6-56

Procedure for Composing and Solving Problems with Electronic Simulators, by B. Kogan. "Avto. i Tele." Jan. 1956. 18 pp. The article develops the procedure for solving linear and nonlinear problems of automatic regulation with electronic dc simulators. Results are given for the solution of a series of problems on an installation of the ESU-5 type. Source 5/6-57

Electric Drives for Heavy Machine Tools, by Ya. Brovman. "Elek." Dec. 1955. 6 pp. Various electrical drives are discussed from an analytical point of view. General operating formulas are derived; constant-power two-motor drives and compound drives are analyzed. The article discusses automatic regulation, range of regulation, use of a rotary self-excited amplifier as a regulator and selection of parameters for the correcting arrangement. Emphasis is placed on a minimum number of coils and contacts. Source 5/6-58

Complex Automation of Blooming Mills, by A. Beerfeld, E. Gnilosyrov, O. Slezhanovsky and N. Tishchenko. "Elek." Dec. 1955. 10 pp. Discussion of the automatic systems for various sections of a blooming mill. A particular mill is discussed, and detailed analysis is given for the following sections: the pressure device that positions the rollers, the main drive, the working and rolling tables and the ingot conveyor. Source 5/6-59

Control in the Steel Industry, Part 2. "Auto. Con." Mar. 1956. 4 pp. A review of techniques used in the steel industry for inspecting, and for controlling dimensions of the steel. Source 5/6-60

How to Apply Basic New Servo Components, by A. Hoffmann. "Auto. Con." Mar. 1956. 6 pp. An electromechanical amplifier, a summing amplifier, a rate gyro, and a compensating amplifier are discussed in relation to their use in a new 3-axis autopilot. Operation of the complete autopilot system is included. Source 5/6-44

INDUSTRIAL ELECTRONICS

Balanced-Capacitance Fence Alarm System, by G. Browning. "El." Apr. 1956. 3 pp. Sensitive electronic system sets off alarm when fence is merely approached. Change in capacitance caused by intruders presence activates alarm. Source 5/6-61

The "Vibrotor," a New Industrial Oscillator for the Frequency Range from 20 to 25,000 Cycles, by G. Hentschel and S. Schweizerhof. "Freq." Feb. 1956. 7 pp. Continuation. Various embodiments developed for different purposes of the alternator described in the preceding issue are set forth. It may be used for dynamic tests, possibly to produce the effects usually obtained by sound or ultra-sound waves, oscillating tools and machinery, oscillations required in experimental and development work, and oscillating problems associated with turbines and compressors. Source 5/6-62

Dip-Soldering by Machine, by L. Biskner. "El. Eq." Apr. 1956. 2 pp. Description of a machine developed to provide consistently uniform soldering by the time saving dip soldering technique. Source 5/6-63

Electronic Music, by H. Le Caine. "Proc. IRE" Apr. 1956. 22 pp. Pitch, loudness and timber are discussed in relation to their counterparts in an electrical signal, frequency, amplitude, and harmonic spectrum. Electronic musical instruments are discussed. Source 5/6-64

Quality Control, Laboratory Style. "El. Eq." Apr. 1956. 2 pp. An outline of the steps used by one firm to completely test products from raw materials to tests of in-service units. Improved performance results. Source 5/6-65

Accessible Modular Construction, by A. Steinkamp. "El. Des." Apr. 1, 1956. 2 pp. Design, advantages, and limitations of accessible modular construction, a packaging method for electronic equipment which uses light weight modular subassemblies which plug into and mount on the back of a hinged front panel. Source 5/6-66

Static Frequency Multipliers for Induction Motors, by G. Schohan. "El Mfg." Apr. 1956. 6 pp. Conversion of 3 phase-60 cps power to 3 phase-180 cps power for portable power tools is demonstrated using 6 saturable core inductances with toroids wound with thin magnetic tape having a rectangular hysteresis loop. Source 5/6-67

Die-Casting Parts for Electronic Devices, by E. Hannon. "El. Des." Apr. 1, 1956. 4 pp. A review of die-casting processes; intended as an aid to the engineer in designing better parts at lower cost. Source 5/6-68

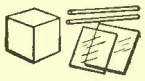
Protective Relays Without The Use Of Nonlinear Elements, by V. Fabrikant. "Elek." Dec. 1955. 6 pp. The article gives design analysis for protective relays without nonlinear elements. Currents and voltages for relay operation are determined, and relay moments are derived. Method for obtaining mutually independent coils is discussed, and a comparison is made between relays with and without nonlinear elements. Souce 5/6-69

Optimum Transfer Number And Power Of A Motor, by L. B. Hailer. "Elek." Dec. 1955. 2 pp. The article discusses and derives the functions which determine optimum transfer number and power for motors in automatic regulation systems. Criteria are given for minimum size and cost, and for maximum initial acceleration of working shaft. Source 5/6-70

A New Fluorescent Lamp in a Starterless Circuit, by W. Elenbaas and T. Hehenkamp. "Phil. Tech." Apr. 1956. 6 pp. New tubular lamp functions without a starter. Ignition voltage lies below 250 v. rms due to 2 features: heating of the filament when the lamp is switched on, and the presence of a conductive strip on the outside of the glass. Source 5/6-71

Thermistor Temperature Control, by P. Malmberg and C. Matland. "Rev. Sci." Mar. 1956. 4 pp. Temperature controller, using small bead thermistors in an ac bridge, has overall range of 20° to 300°C, or —60° to 190°C, using 51A2 or 32A12 thermistors, respectively. Source 5/6-72

Electro-Mechanical Cam, by D. Shaw and O. Schaper. "El. Des." Mar. 15, 1956. 2 pp. Proportional control is achieved with what is basically an on-off system by use of a rotating eccentric contact. Unit supplies angular shaft displacement as a function of time. Source 5/6-201



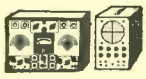
MATERIALS

Synthetic Crude Quartz for Piezoelectric Purposes, by H. Awender and K. Sann. "El. Rund." March 1956. 2 pp. The method to produce electronic grade synthetic quartz developed by the Brush Labs. is described and its properties are compared to those of natural quartz. Source 5/6-73

Effects of High Humidity on Dielectric Properties of Casting Resins, by H. Graves and M. Pizzino. "El. Mfg." Apr. 1956. 5 pp. Testing method and results of a Navy evaluation program on epoxy and polyester compounds. Source 5/6-74

Transformer "Miniaturization" Using Fluorochemical Liquids and Conduction Techniques, by L. Kilham, Jr. and R. Ursch. "Proc. IRE" Apr. 1956. 6 pp. Design details and materials performance in miniature electronic type transformers operating in the 200°C region are discussed. Specific Class A transformers are designed. Source 5/6-75

An Up-To-Date Appraisal of Laminated Plastics for Printed Circuits, by S. Place. "Insul." Apr. 1956. 5 pp. Composition and characteristics of printed circuit base laminates. Source 5/6-76



MEASURING & TESTING

Measuring Microwave Impedance with the Reflectometer, by N. Pappas. "Tele-Tech" May 1956. 3 pp. Practical reflectometer permits rapid measurements of reflection coefficient of r-f lines by separation of incident and reflected waves and formation of their ratio. Sweep oscillator permits rapid assimilation of data as a function of frequency. Source 5/6-202

The Rod-Wavemeter for the Region from 180 to 80000 MC—Design and Measuring Results, by U. Adelsberger. "A. E. Uber." Feb. 1956. 7 pp. The design considerations for rod wavemeters are stated and errors introduced estimated. Structural details and test results for three rod wavemeters are reported. Source 5/6-77

Testing Hardness with Flux Gate Magnetometer, by J. Isaacs and G. Grey. "El." Apr. 1956. 2 pp. Permeability measurement is used as a basis for hardness testing of ferrous metals. Used with steel tubing where magnetic retentivity is proportional to hardness. Source 5/6-78

Meter Design Principles, by M. Triplett. "El. Eq." Apr. 1956. 3 pp. This article describes how the versatility of the VTVM has been combined with the economical operation of the volt-ohm-milliammeter to form a single multipurpose instrument. Source 5/6-79

Determination Of Average Coil Temperature By Resistance Measurements, by I. Syromyatnikov. "Elek." Dec. 1955. 5 pp. Design analysis is given for devices used to measure average temperature by means of coil resistance. Accuracy and practical applications are discussed. AC heating and DC heating are analyzed. Source 5/6-80

Batching and Counting Using Gas-Filled Decade Tubes, by W. Grimmond and W. Leslie. "El. Eng." Apr. 1956. 6 pp. Description of a range of units in the form of building blocks from which a variety of frequency meters, frequency dividers, chronometers, etc. can be assembled. Counting circuits use gas-filled decade tubes. Source 5/6-81

Low-Frequency Power Spectrum Analyzer, by T. Firle. "Rev. Sci." Mar. 1956. 4 pp. Description of a system used to obtain power spectra for the frequency range of .00006 to .02 cps. Low frequencies are shifted into the audio range where they are analyzed with an electronic a-f wave analyzer. Source 5/6-82

High-Speed Scaling with a Decade-Counter Tube, by D. Porat. "Rev. Sci." Mar. 1956. 3 pp. Stray capacitance at the anode of an EIT decade-counter tube, used in conjunction with an energy storage counting circuit, serves as the energy storage element. The stabilizing characteristic of the tube makes the circuit aperiodic. Source 5/6-83

Bolometer Detection of Nuclear Quadrupole Resonance, by H. Robinson. "Rev. Sci." Mar. 1956. 3 pp. Preliminary results in the 30 MC region indicate that a bolometer detection method can be made to operate easily at a sensitivity comparable to conventional regenerative detectors. Source 5/6-84

Time-to-Pulse-Height Converter for Measurement of Millimicrosecond Time Intervals, by W. Weber, C. Johnstone, and L. Cranberg. "Rev. Sci." Mar. 1956. 5 pp. Circuit described measures the time elapsed between a fast-rising signal from a nuclear detector and the next pulse from a steady source of pulses which are evenly spaced in time and occur at an r-f rate. Source 5/6-85

RADAR, NAVIGATION

Calculating Noise Level in Radar Receivers, by D. Haney. "Tele-Tech" May 1956. 3 pp. Signal-to-noise level is determined using a r-f signal generator, the receiver, and a pencil and paper calculation involving the solution of a quadratic equation. Source 5/6-204

Storage-Tube Device Simulates Radar Net, by S. Shenfeld and M. Finkle. "El." Apr. 1956. 3 pp. Video signals which simulate signals received from separate radar stations are generated. Information fed alternately to radar indicators is retained by storage tube. Source 5/6-86

Radar AFC System Uses Mechanical Tuning, by J. Confalone and W. Rambo. "El." Apr. 1956. 4 pp. Signals from radar i-f amplifier controls servo system which tunes L-band local oscillator. I-f changes are sensed by reactance tube. Source 5/6-87

Some Applications of Elliptically Polarized Radiation to High Frequency and Radar Engineering, by G. Pircher. "Rev. Tech." Dec. 1955. 53 pp. This extensive survey is concerned with various applications of elliptically polarized waves, such as rotating joints, continuous phase shifting, specially polarized antennas, duplex and attenuator circuits, and elimination of radar echos. Generation and antenna problems are dealt with as well as measuring procedures; theoretical considerations are presented. Source 5/6-88

Automatic Follow Radars, P. Bouvier. "Rev. Tech." Dec. 1955. 17 pp. The discussion of the underlying principles and the essential parameters for an automatic-follow radar is followed by a detailed description of a series-produced French radar system. Source 5/6-89

Survey of the Theory and Applications of the Electronic Control of Time-Modulated Pulses, by L. Bussillet. "Rev. Tech." Dec. 1955. 18 pp. This survey is concerned with the theoretical aspects of servomechanisms in automatic Radar systems for continuously and discontinuously recurrent echo pulses. Systems of this type are applicable in automatic landing and automatic aviation traffic control equipment. Source 5/6-90

SEMICONDUCTORS

Micro-Power Operation of Silicon Transistors. by E. Keonjian. "Tele-Tech" May 1956. 4 pp. Self-contained equipment that is to operate over a long period of time should consume very small amounts of power. The results of an investigation of silicon transistors in the micro-power region are presented. Source 5/6-205

Vibration Meter Uses Transistors, by J. Kinkel and M. Wilson. "El." Apr. 1956. 3 pp. Battery operated unit measures vibration frequencies from 5 to 1,000 cps over temperature range of —20 to +120° F. Printed circuits are used. Source 5/6-91

Transistors in Instrument Design, by J. Melton and D. Cherry. "El. Mfg." Apr. 1956. 4 pp. Discussion of the extended application of a voltmeter beyond that of conventional meters, because of the use of transistors. Source 5/6-92

Transistors-Vacuum Tubes, by D. Fink. "Proc. IRE" Apr. 1956. 4 pp. Comparison of characteristics and applications of transistors and vacuum tubes. Source 5/6-93

Factors Affecting Reliability of Alloy Junction Transistors, by A. Wahl and J. Kleimack. "Proc. IRE" Apr. 1956. 9 pp. Oxygen and water vapor, when individually in contact with the surface of a transistor, cause substantial changes in the characteristics of germanium alloy junction transistors. The effects of these vapors and other vapors are described. Source 5/6-94

Transistor Equivalent Circuits, by R. Hurley. "El. Eq." Apr. 1956. 4 pp. An equivalent circuit for each principal mode of operation of junction transistors (a-f, power, r-f, and switching) is developed for use as a design aid. Source 5/6-95

Design Transistor Amplifiers for Maximum Power Output, by L. Vallese. "El. Eq." Apr. 1956. 3 pp. Analytical design procedure for common-emitter transistor audio amplifiers is given. Optimum design conditions for RC and transformer coupled amplifiers are derived. Source 5/6-96

Hybrid Parameters for Grounded Emitter Amplifiers with Feedback, by R. Riddle. "El. Des." Apr. 1, 1956. 2 pp. A presentation of the equations necessary to compute the performance of a grounded emitter stage with either shunt or series feedback. Source 5/6-97

Transistor Circuits for Analog and Digital Systems, by F. Blecher. "Bell J." Mar. 1956. 38 pp. Application of junction transistors to

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precision circuits for use in analog computers and the input and output circuits of digital systems. The 3 basic circuits are a summing amplifier, an integrator, and a voltage comparator. Source 5/6-98

Electrolytic Shaping of Germanium and Silicon, by A. Uhlir, Jr. "Bell J." Mar. 1956. 15 pp. Properties of electrolyte-semiconductor barriers, with emphasis on germanium. Use of these barriers in localizing electrolytic etching is discussed. Source 5/6-99

TELEVISION

State of Color Television in the U. S., by C. G. Mayer. "Onde" Feb. 1956. 7 pp. Three-color tubes, color receivers, networks, programs, and studio equipment and transmitters are treated. Source 5/6-100

Modulation Problems in Narrow Band Color TV Engineering, by P. Neidhardt. "El. Rund." March 1956. 6 pp. Various aspects of the NTSC system and the Philips system are investigated with a view to selecting a suitable German system. Other multiplex methods are considered. Source 5/6-101

On the Problem of Afterglow in the "Vidicon", by W. Heimann. "Arc. El. Uber." Feb. 1956. 4 pp. This is a report on experiments conducted to establish the causes of the afterglow in the "Vidicon" picture tube. This effect is attributed mainly to the storage and signal generation processes and to a lesser extent to slow restoration of the original resistance values. Source 5/6-102

Correction Circuits for Color TV Transmitters, by K. Mullenger and R. McMann, Jr. "El." Apr. 1956. 4 pp. Restricted brightness ranges for color cameras is offset by gamma and matrix correction circuits. Hue shift and saturation loss caused by gamma overcorrection is corrected by matrix amplifier. Source 5/6-103

Designing a UHF TV Sweep Frequency Generator, by H. Hanthorn. "El. Des." Mar. 15, 1956. 4 pp. Unit operates from 300 to 950 MC with continuously variable sweep frequency up to 10% of center frequency. Design problems are discussed, and schematic diagram given. Source 5/6-104

A Typical Medium-Power UHF Television Station, by A. Lebedev-Karmanov and E. Glazman. "Vestnik", Jan. 1956. 4 pp. Detailed description of the main sections of a medium-power UHF television station with latest standard equipment. Block diagrams, basic engineering data, principles of operation and performance results are included. Source 5/6-105

Minimum Type TV Station. "Telonde" No. 1. 1956. 9 pp. Description of a "foundation unit" around which, according to intentions, it is possible to add new installations extending the facilities of the station itself or its geographical scope by means of radio links. Source 5/6-106

TRANSMISSION LINES

Sectionalized Spherical Cavities, by G. Boudouris. "Onde" Feb. 1956. 18 pp. Formulas for the resonant wavelength and quality factor of a sectionalized cavity, i.e., a spherical cavity having top and bottom cut off by two parallel planes, are derived. In the extreme cases, the cutting planes spaced by the sphere diameter and almost identical, respectively, a spherical and a cylindrical cavity are obtained; the results reflect this fact. Source 5/6-107

Matching of an Impedance Having a Resistive Component and a Resonance Type Resistance Characteristic, by J. Kornfeld. "El. Rund." March 1956. 2 pp. (Concluding Section). The numerical example of a bolometer feeding line to be matched to a transmitter output is treated on the basis of the formulae derived in the preceding section. Source 5/6-108

The Excitation and Propagation of Eon-Waves in Circular Waveguides with Concentric Coaxial Lines as Input and Output, by Arnold Sander. "Arc. El. Uber." Feb. 1956. 9 pp. The matrices for the 4 terminal networks corresponding to the field and to the hybrid are used to derive the formulas for the behavior of the TM modes. These computations are applicable to below-cutoff attenuators. Source 5/6-109

Attenuation Measurements in Coaxial Cables by Measuring the Input and Output Voltages in the Frequency Range between 300 and 1000 Mc, by E. Scheffler and U. Queck. "Nach. Z." Feb. 1956. 3 pp. Manufactured lengths of cables were tested with this commercially available piece of equipment and errors introduced are evaluated. A simple transformer section for impedance matching purposes is described. Source 5/6-110

