

TELE-TECH & **ELECTRONIC INDUSTRIES**

**1956
WEST COAST
Issue**



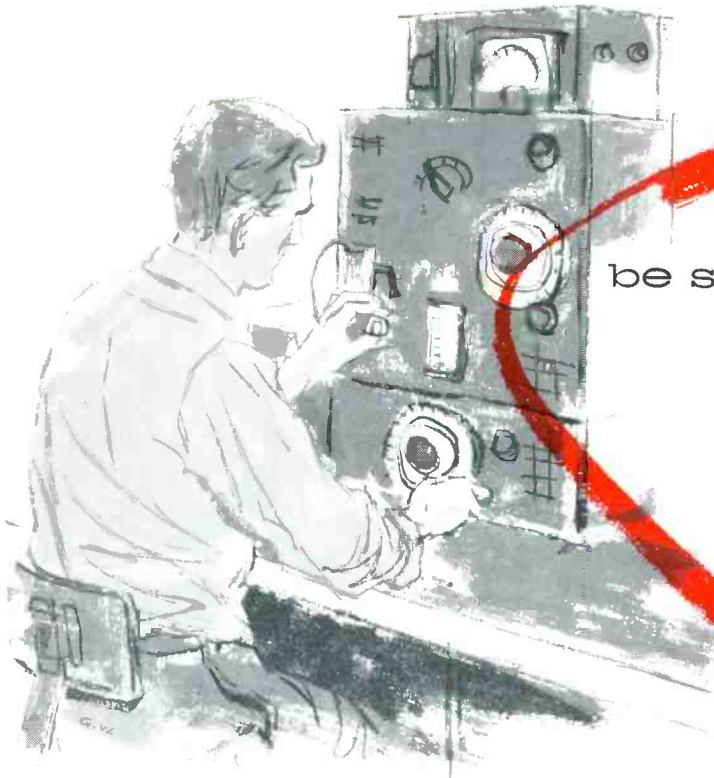
WESCON
August 21-24
PAN-PACIFIC AUDITORIUM
LOS ANGELES

1955 WESCON Convention Report
Ampex's New Video Tape Recorder
Free-Powered Transistor Apparatus

August • 1956
In 2 Sections • Section 1

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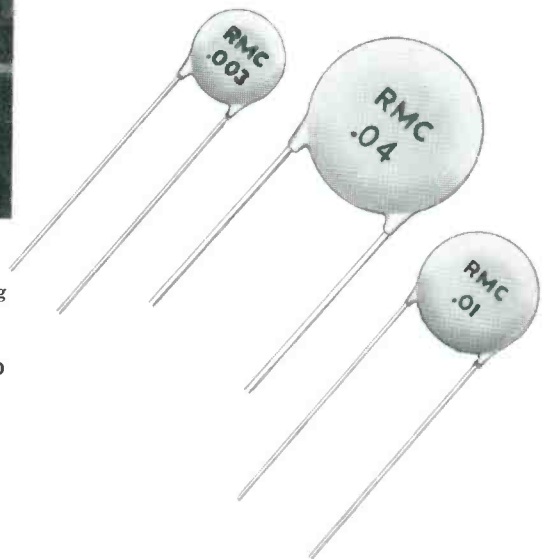


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TELE-TECH &

ELECTRONIC INDUSTRIES

Vol. 15, No. 8

August, 1956

FRONT COVER: California's most distinctive sights, the giant redwood, and Pan-Pacific Auditorium, Los Angeles, home of WESCON, symbolize this 5th Annual West Coast issue of Tele-Tech & ELECTRONIC INDUSTRIES. Details on the activities, technical program and product exhibits at WESCON start on p. 76.

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NEW ELECTRONIC EQUIPMENT

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SECTION TWO: WEST COAST ELECTRONIC INDUSTRIES DIRECTORY

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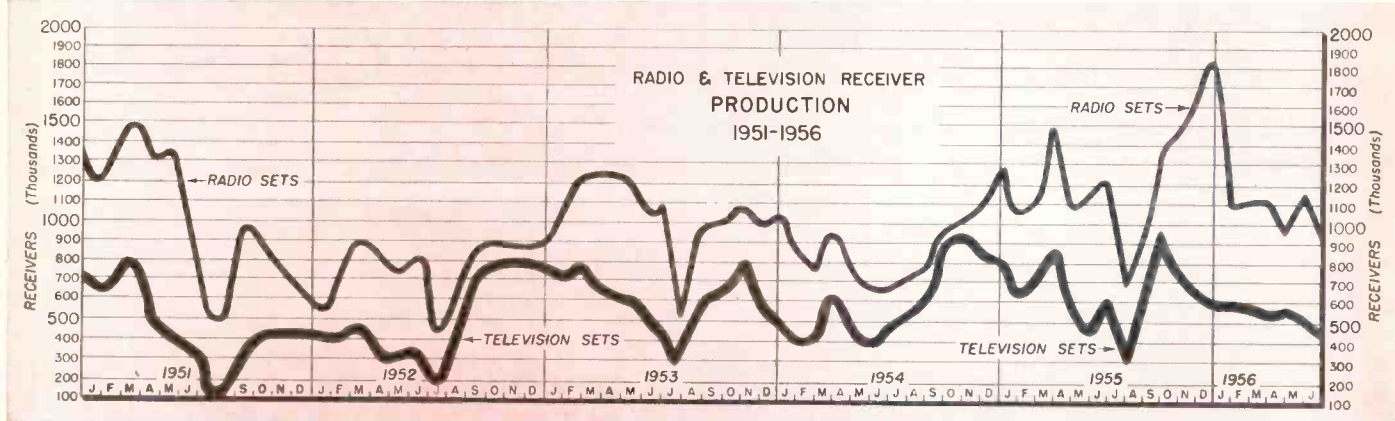
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FAILURES OF ELECTRONIC MANUFACTURERS
(during period Apr. 30, 1955—Apr. 30, 1956)

	1955	1956
Failures	26	29*
Av. Age of Companies (years)	6.5	11
Total Liabilities	\$14,460,000	\$11,055,000

* Products manufactured: components, 17; equipment, 8; phonos, 2; recorders, 1; electronic organ, 1.

From a report by Edward C. Tudor, chairman of the Credit Committee, RETMA to the 32nd RETMA convention, June 12, 1956.

BROADCAST STATIONS IN U. S.

	On the Air	CP's	Applications
AM	2980	160	284
FM	490	57	7
TV	* 379 VHF 98 UHF	** 108 UHF 44 VHF	{ 107 VHF 26 UHF

* Includes 16 VHF and 5 UHF non-commercial stations

** Includes 14 UHF and 8 VHF non-commercial stations

GOVERNMENT ELECTRONIC CONTRACT AWARDS

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

Actuators	\$131,494	Kits, Modification	2,313,317	Relays, Rotary	28,780
Amplifiers	474,841	Loudspeakers	31,080	Relays, Solenoid	84,620
Amplifiers, RF	179,788	Magnetic Tapes	45,048	Simulators	74,498
Amplifiers, Servo	128,876	Meters	27,550	Simulators, Target	29,637
Analyzers, Spectrum	67,178	Meters, Audio Level	64,459	Solder	26,336
Antennas	1,690,222	Meters, Crystal Impedance	25,401	Studio Equipment, Broadcast	61,254
Antenna Towers	152,146	Meters, Frequency	508,045	Switches	815,770
Audio Oscillators	467,583	Meters, Noise & Field	62,400	Switches, Rotary	60,465
Batteries, Dry	1,538,382	Meters, Power	47,329	Switching Assemblies	253,693
Batteries, Storage	288,357	Meters, Radiological Survey	499,400	Telemeter Ground Equipment	1,259,023
Batteries, Zinc—Silver Oxide	74,301	Microphones	423,436	Telemeter Transmitters	66,964
Battery Packs	208,117	Monitors, Clear Text	382,266	Telephone Sets	1,062,699
Calibrators	76,026	Monitors, Frequency	223,200	Telephone Switchboards	168,345
Chargers, Battery	271,197	Monitors, Radar Performance	31,600	Telephone Switching Centers, Transistorized	668,666
Code Generators	51,388	Multimeters	633,522	Telephone Jack Assemblies	72,750
Computers	763,900	Multiplexers	500,105	Telephone Terminals	489,873
Connectors	316,884	Oscillographs	44,502	Teletype Units	4,983,207
Control Monitors	261,852	Oscilloscopes	904,876	Terminals	98,615
Controls	4,732,938	Potentiometers	28,820	Test Sets	571,259
Converters, Analog	40,923	Power Supplies	168,871	Test Sets, Audio	41,100
Converters, Frequency	241,700	Radar Equipment	9,973,375	Test Sets, Electric Cable	61,500
Countermeasures Sets	45,026	Radio Beacon Communication Sets	568,081	Test Sets, Impedance	66,810
Crystal Units	207,410	Radio Central Systems	396,279	Test Sets, Insulation	39,520
Delay Measuring Sets	35,139	Radio Compasses	1,154,356	Test Sets, Radar	38,318
Diathermy Equipment	31,185	Radio Direction Finders	45,653	Test Sets, Radio	357,183
Dosimeters	330,460	Radio Receivers	2,539,273	Test Switchboards	34,614
Filters, Band Pass	329,397	Radio Receiver-Transmitters	6,511,383	Timing Sets	464,935
Generators, Signal	91,607	Radio Sets	3,189,385	Transformers	45,522
Handsets	548,376	Radiosondes	2,365,470	Transmissometers	80,349
Headsets	201,783	Radio Transceivers	31,578	Transmitters, Pressure	69,778
I. T. V. Systems	39,990	Radio Transmitters	552,022	Transmitters, Rate of Fuel Flow	215,662
Indicators	1,252,969	Receivers, Anti-Jamming Test	97,749	Tubes, Electron	1,490,456
Indicators, Azimuth	160,284	Recorders	3,966,659	Tubes, X-Ray	29,400
Indicators, Pressure	180,051	Recorders, Video Tape	75,021	Vibrators	25,120
Inspection Sets, Magnetic	169,039	Rectifiers, Metallic	131,850	Voltage Dividers	31,539
Insulators	50,988	Relays	60,080	Windows, Electrically Conducting	30,556
Intercom Units	186,889	Relays, Motor Driven	52,460	Wire & Cable	2,787,206
Inverters	197,340	Relays, Polar Telegraph	28,952		
Kits, Avionic Modification	296,074				