Establishing Complicated Fields by Means of Multi-Dimensional L-C Networks, by H. Schneider. "Nach. Z." Feb. 1956. 7 pp. The method, suggested by Kron (I.R.E. Proc., 1944), of establishing the electromagnetic field in a wave guide by measuring the voltages in an equivalent network structure is used in the design of one two and one three dimensional structures using cable sections as network elements. Particular attention is given to the error introduced by the residual reflection at the boundary which does not exceed 1%. Source 5/6-111

The Optimum Tapered Transmission Line Matching Section, by R. Collin. "Proc. IRE" Apr. 1956. 10 pp. By neglecting the square of the reflection coefficient in the differential equation for the reflection coefficient on the taper, a synthesis procedure is derived for obtaining an optimum taper, which, compared to the exponential and Gaussian tapers, is 13.9% and 27% shorter respectively. Source 5/6-112

A New Annular Waveguide Rotary Joint, by K. Tomiyasu. "Proc. IRE" Apr. 1956. 6 pp. New rotary waveguidejoint permits multiple stacking of similar joints on a common axis. The joint will carry high power and permit low VSWR and low insertion loss operation. Source 5/6-113

A Double-Slab Ferrite Field Displacement Isolator at 11 KMC, by S. Weisbaum and H. Boyet. "Proc. IRE" Apr. 1956. 2 pp. Isolator constructed for 10.7 to 11.7 KMC band has following performance: reverse loss of 70 db rrom 10.8 to 11.7 KMC, and 64 db at 10.7 KMC; forward loss less than 1 db, except 1 to 1.2 db between 11.6 and 11.7 KMC; VSWR less than 1.15, except 1.15 to 1.20 between 11.6 and 11.7 KMC; variation in forward loss less than 0.1 db for any 20 MC channel. Source 5/6-114

TUBES

10-Channel Time Division Multiplexer, by Dr. H. Moss and S. Kuchinsky. "Tele-Tech" May 1956. 4 pp. Magnetron beam switching tube is used to simulate action of a 10-contact single channel switch. Sampled voltages are mixed in the common cathode, using a unique gating circuit. Source 5/6-207

Using Traveling Wave Tubes, by R. White, "El." Apr. 1956. 2 pp. Bandwidth, power output, modulation, limiter, and mixer considerations in applying TW tubes. Source 5/6-115

New Applications For Beam Switching Tubes, by J. Bethke. "El." Apr. 1956. 5 pp. Accurate visual readout is combined with high speed electronic reset in a 10 target magnetron switching tube. Application in counter, multiplexer, and gate circuits is given. Source 5/6-116

Temperature Effects on V-R Tube Operation, by E. Handley. "El. Des." Mar. 15, 1956. 4 pp. Bulb temperature and change in tube drop are considered. Temperature where voltage minimum occurs is an indication of tube performance. Source 5/6-117

On the Technology of Magnetrons and Klystrons, by E. Dorgelo. "Vak.-Tech." Feb. 1956. 11 pp. The technological problems arising in the manufacture of magnetrons and klystrons, such as accurate measurements, energy losses in walls and poorly conducting sections, reflections at connecting guides, and in particular cathode requirements, are set forth in detail. Source 5/6-118

Travelling-Wave Resonator, by L. Milosvic and R. Vautey. "Rev. Tech." Dec. 1956. 16 pp. A short introduction is followed by a detailed description of the design and operation of a travelling-wave resonator installed at the Compagnie Française Thomson-Houston. Source 5/6-119

Analysis of the Grid Current, by W. Knappe. "Freq." Feb. 1956. 7 pp. Expressions for the grid current are derived for a linear, quadratic or cubic grid-voltage grid-current characteristic. Fourier analysis yields the dc component, the fundamental component, as well as the first two harmonics; these contributions to the grid current are shown in graphs. Source 5/6-120

A Simple Optical Method for the Determination of the Grid-Cathode Distances in Electron Tubes, by W. Guber and W. Stetter. "Nach. Z." Feb. 1956. 3 pp. The optical design of the instrument, relying on shadow measurements, is described. An accuracy of ± 5 microns is obtained; the pitch of the grid wires is indicated and surface finish is tested. Source 5/6-121

IRE Standards on Electron Devices: Definitions of Terms Related to Storage Tubes, 1956. 25 definitions of terms related to storage tubes as approved by the IRE Subcommittee on Storage Tubes. Source 5/6-122

Effects of Circuit Parameters on Thyratron Performance, by P. Chin and E. Moyer, "El. Mfg." Apr. 1956. 9 pp. Explanation of the effects of circuit phenomena on the pattern of grid control. Grid-cathode capacitance and load-circuit variables are covered. Source 5/6-123

High Power from Miniature Tubes, by J. Revis. "El. Des." Apr. 1, 1956. 2 pp. Circuit is given for increasing the efficiency of a power amplifier circuit, and consequently lowering the power dissipation. Cooling problems are reduced. Source 5/6-124

Some New Types of High-Voltage Low Current Vacuum Triodes, by R. Feinberg and K. Burn. Characteristics and typical applications of high vacuum triodes which were developed to operate with plate currents of the order of 1 to 10 ma. at plate voltages ranging from 1 kv to 20 kv. Source 5/6-125

A Large Signal Theory of Traveling Wave Amplifiers, Including the Effects of Space Charge and Finite Coupling Between the Beam and the Circuit, by P. Tien. "Bell J." Mar. 1956. 26 pp. The non-linear behavior of the TWA is calculated by numerically integrating the motion of the electrons in the presence of the circuit and the space charge fields. A method of calculating the backward wave is

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presented and its effect discussed. Source 5/6-126

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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.

Price List No. 25. March 1956. Free (OTS). Semi-annual cumulative listing of printed AEC reports available for sale from OTS. Source 5/6-127

TID-1901. March 1956. Free (OTS). This bulletin is a listing of reports just made available under the AEC's stepped up program of declassification and release of reports. Source 5/6-128

Paper No. 225-55/DO-69. Radio Technical Commission for Aeronautics, Room 2036, Building T-5, 16th St. & Constitution Ave., N. W., Washington 25, D. C. Price 30¢. Recommends minimum performance standards and standard test conditions and methods for airborne VOR receivers operating in the 108-118 MC range. Source 5/6-129

Paper No. 196-55/DO-68. Radio Technical Committee for Aeronautics, Room 2036, Building T-5, 16th St. & Constitution Ave., N. W., Washington 25, D. C. Price 65¢. Report on a study on remoting long range radar displays. Analyses were made of 3 types of systems: manual, broad bandwidth, and narrow bandwidth. Source 5/6-130

Techniques for Application of Electron Tubes in Military Equipment (PB 111644R), by R. Whitlock, USAF. Oct. 1955. 295 pp. $5. (OTS) Properties of electron tubes and the effect of these properties in circuit design. Mechanical, electrical, environmental, and application information on specific types is given. Source 5/6-131

Diffraction of Surface Waves by a Semi-Infinite Dielectric Slab (PB 119255), by C. Angulo, Brown U. Aug. 1955. 72 pp. Mic $4.50, pho $12.30. (LC) Study of the effect produced by the abrupt termination of the dielectric slab. The diffraction problem is attacked by modal analysis, considering the dielectric slab as an open waveguide. Source 5/6-132

Digest of Literature on Dielectrics, Vol. 18, 1954 (PB 119254), edited by H. Philofsky and R. Crowe, National Research Council. June 1955. 188 pp. $3. Order from NAS-NRC Publications Office, 2101 Constitution Ave., Washington 25, D. C. Topics include: instrumentation and measurements; tables of dipole moments, dielectric constants, and dielectric relaxation values; conduction phenomena and breakdown in dielectrics; ferroelectric and piezoelectric materials; ferromagnetic materials; rubber, plastic, and ceramic insulation; and insulating films and liquids. Source 5/6-133

Exact Method for the Study of the Distribution of Electrical Relaxation Times, Applied to the System Water (PB 119155), by H. Schwan. 1954. 9 pp. Mic $1.80, pho $1.80. (LC) Technique is based on the fact that dielectric losses, determined at considerably lower frequencies than the average characteristic frequency, are extremely sensitive to small changes in the distribution law. The dielectric behavior of water can be shown to be characterized by one single relaxation time. Source 5/6-134

Increasing the Reliability of Electronic Equipment by the Use of Redundant Circuits (PB 111740), by C. Creveling, NRL. Dec. 1955. 14 pp. 50¢. (OTS) Equations relating reliability to the number of circuit elements in the redundant and non-redundant cases are derived and applied to examples which show the degree of improvement which can be achieved. Source 5/6-135

Investigation of Atmospheric Radio Noise. Scientific Report No. 8 for the Period 1 Apr.-30 June 1955. (PB 119364), by A. Sullivan, S. Hersperger, R. Brown, and J. Wells, Fla. Eng'g and Industrial Experiment Station. July 1955. 143 pp. Mic $7.20, pho $22.80. (LC) Study of the probability distribution of atmospheric noise amplitudes is extended to very low probability levels. The effect of atmospheric noise on a frequency-shift radioteletype system is presented. Circuit diagrams and bandpass characteristics of the FSK system are given. Source 5/6-136

Leakage Characteristics of the 1B62A TR Tube Under Elevated Ambient Temperature Conditions (PB 119427), by I. Reingold, Evans Signal Lab. July 1955. 17 pp. Mic $2.40, pho $3.30. (LC) Topics include: TR tubes, leakage in electron tubes; thermal properties of electron tubes; and testing electron tubes. Source 5/6-137

New Method of Antenna Array Synthesis Applied to Generation of Double-Step Patterns (PB 119431), by C. Sletten, P. Blacksmith, and G. Forbes, USAF. Oct. 1955. 35 pp. Mic $3, pho $6.30. (LC) A method of synthesizing linear antenna arrays using the natural phase distribution that exists on transmission lines is applied to an asymmetric pattern. Source 5/6-138

Principles of the Exact Theory of the Wave Field of a Transmission Line (PB 119437), by G. Grinberg and B. Bonshtedt. June 1953. 41 pp. Mic $3.30, pho $7.80. (LC) Starting from a rigorous formation, the problem is solved of electromagnetic wave propagation along a single conductor above a plane and homogenous earth. Source 5/6-139

Quarterly Progress Report No. 7, for the Period Oct. 1-Dec. 31, 1954 (PB 119194), by J. Axtell, Jr., Calif. U. Jan. 1955. 46 pp. Mic $3.30, pho $7.80. (LC) Scattering and diffraction of electromagnetic waves, broadband waveguides, and impedance matching. Source 5/6-140

Radiating Discontinuity on a Corrugated Surface Transmission Line (PB 119205), by M. Ehrlich and I. Williams, Microwave Radiation Co. 1955. 44 pp. Mic $3.30, pho $7.80. (LC) The study was formulated to obtain data essential in the use of surface wave excited discontinuities as antenna elements. Source 5/6-141

Study to Guide Ordnance Designs to Meet New Horizons for Electronic Assembly (PB 111997). Stavid Eng'g., Inc. Sept. 1955. 54 pp. $1.50. (OTS) Summary of the developments, advantages, and applications of: mechanized manufacturing methods which provide enormous production capacity at low cost and high reliability; development of ultra-small electronic parts; and new form concepts for electronic products. Source 5/6-142

Analysis of a Frequency Modulated Multi-Signal (PB 119446), by W. Jones, USAF. Nov. 1955. 20 pp. Mic $2.40, pho $3.30. (LC) Mathematical analysis of a specific FM signal is made and extended to cover general cases. Distribution of power components and the frequency bandwidth needed for 99% power transmission is emphasized. Source 5/6-143

Behavior of Piezoelectric Transducer Systems, Technical Report IV (PB 119210), by H. Ozaki, J. Hamilton, and L. Harris, Utah Eng'g Experiment Station. Aug. 1954. 139 pp. Mic $6.90, pho $21.30. (LC) Cavitation theory and testing equipment; cavitation in viscous liquids; crystal transducer tests; and electrical producers of piezoelectric crystals. Source 5/6-144

Circuit Equations for Rectifier and Magnetic Amplifier Circuits (PB 111770), by D. Schaefer, NRL. Nov. 1955. 36 pp. $1. (OTS) A new method of formulating circuit equations and a new type symbolism and algebra is presented for analyzing circuits containing linear piecewise elements such as rectifiers and rectangular loop magnetic cores. Source 5/6-145

Circuit Minimization: Minimal and Irredundant Boolean Sums by Alternative Set Method (PB 119207), by E. Samson and R. Mueller, USAF. June 1955. 15 pp. Mic $2.40, pho $3.30. (LC) A rigorous algorithm is presented for finding all the irredundant and minimal sum or product expressions of a Boolean function. Source 5/6-146

Contribution to the Study of the Polarization of Vertical Incidence Ratio Echoes from the Ionosphere (PB 119189), by W. Snyder, Stanford U. May 1955. 213 pp. Mic $9.60, pho $33.30. (LC) A general expression for the magneto-ionic characteristic polarizations of an homogenous medium containing several types of charged particles is presented. Source 5/6-147

Diffraction of a Perfectly Conducting Half-Plane of Electromagnetic Waves Emitted by an Arbitrarily Oriented Electric and Magnetic Dipole (PB 119433), by Y. Vandakurov. June 1953. 23 pp. Mic $2.70, pho $4.80. (LC) A rigorous solution is presented of the diffraction of these waves. The result is given as a single integral, between finite limits, of tabulated functions. Source 5/6-148

Diurnal Carrier-Phase Variation of a 16-Kilocycle Transatlantic Signal (PB 118403), by J. Pierce, Harvard U. Oct. 1954. 18 pp. Mic $2.40, pho $3.30. (LC) Diurnal variation of arrival time has been found to be about 40 microseconds. Reliable networking of frequencies is made possible stable propagation and narrow bandwidths. Source 2/6-137

Discontinuity in the Temperature Coefficient of the Velocity of Ultrasonic Waves in Polymeric Materials (PB 118708), by R. Work, Princeton U. Sept. 1955. 11 pp. Mic $2.40, pho $3.30. (LC) Support of belief that discontinuity is a manefestation of sudden change in expansion coefficient that occurs at glass transition temperature. Source 2/6-138

Detection of Propeller and Sambo Modulations (PB 118275), by J. Lawson, MIT. May 1944. 131 pp. Mic. $6.90, pho $21.30. (LC) The asymmetrical treatment of propellers by special material to produce subharmonics of the normal propeller modulation. Source 2/6-148

Electrical Study of Bicrystal Interfaces (PB 118619), by H. Matare, Signal Corps. Apr. 1955. 37 pp. Mic. $3.00, pho $6.30. (LC) Grain-boundary properties, bicrystal growing and orientation measurements, electrical measurements, and modulation of a current through a bicrystal by means of a polarization of the interface. Source 2/6-149

Orientation of Electrical-Breakdown Paths in Alkali Halide Single Crystals (PB 118633), by M. Caspari, MIT. Nov. 1954. 57 pp. Mic $3.60, pho $9.30. (LC) Dielectric properties of

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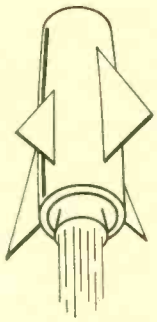

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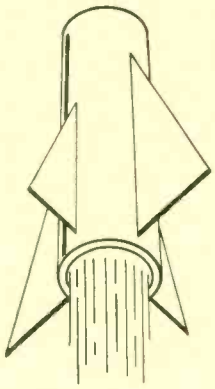

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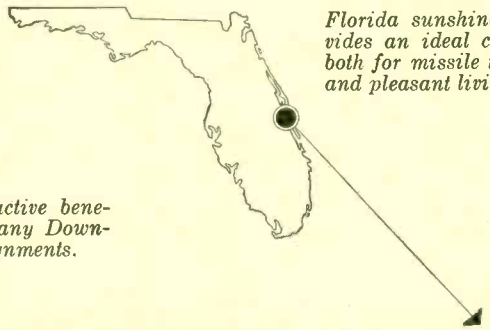

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alkali halide crystals, breakdown theory of dielectrics, and design of crystal holders. Source 2/6-160

On the Pressure Shift of the High-Order Lines of the Spectral Series (PB 118655), by E. Fermi, translated from Italian by E. Kuhlstein and J. Estam. Mar. 1955. 18 pp. Mic $2.40, pho $3.30. (LC) The shift of the higher terms of the absorption series of alkaline vapors, observed by Amaldi and Segre when the vapor is present in an atmosphere of foreign gas. Source 2/6-165

Slope-O-Meter, an Instrument for the Rapid Determination of Particle Radius and Concentration in the Laboratory and Field (PB 118274), by V. LaMer and S. Hochberg, Columbia U. June 1944. 13 pp. Mic $2.40, pho $3.30. (LC) Measuring instruments of particles and particle size. Source 2/6-175

PATENTS

Complete copies of the selected patents described below may be obtained for $.25 each from the Commissioner of Patents, Washington 25, D.C.

Systems for Beaconing and Radio Position Determination, #2,727,231. Inv. P. Gaudillere. Iss. Dec. 13, 1955. Pair of spaced transmitters emit signals of different but close frequencies. Phase and time measuring means determine position. Source 2/6-214

Antenna for Radiating Elliptically Polarized Electromagnetic Waves, #2,727,232. Inv. S. Pryga. Assigned North American Aviation. Iss. Dec. 13, 1955. Microwave antenna with cylindrical dipole has J-shaped slot in radiator. Source 2/6-215

Dielectric Rod Antenna, #2,727,233. Inv. L. Eyges. Assigned U.S. Navy. Dielectric rods at mouth of horn shift axis of directivity of propagated energy. Source 2/6-216

Double Lobe Pulse Echo Locator Display, #2,726,385. Inv. J. Moore. Assigned U.S. Navy. Iss. Dec. 6, 1955. In a pulse echo system, a plurality of movable directional antennas are employed to produce indications along the time base of a crt trace. Source 2/6-223

Means for Recording the Readings of an Instrument or Group of Instruments, #2,726,130. Inv. S. Meadows and R. Saxby. Assigned Southern United Telephone Cables. Iss. Dec. 6, 1955. Record-printer types instrument readings. Actuating circuit is established through multi-point switch. Source 2/6-224

Modulated Galvanometer Recording of Transient Signals, #2,726,131. Inv. J. Skelton. Assigned Esso Research & Eng. Iss. Dec. 6. 1955. Optical system uses oscillating light beam striking moving photographic medium. Transient causes modulator to change oscillator amplitude. Source 2/6-225

Voltage Divider, #2,726,304. Inv. W. Gribble. Assigned Erie Resistor. Iss. Dec. 6, 1955. Spoke-like resistance elements printed on a tube socket base connect a series of terminals with a printed bleed resistance. Source 2/6-226

Electronic Resistor, #2,726,306. Inv. H. Ferguson. Iss. Dec. 6, 1955. Resistor comprises ceramic core with coating of mixture of phenol, formaldehyde and graphite. Source 2/6-227

Electromechanical Computers, #2,726,365. Inv. K. Bildeback. Assigned Schlumberger Well Surveying. Iss. Dec. 6. 1955. Three voltage sources and motor-controlled transducer provide a computed indication of the relationship of the voltages. Source 2/6-228

Measurement of Phase Modulation, #2,726,367. Inv. D. Moore. Assigned RCA. Iss. Dec. 6, 1955. Apparatus measures phase modulation in the presence of amplitude modulation. Sources of modulated and reference waves, together with phase detector measure phase. Source 2/6-229

Circuit Means for Selecting the Highest or Lowest of a Plurality of Signals, #2,725,549. Inv. W. Dunnet. Assigned Westinghouse. Iss. Nov. 29, 1955. In an auctioneering circuit using magnetic cores, connection of windings and rectifiers is such that saturation causes voltage to be selected according to ampere-turns of the control winding. Source 2/6-232

Transducer Exciting Circuits, #2,725,547. Inv. R. Fryklund. Assigned Raytheon. Iss. Nov. 29, 1955. In apparatus for exciting a piezoelectric transducer, capacitance characteristic of transducer is utilized in applying resistor-dc source across transducer to ground. Source 2/6-233

Electrical Tuning Devices, #2,725,536. Inv. A. Hylas. Assigned A. B. DuMont Labs. Iss. Nov. 29, 1955. Device comprising a channel with conductive side walls of circular shape, utilizes a conductive strip joining these walls along one boundary. Strip secured to a shaft allows unit to be tuned. Source 2/6-234

Gas Discharge Coupling Device for Waveguides, #2,725,531. Inv. M. Fiske. Assigned General Electric. Iss. Nov. 29, 1955. Hollow-pipe type dielectric waveguide coupled to high frequency external circuit employs electrodes positioned on opposite sides of the guide, and region of charged particles to serve as coupling. Charged region is wholly contained within the guide. Source 2/6-235

Apparatus for Determining Phase Angle and Direction, #2,725,528. Inv. R. Werner. Assigned General Dynamics. Phase difference between two ac voltages of substantially the same frequency is measured by converting waveforms into square waves, and applying them to a phase direction circuit having two electron discharge devices. Source 2/6-236

System for Measuring Amplifier Phase Shift, #2,725,527. Inv. C. McClure. Assigned Socony Oil. Iss. Nov. 29, 1955. Pair of sine wave generators with two synchronized rotating magnetic elements, and two coils, produce pattern on an oscilloscope dependent on the phase of applied signals. Pattern may be measured for direct indication of amplifier phase shift. Source 2/6-237

Differential Coupling Circuit for Multi-Stage Half-Wave Magnetic Servo Amplifiers, #2,725,521. Inv. W. Geyger. Assigned U.S. Navy. System having plurality of saturable magnetic cores, with ac source and interstage coupling, uses elements so poled that half-wave current pulses flow through branch circuits on the same half-cycle as the ac source. Source 2/6-238

Antenna for Mobile Communications, #2,725,473. Inv. W. Darling. Assigned RCA. Iss. Now 29, 1955. Half-wave length of radiating section is connected to a looped non-radiating section comprising three parallel one-sixth wavelength sections. Below this is a second radiating section feeding energy to the non-radiating section. Source 2/6-239

Variable-Capacitor Transducer, #2,725,548. Inv. W. Harris. Assigned Harris Transducer. Iss. Nov. 29, 1955. A geophone includes among its component elements an annular capacitive transducer with inner and outer electrodes, a piston, a yieldable incompressible material filling the interior, and a diaphragm in pressure transmitting relationship to the material. It is electrically responsive to radially directed pressure fluctuations. Source 2/6-240

Magnetic Amplifier Electrical Position Control System, #2,725,519. Inv. F. Malick and C. Mershon. Assigned Westinghouse. Iss. Nov. 29, 1955. Error detecting circuit supplies signal to two magnetic amplifier channels, which provide control signals responsive to the error quantities. Saturating rectifier and negative coefficient resistors are used. Source 2/6-241

Broad-Band Phase-Shifting Circuit, #2,726,368. Inv. J. Bangert and E. Green. Assigned Bell Labs. Iss. Dec. 6, 1955. From input signal with bandwidth of the order of megacycles, a quadrature voltage is produced by a four-arm bridge circuit have two high impedance zero-loss arms and two RC arms. Source 2/6-230

Indicating System, #2,725,550. Inv. A. Prior. Assigned Bendix Aviation. Iss. Nov. 29, 1955. In a system for indicating the value of a condition, a droop signal is provided by transmitter and indicator signal generators to control indicator generator. Difference between two signals disappears when condition becomes constant. Source 2/6-231

Recording of Colored Images, #2,736,762. Inv. R. Kell, Assigned RCA. Iss. Feb. 28, 1956. First and second color signals amplitude modulate 2 carriers. The modulation products are combined with the brightness signal to form a composite signal which in turn controls a light emitter, whose light variations are recorded on film. Source 5/6-210

Automatic Switching, #2,736,765. Inv. R. Lohman. Assigned RCA. Iss. Feb. 28, 1956. In a color TV receiver, the sync pulse is separated from the color subcarrier by using the pulse to cutoff the subcarrier demodulator. This is done using a charging capacitor to cutoff a transistor which controls the demodulator. Source 5/6-211

Sound Recording System, #2,736,774. Inv. A. Robinson and I. Robey. Iss. Feb. 28, 1956. The carrier of an AM signal is suppressed, multiplied in frequency, recombined with the modulation components, and recorded on a physical record. Source 5/6-212

Distributed Pulse Height Discriminator, #2,736,801. Inv. C. Weigand and O. Chamberlin. Assigned USA. Iss. Feb. 28, 1956. Each cathode of a series of diodes is connected to a different tap on each inductance of a series string of inductances, and the anodes connected together and to a positive voltage. A positive voltage pulse will be transmitted only when its height exceeds the voltage applied to the anodes. Source 5/6-213

Receiver for at Least Two Ultra-High Frequency Ranges, #2,736,798. Inv. G. Lubben. Assigned Hartford National Bank. Iss. Feb. 28, 1956. Variable frequency and fixed frequency oscillators are mixed to obtain the variable algebraic sum of their frequencies during reception of the higher of the 2 UHF ranges. This "sum" frequency is mixed with the signal to obtain an i-f. When the lower of the 2 ranges is received, the fixed frequency oscillator is cutoff, and the variable frequency mixed with the incoming signal, again producing the i-f. Source 5/6-214

Blocking Oscillator, #2,736,806. Inv. J. Miller. Assigned USA. Iss. Feb. 28, 1956. Circuit consists of 2 blacking oscillators, each with the primary of a transformer in its plate circuit. The secondary of each transformer is connected to the grid of the other oscillator through a capacitor. The cathodes are connected together and connected through individual resistors to their respective grids. Source 5/6-215

Automatic Gain Control Arrangement for Pulse Signaling System, #2,737,582. Inv. F. Hall. Assigned Amalgamated Wireless (Australasia) Ltd. Iss. Mar. 6, 1956. AVC produced by grid rectification is controlled by connecting a series resistor, diode, resistor, combination between grid and ground, with the cathode of the diode toward the grid. A negative biasing potential, connected to the anode of the diode for controlling its conductivity, provides a gated release time constant for the AVC potential developed on the grid. Source 5/6-216

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A quick-selection chart, listing General Electric's 600-ma. series-string receiving type tubes —all of controlled heater warm-up design— now is available from the G-E Tube Department, Schenectady, N. Y. (Ask for B-5-4)

Power Supply

Bulletin from the James Vibrapower Co., 4050 N. Rockwell St., Chicago 18, Ill., describes and illustrates mobile fixed power supply Model C-1450 designed to power both transmitter and receiver. (Ask for B-5-5)

Communication Systems

Highly informative, 8-page brochure from Bell & Gossett Co., Morton Grove, Ill., describes the Dualex Digital Selective Calling System, as well as other electronic communication systems produced by the company. (Ask for B-5-6)

Tandem Transistors

4-page bulletin from MarVelco Electronics Div., National Aircraft Corp., 3411 Tulare Ave., Burbank, Calif., contains description and specifications of the MT-1 Tandem Transistor. (Ask for B-5-7)

TV Lens

New catalog of selected lenses mounted to fit the Image-Orthicon Studio and Field Cameras has just been released by Burke & James, Inc., 321 S. Wabash Ave., Chicago 4, Ill. (Ask for B-5-8)

Electronic Equipment

Bound, comprehensive catalog supplying illustrations and data on aviation, communication, broadcast, amateur, and industrial equipment manufactured by the Collins Radio Company, Cedar Rapids, Iowa, is now available. In addition, the modern manufacturing and engineering facilities of the company are described. (Ask for B-5-9)

Aircraft Pulleys

New colorful folder from The Formica Company, Cincinnati 32, Ohio, describes Formica's Approved Aircraft Pulleys. Cut-away diagrams of ball bearing pulleys, standard control pulleys and complete specifications are included. (Ask for B-5-10)

Magnetic Remanence

Jan.-Feb. issue of Applied Magnetics, published by The Indiana Steel Products Co., Valparaiso, Ind., contains informative article by Dr. Rudolf K. Tenzer on the subject of the effects of temperature on magnetic remanence. (Ask for B-5-11)

Telephone Systems

Combination descriptive bulletin and file folder on automatic private communication systems has been released by North Electric Company of Galion, Ohio. It describes in detail a wide variety of automatic telephone systems designed for private use under the North trade name "Privatel." (Ask for B-5-14)

Computers in Business

4-page brochure describing a series of 4 35MM filmstrips on the use of electronic computers in business, distributed by the Visual Education Dept. of the American Management Association, 1515 Broadway, New York 36, N. Y., is available. (Ask for B-5-15)

Capacitors

Chicago Condenser Corp., 3255 W. Armitage Ave., Chicago, Ill., has issued a new 20-page catalog describing the company's complete new line of capacitors. (Ask for B-5-16)

Tape Recorders

Series 30 Berlant Deluxe Recorders, all with hysteresis synchronous direct drive, are described in bulletin issued by Berlant-Concertone, 655 W. Washington Blvd., Los Angeles 15, Calif. (Ask for B-5-17)

Electronic Systems

8-page, color catalog from Craig Systems, Inc., Danvers, Mass., describes and illustrates air traffic control, and communication systems as well as protective transit cases manufactured by the company. (Ask for B-5-18)

Tubes

Thyratrons, Hydrogen Thyratrons, Rectifiers, and Twin Power Triodes products of Chatham Electronics, Livingston, N. J., are described and illustrated in a 4-page folder just released. (Ask for B-5-19)

Power Supply Tech Data

NJE Corporation, 345 Carnegie Ave., Kenilworth, N. J., announces the availability of a tech data file that provides complete ratings on over 500 stock-model supplies, in addition to a thorough tech discussion of methods of rating power supply performance. (Ask for B-5-20)

DC Power Supplies

Check list of regulated and unregulated dc power supplies, with model numbers, specifications, and prices is available in the form of a 4-page illustrated folder from Lambda Electronics Corp., 11-11 13th St., College Point 56, N. Y. (Ask for B-5-21)

Relays

22-page, color, industrial bulletin from Stromberg-Carlson Co., 100 Carlson Rd., Rochester 3, N. Y., contains design features, illustrations, and descriptions of relays available to industry for electro-mechanical switching purposes. (Ask for B-5-22)

X-Y Plotter

Brochure describing new series of X-Y Plotters and input accessories is available from Librascope, Inc., 808 Western Ave., Glendale, Calif. Illustrated presentation contains detailed specifications and applications of the X-Y Plotter for rapid graphic depiction of one independent variable in terms of another. (Ask for B-5-23)

Infrared Analyzer

A new specification sheet on the Liston-Becker Infrared Analyzer, Model 15A, is now available from Beckman Instruments, Inc., Fullerton, Calif. Instrument consists of an analyzer unit and an amplifier unit and may be used in conjunction with various makes of recorders. (Ask for B-5-24)

Inductronic Instruments

Bulletin issued by the Weston Electrical Instrument Corp., Newark 5, N. J., contains a series of technical articles on the Weston line of Inductronic Instruments, compiled for easy reference. (Ask for B-5-25)

Human Engineering

Human Engineering is the subject of a 16-page brochure, listing key personnel, facilities, and methods of the Human Engineering Section, Crosley Gov't. Products Div., AVCO Manufacturing Corp., Cincinnati 15, Ohio. (Ask for B-5-26)

Grip Selector

Mathias Klein & Sons, 7200 McCormick Rd., Skokie, P. O. Chicago 45, Ill., has available copies of the "Klein Grip Selector" which immediately shows the proper Klein grip to use on all the popular sizes and types of wire. (Ask for B-5-27)

Resistors

Catalog Data Bulletin C-1a, from International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa., furnishes comprehensive data on construction, features, types, ratings, etc., of tubular and flat power wire wound resistors. Detailed charts and graphs are contained in 12-pages. (Ask for B-5-28)

Components

4-page brochure from David Sonkin Associates, Lucas Bldg., 10 Fiske Place, Mount Vernon, N. Y., illustrates items and supplies names of a comprehensive group of component manufacturers. (Ask for B-5-101)

Rack & Panel Connectors

Dimensions, current ratings, and availability for the rack and panel connectors manufactured by the American Phenolic Corporation, Chicago 50, Ill., are contained in the new 12-page, multi-colored R2 Catalog recently released. (Ask for B-5-2)

Motors

Servo-Tek Products Co., Inc., Surplus Division, 1086 Goffle Road, Hawthorne, N. J., has issued Catalog No. 42 supplying 32 pages of surplus motors and controls listings. Illustrations, prices, and descriptions are complete. (Ask for B-5-3)

Industrial TV Illumination

4-page folder, amply illustrated, describes the Type B Hinelight, supplying shadow-free illumination for industrial TV application, manufactured by Hinelight Corp., 2538 John St., Fort Wayne, Ind. (Ask for B-5-12)

VLF Equipment

Illustrated, 4-page folder on versatile Very Low Frequency radio interference and field intensity measuring equipment is available from Stoddard Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif. (Ask for B-5-13)

WASHINGTON

News Letter

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

DEFENSE NEEDS TRIPLED—For the 1957 government fiscal year, starting next July 1, the Department of Defense has asked Congress to appropriate more than $1 billion for the requirements of the armed services for communications and electronics equipment and components. "This is just about three times the amount provided in fiscal year 1956," the Defense Department informed Congress, "and reflects, for the most part, the high cost of expanding and improving our extensive system of radar defenses and related communications systems." The guided missile program in which a major expenditure is for electronics and communications items will be a major portion of the military budget for this field and, in addition, the Defense Department is planning to spend another quarter-billion dollars in guided missile research and development. Acceleration of the installation of the Air Force's semiautomatic ground environment (SAGE) system and the distant early warning (DEW) line project are two most important programs, Air Force Secretary Donald Quarles told the House Appropriations Committee.

TV EXCISE TAX—Because Hoffman Electronics Corp. President H. Leslie Hoffman who heads the Radio-Electronics-Television Manufacturers Association made such a convincing presentation before the Senate Interstate and Foreign Commerce Committee, there is renewed hope that Congress will lift the federal 10% excise tax on all-channel color television sets which is now imposed on black-and-white receivers at the manufacturers' level. Mr. Hoffman brought to the attention of Senator Magnuson (D., Wash.) chairman of the Senate committee, and the other Senators on that body that elimination of this excise levy would aid the uhf television problems and would definitely benefit the distribution of color television sets to the public. Even though members of Congress are endeavoring to preserve all possible sources of governmental tax revenue sources, the Hoffman presentation pinpointed interest by Senators and also Congressmen on the impact of this tax in retarding color and uhf television expansion. He has been joined by the FCC and the networks.

LONG HAUL—The FCC planning on television allocations is still preliminary in that its staff is working principally on engineering phases and it looks like several months will elapse before the staff can bring to the Commissioners definitive recommendations. There are many facets in the FCC's survey of UHF-VHF television from the standpoint of a future revamping of the allocation plan. Strong sentiment exists for deintermixture and although not likely to materialize there is some FCC sentiment for an all-UHF allocations blueprint as the ideal solution. As previously forecast in this column, the proposal of swapping spectrum space for television by the government and military radio services which is being discussed between the FCC and the Office of Defense Mobilization (ODM) has little, if any, chance of consummation in the immediate future because of the importance of national security.

LOT OF WORDS—Broadcasting and television, particularly the role of networks and the status of UHF and subscription television, have been the subject of investigations by Congressional committees, both Senate and House, since they are felt to be popular topics during a national election campaign period. But there is a lot of talk and that is about all. No legislation results are anticipated and the silver lining out of all this furor may be that the senators and congressmen involved in these investigations will become familiar with radio broadcasting and television and the constructive accomplishments of these two important media of public communication.

MOBILE INTERFERENCE—Long distance scatter propagation is an excellent tool for radio communications in countries with large land areas such as Brazil, Canada, Russia and French Africa but if employed on the frequencies used in the United States for land mobile radio services scatter operations in other countries present a potentially serious source of interference, FCC Safety and Special Radio Services Bureau Chief Curtis B. Plummer has warned the American mobile radio equipment manufacturers and service operators and engineers. It may be, he suggested, in the interest of American mobile radio services to reserve some in-between channels for the foreign nations' use or to decide to set aside some special international channels for long distance scatter operations.