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TYPICAL ITEMS

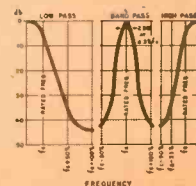
Type No.	Application	MIL Type	Pri. Imp. Ohms	Sec. Imp. Ohms	DC in Pri MA	Response ± 2 db (Cyc.)	Max. level dbm
H-30	Input to grid	TF1A10YY	50*	62,500	0	150-10,000	+13
H-31	Single plate to single grid, 3:1	TF1A15YY	10,000	90,000	0	300-10,000	+13
H-32	Single plate to line	TF1A13YY	10,000*	200	3	300-10,000	+13
H-33	Single plate to low impedance	TF1A13YY	30,000	50	1	300-10,000	+15
H-34	Single plate to low impedance	TF1A13YY	100,000	60	.5	300-10,000	+6
H-35	Reactor	TF1A20YY	100 Henries-0 DC, 50 Henries-1 Ma. DC, 4,400 ohms.				
H-36	Transistor Interstage	TF1A15YY	25,000	1,000	.5	300-10,000	+10

*Can be used with higher source impedances, with corresponding reduction in frequency range and current

COMPACT HERMETIC AUDIO FILTERS



UTC standardized filters are for low pass, high pass, and band pass application in both inter-stage and line impedance designs. Thirty four stock values, others to order. Case 1-3/16 x 1-11/16 x 1-5/8 - 2-1/2 high . . . Weight 6-9 oz.

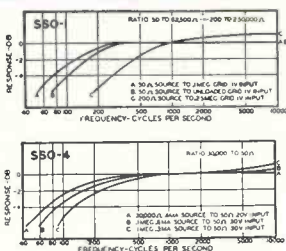
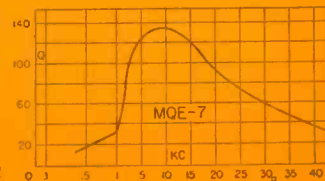


HERMETIC MINIATURE HI-Q TOROIDS

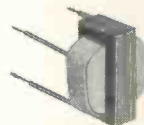
MQE units provide high Q, excellent stability and minimum hum pickup in a case only. 1/2 x 1-1/16 x 17/32 . . . weight 1.5 oz.

TYPICAL ITEMS

Type No.	Inductance	DC Max.
MQE-1	7 mhy.	135
MQE-3	20 mhy.	80
MQE-5	50 mhy.	50
MQE-7	100 mhy.	35
MQE-10	.4 hy.	17
MQE-12	.9 hy.	12
MQE-15	2.8 hy.	7.2



SUB-SUBOUNCER AUDIO UNITS



UTC Subouncer and sub-subouncer units provide exceptional efficiency and frequency range in miniature size. Constructional details assure maximum reliability. SS0 units are 7/16 x 3/4 x 43/64 . . . Weight 1/50 lb.

Type	Application	Level	Pri. Imp.	MA D.C. in Pri.	Sec. Imp.	Pri. Res.	Sec. Res.
*SS0-1	Input	+ 4 V.U.	200 50	0	250,000 62,500	13.5	3700
SS0-2	Interstage /3:1	+ 4 V.U.	10,000	0-.25	90,000	750	3250
*SS0-3	Plate to Line	+20 V.U.	10,000 25,000	3 1.5	200 500	2600	35
SS0-4	Output	+20 V.U.	30,000	1.0	50	2875	4.6
SS0-5	Reactor 50 HY at 1 mil. D.C. 4400 ohms D.C. Res.						
SS0-6	Output	+20 V.U.	100,000	.5	60	4700	3.3
*SS0-7	Transistor Interstage	+10 V.U.	20,000 30,000	.5 .5	800 1,200	850	125

* Impedance ratio is fixed, 1250:1 for SS0-1, 1:50 for SS0-3. Any impedance between the values shown may be employed.



SUB-SUBOUNCER (WIDE RANGE) AUDIO UNITS

Standard for the industry for 15 yrs., these units provide 30-20,000 cycle response in a case 7/8 dia. x 1-3/16 high. Weight 1 oz.

TYPICAL ITEMS

Type No.	Application	Pri. Imp	Sec. Imp
0-1	Mike, pickup or line to 1 grid	50, 200/250, 500/600	50,000
0-4	Single plate to 1 grid	15,000	60,000
0-7	Single plate to 2 grids, D.C. in Pri.	15,000	95,000
0-9	Single plate to line, D.C. in Pri.	15,000	50, 200/250, 500/600
0-10	Push pull plates to line	30,000 ohms plate to plate	50, 200/250, 500/600
0-12	Mixing and matching	50, 200/250	50, 200/250, 500/600
0-13	Reactor, 300 Hys.—no D.C.; 50 Hys.—3 MA. D.C., 6000 ohms		

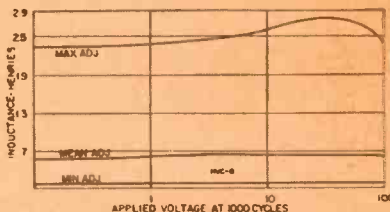
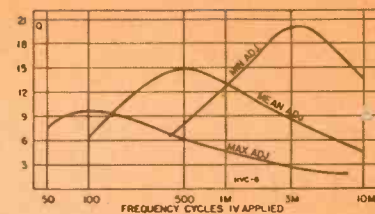


HERMETIC VARIABLE INDUCTORS

These inductors provide high Q from 50 - 10,000 cycles with exceptional stability. Wide inductance range (10-1) in an extremely compact case 25/32 x 1-1/8 x 1-3/16 . . . Weight 2 oz.

TYPICAL ITEMS

TYPE No.	Min. Hys.	Mean Hys.	Max. Hys.	DC Ma
HVC-1	.002	.006	.02	100
HVC-3	.011	.040	.11	40
HVC-5	.07	.25	.7	20
HVC-6	.2	.6	2	15
HVC-10	7.0	25	70	3.5
HVC-12	50	150	500	1.5



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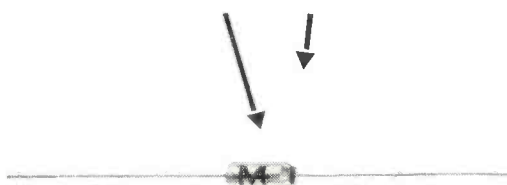
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50 MFD 6 VOLTS

25 MFD 15 VOLTS

15 MFD 30 VOLTS

8 MFD 50 VOLTS



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TELE-TIPS

HI-FI is acquiring a host of fancy new names as it reaches into new areas of the world. Here is a run-down on the latest, courtesy of the New York Times.

- Arabic—shaded elhassasieh
- French—haute fidelite
- German—3-D Klang
- Greek—alitheni apodosi
- Italian—alta fedelta
- Russian—chastosta visokoy tochnosti
- Spanish—alta fidelidad

PORTABLE ELECTRO-CARDIOGRAPH invented by a Hamburg, Germany professor is claimed to make it possible to diagnose heart ailments of patients thousands of miles away by telephone.

ELECTRONIC 'PROF SAVER' devised by University of Tennessee professor computes the average of 10 differently weighted marks for semester's work in engineering drawing.

IRE, Long Island section, got such a tremendous response to their announcement of a field trip to Grumman Aircraft that they had to drop the idea. More than 1,000 replies were received.

SALARY INCREASES were received last year by 75% of American business executives in the "middle management" category, those between the policy-making level and general foreman. Thirty-five percent of the raises were between 5% and 9% of salary and were given for reasons of merit.

ELECTRONIC DATA PROCESSING will be applied to 30,000,000 paper checks issued by the Government. The Treasury anticipates savings of more than \$2,000,000 by converting to EDP.