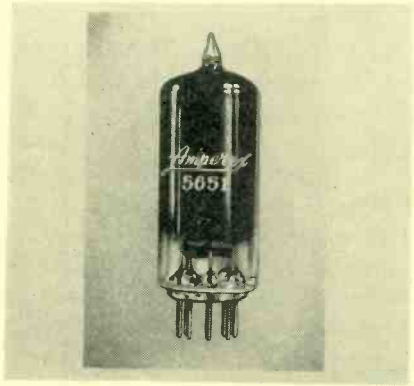
National Press Building
Washington, D.C.

ROLAND C. DAVIES
Washington Editor

New Technical Products

VOLTAGE REFERENCE TUBE

Type 5651 is a new cold-cathode discharge miniature voltage reference tube. It is designed for use in dc amplifiers, stable regulated power supplies, oscilloscope calibrators, and similar applications. Special processing of the tube and its elements insures extremely stable operation and freedom from long and short-term drift. Operating voltage range of the 5651 is 82 to 92 v.; current range is from 1.5 to 3.5 ma. The tube incorporates many of the design and processing features of the Amperex OG3. **Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L.I., N.Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-14)

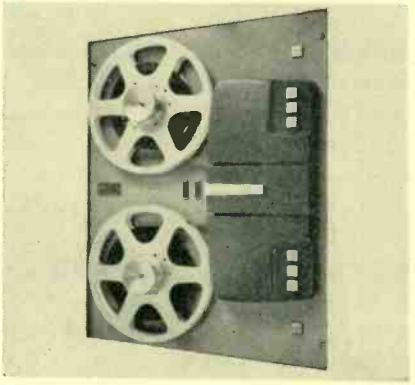


VOLTAGE DIVIDERS

RACKVIDERS, Model RV-521 and RV-622 are fully shielded and are usable from dc through 10 kc. They can be mounted in any standard relay rack with 19 inch panel spacing. Both have an input resistance of 10,000 ohms and a linearity of better than 25 parts per million. Model RV-622 uses six separate switching decades to provide voltage division with a resolution of 1 part per million. In the Model RV-521, four decades and one interpolating potentiometer provide voltage division. The resolution of the Model RV-521 is better than 0.3 parts per million. **Electro-Measurements, Inc., 4312 S. E. Stark St., Portland 15, Ore.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-41)

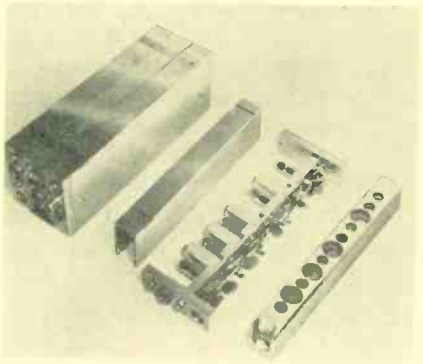
TAPE TRANSPORTS

Series FR 200 is a new series of magnetic tape transports for the recording and reproduction of information in digital form. The new units consist of 4 major subassemblies: the tape transport proper, the head assembly, the electronic control unit, and a servo control system. Typical is Model FR 207 designed to record seven tracks on ½ in. tape, with a tape speed of 30 in. per sec. Units accommodate either 8 or 10½ in. NARTB reels. The 10½ in. reel has a capacity of 2400 ft. of acetate-base tape or 3600 ft. of polyesterbase tape. **Ampex Corp., 934 Charter St., Redwood City, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-5)



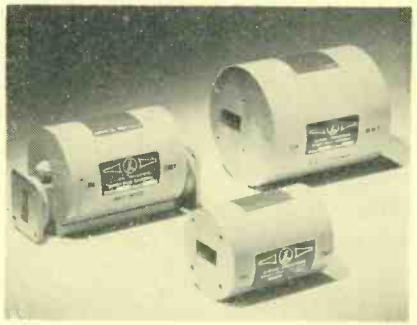
SUBMINIATURE RECEIVERS

Subminature AM and FM receivers, individually constructed as three compact modules are now in production. Each module (RF Assembly, IF Assembly, and Power Supply) weighs approx. 2 lbs. with dimensions of 1 in. x 3 in. x 9 in. Available in several freq. ranges from 40 to 235 mc, the receivers feature crystal freq. control, wide band freq. response, excellent sensitivity, quieting and noise rejection. Subminature power supply operates independently or in conjunction with receiver. **Instrument and Electronic Div., Land-Air, Inc., Oakland International Airport, Oakland, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-10)



MAGNETRON LOAD ISOLATORS

Litton X-Band Load Isolators make it possible to operate magnetrons and klystrons into long lines or high VSWRs without "long line" effects or other loading problems. Compact and light, the isolators provide 10 to 18 db isolation between source and load with an insertion loss of 0.5 to 1 db. A wide band of 8600 to 9600 mc is covered at average power levels of 20 to 300 w. and peak power of 100 to 300 kw. The isolators are designed with min. package sizes, and will operate at temps. up to 100° C without degradation. No special cooling is required. **Litton Industries, Components, Div., 336 N. Foothill Rd., Beverly Hills, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-12)



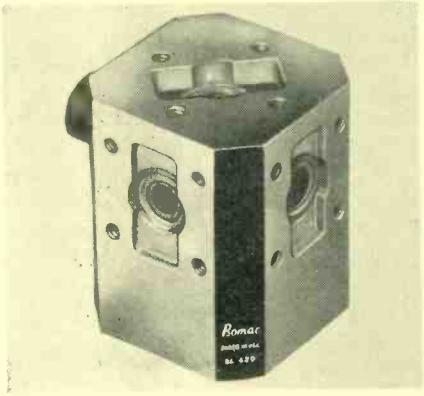
POTENTIOMETER

Model HM-100 is a precision multiturn potentiometer available with either flexible or turret type terminals. Pots have a 1 oz. in. max. starting torque, and a net weight of 1.2 oz. Case dimensions: 1 in. diam., 1 in. long from mounting surface to rear of case. Rated at 2 w. at 40°C., standard linearity is ± 0.5%. Resistance values from 500 to 100,000 ohms. Standard tolerance ±5%; however, tolerances as low at ±0.5% can be obtained. **Circuit Instruments Inc., P.O. Box 355, 1927 First Ave. S., St. Petersburg, Fla.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 2-1)

New Laboratory Equipment

DISCRIMINATOR CAVITY

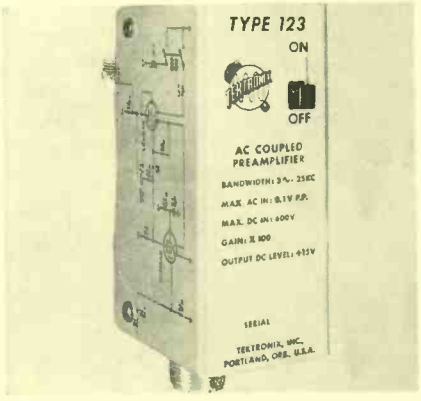
The basic cylindrical X-band Dual Mode Discriminator Cavity employs the TE112 mode and is made of invar. The assembled unit is evacuated, baked and filled to suit hold-off power require-



ments. Loaded Q and insertion loss may be widely varied. Precision tuning and compensation are accomplished with a tuner opposite the input. The two outputs are placed at 45° to the input and 90° from each other. Then by placing two capacitive-type tuners diametrically opposite the output they control, a frequency splitting is effected which is adjustable from 0 to 5 MC. **Bomac Laboratories, Inc., Beverly, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-8)

LOW-LEVEL PREAMPLIFIER

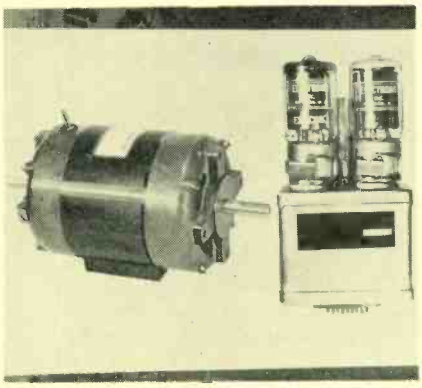
The Type 123 is a battery-powered ac-coupled preamplifier with a voltage gain of 100. Passband is within 3db from 3 cycles to 25 KC, within 2% from 15 cycles to 6 KC. Max. input signal is 0.1v P-P. It is fitted with coaxial input and output connectors, permitting mounting on an oscilloscope or other



instrument, or mounting to a cable for use as a probe. Dimensions are 3⅝ in. high, 1½ in. wide, 2 3/16 in. deep, not including connectors. Weight: 10 oz. **Tektronix, Inc., P. O. Box 831, Portland 7, Ore.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-103)

MOTOR REGULATOR

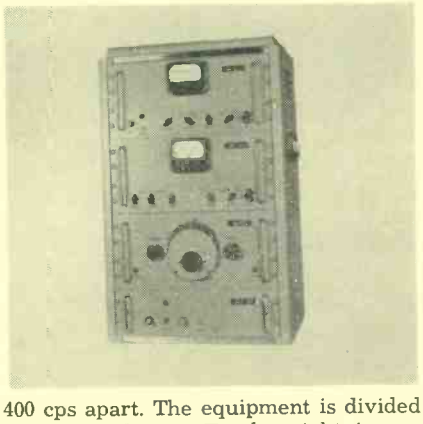
Motor and speed regulator for use with film, tape, chart, and other forms of transport mechanisms requiring torque in the order of 5 oz.-inches, has been developed. The motor is a 400



cycles induction type with permanent-split capacitor phase. The regulator maintains within 1%, any selected speed between 300 and 16,000 rpm regardless of load and regardless of wide fluctuations in line voltage and frequency. With a calibrated dial, any speed may be accurately pre-selected. The drive may be used wherever speed adjustability with close regulation is required. **Wac Engineering Co., 35 South St. Clair St., Dayton 2, Ohio.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-51)

DISTORTION ANALYZER

Model 863 Two-Tone Distortion Analyzer, measures the intermodulation of two signals in a non-linear network. The equipment consists of an Oscillator Unit, an Amplifier Unit, a Receiver Unit, and a Power Supply. The Oscillator and Amplifier Units generate a variable two-tone signal with a minimum of spurious output frequencies. The two tones are of equal amplitude and spaced



400 cps apart. The equipment is divided into four chassis. Total weight is approx. 160 lbs. Power source required is 100-130 v., 60 cps at 200 w. **Radio Frequency Laboratories, Inc., Powerville Rd., Boonton 20, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES (2-27)

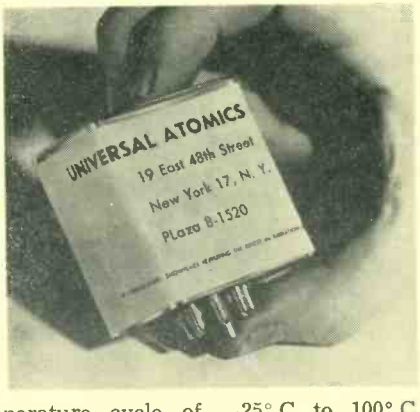
POWER SUPPLY

Precision regulated power supply, Model PR 300, has an output tolerance for line voltage fluctuations up to 10%, of .002% or less. Reliability of voltage readings is .02% or 5 millivolts, which-

ever is greater. Other inherent characteristics: excellent degree of stability, low ripple present in output voltage, and low impedance. Output voltages delivered are from 10 to 310 v. in 1 v. steps, continuously variable between steps, at 150 ma.; from 0-150 v. continuously variable at 5 ma. and 6.3 volts at 3 am. center tapped, unregulated. **Oregon Electronics, 2232 E. Burnside St., Portland 15, Ore.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-18)

DC TO DC POWER SUPPLIES

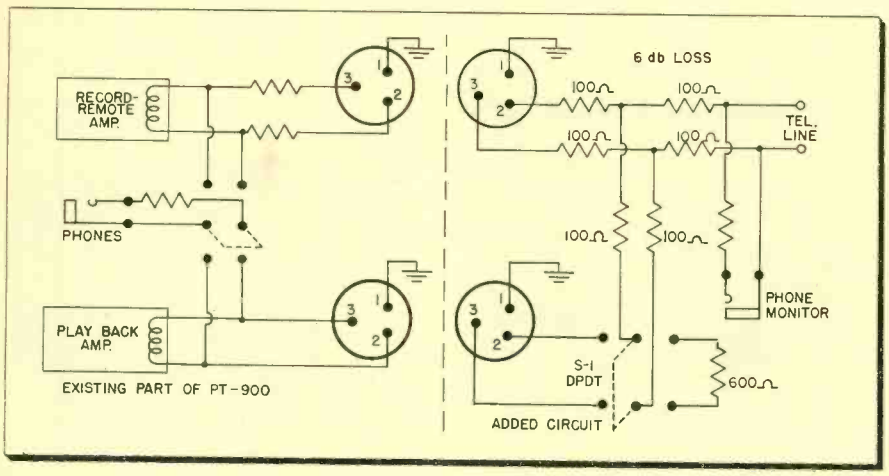
A new line of completely transistorized dc to dc power supplies that can produce up to 16,000 v. from 1½ v. of input is now available. These lightweight units (approx. 6 oz.) occupy about 4 cu. inches, can be used in all cathode ray and infra-red applications. They are rugged to withstand 20,000 G's or more, recover instantaneously from shorting, and have an ambient tem-



perature cycle of −25° C to 100° C. They come in rectangular or cylindrical shape, and can be custom made to fit any specifications. **Universal Atomics Corp., 19 E. 48th St., New York 17, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 4-21)

CUES for BROADCASTERS

Practical ways of improving station operation and efficiency



Circuit provides for combined recorded and live commentary from remote locations. PB amplifier is fed directly to phone line

Remote Broadcast With Tape Recorder

HENRY C. LOVELL, Ch. Engr.
WHIR, Danville, Ky.

THIS circuit was designed for a PT-900 Tape Unit, but can be used with any equipment having separate record and playback amplifiers. The necessity for the circuit was brought about by our operations at a county fair. One telephone line was installed at the most appropriate point. Our announcer used a portable battery-operated recorder to interview contestants, prize winners, farm people, etc. At broadcast time we used a combination of live commentary with portions thrown in from the taped material. At other times, the whole program would be taped and replayed by the engineer at air time, while the announcer was off getting more material.

The Record amplifier in the PT-900 is also a very good remote amplifier, giving a 3-mike input. This is used for the live portion of the program. The playback amplifier is fed (through our circuit) into the telephone line. By using switch S-1, the tape can be removed from the line and changed or rescued while the live portion is being used. The network of 100 ohm resistors matches the lines with about 6 db loss. The existing VU meter on the recorder gives both remote and play levels. This circuit could be made a bit more flexible by adding a switching arrangement and combining the two phone monitors.

Eliminating Dangling AC Cords

THEODORE KALIN, Ch. Engr.
WEIM, Fitchburg, Mass.

MANY pieces of test equipment and other types of equipment come with an AC cord for supplying power, attached. This cord has been wrapped around the equipment or coiled up and allowed to dangle. To eliminate this annoying dangling cord, I install two cabinet knobs or drawer pulls on the back of the piece of equipment. The AC cord can then be coiled neatly around these drawer pulls, where it is convenient and out of the way. In using the equipment, if it is the type that lies flat, the knobs on the back allow a slight tilt which often makes it easier to read the instrument, when working from a sitting position at a workbench. Of course, if the instrument is used in an upright position the knobs do not interfere.

Filling Blank Rack Space

JAMES W. POOLE, Ch. Engr.
WFTR, Front Royal, Va.

INSTEAD of buying blank panels to fill the blank rack space left after mounting a new Ampex tape recorder, I cut some Reynolds do-it-yourself aluminum into the desired 19 in., and fitted it into the openings. In some instances where the sheets were too thin to fit flush between two thicker steel panels, I backed them with masonite sheets. By spraying the sheets with the new spray-can paints, almost any color can be had. Clear plastic spray will prevent fingerprints from marring the surface.

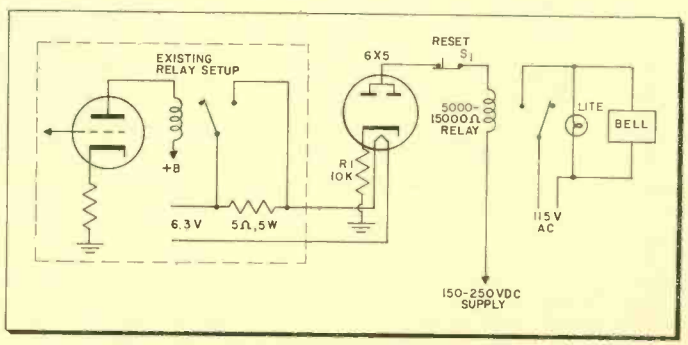
Conelrad Alarm Modification

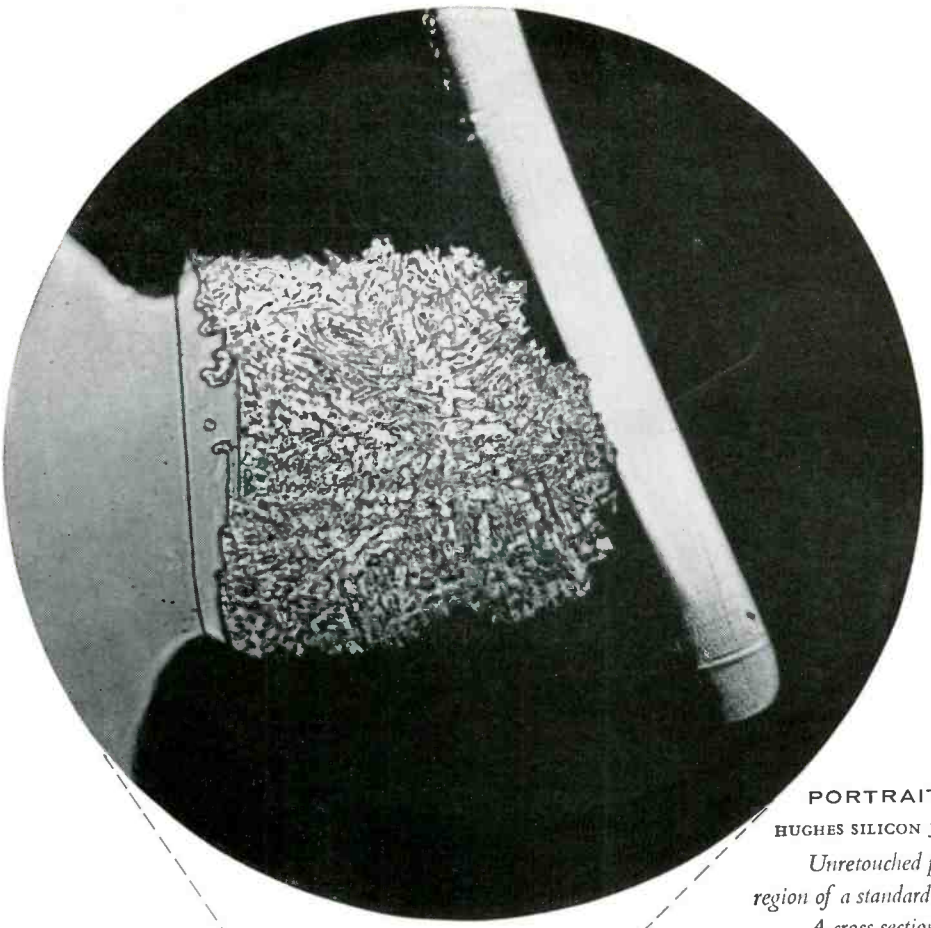
GEORGE O. WUSSOW, Ch. Engr.
KVCV, Redding, Calif.

THERE have been many circuits devised and recommended for use on the existing Conelrad carrier interruption scheme, but I have yet to see one that takes care of selective fading so as to keep the alarm from being actuated unless the carrier is off for 5 secs. or longer.

I devised a simple, dependable system that can be added to the existing carrier interruption device to provide the necessary delay before the alarm goes off, so that fading of less than 3 secs. duration will not trip the alarm. In the circuit illustrated, R_1 can be selected to give time desired depending on coil resistance of relay in plate of 6X5. A reset switch "S_1" breaks current drag on power supply which may affect reset of front end of relay chain.

With this circuit fading of less than 3 secs will not trip the alarm

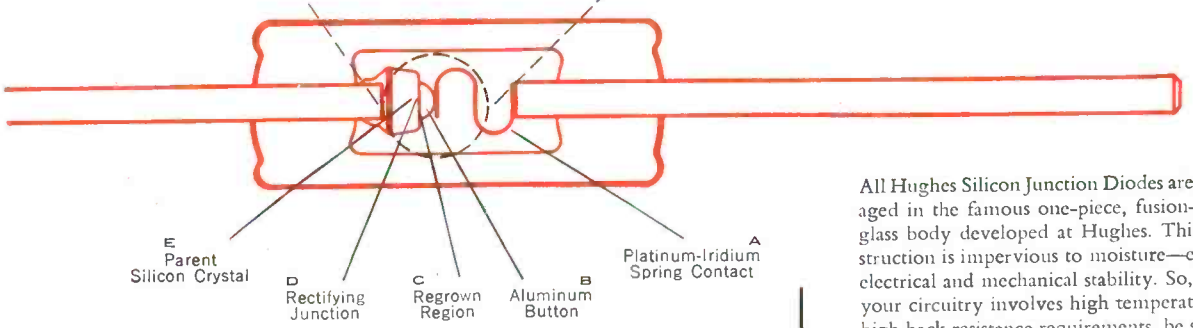




PORTRAIT OF RELIABILITY

HUGHES SILICON JUNCTION DIODES

Unretouched photomicrograph of the junction region of a standard Hughes Silicon Junction Diode. A cross section, taken at 220 magnification.



RELIABILITY YOU CAN SEE

In this cross section (made from a standard, non-selected production specimen), renowned Hughes quality is clearly visible. (A) The platinum-iridium whisker makes firm, positive contact with the aluminum button. (D) The rectifying junction is clean, sharp, and straight. (E) The parent silicon crystal is free from strain-induced cracks, fissures or blemishes around the junction. Such meticulous workmanship gives microscopic evidence that, in semiconductors, HUGHES QUALITY *means* HIGHEST QUALITY.

**Characteristics rated at 25° C and at 150° C. Ambient operating range, —80° C to +200° C.*

Actual size

***Dimensions, diode glass body: 0.265-inch by 0.105-inch, maximum.*

All Hughes Silicon Junction Diodes are packaged in the famous one-piece, fusion-sealed glass body developed at Hughes. This construction is impervious to moisture—ensures electrical and mechanical stability. So, when your circuitry involves high temperature or high back resistance requirements, be sure to specify *Hughes* Silicon Junction Diodes. Available now, at lower prices, in nine different standard and several special types. And, as always, they are First Of All . . . For RELIABILITY!

FEATURES:

*High Temperature Operation**
Extremely High Back Resistance
Very Sharp Back Voltage Breakdown
Excellent Forward Conductance
*Subminiature Size***
Exceptionally Stable Characteristics

For descriptive product information, please write:

HUGHES

SEMICONDUCTORS
HUGHES PRODUCTS
International Airport Station
Los Angeles 45, California

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

Avionics Conference

(Continued from page 92)

9:00—"An Approach to Designing Interference Free Electronic Systems," F. S. Scarborough and F. E. Garlington, Sprague Electric Co.

9:30—"Grounding and Bonding," A. G. Berbert, Burndy Engr. Co., Inc.

10:00—"Adaptive and Distribution - Free Filters," L. E. Mertens, Radio Corporation of America.

10:30—"Guide to the Selection of Radio Frequency Cables," Charles C. Camillo and G. J. Mares, American Phenolic Corp.

11:00—"Recent Improvements in R-F Cable Assemblies," J. M. Caller, Sandia Corporation.

SEMI-CONDUCTOR CIRCUITS II

Moderator: Dr. Lloyd DeVore, Stewart-Warner Corp.

9:00—"Design and Application of Transistorized Regulated Power Supplies," S. Sherr, P. Levy and T. Kwap, General Precision Lab.

9:30—"A Transistorized DC to AC Inverter with Good Regulation," R. M. Hubbard, Boeing Airplane Co.

10:00—"Operation of a Saturable Core Square Wave Oscillator," Donald C. Mogen, Minneapolis-Honeywell.

10:30—"A Four-Quadrant Voltage Multiplier," Glenn L. Keister, Boeing Airplane Co.

11:00—"A Fixed Tuned 12.5 Mc F.M. Transistor Receiver," A. M. Boothe, Crosley Div. of AVCO.

ANTENNAS II

Moderator: Dr. Thomas Tice, Ohio State University Research Foundation

9:00—"The Probe Excited Airframe as a High Frequency Antenna," T. G. Dalby, Boeing Airplane Company.

9:30—"Antenna Coupler Efficiency Considerations in Airborne Liaison Communications Systems," M. Shoquist and L. E. Sabine, Remington Rand.

10:00—"Decoupling of Small Horn Antennas," William S. Carley, Emerson Television & Radio.

11:00—"Automatic Boresight Measuring Equipment," John B. Damonte, Dalmo Victor Company.

Wednesday Afternoon

COMPUTERS II

Moderator: R. C. Newhouse, Bell Telephone Laboratories, Inc.

2:00—"Digital Computer System for Airborne Applications," Walter J. Moe, Remington Rand.

2:30—"Logic Circuits for a Transistor Digital Computer," G. W. Booth and T. P. Bothwell, Radio Corporation of America.

3:00—"An 'All-Transistor' Buffer Unit Using Coincident Current Storage," J. A. Kershaw, Remington Rand.

3:30—"Precision Analog Computer Amplifier Utilizing Silicon Transistors," Charles R. DeWeese, Texas Instruments, Inc.

4:00—"Applications of Transistorized Binary Counters in Digital Timing Systems," Charles W. Skelton, Texas Instruments, Inc.

ANALYSIS TECHNIQUES

Moderator: Dr. A. R. Carron, United States Air Force Institute of Technology

(Continued on page 118)

S-BAND SWEEPER

2,000 mc to 4,000 mc completely electronic sweep . . . ± 1 db constant output over 100 mc

Rapid dynamic visual testing of frequency characteristics of microwave equipment and components.

SAVES ENGINEERING MANHOURS

MODEL CS-1

SPECIFICATIONS:

Frequency range	2,000 to 4,000 mc. ±5%
Output	0.1 to 0.8 watts.
Output Variation	Approximately ±1 db when swept over 100 mc.
Sweep Width	0 to 2,000 mc, adjustable.
Sweeper Rate	60 cps.
Operating Voltage	115 v ±10%, 50-60 cps.
Input Power	Approximately 350 watts.
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L, C, and X Band units also available

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Model CS-1 is completely electronic—no moving parts. It utilizes a backward traveling wave oscillator tube which is electronically tuned. Six direct-reading meters allow constant visual monitoring. This unit is used in conjunction with Model DS-1 Display Unit, or a versatile oscilloscope.

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Avionics Conference

(*Continued from page* 116)

2:00—"Analysis and Prediction of Servo Gearing Performance," P. R. Jones, Collins Radio Company.

2:30—"A Digital Technique for Rapid and Accurate Evaluation of Trigonometric Functions," G. W. Oberle, Glenn L. Martin Company.

3:00—"The Mathematical Theory of Straight Line Approximations to Logarithmic Curves," Dr. Harold Goldberg, Emerson Television & Radio.

4:00—"Plotting 'Success-or-Failure' Test Results by Means of a Cumulative Performance Chart," Morten Gale, Emerson Television & Radio.

ELECTRON TUBES II

Moderator: Walter C. Kirk, Consulting Engineer

2:00—"The Unreliable Universal Component," M. A. Acheson, Sylvania Electric Products, Inc.

2:30—"A New Magnetron for Commercial Airborne Weather Radar," W. F. Belz and R. W. Kissinger, Radio Corp. of America.

3:00—"Development of a 5-Inch, Direct-View Storage Tube," E. M. Smith, Radio Corporation of America.

3:30—"The Relation Between Performance and Reliability in Tubes," George D. O'Neill and M. A. Acheson, Sylvania Electric Products, Inc.

4:00—"A Comprehensive Quality Control Program Designed to Improve Subminiature Tube Reliability," H. H. Hoyle and H. J. Davis, Raytheon Mfg. Company.

4:30—"Life Test Performance of Reliable Tubes at Maximum Ratings," Thomas J. White, Raytheon Mfg. Company.

EQUIPMENT

Moderator: Paul G. Wulfsberg, Collins Radio Company

2:00—"A Precision Long Range Radio Navigation System," W. Dean, R. Frank and W. P. Frantz, Sperry Gyroscope Company.

2:30—"An Airborne Single Sideband Transceiver," E. L. Martin, Collins Radio Company.

3:00—"Locally - Generated - Keying - Tone Squelch," L. M. Harris, Jr., Stromberg-Carlson Co.

3:30—"True Mass Liquid Quantity Gage," Willis Lindemann, Minneapolis-Honeywell Regulator Company.

4:00—"Streamlining a Radar Data Distribution Unit," Howard A. Bleam, Admiral Corporation.

4:30—"A 20 to 70 MC Stable Radio Receiver Tuner," W. R. Harter, Crosley Div. of AVCO.

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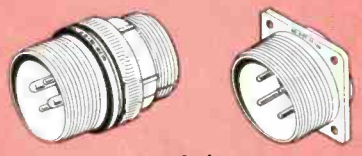

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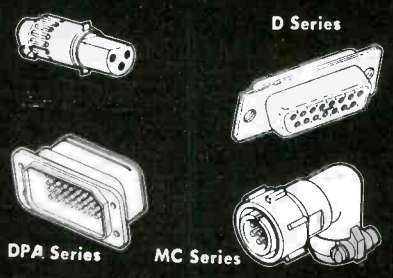
Also, heavy-duty watertight units; external power plugs and receptacles; high-voltage types; special breakaway designs.

MINIATURES



Cannon miniatures and subminiatures are designed for amplifiers, miniature indicators, computer circuits, telemetering equipment, small pre-amps, and general instrumentation where space is limited and current requirements are generally not over 5 amperes. Variety of shell styles, junction shell, and insert arrangements. 3 to 50 contacts, plus coaxials.

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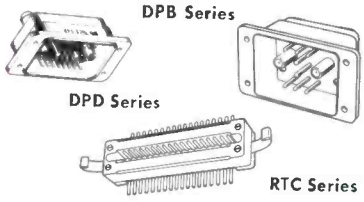

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Permit quick disconnect, interchange, replacement, testing and inspection of assemblies and sub-assemblies. For transmitters, TV cameras, control equipment, radar, etc. Rack-and-panel, integral clamp, shell-less types, bail-and-gear disconnects, center-screw extraction, 10 to 156 contacts including high voltage.

Printed circuit connectors in 5 sizes, 10 to 44 gold-plated contacts, Zytel shells.

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Cannon also makes plugs for switching and patching, test point jacks, external power connectors, missile launching connectors, buffet connectors, cable terminals, dc solenoids.

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Cannon Connectors are available from more than 1000 audio-industrial-electrical distributors from coast to coast

Radar Receivers

(*Continued from page 75*)

$$\text{And} \quad \bar{y} = \int_0^\infty y\,P(R)\,dR \qquad (16)$$

$$= \int_0^{R_o} y\,P(R)\,dR$$

So when it can be safely assumed that

$$\int_0^{R_o} R^2P(R)dR \cong \int_0^\infty R^2P(R)dR \qquad (17)$$

$$\int_0^{R_o} R^4P(R)dR \cong \int_0^\infty R^4P(R)dR \qquad (18)$$

$$\int_0^{R_o} R^6P(R)dR \cong \int_0^\infty R^6P(R)dR \qquad (19)$$

then the preceding derivation of the formula for the rms noise level in the radar receiver is approximately correct.

Application to 600 MC Radar

The experimental measurement of α's was accomplished as follows: The 6H6 diode in the receiver was replaced with a pair of 1N56

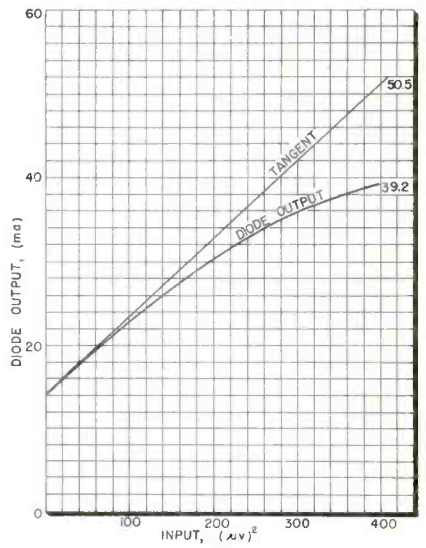
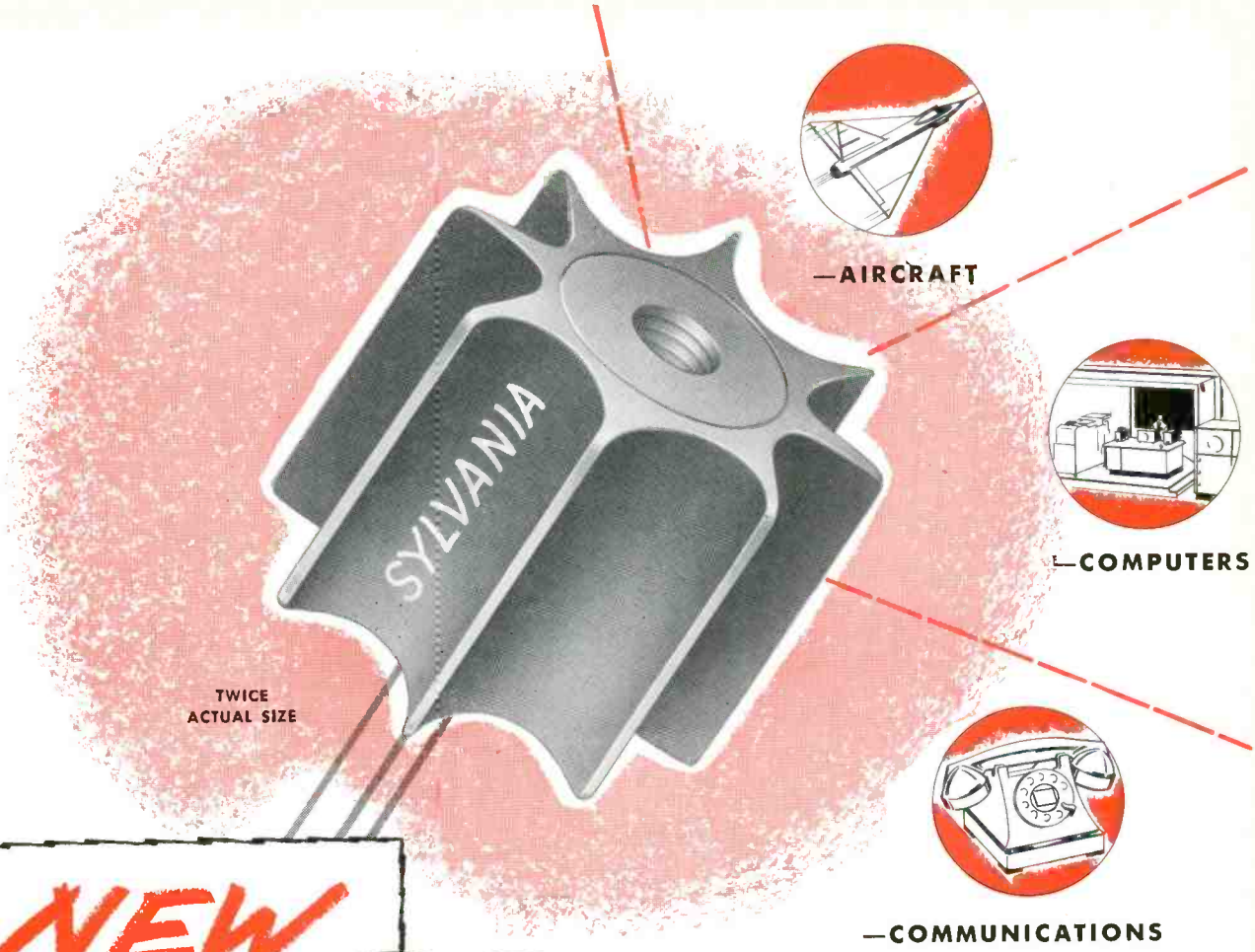