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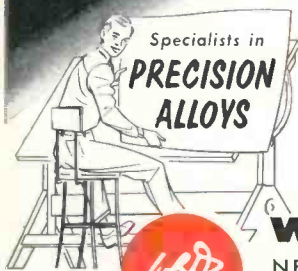
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Dept. H-119, Building 15-1, Camden, N. J.

Please send me complete information on the following instruments:

Send name of nearest representative

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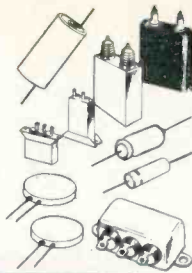
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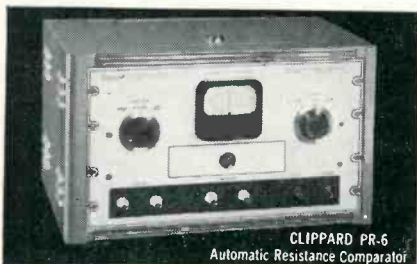


**CLIPPARD PC-5
AUTOMATIC CAPACITANCE COMPARATOR**

If you would like to increase the speed of checking capacitors, or the capacity of specific circuitry at your plant or laboratory, here is the instrument that will do the job for you . . . AUTOMATICALLY!

Simply select the range and tolerance you desire, connect a standard and the Clippard PC-5 Automatic Capacitance Comparator instantly indicates variations in per cent deviation. With automatic gating and loading mechanisms it will also serve as the "brain" or master control unit of many automatic work functions in a variety of industrial applications.

A companion instrument, the Clippard PR-6 Automatic Resistance Comparator, performs equally useful work where high speed and extremely accurate determination of resistance is involved. Range is 100 ohms to 100 megohms with accuracy of better than $\pm 1\%$!



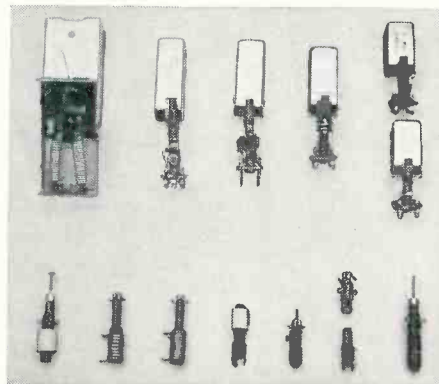
**CLIPPARD PR-6
Automatic Resistance Comparator**

These precision instruments are of rugged laboratory-quality, made for millions of cycles of trouble-free operation. Used individually, or incorporated into automated production systems, they quickly pay for themselves in time saved, better quality control and increased production.



Get the jump on COLOR TV thru our "know-how"!

Shown at the right are samples of COLOR TV coils and sub-assemblies we are now producing in quantity for the Radio Corporation of America. Years of manufacturing experience and months of planning and tooling preceded actual production. If you, too, are interested in finest quality color TV coils, windings and sub-assemblies, our "know-how" and facilities can solve your problems quickly. Send us your requirements and we will be happy to quote.



Clippard

INSTRUMENT LABORATORY, INC.
7382-T Colerain Road, Cincinnati 24, Ohio

Manufacturers of R. F. Coils, Electronic Equipment, Miniature Pneumatic Devices

Anthony Scala has been elected president of Chatham Electronics Div., Gera Corp., Livingston, N. J. He was formerly vice president and general manager, and is still a vice president of Gera and a director of the parent organization, RKO Industries Corp.

Philip S. Fogg has become chairman of the board of Consolidated Electrodynamics Corp., Pasadena, Calif., and Hugh F. Colvin has succeeded him as president of the firm. Mr. Fogg will continue as Consolidated's chief executive officer.

James O. Burke has been elected president of Standard Coil Products Co., Inc., Melrose Park, Ill. He succeeds Glen E. Swanson, who becomes chairman of the board.

Robert S. Goodyear has been named president of Fenwal Electronics, Inc., Framingham, Mass., a new firm specializing in precision thermistor manufacture and in sensing elements incorporating thermistors.

C. Arthur Foy has been made manager of sales promotion for the Audio Div.; Albert J. Melrose is now manager of the Central Mid-West District, including metropolitan Chicago; and Ralph H. Sprague is manager of the newly-designated Mid-West District for the Audio Div., all of Ampex Corp., Redwood City, Calif. Foy is headquartered in Redwood City, while Melrose and Sprague are located in the Ampex Chicago offices.

Harold S. Geneen was recently elected executive vice president of Raytheon Mfg. Co., Waltham, Mass.

James J. Halloran has been elected secretary-treasurer of Electro Engineering Works, Inc., San Leandro, Calif. He is also vice president in charge of engineering for the firm. Mr. Halloran succeeds Alex W. Fry.

Mrs. Sylvia Anthony Nelson, of Mt. Vernon, Ohio, has been made chairman of the board of Electronics Equipment Engineering, Inc., Dallas, a new firm in the field of building airborne electronic accessories for civil and military aviation.

Amphenol Electronics Corp. of Chicago, has established an engineering and sales office at 5356 West Pico Blvd., Los Angeles, under the direction of a newly-appointed district manager, James Schaefer. Marshank Sales Co., Los Angeles, will continue to handle Amphenol business in its area. Wally Wasson has been named Chicago district manager for Amphenol,

(Continued on page 176)

MAGNETIC AMPLIFIERS · INC

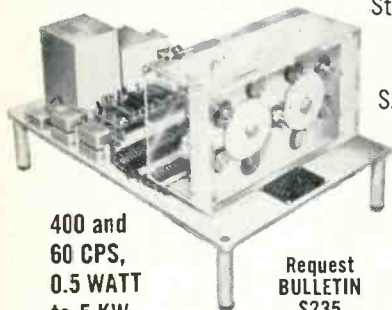
632 TINTON AVENUE, NEW YORK 55, NEW YORK • Tel. CYPress 2-6610
 WEST COAST DIVISION
 136 WASHINGTON ST., EL SEGUNDO, CALIFORNIA • Tel. EAStgate 2-2056



SERVO MAGNETIC and TRANSI-MAG® AMPLIFIERS

Standard AC and DC Amplifiers include:

MAGNETIC PRE-AMP + SATURABLE TRANSFORMERS, MAGNETIC PRE-AMP + HIGH GAIN MAGNETIC AMPLIFIERS, and the TRANSI-MAG incorporating TRANSISTORS and HIGH GAIN MAGNETIC AMPLIFIERS.



400 and 60 CPS, 0.5 WATT to 5 KW

Request BULLETIN S235

SPECIAL PURPOSE ANALOG COMPUTERS

Complete SERVO SYSTEM ENGINEERING for automation and control, including design, development and production.



MAGNE-SPEED® VARIABLE SPEED DRIVES

JR. — 1/8, 1/15, 1/40 HP.

SIZE I — 1/4, 1/3, 1/2 HP.

SIZE II — 3/4, 1, 1 1/2 HP.

SIZE III — 2, 3, 5 HP.

Request BULLETIN S580



SIZES I, II, III and JR.

Non-electronic, stepless instart starting; compact, 50:1 speed range, good regulation without tachometer. Long life, virtually maintenance-free, low cost; fast response, reversibility, dynamic brake, local or remote control.

AUTOMATIC UNIVERSAL TRANSISTOR and POWER-TRANSISTOR CURVE TRACER



Displays Collector and Transfer Curves on Cathode Ray Oscilloscope. Handles all types of transistors and power transistors. Curve tracer permits rapid determination of parameters. For selecting, matching and detecting anomalies and rejects.

Model 200A — TRANSISTOR CURVE TRACER — BULLETIN S393
 Model 300A — POWER-TRANSISTOR CURVE TRACER — BUL. S667

MODEL 240 PHASE ANALYZER and VACUUM TUBE VOLTMETER

Easily operated instrument for making complex measurements. Phase and voltage AC signals measured simultaneously, and read directly from dial and meter scales. Indispensable for alignment of SERVO SYSTEMS, measurement of input requirements of non-linear loads and determination of amplifier input impedances.



Request BULLETIN S675

VOLTAGE-CURRENT-FREQUENCY REGULATORS

MODERN TUBELESS, REGULATED RECTIFIER LINE — Virtually maintenance-free operation.

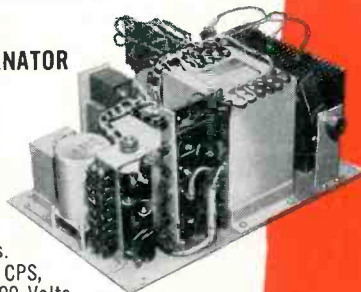
SIZES:

1—3-32 V. D.C., 5 Amps.
 2—3-32 V. D.C., 15 Amps.
 3—3-32 V. D.C., 30 Amps.
 4—1.5-16 V. D.C., 10 A.
 5—1.5-16 V. D.C., 30 A.
 6—1.5-16 V. D.C., 60 A.



DIESEL or MOTOR GENERATOR—ALTERNATOR REGULATORS

Provides high accuracy, fast response and dependability. Rugged construction, employs no tubes. Meets applicable government specifications. Standard 30 KVA, 400 CPS, 3-Phase 4-Wire 115/200 Volts PACKAGE SUPPLY or CUSTOM DESIGNS for specific machines.