Fig. 5: Diode output vs. receiver input

crystal detectors. A sensitive microammeter was placed in the output circuit of the second detector. Output current was obtained as a function of voltage and is plotted as a function of the square of the voltage in Fig 5. By interpolation

(*Continued on page 123*)



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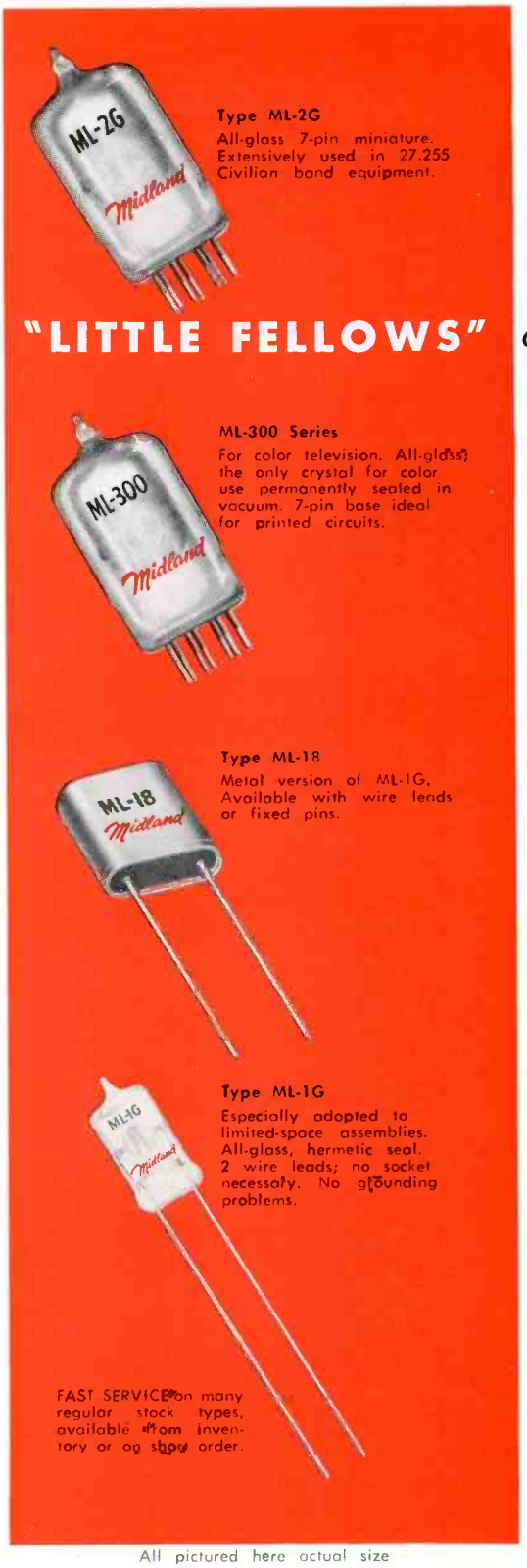

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. . . every one produced to the industry's highest standards.

Radar Receivers

(*Continued from page* 120)

at the points marked the characteristic constants were computed in the determination of the noise voltage.

When the i-f strip was opened by removing a tube, the output current went to zero, thereby establishing the unexcited response of the second detector as equal to zero.

From experimental data (See Fig. 5), the α's are valued as follows:

$$\alpha_0 - a_0 = 14.3 \text{ ma.} \quad (21)$$
$$\alpha_2 = 9.05 \text{ ma./(volts x } 10^{-5})^2$$
$$\alpha_4 = -0.6 \text{ ma./(volts x } 10^{-5})^4$$
$$\alpha_6 = 0.1051 \text{ ma./(volts x } 10^{-5})^6$$

When these numerical values are used, the equation for μ can be solved readily for its value in 10^{-5} v. units.

$$0.6306\mu^6 + 1.2\mu^4 + 9.05\mu^2 - 14.3 = 0 \quad (22)$$

By solution

$$\mu^2 = 1.264 \text{ x } (10^{-5})^2 \text{ v. rms} \quad (23)$$
$$\mu = 1.12 \text{ x } 10^{-5} \text{ v. rms} \quad (24)$$
$$= 11.2 \ \mu\text{v. rms}$$

References

1. S. O. Rice, "Mathematical Analysis of Random Noise," Part III *B.S.T.J.*, Vol. 24, pp. 46-158; 1945.
2. J. I. Marcum, "A Statistical Theory of Target Detection by Pulsed Radar," RM-754; 1 Dec. 1947, and "A Statistical Theory of Target Detection by Pulsed Radar," Math. Appendix to RM-753, Rand Corp.; 1 Dec. 1948.

Electronic Reliability

(*Continued from page* 90)

manufacturer is free to innovate and to use his own judgment in determining the wishes of customers which may not be completely agreed upon by all or clearly stated in the Characteristic. An airline, before committing to buy this or that equipment, carefully evaluates all the competitive products and then buys the best one only after having seen and tested the final products. The airline must have convinced itself of the potential seller's ability to produce the equipment and to offer continuous service to the customer. This follow-up service is another by-product of the continuing market for a good radio.

(*Continued on page* 124)

Electronic Reliability

(*Continued from page* 123)

The Equipment Characteristics as well as Report 403 are only guidance papers to acquaint the seller with the customer's needs, without restricting his ingenuity to meet operational requirements in his own way. However, the airlines have amassed a tremendous amount of know-how and experience in their efforts through the years to obtain reliability and long-term satisfactory performance. Since an airline will spend perhaps ten times the original cost of an equipment to maintain it during its useful life, it is highly prudent to guide the designer to the practices which have proved sound and to help him avoid the pitfalls which may not be evident at the designer's bench.

Report 403 clearly indicates a conservative view toward new innovations, while not restricting the designer if he can prove that a new technique is sound and reliable.

Transistors

Transistors and the newest semiconductors are good examples. The airlines are at this time urging all possible caution in the use of transistors in major equipment because their reliability has not been completely proven and because of the rapidly changing state of the semiconductor art. At the same time the design of transistorized microphone preamplifiers, isolation amplifiers and other equipment is going forward. This is encouraged to give both the designer and the user the necessary field experience and data for possible future commercial application, even though many airlines want to wait and see before using transistors in equipment which must be at all times completely dependable.

Electron Tubes

In the field of electron tubes, the airlines and ARINC have pioneered in the "reliable" or "special quality" tube types. Tremendous amounts of field data on

miniature tubes have been gathered and as a result of a cooperative program of tube improvement over the years by the airlines, the military, and the tube manufacturers a small group of special quality tubes has evolved. By designating a relatively small number of universally applicable types in another ARINC report (ARINC Report 402A, Preferred List of Special Quality Tubes) and encouraging their use in airline equipment, the improvement effort has been concentrated on this limited number to the advantage of both the manufacturers and the users. Each of the industry Characteristics strongly urges the use of tubes from the ARINC Preferred List of Special Quality Tubes.

Tube Program Success

A striking example of the success of the tube program is exemplified by the result of a surveillance test conducted on 200-1952 vintage special quality tubes. These tubes, type 5814, were all made by one manufacturer and tested in one airline. Of 200 tubes, 199 were still in service after 1000 hours of airline service. Recent analysis shows that 60% of these same tubes are still in service after 10,000 hours of airline use!

More recent tests of late vintage improved tubes of the same type show further improvement and even better service life.

Report 403 includes a section on application pitfalls, since the best tube is worthless in an improper application. The Report discourages the use of subminiatures for the simple reason that there is not as much known about them. While the miniature tube comes with a long pedigree of past history, the subminiature comes without the benefit of long airline service and proven performance. Since the tubes would have to be mounted for quick removal and since the airlines do not condone soldered-in tubes of any kind at this time, the stated advantage of subminiatures is primarily academic in airline applications.

(*Continued on page* 126)

Electronic Reliability

(*Continued from page* 125)

Operation vs. Performance

Report 403 points out that use of high-performance tubes and components in which every last drop of capability is squeezed out to get that last bit of gain is not desired when other, more conservative parts would give longer life and better stability. It is usually better, in airline equipment, to add an extra stage or a larger-rating component instead of trying to utilize too few tubes and components close to ratings. The airlines cannot depend on maintaining near-rating stage gains over the long time desired between overhauls, and with the large voltage variations encountered in service.

Components

The airlines encourage the use of military specifications for components and good-practice standards for the design of airline radio equipment, but they do not exclude equivalent or better components or processes simply because they are not covered by a Government or military specification. The designer is always urged to build the best possible box, not one which merely conforms to specifications.

One typical old and time-honored practice disposed of by Report 403 is the need for a mechanical joint in addition to a solder joint. Many a component or terminal board has been ruined because one or more leads were wrapped around a tie point when a failed component was to be removed. The airlines have had good success with use of simple solder joints so that a component may be removed as often as necessary by merely melting the solder.

Printed Circuits

Since the expected service life of an airline equipment is usually far longer than that of the constantly changing military equipment, careful consideration must be given to the long-term eco-

nomics of servicing and maintaining the gear. Printed circuit boards or potted assemblies may be an expensive luxury if a whole circuit subassembly must be destroyed in order to replace a two-cent resistor. Printed wiring has many attractions, but its design must permit ready replacement of components many times during the equipment's life without destroying the integrity of the print-wire board.

Removable Subassemblies

On the other hand, the airlines are encouraging the use of removable subassemblies, such as i-f amplifiers, resonant cavities, and the more conventional forms of modular construction. The emphasis is always on ready accessibility, and ease of trouble shooting and servicing. Recognizing that the best-engineered radio will fail, every effort is encouraged to permit in-chassis testing and facilities to perform every necessary performance check before removing either components or tubes from the chassis. In the design of equipment the designer is urged to provide methods to monitor deteriorating performance so that the occurrences of catastrophic failures while equipment is installed in the aircraft are reduced to the absolute minimum.

Lesson in Approach

Report 403 offers guidance to designers not only of airline equipment, but also of military and other commercial electronic gear. Its approach is informal and it depends entirely on good will and an honest effort by all concerned to contribute to long-term satisfactory performance. The material is based on the experience of people who must keep airplanes going 10 hours per day every day. While the airlines approach can not be applied completely to the problems of all users of airborne electronic equipment, the success of this program bears careful analysis. There is no more glaring spotlight than frustrated passengers delayed while a radio set is being replaced because V-303 just quit.

Reflectometer

(*Continued from page 73*)

cps in some practical systems). The ratio-meter forms the ratio of the reflected to incident voltages and a meter reading results. Also there is an output, for recording purposes, proportional to the meter deflection. The ratio-meter is designed to provide 100%, 30%, 10% and 3% full scale readings (with appropriate range switching). The ratio-meter's reading is independent of the source's output power variations encountered in practice. Specifically a range of 13 db is accommodated.

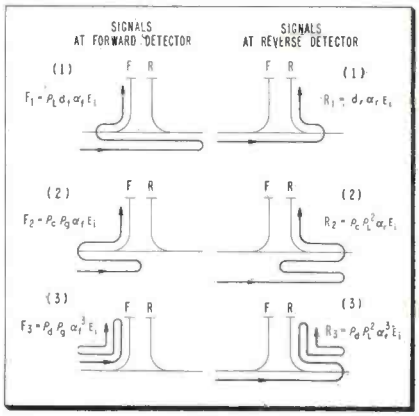


Fig. 7: Signal paths

Any source of modulated r-f power which has an output greater than 1 mw can be used. A sweep oscillator for use in reflectometer systems is available. Such an oscillator makes possible the use of the high speed data presentation abilities of the reflectometer. The sweep oscillator may be manually tuned. This feature is desirable when narrow band resonance phenomena are under investigation. An interesting point is that even if only manually tuned, the system can still provide data faster than existing impedance measuring systems.

Calibration and Errors

The practical system is calibrated by placing a short or other known reflection load on the end of the line. A short on the line should yield a 100% reading independent of frequency. The system errors give rise to deviation from 100% as frequency is varied. Fig. 4 illustrates this point over the frequency band 8.2 to 10 KMC. Note that the average reading is 100% and that a periodic ripple is present. This ripple is caused by mismatches in the system which give rise to spurious signals. The flatness of the trace's average (Fig. 4) at-

tests to the independence of frequency of the ratio of the (crystal) detector's rectification efficiency. In this case, the reflected detector's mismatch is the main source of the ripples (R_3 of Fig. 7). F_3 of Fig. 7 is analogous to R_3 for it is due to the first detector and source mismatches. Improper flange alignment between the two couplers gives rise to spurious signals F_2 and R_2. The spurious signals that dominate at low load reflections arise from the imperfect coupler directivities (R_1 and F_1 of Fig. 7). A directivity greater than 40 db results in error signals equivalent to load reflections which are less than 1%. Therefore the system error can be 100% when a 1% load is measured, but proper interpretation of the data prevents this. The data resulting from a load whose reflection is less than ½% over the band are shown in Fig. 5. The fine structure is due to the spurious directivity signals and the large but slow variation is due to mismatches within the crystal detectors.

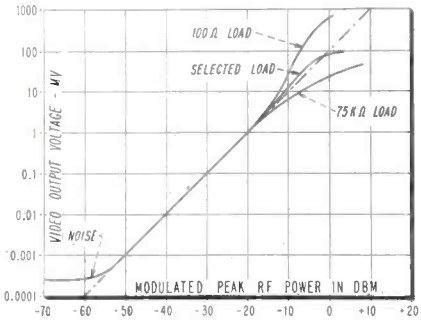


Fig. 8: Output under various loads

There are occasions when it is advantageous to calibrate at reflections other than 100%. A calibration line resulting from a standard 20% reflection is shown in Fig. 1. The ripples are smaller than in the 100% case because the spurious signal that dominates under these conditions is proportional to the load reflection.

The total system error can best be expressed as an equivalent SWR for purposes of comparison with slotted line systems. The residual SWR of a good slotted line is 1.02, independent of the magnitude of the reflection coefficient. The reflectometer residual SWR, on the other hand, is a function of the magnitude of the reflection coefficient. Fig. 3 summarizes the major cases.

Transistor Warning!

RETMA is warning its members that they should look carefully into the quality and operation of any silicon junction transistors that they plan to purchase abroad.

Non-Linear Capacitors

(*Continued from page* 69)

At the low frequency-high field corner, a dip in the Q occurs at around 35 MC. This dip is the seventh harmonic of a piezoelectric resonance occurring in this case at 5 MC. This behavior is shown in Fig. 3. Only two curves of the family are shown in Fig. 3; namely, that for zero field and for the maximum field. It is well known that the $BaTiO_3$ ceramics are piezoelectric. Due to the small bulk of our samples, the fundamental resonance occurs at the relatively high frequency of 5 MC. The odd harmonic behavior is typical of a thickness-mode piezoelectric resonance. Note that for zero field the material continues to show an increase in Q as the frequency is lowered, whereas upon the application of the biasing field, severe resonant dips are apparent. The net effect is that the QEF surface of Fig. 2 for the frequency range 2.5 to 250 MC is heavily wrinkled in the 2.5 to 25 MC region. However, since these piezoelectric resonances occur in the lower frequency range, it is possible by utilizing a thicker capacitance, to lower the frequency at which the resonances occur. In other words, the piezoelectric resonances can generally be shifted out of the frequency range of interest.

The measurements of the dielectric losses from 25 to 250 MC were made with the aid of a Boonton 190-A high frequency Q-meter. Readings were taken with the sample switched in and out of the Q-meter circuit with stray capacities approximately constant. The diagram for the switching plate is shown in Fig. 4. This plate mounts directly on the "C" terminals of the Q-meter and the switching is then accomplished by tightening or loosening the Q meter terminal nut. Fig. 6 is a photograph of the plate in place on top of the Q-meter.

Our measurements indicate that the dielectric constant of Ba-Sr-TiO_3 ceramics is unaffected up to 250 MC. Work carried on in Great Britain by Powles and Jackson, and also by Davis and Rubin[1] and others in this country, indicates that this is also the case up to 3000

MC for these ceramics. The early results reported by Von Hippel[2] and Powles and Jackson on poly crystalline barium titanate show that the real part of the dielectric constant rolls off quite rapidly above 800 or 900 MC for pure $BaTiO_3$ ceramics, so that one would expect that tunability would be limited above these frequencies for the pure composition. At any rate, for high frequency oscillators (at least up to 250 MC) the tuning

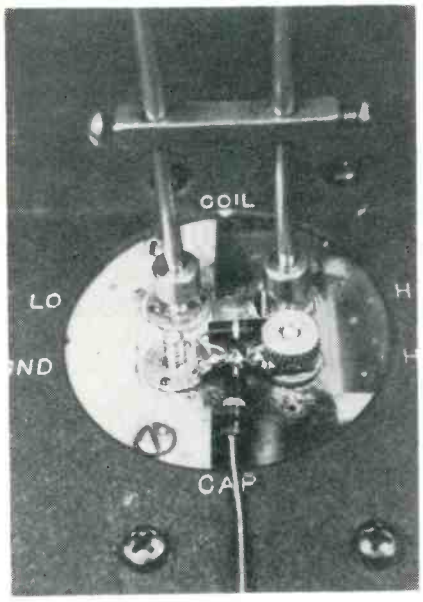


Fig. 6: Plate in place on top of Q meter

range is not reduced by any reduction in tunability of the material, but by such effects as capacitive strays.

Preparation of Capacitors

For very high frequency applications, capacitors with starting values[3] of 10 to 50 $\mu\mu f$ are desirable. Since the dielectric constant is large, and since thin materials are preferred[4], the dimensions of the ceramic dielectric become very small. The procedure for constructing these subminiature capacitors is as follows: A flat plate or disc of the ceramic dielectric which has been provided with silver electrode surfaces is cemented to a glass microscope slide to provide mechanical rigidity. The ceramic plate is then diced on a Norton grinder by means of a thin abrasive wheel. The size of the dice depends on the capacities desired. For the VHF applications, a typical size is a cube about .020 in. on a side. The dice are then removed from the micro-

(*Continued on page* 132)

Non-Linear Capacitors

(*Continued from page* 131)

scope slide by dissolving the cement, and the ceramic cubes are washed and spread out over the working area. One inch of insulation is now stripped from a short length of stranded wire, and the strands are fanned out. The ends of the strands are then tinned by dipping in molten solder. The ceramic dice are then picked up one at a time by placing the wire strands against the silver electrode and holding a small soldering iron about a quarter of an inch from the end of the wire strand. The solder melts down the wire and "sweats" the ceramic tube into place. This procedure is shown in Fig. 7.

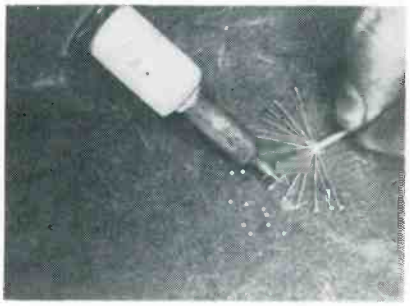


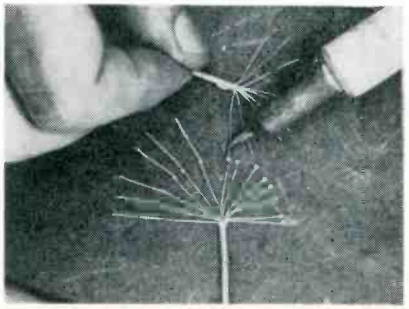
Fig. 7: Ceramic tubes are "sweated" in place

The second lead wire is similarly attached as is shown in Fig. 8. A low power microscope is used in these operations. After the second wire is attached, the units, which are still attached in a "bunch" to the original stranded wire, are washed in toluene and acetone and are then separated and "potted" in a plastic bead. Finished units are shown in Fig. 9.

Tuned Resonant Circuit

A capacitor tuning element consists of a pair of ferroelectric capacitors in series. When such an element is connected across an in-

Fig. 8: Attaching the second lead wire



ductance, a voltage-tunable resonant circuit is obtained.

The resonant frequency is controlled by applying a variable dc voltage to the junction of the two capacitors with a ground return at one end of the coil.

Tuned Low-Power Oscillator

Using a circuit as described above, it has been possible to develop dielectric-tuned wide-range VHF low-power swept oscillators. In the 25-150 MC range, the Colpitts or Hartley circuit using a high g_m triode gives very good results. One is able to obtain tuning ratios of better than 2:1 with power outputs in the order of 50 mw. In the 150-400 MC range the most satisfactory

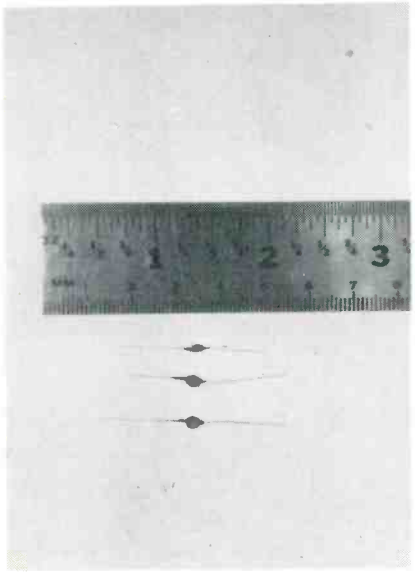


Fig. 9: Finished unit, "potted" in plastic

circuit appears to be the ultra-audion using a series tuned resonant tank circuit and a high g_m triode. In both ranges a subminiature capacitor made from a commercial ceramic material gives the best results. Fig. 10 shows schematics of typical circuits designed to tune the ranges 50-100 MC and 250-385 MC. With the development of improved production techniques in making these capacitors, it is expected that this frequency may be extended.

Tunable Power Oscillators

When large signal phenomena are to be considered, as in the case of high-power oscillators, the rf voltage applied to any tuning element must be restricted in order to avoid excessive dielectric heating.

(*Continued on page* 134)

Non-Linear Capacitors

(*Continued from page* 133)

In order to accomplish this, several capacitors are arranged as shown in Fig. 5. Here the capacitors are in series across the rf signal and in parallel with the biasing field. The resistors are used for decoupling. With this arrangement the rf field is divided among the capacitors, but no increase in the voltage required for tuning is necessary. This push-pull circuit proved to be superior to the other circuits used in the range of 40 to 100 MC. The capacitor stacks used

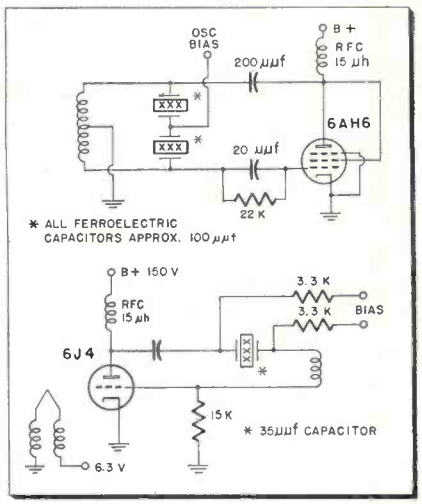


Fig. 10: Ckts for 50-100, 250-385 MC

were between 100 and 200 *μμf*.

The capacitors must not be allowed to heat excessively because the capacitance range, and hence the tuning, is drastically reduced at temperatures much above the Curie point. To prevent excessive temperature rise, a strong jet of air was directed on the stack during operation.

Fig. 11 shows the results of the tests carried out on the power oscillators. Two effects are immediately apparent: (1) At constant anode supply voltage there is an increase in output power, in addition to the increase in frequency, when the dc bias is applied. This is due to the increased Q of the capacitors at large dc field values. (2) An increase in output power level (produced by raising the anode supply voltage) was found to reduce the tuning range in spite of the presence of the jet of cooling air. It was concluded that the

jet of air does not provide adequate cooling for cw operation.

When the oscillator was operated at high power but pulsed on a sufficiently small work cycle so that the capacitors remained relatively cool, the tuning range was about the same as for low power cw operation. The power output was roughly 3 w. at the high power level, and about 100 mw. at the low power level.

Conclusions

Electronic frequency control is flexible, versatile and in many applications essential. This feature of the ferroelectric tuning technique makes it applicable to sweep generators, spectrum analyzers and a variety of other applications where wide-range rapid scan tuning is used.

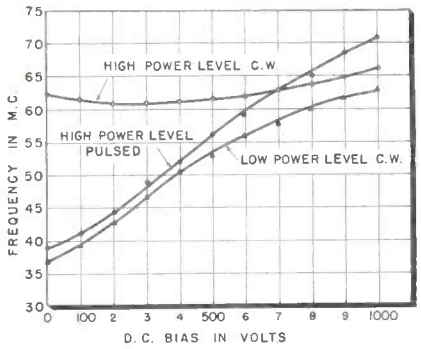


Fig. 11: Test results on power oscillators

To judge from the relaxation measurements on several samples of titanate ceramics, the upper practical limit of sweeping appears to be about 100 KC. However, for small frequency deviations, scan rates of the order of 500 KC have been reported.[5] The major difficulty at present is that of obtaining a large tuning ratio while maintaining a small temperature coefficient. However, this difficulty may be considerably reduced through the development of new materials and manufacturing techniques.

References

1. Luther Davis, Jr., and L. G. Rubin, "Dielectric Properties of Barium-Strontium Titanate Ceramics at 3000 Megacycles," *J. of Applied Physics*, Vol. 24, No. 9, Sept. 1953.
2. Ref. quoted in Kittel, *"Information to Solid State Physics,"* p. 130, John Wiley and Sons, N. Y.
3. Starting value is the value at zero dc electric field.
4. Thin materials are preferred to reduce the dc voltage required for tuning.
5. M. Apstein and H. H. Wieder, "Capacitor-Modulated Wide Range FM System," *Electronics*, Vol. 26, Oct. 1953, p. 190.

News of Reps

REPS WANTED

Engineering reps wanted for line of silicon transistors. To industrials and distributors. For all areas, except metropolitan N. Y. (Ask for R-5-1.)

Reps wanted for line of pressure sensitive electronic adhesive foils – aluminum, copper and lead – used in making printed circuit prototypes, for small product runs and general lab use, and in repair of magnetic tapes and magnetic sound films. Also electronic chemicals, lacquers, adhesives and protective coatings. (Ask for R-5-2.)

Non-Linear Systems Inc., Del Mar, Calif. has appointed the following reps: **M. E. Gerry & Co., Inc.**, 230 Bayard Rd., Upper Darby, Pa. for Phila., Eastern Pa., Wash., D. C., Md., Southern N. J., and Northern Va. **Gerard G. Leeds Co.**, 12 Crampton Lane, Great Neck, N. Y., for metropolitan N. Y., Northern N. J., upstate N. Y., and Fairfield County, Conn. and **M. P. Odell Co.** in the Dayton, Detroit, Pittsburgh and Western Pa. areas.

Mel Schwartz has established a reps office at 39-16 Tierney Place, Fairlawn, N. J. serving the industrial electronic field.

Albert S. Myers, Jr. joins **Louis A. Garten & Assoc.** in charge of their new branch office at 333 Wellesley Rd., Phila., Pa.

Nick J. Faymoville, Jr., 1400 Park Ave., Minneapolis, Minn. is the new rep for Littelfuse, Inc. for Minn., N. & S. Dak., and Northwestern Wisc.

New office of **Neeley Enterprises** at 126 S. Water Street, Las Cruces, will serve the Southern part of N. M. Manager is Earl C. Davis.

Harry C. Gawler was honored by A. B. DuMont Labs. at a dinner marking his 25 years service as a DuMont rep.

Aero Engineering Div., Mineola, N. Y. will represent Robinson Aviation Inc. in territories east of the Miss. River.

E. B. Ruzicka joins **Westron Sales and Engineering**, West Coast rep, as sales engineer.

Everett Assoc., Inc., Chicago, Ill. is representing Electronic Tube Corp., Phila. manufacturer of CRT's, oscilloscopes, and oscilloscope cameras.

M. Clifford Agress will represent Universal Atomics Corp's line of transistorized power supplies for the N. Y. and N. J. metropolitan areas.

Lester L. Dunscomb has joined the staff of **Ridley Assoc.**, Chicago.

Terminal Radio International, Ltd., N.Y.C. has been named exclusive export sales agents for all countries except Canada by Condenser Products Co., Div. of New Haven Clock and Watch Co.

James B. Lansing Sound Inc. has appointed three new reps: **Don B. Hamilton Co.**, Minn.; **Gene Rosen & Assoc.**, Rockville, Md.; and **Forristal-Young Sales Co.**, St. Louis.

Frank A. Emmet Co., Los Angeles, Calif. is now representing Shallite, Inc. in Ariz., Southern Nev., and Southern Calif.

R. Edw. Stemm has been named sole representative in the mid-west by Shielding Inc., Riverside, N. J.

W. S. Hartford will handle sales of Webcor phonographs, tape recorders, and changers in the Southeastern U. S. from offices at 1051 Mark Trail, Decatur, Ga.

Harold F. Wyman is now exclusive sales rep for Du Mont 2-way mobile radio equipment in all of New England except Conn.

Radio Receptor Inc., Semi-conductors Div. adds two reps: **H. W. Knaggs Co.**, Belleville, Ill. for Mo., Iowa, Kansas, Eastern Neb., Southern Ill.; and the **Engineering Services Co.** of St. Louis, and Kansas City, Mo. to cover industrial and manufacturer accounts for the same territory.

G. S. Marshall Co. announces a new sales office at 3686 Baker Place, Tucson, to handle sales in Ariz. and N. M. Manager is **R. T. Williams.**

Allen I. Williams Co., 124 W. 12th Ave., Denver, Col., has been named rep by Helipot Corp., S. Passadena, Calif.

Arthur Z. Adelman has rejoined the **Leon L. Adelman Co.** following his tour of duty with the Army.

Gray Research & Development Co., Inc., Manchester, Conn. has named 10 new reps: **Antle-Smith**, Dallas, Tex.; **E. W. Brandt Co.**, San Francisco, Calif.; **J. K. Dooley**, Seattle, Wash.; **F. A. Dougherty & Co.**, Cleveland, Ohio; **Goldman Reiss & Co.**, Brookline, Mass.; **Mark Markham**, Audio Marketing Services, Los Angeles, Calif., **Walter F. Marsh**, Oak Park, Ill.; **Mitchell and Morris Co.**, Indianapolis, Ind.; **Dick Hyde**, Hyde Sales Co., Denver, Col.; and **Maury Farber**, Buffalo, N. Y.

D. K. MacLennan Co., 921 Westwood Blvd., Los Angeles, Calif., will represent Olympic Radio & TV Inc. on the West Coast.

Video Tape Recorder Developed By Ampex

A new video tape recorder (VTR) developed by Ampex records a full hour TV program on 14-in. reel of 2-in. wide tape at a speed of only 15 in./sec. It is commercially available, and CBS has ordered three units at $75,000 each. It records 4 mc band by using unique four-head assembly on drum rotating at 14,000 rpm, one head always in contact with tape. Magnetic signals for video are recorded transversely across tape, rather than longitudinal as in conventional recorders. Units will first be used for network delayed programs. Compared to film-kinescope recording, VTR is less costly, has better quality, allows immediate playback, requires no processing, and may be reused.

Silicon Transistors

(*Continued from page* 78)

tion made was that the amplifier have a flat frequency response from 50 to 15,000 CPS. ±3db.

Since in the micro-power operating region the parameters of the transistors undergo large adverse changes, it is difficult to expect an efficiency in that region much higher than 10%. Consequently the maximum output power is set at 0.01 mw due to the restriction on the dc power consumption (0.1 mw). The limits on the power gain of the amplifier were arbitrarily picked as 35 to 40 db, which corresponds to input power and input voltages of 0.003 to 0.001 mw and 5 to 10 mv respectively. It would be undesirable to increase the input signal further due to the fact that the relatively low values of collector voltage (below 1.5 v.) would cause distortion.

Temperature Range

The temperature range over which the amplifier should give satisfactory operation is −25 to +75°C with the overall power gain not varying more than ±3 db.

The first step in the design of this amplifier is the determination of the requisite number of stages. Since the required overall power gain should be between 35 and 40 db it could normally be obtained

from one grounded emitter stage. However, due to the specification of high input impedance, it necessitates the use of two stages with the first stage operated with large degenerative feedback. Due to the low output resistance required (600 ohm), it was decided to use a transformer with a turns ratio of 10:1.

The two stage-grounded emitter amplifier shown in Fig. 6 stemmed from the above considerations.

The technical specifications of the amplifier are as follows:

Max. output voltage	*76 mv*
Max. output power	*10 μw*
Input impedance	*30 kΩ*
Output impedance	*600 Ω*
Overall gain	*37 db*
Emitter current of 1st stage	*20 μa*
Emitter current of 2nd stage	*40 μa*
Overall current consumption (including the bleeding networks)	*65 μa*
Supply voltage	*1.5 v*
Fequency response	*20 - 20000 CPS within ± 3 db*

Temperature Compensation

To compensate for temperature variations of the amplifier output, resistance R_2 was replaced by the network shown in Fig. 11. r' is a G. E. ceramic thermistor, the temperature—resistance curve of which is shown in Fig. 10. Also

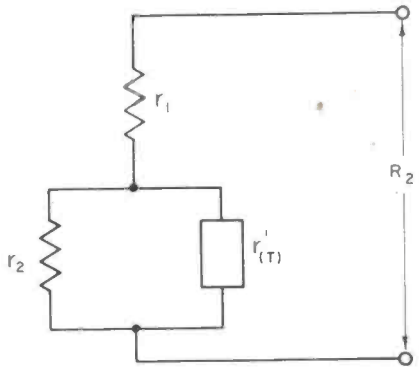


Fig. 11: R_2 compensates for temp. variation

shown in Fig. 7 is the resistance R_2, needed to obtain a constant gain from the amplifier over the temperature range of +30° to +75°C.

Using the graphical method of obtaining a desired characteristic from a given temperature sensitive resistor, a temperature compensating network was designed and the following values of the resistors shown in Fig. 11 were obtained:

$r_2 = 130\ K\Omega$

$r_1 = 80\ K\Omega$

(*Continued on page* 140)

Silicon Transistors

(*Continued from page* 139)

Operating Characteristics

Fig. 9 shows the frequency characteristic of the amplifier illustrated in Fig. 10. The dotted line shows the frequency characteristic of the amplifier with capacitor C_1 removed. As can be seen, there is an increased response at higher frequencies resulting from the addition of positive feedback through capacitor C_1 without affecting the response at lower frequencies. The characteristic is flat within ±1 db from 50 to 18,000 CPS.

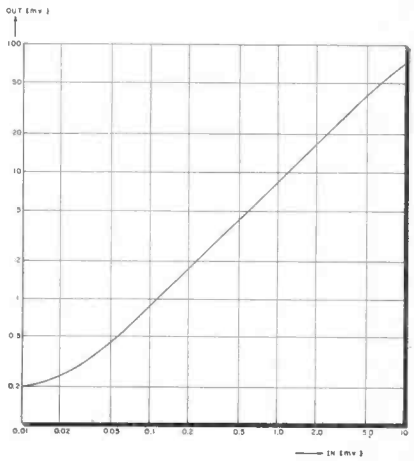


Fig. 12: Amplitude characteristic of amp.

Fig. 12 shows the amplitude characteristic of the amplifier to illustrate its linearity and dynamic range. (Ratio of the maximum to the minimum undistorted output.) As it can be seen, the dynamic range is in the order of 54 db. The upper limit of the dynamic range is limited by the signal swing at the primary winding of the transformer. This signal swing should not over exceed the collector voltage of the transistor; otherwise, distortion in the form of clipping will result. The lower limit of the dynamic range is determined by the noise level of the amplifier and the minimum permissible signal to noise ratio. According to measurements, the equivalent noise voltage at the input of the amplifier was in the order of 3 to 4 μv. If we assume a signal to noise ratio of 14 db, the minimum undistorted signal is approximately 20 μv.

Fig. 8 shows the results of the temperature test on the compen-

(*Continued on page* 142)

Silicon Transistors

(*Continued from page* 140)

sated and uncompensated amplifier. As can be seen, the temperature characteristic of the amplifier is exceptionally good. The amplifier is compensated over the range −25 to +75°C with a gain variation of 1.2 db. The amplifier is mounted in a plastic tube ¾ in. in diameter and 3 in. long. The case also contains a 1.35 v. battery cell. As was mentioned above, the amplifier will operate continuously for the shelf life of the battery i.e., over 3 years. For the same reason the amplifier does not need a switch which can be of great advantage for many applications.