Request BULLETIN S436

MAGNETIC AMPLIFIERS · INC



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).

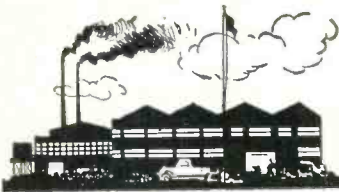
These high-accuracy units are available in close resistance tolerances down to $\pm 0.1\%$. They are carefully and properly aged by a special Sprague process so that they maintain their accuracy within the limits set by the most stringent military specifications.

SPRAGUE

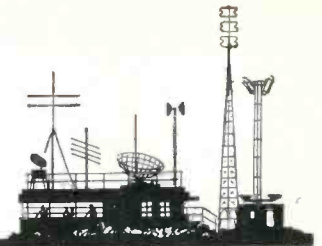
FOR COMPLETE DATA
WRITE FOR COPY
OF SPRAGUE
ENGINEERING
BULLETIN NO. 122A



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



As We Go To Press...



World Radio Experts To Meet in Warsaw

Warsaw will serve as host this summer to about 500 radio-communications experts from all parts of the world. They convene in the Polish capital on August 9 for the Eighth Plenary Assembly of the International Radio Consultative Committee (IRCC) whose fourteen study groups will examine technical problems and operations.

The IRCC, with headquarters in Geneva, was founded in Washington in 1927 and is a permanent body of the International Telecommunication Union.

Air Force Receives New Ground Guidance Set

The United States Air Force has announced the delivery of new, air-transportable close-support ground guidance radar to operational elements.

This Close Support Control Set, called the MSQ-1A, was designed and built by the Reeves Instrument Corporation, a subsidiary of Dynamics Corporation of America, at a cost of approximately \$40,000,000.

The Air Force indicates that the MSQ-1A system consists of three basic vans—radar, computer, and communications. The radar van tracks friendly aircraft and furnishes continuous data to the computer van for evaluation.

Sylvania Centralizes Operations In Univac Processing Center

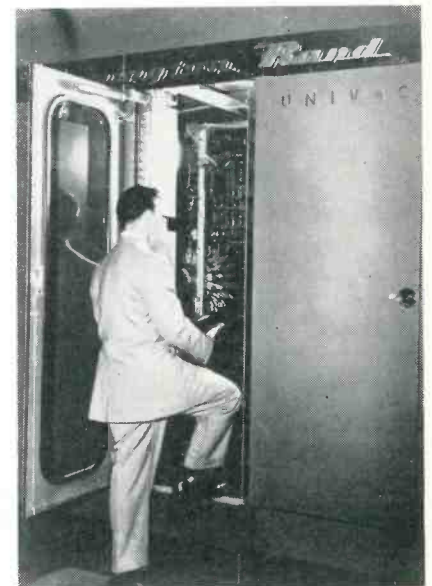
A nation-wide private wire system has been put into operation to link the seventy-one plants, laboratories, sales offices, warehouses, divisional headquarters, and executive offices of Sylvania Electric Products, Inc.

The versatile network, leased from Western Union, automatically routes coded messages to the appropriate station. Administrative messages are routed to telegraph printers where they are received ready for delivery to the department or person concerned. Coded data messages, however, are classified and transmitted automatically to the Data Processing Center in Camillus, where a "Univac" computer and subsidiary electronic equipment convert the information into summarized data on which can be based decisions at the corporate, divisional, or plant level.

In the case of a piece of data processing information originating at a Sylvania plant or other facility, the information is punched on paper tape. The tape is fed into electronic equipment which translates the message into electrical impulses that travel by the network from the transmitting point to the switching center, where the message is automatically punched on paper tape. Through a similar

process, the message is transmitted from the switching center to the Data Processing Center at Camillus.

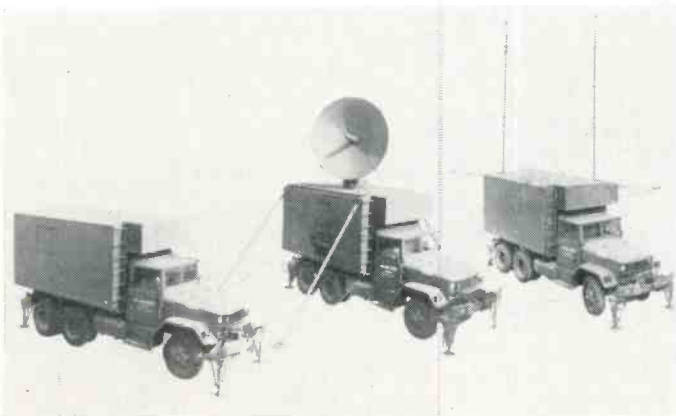
At the Center, an electronic device again converts the information to paper tape, which in turn is converted to punched cards. The information on the punched card is conveyed to a unit which translates the information to metal magnetic



An 18,000-mile private wire system feeds all Sylvania data into this 10-ton central computer. Data correlation results previously requiring weeks can now be obtained in a matter of hours

tape. Then, a unit called a "Uniservo" carries the information from the magnetic tape into the "Univac" where computations are made in accordance with instructions fed into the computer. Magnetic tape then carries the completed computation, via "Uniservo," to a high speed printer, where the results of the computation are put on paper in readable form.

More News on page 14



These computer, radar, and communications vans are part of the USAF air-transportable Close Support Control Set

Sylvania develops a

power

NEW

new



POWER TRANSISTOR—

provides $2\frac{1}{2}$ watts
Class A output with
*5% total harmonic distortion

FEATURES—

- 10 watts maximum collector dissipation
- 2 amps max. collector current
- 40 volts max. collector voltage
- New heliarc-weld hermetic seal
- 30 db minimum power gain (typically 35 db)
- 85° C storage temperature
- 100° C operating temperature
- derating—3° C per watt (typically 2° C per watt)

new



DETECTOR-DRIVER

Type 12J8—delivers 20 mw signal
power output with
*5% total harmonic distortion

CHARACTERISTICS—

- zero signal plate current —14 ma
- zero signal screen current—3 ma
- plate resistance —2000 ohms
- transconductance —540 μ mhos
- plate voltage —12.6 volts
- heater voltage —12.6 volts

low distortion*



pack for

HYBRID AUTO RADIO

**combined engineering forces produce new power transistor
and detector-driver tube—full line of 12-volt tube types
completes auto radio complement.**

SYLVANIA, in close co-operation with leading auto radio manufacturers, has just completed a full-time joint engineering project to develop a transistor-tube "power pack" for new hybrid auto radio designs.

Result of this combined engineering program is a new power transistor and the type 12J8 detector-driver tube especially designed to produce high current at low plate voltage for optimum power coupling to the output transistor.

Other important power transistor features include a heliarc-weld hermetic seal for ruggedness and a storage temperature of 85° C to eliminate heat problems under inoperative conditions.

Sylvania also offers a full line of 12-volt tubes to complete auto radio complements.

Designers of transistorized equipment will find Sylvania's new transistor highly useful in all power applications calling for a maximum collector dissipation of 10 watts.

Engineering Sample Offer

Sylvania will honor all bona-fide requests for engineering samples of the new hybrid "power pack" including the new power transistor and driver tube 12J8, plus samples or information on 12-volt types to complete your auto radio complement.

For samples of the power transistor for use in other applications, write on your company letterhead indicating your intended use.



SYLVANIA®

SYLVANIA ELECTRIC PRODUCTS INC.
1740 Broadway, New York 19, N. Y.
In Canada: Sylvania Electric (Canada) Ltd.
University Tower Bldg., Montreal

LIGHTING • RADIO • TELEVISION • ELECTRONICS • ATOMIC ENERGY

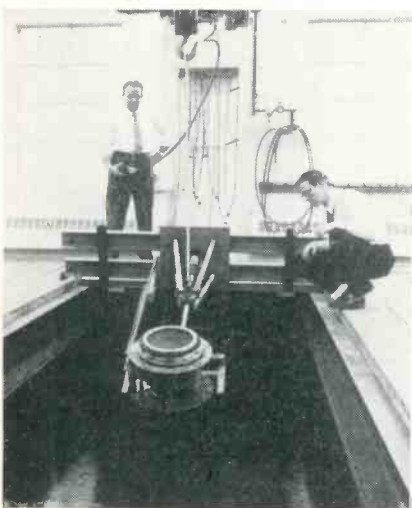
As We Go To Press . . . (Continued)

Barium Titanate Sonar Transducer

A new type of sonar transducer element made of barium titanate, a non-strategic material, has increased ability to handle underwater sound energy, as compared to strategic materials (such as nickel) which were previously used.

Increased efficiency will result from the new transducer elements because the mechanical and electrical losses in barium titanate are lower than materials previously used. This means that smaller transmitting equipment may be used on shipboard.

Barium titanate also has a high dielectric constant and since it is a low impedance material the voltage requirements are low. This will permit high power operation without voltage breakdowns which have often limited sonar operations. The natural properties of barium titanate make it an ideal material for sonar transducer elements.