The interchangeability of transistors in the experimental amplifier was tested at room temperature with a limited number of available silicon transistors. The results showed the first stage was not critical, any of the 10 transistors could be used with little effect on the operating characteristics of the amplifier. The second stage, using a 905 transistor, was more critical. While all ten of the available transistors could be used in that stage, the overall power gain of the amplifier was decreased by 3 to 7 db. However, these results can not be considered entirely representative in view of the limited number of transistors available.

FM/FM Telemetering

(*Continued from page* 79)

and are in present use in telemetry systems. One is specified to be 300 KC wide and the other is specified to be 500 KC wide. It is essential to know which receiver bandwidth is available for use with the system since this often places a limitation on the modulation of the FM transmitter.

In a sinewave amplitude modulated r-f signal, there are only two significant side bands and both are independent of the percentage of amplitude modulation. For example:

A 220 MC transmitter amplitude modulated at 70 KC with a sine wave may have a frequency spec-

trum analysis as shown in Fig. 1. From this, it is apparent that a reception bandwidth of ±70 KC or 140 KC is adequate. Actually, in amplitude modulation, it is possible to utilize single sideband techniques, thus reducing the required reception bandwidth with effectively no loss in reproduction of the modulation signal.

However, the analysis is quite different when the transmitted signal is frequency modulated by a sine wave. The sidebands generated become less easy to determine since the sidebands depend not only upon the frequency of the modulation but also the deviation of the FM transmitter. In fact, under certain conditions of modulation frequency and deviation, the spectrum analysis of the signal shows zero power at the transmitter center frequency with all of the RF power distributed among the numerous sidebands. The sidebands then can cover a very wide frequency spectrum and, although they can be calculated, the calculation can become rather involved.

Rule of Thumb

Fortunately, there is a rule of thumb that allows one to be sure of receiving 90% of the sideband power in a given bandwidth or reception. This 90% power appears to be adequate for reproduction of the original signal.

Simply stated, the rule of thumb is that with a given bandwidth of reception, if you subtract bandwidth equal to the highest modulating frequency from each side of the given bandwidth, you have left a bandwidth figure that specifies the maximum possible deviation. The maximum possible deviation stated in ± KC is equal to one half of the remaining bandwidth.

For example: If we have a reception bandwidth of 300 KC (same as ± 150 KC) and if we have an FM modulating frequency of 70 KC, we will have left, after subtraction, a bandwidth of 160 KC, half of which (80 KC) is available for deviation of the RF carrier. In other words, the maximum carrier deviation under this case is ± 80 KC. This gives a modulation index of slightly over 1. However, if the reception bandwidth is 500 KC in the same situa-

(*Continued on page* 144)

FM/FM Telemetering

(*Continued from page* 143)

tion, a modulation index of 2.5 can be achieved (provided there are no other limiting factors) which provides better noise suppression in an FM system. Note that this rule of thumb presupposes that the modulating frequency is sinusodial. If the modulating frequency happened to be a 70 KC square wave, the rule of thumb example is not valid when only the first harmonic is considered. The modulation of the transmitter with a 70 KC or 40 KC square wave was rather common at one time and there are undoubtedly systems still in use that do this. This takes care of the highest frequency subcarrier. What then of multiple subcarriers? It is true that each subcarrier modulating frequency produces transmitter sidebands due to the individual subcarrier frequency and deviation, however, the reception bandwidth is not exceeded, provided the highest subcarrier frequency was used in the rule of thumb calculation and provided that the maximum deviation determined by the calculation is equal to or greater than the algebraic sum of the individual subcarrier deviations.

Total Deviation

The instantaneous total deviation is less than the algebraic sum of the individual deviations during most of the time that an FM transmitter is modulated by a composite waveform (linear summation of the subcarrier oscillator frequencies) and graphs have been presented which allow an improvement factor to be applied. This improvement factor is based on allowing a certain percentage of noise (usually 10^{-3}) due to instantaneous over modulation of the system.

It must be remembered, however, that, in cases of stating the improvement factor, the factor is based on equal deviations by the individual subcarrier oscillators. This situation is rarely observed in present day practice. Where the subcarrier oscillators present unequal deviations, the calculation of improvement factors become quite involved.

What division of the allowable

deviation can be made between the various subcarriers?

Much has been said about the advantages of the three-halfs power taper and/or the linear taper for best signal-to-noise ratio in cases of week (below receiver limiting) signals. However, it has been the experience of this writer that all channels become noisy, irrespective of taper or lack of taper, when very weak RF (less than 6 μ) signals are present. In addition, systems employing 6 or more subcarriers become impractical to handle on a linear or three-halfs power taper basis since they generally violate bandwidth requirements and/or linear system requirements.

The primary objective in setting up the modulations is to present an adequate amplitude of signal to the discriminator so that limiting (noise quieting) takes place while not violating bandwidth requirements. In general, on the lower frequency channels, 3 KC deviation is sufficient (this writer recommends 4 KC for purposes of engineering conservatism) and on the higher frequency channels 8 to 10 KC appears to be adequate. The channels in the mid-frequency range can fall in between these two figures.

Non-Linearity

A source of system non-linearity (usually not a bandwidth problem) is in the subcarrier audio modulating circuit of the transmitter, as previously discussed in the summary and in the subcarrier audio circuits of the receiving system before subcarrier separation by band pass filters. These limitations must be known and observed if the linear system operation is to be achieved.

B. Subcarrier Receiver Bandwidth. The statements made about r-f receiver bandwidths apply equally well to the bandwidth limitations of the subcarrier discriminators with their associated band pass and low pass filters (if used). However, where the receiver has fixed bandwidths, each subcarrier band pass filter has a different bandwidth than adjacent subcarrier bandwidth such that each subcarrier channel must be considered separately. Some of the individual subcarriers have alternate bandwidths which may be specified.

(*Continued on page* 147)

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VHF Band: Range 30 to 220 mc with fundamental frequency output of 1.0 V rms into 75 ohms. Sweep width variable to at least 15 mc.

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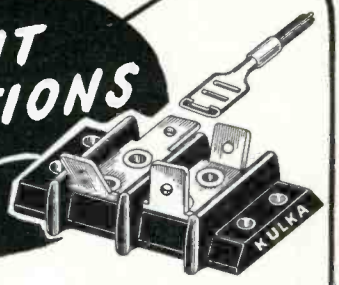

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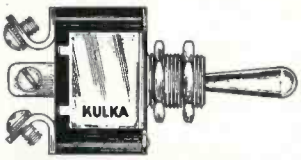

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FM/FM Telemetering

(*Continued from page* 145)

The information signal fed to each subcarrier oscillator can be dc, ac both sinusoidal or non-sinusoidal, pulses, or combinations of these waves. When the modulating signals are dc or low frequency ac sine waves, the problems are easily resolved. However, if non-sinusoidal wave forms are used as modulation signals, the problem of proper utilization the bandwidth of the discriminator is more difficult.

In essence, the best signal to noise ratio is achieved when the bandwidth of the reception filter is completely filled with side band power. If the side band power is significantly greater than or is significantly less than the reception band pass filter, the system is more susceptible to noise. Then, in this application, the best signal to noise ratio is not a function of a large modulation index. Admittedly, in FM signals, a modulation index of 5 has better signal to noise characteristics than a modulation index of 2, provided the reception bandwidth is designed to handle this index. In the case of FM/FM telemetry, where reception bandwidths are fixed and the frequency spectrum of the modulation is fixed, attempts to achieve an arbitrary modulation index can only lead to trouble. Not only does the individual subcarrier become noisy, but extreme cases can cause adjacent channel interference due to significant side band power appearing within the adjacent channel bandwidth.

Square Wave

In considering square wave modulation (also known as commutation or PAM/FM/FM) signals placed on a subcarrier, it is not valid to assume that the first harmonic of the signal is the only harmonic of significance. Usual practice requires the consideration of at least the fifth harmonic.

If one follows the concept of fixed reception bandwidths in telemetry, it is possible to achieve, with a great degree of reliability, better frequency response (at the expense of deviation) than is listed in the Research Development Board (RDB) recommendations for FM/FM telemetry.

Space Satellite

(*Continued from page* 11)

There a spinning movement will be imparted to the third stage rocket to insure directional stability. By that time, the third stage will be set on its course; the second stage will drop off; and the third stage will start firing.

The third stage rocket carrying the sphere has no guidance system. Its job is to boost the satellite's speed to approximately 18,000 MPH. This high speed, necessary to counteract the earth's gravitational pull, will be attained at the rocket's burnout.

At burnout, the satellite may be nudged ahead by means of a releasing device in the nose of the rocket. Therefore its speed will be slightly greater than that of the rocket shell, which will not drop to the earth, but will trail the satellite until atmospheric drag causes both gradually to slow down and spiral toward a lower atmosphere.

Through friction induced by passing into this denser atmosphere, both satellite and rocket will burn briefly and disintegrate after the manner of meteors.

The Martin Company is prime contractor for the Vanguard launching vehicle. General Electric Company has a contract with Martin for the rocket motor to be used in the first stage, which is an advance of the Viking rocket built for the Navy.

Multiplexer

(*Continued from page* 82)

pulse stretchers. Fig. 9 gives an idea of the magnitude of the commutation pulse. In this photograph the elapsed time between the two separate pulses is 20 μs so that the commutation pulse is over in about 2 μs.

The effect of the commutation pulse depends markedly on the way the whole system is being used. If a display of the form illustrated in Fig. 7 (i.e. a line sequential system is involved) then the only limitation that the

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commutation pulse imposes is that its duration must not be long compared with the duration of one scanned line. This is a somewhat arbitrary limit and probably means that the minimum duration of each sampling period must not be less than about 10 μs.

If on the other hand, we are using the multiplexing system in its more fundamental way, namely, as a means of point by point

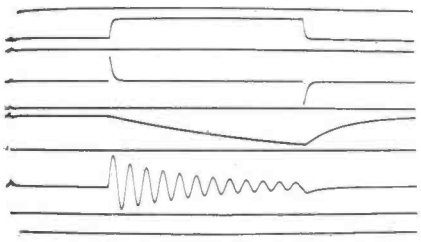

Fig. 7: Display for line sequential system

sampling of a complex wave with the intention of re-constructing the wave so sampled, then we see that the effect of the commutation pulse will be to introduce amplitude errors and some measure of cross-modulation between the successive samples. Again, the limit is somewhat arbitrary but probably a 5 or 10 μs. Sampling period is about the minimum in most applications. If we take 10 μs as the minimum which is fairly safe,

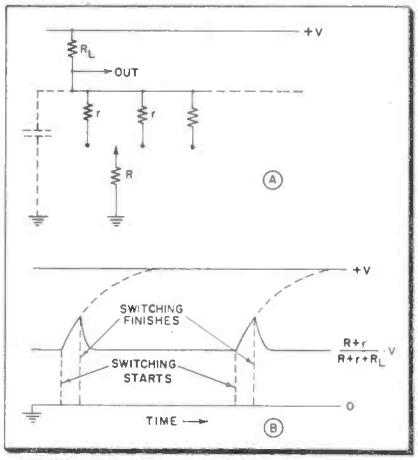

Fig. 8: Noise in multiplexing system

then the maximum sampling rate for each of the 10 channels is clearly 10 KC so that by information theory it follows that the max-

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imum usable band width in each of the separate channels is 5 KC.

2. Magnetron Noise. Fig. 10 shows a picture of the 10 different levels for the Beamplexer in the absence of any input signals. These levels have been set by adjustment of R_1 in Fig. 4. However, for channel #7 the clamping diode d-1 of Fig. 4 has been omitted and it will be noted that this channel contains a good deal of noise due to direct transmission of electron turbulence in the magnetron into the gate signal path. The switching transient is also very much longer when the diode is omitted.

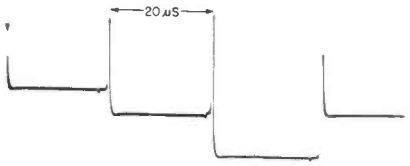

Fig. 9: Commutation pulse is over in 20 us.

Fig. 10: The 10 levels, in absence of input

This is due to the relatively long natural time constant in the cathode of the gate tube.

Beamplexer Characteristics

Equivalent noise input at grid of gate output—15 mv.
Commutation pulse length (to 5% point)—approximately 1.5 μs.
Input impedance for signal circuit—0.5 μf in series with 10 KΩ
Maximum input voltage range, (5% linearity) ± 15 v.
Band width of gating amplifier—500 KC
Maximum switching rate, contact to contact—200 KC
Minimum rest time on each channel (limited by commutation pulse interference)—10 μs.
Input triggering pulse—.5 v. into 1 MΩ
Maximum output voltage range, (5% linearity) ± 15 v.

Improved Gating Systems

As mentioned, the gating sys-

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While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this index.

Multiplexer

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tem employed is a compromise between cost and performance. Fig. 11 shows a much more efficient gating method which would permit the examination of signals in the micro-volt range. In this circuit, which is dc coupled throughout, V_1 represents the phase inverter tube and the long-tailed degenerate pair V2a and V2B are the true mixing tubes. In effect,

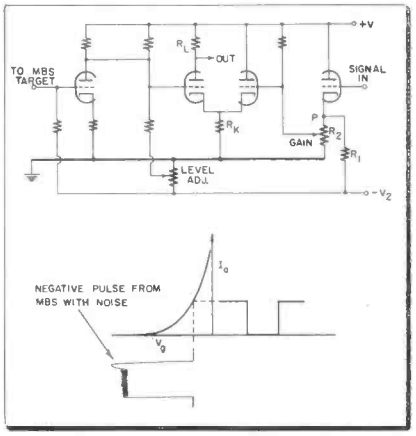

Fig. 11: More efficient gating method

the left hand portion of this twin triode receives the gating pulse on its grid and the signal on its cathode through the common load R_K. V_3 serves as a cathode follower and attenuator for the signal. By suitable adjustment of R_1 and V_2 the point P may be brought to ground potential so that the gain control R_2 causes no change in the output level. The latter is controlled by the level adj. potentiometer R_3. This system is a very much superior gating method to the one described but of course involves four tubes instead of one and, in addition, three of these tubes carry their standing anode current even when the signals are not being sampled. This involves a very much larger power consumption which may not be justified in many of the less exacting applications.

References

1. "The Magnetron Beam Switching Tube —Its Operation and Circuit Design Criteria." S. P. Fan. *Jour. Brit. Inst. of Radio Engineers,* Vol. 15, No. 7, July 1955.
2. "Magnetron Beam Switching Tube." Hilary Moss. *Pro. National Telemetering Conference,* Chicago. May 1955.

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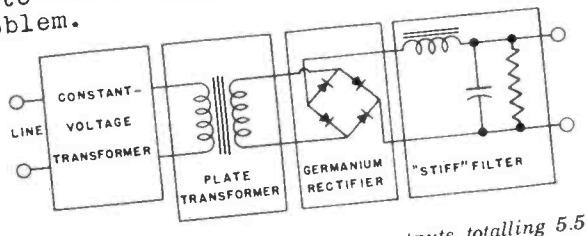

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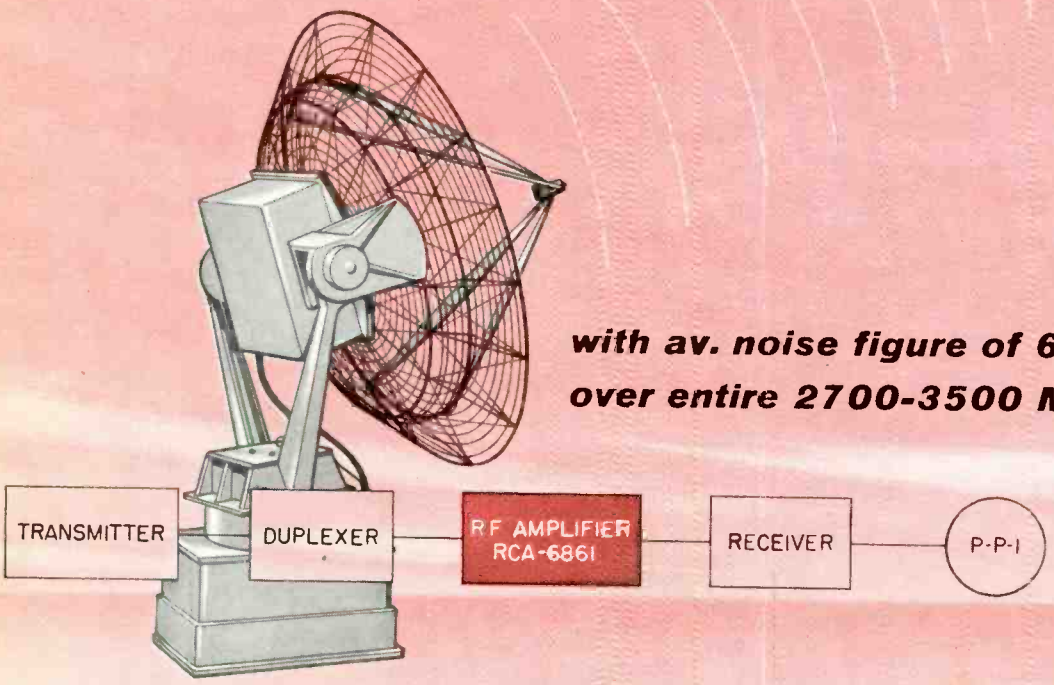

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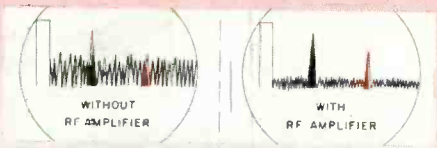

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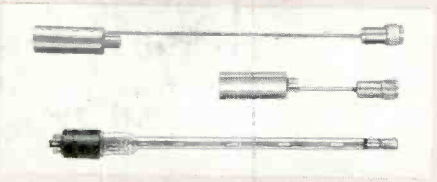

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