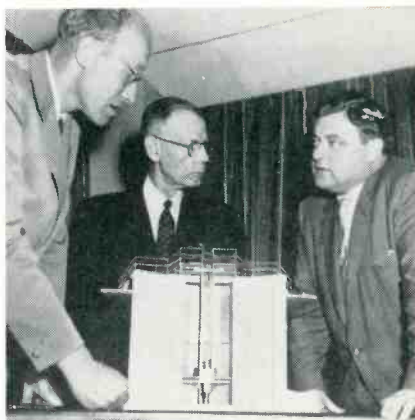


New sonar test facilities at GE

New Plant For Atlas Missiles

A new \$40,000,000 "Convair Astronautics" plant will be built in San Diego by Convair Div., General Dynamics Corp., for the manufacture of the Atlas intercontinental ballistic missile.

The Atlas is one of the three intercontinental missiles now under development by the U.S.



Gen. Walter Bedell Smith, of AMF Atomics, Inc., discusses new reactor with German officials

New Reactor For Free Europe

A "Swimming Pool" research reactor will be built by AMF Atomics, Inc., subsidiary of American Machine & Foundry Co., at Munich's Technische Hochschule, one of Germany's leading advanced technological institutes.

Unprecedented in free Europe, it will be the first reactor to be installed at a university for training engineering students in nuclear science, and will be the heart of a new nuclear research center at the university.

Construction of the one megawatt "swimming pool" type reactor is scheduled to start in October

Triggered Radar Beacon Aids Midair Rendezvous

A new flying aid is a high powered, airborne radar beacon that enables long range aircraft of the Strategic Air Command to locate each other and pinpoint the exact position in space of tanker planes, regardless of darkness or weather. Other tactical applications of the device for precisely accurate aerial rendezvous and reconnaissance still are unannounced.

Signals can be triggered automatically by the interrogating radar of fuel-hungry Air Force planes, to locate an individual tanker aircraft. Assured mid-air refueling can double or triple the effective reach of USAF's long-range aircraft.

TV Service Survey Shows Customers Usually Pleased

That an overwhelming majority of the nation's 36,000,000 television set owners are well satisfied with the promptness, quality, prices and courtesy of TV service technicians was disclosed in the latest nationwide survey conducted by Elmo Roper, market research expert, for the RCA Service Company, Inc.

The survey revealed that 91 per cent of the set owners interviewed were pleased with the quality of the serviceman's work, the same percentage reported the serviceman was pleasant and courteous, 83 per cent were satisfied with the price and 89 per cent thought their call for service was answered promptly. Eighty-three per cent said they would call the same service firm again.

Fifty-two per cent of all persons interviewed, who made calls for service during the past year, reported "same day" service: 18 per cent received service the next day; nine per cent during the next two days—or 79 per cent of all service calls were answered within two days of the call.

While the median cost of service calls increased in the past 15 months, reflecting the increased age of the average TV set, 83 per cent of the persons interviewed reported satisfaction with the prices charged, while 13 per cent said the prices were "not very good" and four per cent did not know or did not answer.

Olympic buys Presto

Olympic Radio & Television, Inc., of New York, has announced the purchase of Presto Recording Corporation of Paramus, New Jersey, as part of its continuing expansion in the electronics field.

Presto, a manufacturer of tape and disc sound recording and playback equipment for industrial and home use, will operate under its present management but as a wholly-owned subsidiary of Olympic.

More News on page 18

Complete Flexibility



Collins announces the new 212F-1 Speech Input Console — an attractively styled, packaged unit featuring complete flexibility. It provides complete control over simultaneous broadcasting and auditioning from any combination of three out of eight possible inputs. The addition of two pre-amplifiers provides for mixing five of twelve possible inputs. The 212F-1 also provides for monitoring of program, audition, or remote lines, and control of speakers and warning lights.
Available now — \$995.

Flexible

- Modular construction
- Plug-in amplifiers, relay unit and power supply
- All components in console cabinet — no additional rack space required
- Only three tube types, only two amplifier types
- Three cue pots
- Two spare key switches for custom wiring

Convenient

- Easy accessibility to all cabling, wiring and sub-units
- Front panel hinged — tilts forward for instant inspection or removal of all amplifiers, power supply and relay unit
- A test cable to externally service any of the amplifiers, power supply or relay unit while console is in operation
- All mixer knobs and associated key switches color coded
- Plastic covered write-in strips for input switches, remote switches and mixer attenuators

For complete information on Collins 212F-1 Studio Console contact your nearest Collins representative.

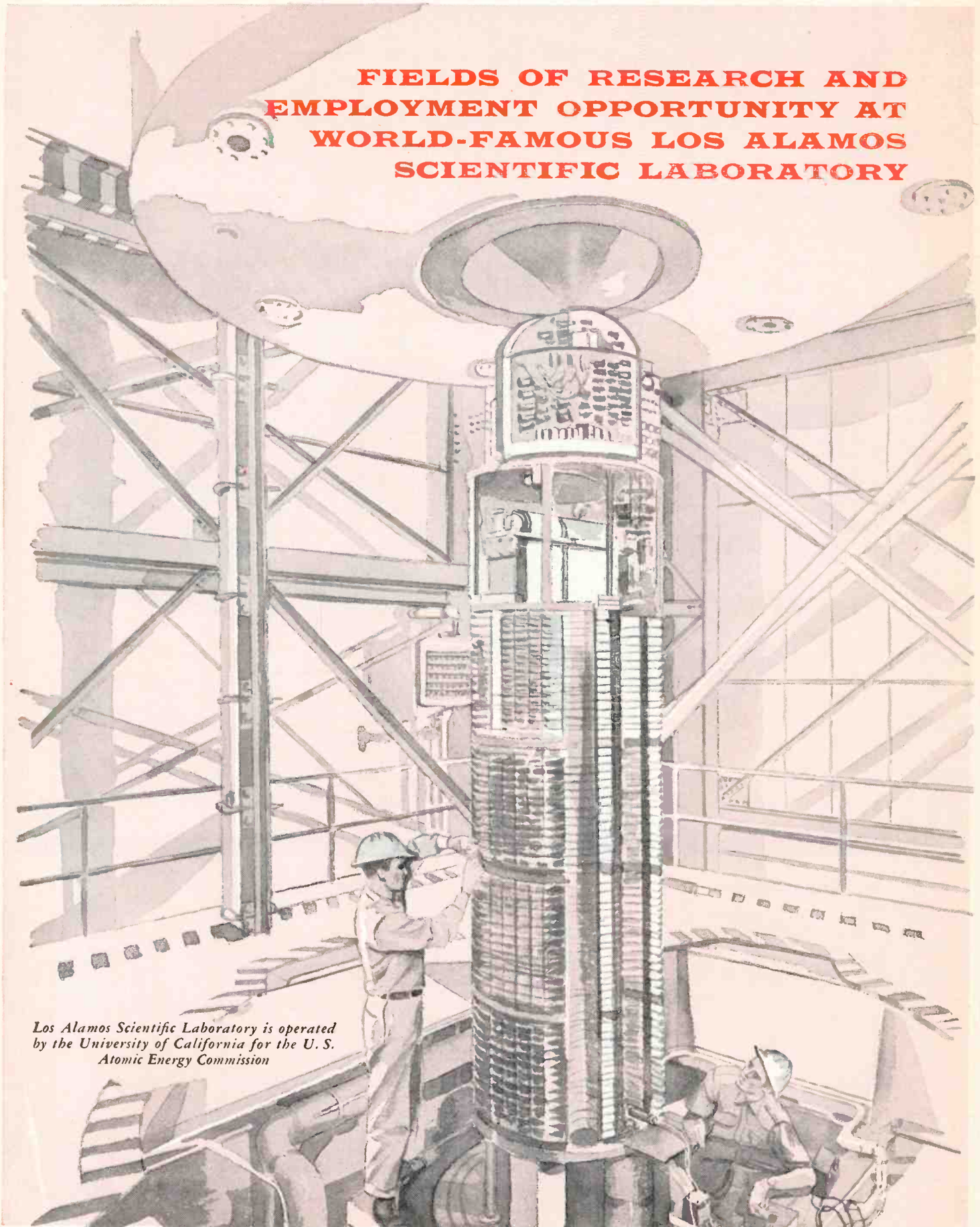
Collins

CREATIVE LEADER IN COMMUNICATION



COLLINS RADIO COMPANY, 315 2nd Avenue S.E., Cedar Rapids, Iowa • 1930 Hi-Line Drive, Dallas 2 • 2700 W. Olive Ave., Burbank 261 Madison Ave., New York 16 • 1200 18th St. N.W., Washington, D.C. • 4471 N.W. 36th St., Miami 48 • 1318 4th Avenue, Seattle Dogwood Road, Fountain City, Knoxville • COLLINS RADIO COMPANY OF CANADA, LTD., 11 Bermondsey Road, Toronto 16, Ontario

**FIELDS OF RESEARCH AND
EMPLOYMENT OPPORTUNITY AT
WORLD-FAMOUS LOS ALAMOS
SCIENTIFIC LABORATORY**



*Los Alamos Scientific Laboratory is operated
by the University of California for the U. S.
Atomic Energy Commission*

Theoretical Physics and Mathematics

In the field of theoretical physics, the Laboratory carries on studies of nuclear theory, equations of state, mathematical analysis methods, hydrodynamics problems and various aspects of applied mathematics. The Theoretical Division is also concerned with the conceptual design of nuclear weapons, and supports many non-weapons activities such as the nuclear reactor and propulsion programs. The equipment used includes the Los Alamos-developed Maniac, the Maniac II, two IBM 704's and an IBM 701.

Experimental Nuclear Physics

Much of the work in experimental physics is concerned with nuclear properties of various materials. Fundamental studies are made of nuclear forces, neutron and charged-particle reactions and cross sections. Experimentation in controlled thermonuclear reactions is assuming increasing importance. Among the facilities available are three Van de Graaffs, two Cockcroft-Walton machines and a variable energy cyclotron.

Electronics and Instrumentation

The Laboratory is engaged in the design and development of nuclear physics research instruments, scintillation counters, fast pulse amplifiers, multi-channel analyzers, fast oscilloscopes, radiation detection instruments, electronic controls and control systems, and high-speed cameras which operate at 15 million frames per second. Electronics specialists also assist in the design of digital computers and of instruments for studying nuclear and thermonuclear detonations.

Nuclear Reactor Research

In connection with the peacetime applications of nuclear energy, the Laboratory is currently developing several advanced power reactors of unusual design. In addition, two research reactors are available for experimental studies. The remotely controlled critical assembly machines, known as Topsy, Godiva and Jezebel, constitute neutron research tools of a unique character.

Nuclear Propulsion

The Laboratory is actively engaged in the application of nuclear energy to the new and challenging field of self-propelled mobile reactors. There are studies in progress relative to engine design, heat transfer, controls and instrumentation.

Chemistry

Research in chemistry is devoted largely to inorganic and physical studies, especially of materials such as uranium, plutonium, deuterium and tritium used in nuclear energy systems. Radiochemical methods are applied in various investigations. Much work is being done on reaction kinetics, the effects of radiation on chemical reactions, complex ion formation and the determination of heats of combustion and solution. Extensive analytical studies include the use of a great variety of instruments, as well as the techniques of microanalysis.

Metallurgy and Metallurgical Engineering

Research activity and development in this field includes investigation of the metallurgical properties of materials used in nuclear energy systems; studies of extremely refractory substances, ceramics, cermets and plastics; the behavior of materials under extremely high temperatures and high pressures; studies of the properties of plutonium and its alloys, with increasing reference to their use in reactors, and of uranium and its alloys; development of fabrication techniques for various metals and alloys; and the high temperature properties of refractory metals tungsten, molybdenum, columbium, etc.

Weapons Physics, Design and Testing

Still the nation's principal institution for nuclear and thermonuclear weapons research, the Laboratory takes nuclear weapons from the concept stage to proved performance as determined by field tests. Activities in weapons research and development include the mechanics and dynamics of initiating a nuclear energy release; the behavior of supercritical systems; the testing of nuclear devices and weapons assemblies in Nevada and in the Pacific; engineering design of tests and prototypes of nuclear systems; and the design and development of nuclear weapons components and the techniques for their manufacture.

Explosives Research and Development

Work in this field includes study of fabrication, storage and stability problems of explosives; making and evaluating novel organic chemical compounds of possible use as explosives; mechanics and dynamics of explosive phenomena; and physical and chemical properties of explosive material using mass spectrometer, infra-red spectrometer, X-ray equipment and other analytical techniques. High explosives are employed in research on equations of state and shock wave phenomena.

Mechanical Engineering

Design and development work is carried on in connection with weapons design, field test facilities, the power reactor and propulsion programs, servo-mechanisms and remote control systems. High explosives systems are designed and manufactured. Other types of work are estimating, cost analysis and liaison between architectural engineers and contractors.

Chemical Engineering

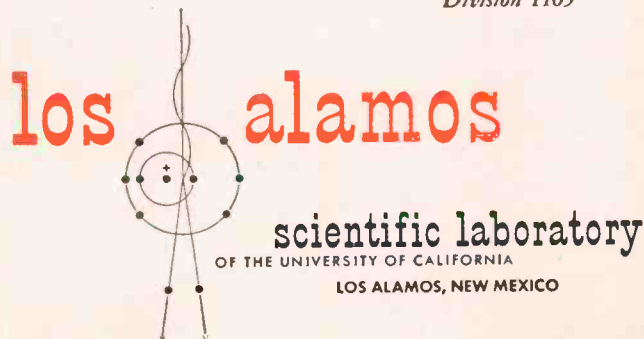
Chemical engineering work includes studies of heat transfer, fluid flow, solvent extraction, evaporation, distillation and systems at extreme temperatures and pressures. Problems supporting inorganic and physical chemistry research projects are also undertaken. Other activities are the remote control handling of radioactive materials and corrosion and erosion studies.

Electrical Engineering

Much effort is devoted to the design of induction heating systems for study of alloys at extremely high temperatures; of DC power supplies at currents up to 100,000 amperes; of servo-mechanism controls for nuclear reactors; and of high magnetic field systems. Work is done in planning, building and installing power distribution systems and their controls.

The Laboratory now has staff openings for technically qualified people interested in these fields of research and development. For additional information address your inquiry to

*Director of Personnel
Division 1105*



Electronic Industries Boom in Puerto Rico

Since 1950, the manufacturing activities of electronics branch plants in Puerto Rico have expanded to a present level of \$11½ million a year. Products include radios, radar equipment, pulse generators, diodes, cathode ray tubes, sub-components, exposure and light meters, rectifiers, television antennas, carbon and steel gages, and crystal ovens. So far,



This plant, making exposure meters, is part of Puerto Rico's industrialization program

25 U. S. mainland firms have set up electronics branch plants in Puerto Rico, including Sperry Rand, Sylvania, Hermetic Seal, Weston, and Carborundum.

Mainland plants are finding component production in Puerto Rico offers many advantages including a ten year "tax holiday" on local taxes, no federal taxes, favorable wage differential, and various helpful inducements offered by the local government.

Further details can be obtained from Economic Development Administration, 579 Fifth Ave., New York 17.

22-In. Color TV Line

A new line of color TV receivers, featuring a 22-inch rectangular all-glass color tube, has been announced by the television-radio div. of Westinghouse Electric Corp. At the same time, a new line of 21- and 24-inch black-and-white TV receivers, and several additional radio receivers were introduced.

More News on page 20

Coming Events

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

- Aug. 20-21: The National Telemetering Conference**, sponsored jointly by the IRE, the AIEE, the IAS, and the ISA, in Los Angeles, Calif.
- Aug. 20-24: Conference on Scientific and Technical Writing**, by the Institute for Cooperative Research of the University of Penn., Philadelphia, Pa.
- 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. 10-12: Inf. Theory Symposium**, sponsored by IRE-PGIT and M. I. T.; at Cambridge, Mass.
- Sept. 11-12: Second RETMA Conference on Reliable Electrical Connections**, at Irvine Auditorium, University of Penn., Philadelphia, Pa.
- Sept. 12-14: Third National Conference on Tube Techniques**, sponsored by the Working Group on Tube Techniques of the Advisory Group on Electron Tubes; at Western Union Audit., 60 Hudson St., New York.
- Sept. 14-15: Prof. Gp. on Broadcast Transmission Sys., 6th Ann. Fall Symposium**; tech. sessions at Mellon Institute Auditorium, Pittsburgh, Pa.
- Sept. 17-18: Adv. Gp. on Electron Tubes, Working Gp. on Semiconductor Devices—Transistor Reliability Symposium**; at Western Union Audit., 60 Hudson St., New York.
- Sept. 17-21: Symposium on radiation effects on materials**, sponsored jointly by The Atomic Industrial Forum and ASTM; at ASTM Pacific Area National Meeting, Los Angeles, Calif.
- 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: 12th Annual Conference of the NEC**; at the Hotel Sherman, Chicago, Ill.
- Oct. 1-3: Canadian IRE Convention and Exposition**; in the Automotive Bldg., Canadian Natl. Exhibtn. Park, Toronto.
- Oct. 8-9: Second National Symposium on Aeronautical Communications**, sponsored by the IRE Prof. Gp. on Communications Systems; at the Hotel Utica, Utica, N. Y.
- Oct. 9-10: Conference on Computer Applications**, sponsored by Armour Research Foundation of Illinois Institute of Technology, Chicago, Ill.
- Oct. 15-17: Radio Fall Meeting**, sponsored jointly by the IRE and RETMA, at the Hotel Syracuse, Syracuse, N. Y.
- 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: Annual Display of Aircraft Electrical Equipment**, by the Aircraft Electrical Society, at PanPacific Auditorium, Los Angeles, Calif.
- Oct. 29-30: Third Annual East Coast Conference on Aeronautical and Navigational Electronics**, sponsored jointly by the Baltimore Section of IRE and the IRE Prof. Gp. on Aeronautical and Navigational Electronics; at the Fifth Regiment Armory, Baltimore, Md.

Abbreviations:

- ASTM: American Society for Testing Materials
 AIEE: American Institute of Electrical Engineers
 IAS: Inst. of Aeronautical Sciences
 IRE: Institute of Radio Engineers
 ISA: Instrument Society of America
 NEC: National Electronics Conference
 RETMA: Radio-Electronics-TV Manufacturers Assoc.
 WESCON: Western Electronic Show and Convention

1 MINIATURE — Actual size shown. Diameter, 1¼". Overall length, 2".
Ideal for pulsed beacon applications.

2 EXCELLENT VIBRATION PERFORMANCE
Reliable characteristics up to 10 g.'s from 20 to 1000 c.p.s.

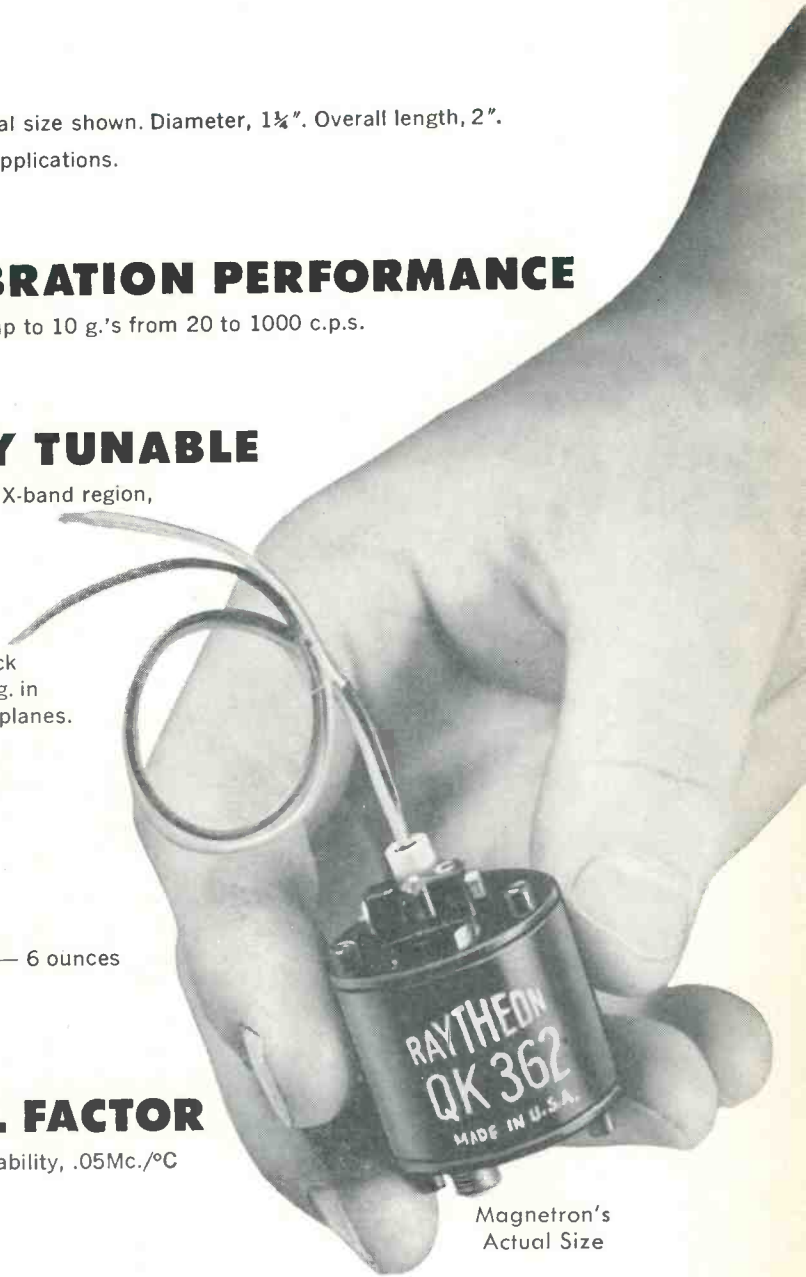
3 MECHANICALLY TUNABLE
Tunes mechanically over X-band region,
9300-9500 Mc min.

4 RUGGED
Withstands 1,000 g. shock
along cathode axis. 500 g. in
two other perpendicular planes.

5 PULSE POWER
50 watts peak

6 LIGHTWEIGHT — 6 ounces

7 LOW THERMAL FACTOR
Exceptional frequency stability, .05Mc./°C



Magnetron's
Actual Size

CHALLENGING CHARACTERISTICS

FOR YOUR NEW EQUIPMENT DESIGNS

For specifications on the extraordinary QK 362 magnetron write today. Similar tubes at other frequencies and power levels are available. Ask for copies of latest bulletins listing most of our

unclassified Magnetrons and Klystrons and special tubes. Call on us for help in your microwave problems. There is no cost or obligation, of course.



Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Microwave and Power Tube Operations, Section PT-72
Waltham 54, Massachusetts

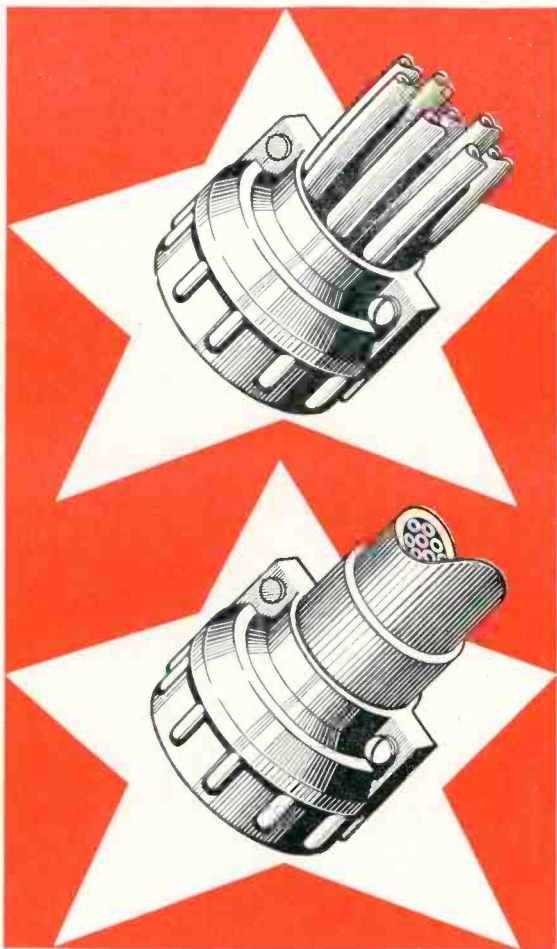
Raytheon makes: Magnetrons and Klystrons, Backward Wave Oscillators, Traveling Wave Tubes, Storage Tubes, Power Tubes, Receiving Tubes, Picture Tubes, Transistors.

Bendix

Builds a Better Cable Clamp—the

AN3057B

Inexpensive, Efficient, Versatile



The new Bendix AN approved AN3057B cable clamp is now available. Engineered by Bendix* to the highest-quality standards, this cable clamp offers major design improvements. The clamping action is radial and completely eliminates wire strain and chafing by holding the wire bundle firmly in rubber. This clamp will accommodate a wide range of wire bundle sizes, but an even greater range can be handled through the use of the Bendix AN3420A accessory telescoping sleeve.

The new AN3057B cable clamp will also waterproof multi-conductor rubber-covered cable on the rear of a connector, or where moisture-proof entrance through a bulkhead or into an equipment box is required.

Complete detailed information is available on request.

*TRADEMARK

Bendix SCINTILLA DIVISION OF **Bendix**
SIDNEY, NEW YORK AVIATION CORPORATION

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

FACTORY BRANCH OFFICES:

117 E. Providencia Avenue, Burbank, California • 512 West Avenue, Jenkintown, Pennsylvania • Stephenson Building, 6560 Cass Avenue, Detroit 2, Michigan • 5906 North Port Washington Road, Milwaukee 17, Wisconsin • Hulman Building, 120 W. Second Street, Dayton 2, Ohio • 8401 Cedar Springs Road, Dallas 19, Texas • Boeing Field, Seattle 8, Washington • 1701 "K" Street, N. W., Washington 6, D. C.

ITV for Atomic Plant Uses Color Wheel

Scientists are now using specially-designed color television to help them perform work in radioactive areas at the Hanford plutonium plant, operated by General Electric for the Atomic Energy Commission.



Color TV guides the operator of a giant overhead crane in a radioactive area

Crane operators, who formerly observed their work by means of a periscope, now have a closed circuit color TV system. High image brilliance on the TV screens and added depth perception afford easier operation of giant crane hooks.

Color TV was chosen primarily because the remote manipulation problem involves color coded objects and also because it gives added depth perception and better object resolution.

The TV system uses the rotating color wheel principle because of the resulting simplicity, economy, color rendition, definition, and low maintenance cost.

New SAGE Computer Joins Defense Network

The first large-scale computer for the nation's vast new electronic air warning network is now being installed.

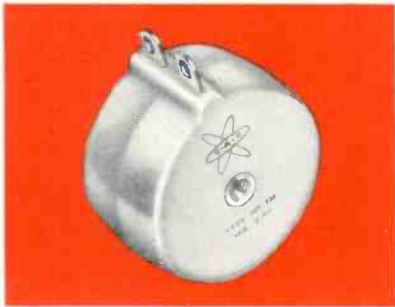
Our growing continental air defense system, known as the Semi-Automatic Ground Environment (SAGE) system, combines the

(Continued on page 176)



UNCASED TOROIDS

Basic inductor component. Plain, wax or plastic dipped with flex-leads. Hi Q values 10cps to 10mc. Complete range of sizes: subminiature, wedding ring and up to 12" OD. Standard inductances stocked for immediate delivery. Mass production utilizing CAC-designed winding equipment enables swift completion of large orders.



PLASTIC CASED TOROIDS

CAC compression molded toroids per Mil specs have become the standard of the industry. Most compact design—may be stacked—mounted by center bushing which absorbs mounting pressures—sturdy, tinned terminals—arrangements available up to 6 terminal connections. Standard inductance values shipped from stock—special inductances and configurations supplied promptly on request.

**TOROIDAL
INDUCTORS**



Precision... Delivery... Quality...

Growth and development of CAC has been rapid since its organization following World War II. It is made up of young, but highly experienced management and personnel. Unique manufacturing equipment (much of it CAC-designed) and leadership in production "know-how" offer PRECISION... DELIVERY... and QUALITY.

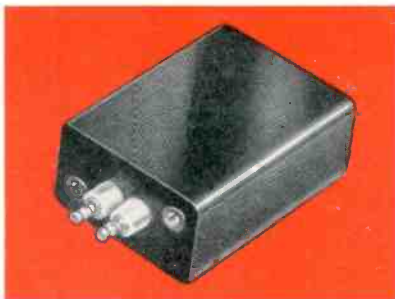
Whether your need is for one toroidal component... or a million, CAC is prepared to serve you.

COMMUNICATION ACCESSORIES CO.

World's Largest Exclusive Producer of Toroidal Windings

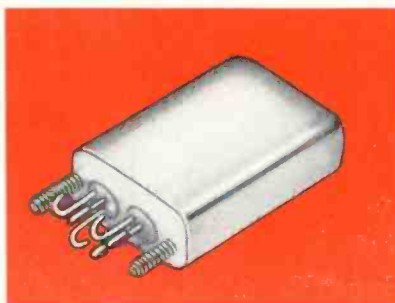
HICKMAN MILLS, MISSOURI • PHONE KANSAS CITY, SOUTH 1-5528

A Subsidiary of Collins Radio Company



HERMETICALLY SEALED CASED TOROIDS

CAC "HS" series provides metal encased, hermetically sealed units complying with MIL specifications. Mounting area minimized—extremely low hum pickup—terminals of proven design using Teflon assure permanent seal at temperature extremes. Rugged construction—convenient mounting facilities. To insure stability, cores are thermo-cycled prior to encasement. Standard inductances in stock.



SUBMINIATURE TOROIDS

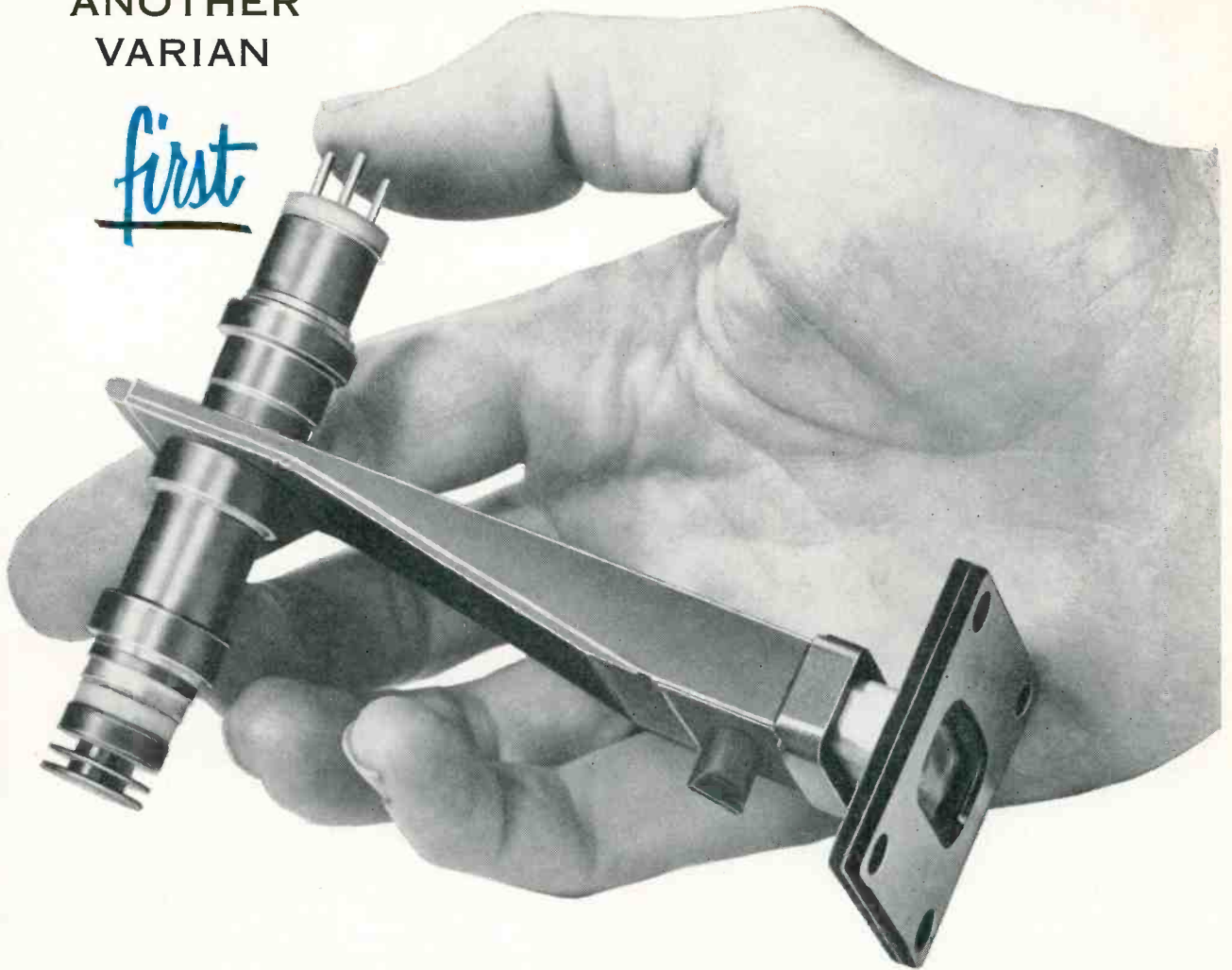
Uncased, plastic molded and hermetically sealed in three standard core types (others available). Designs for all requirements—for chassis mount or printed circuits.

For the engineer whose design considerations dictate the utmost in electrical performance versus size, CAC's subminiature toroids present the answer.

Catalogs on Individual Components are Available on Request.

ANOTHER VARIAN

first



A MINIATURE backward wave oscillator

This Varian Model VA-161 is the *only* rugged, system-tailored, voltage-tuned Backward Wave Oscillator now available for radars, signal generators, search receivers and related microwave equipment. Here are some of its important advantages:

- ✓ Instantaneously tuned by changing voltage.
- ✓ Low voltage requirements... operates over a frequency range of 8.2 to 12.4 kMc on less than 600 volts.
- ✓ Existing radar system power supplies can be used... operates over the normal 8.5 to 9.6 kMc radar band on 300 volts or less.
- ✓ Designed for modern miniaturized equipment... small, compact... body measures approximately 4" x 3/4".

- ✓ Withstands shock and vibration... rugged metal and ceramic construction.
- ✓ Permanent magnet weighs less than 5 pounds... eliminates need for electromagnet *and* its power supply.
- ✓ Power output is smooth across entire tuning range... fluctuations are small.
- ✓ Low thermal drift.

Additional tubes covering other frequencies are being developed to help solve your microwave system problems.

SYSTEM DESIGNERS... Why not get the full story on this important new Backward Wave Oscillator? For complete technical data, write Applications Engineering Dept.

THE
MARK OF
LEADERSHIP



VARIAN associates

PALO ALTO 10, CALIFORNIA

Representatives in all principal cities

KLYSTRONS, TRAVELING WAVE TUBES, BACKWARD WAVE OSCILLATORS, LINEAR ACCELERATORS, MICROWAVE SYSTEM COMPONENTS, R. F. SPECTROMETERS, MAGNETS, MAGNETOMETERS, STALOS, POWER AMPLIFIERS, GRAPHIC RECORDERS, RESEARCH AND DEVELOPMENT SERVICES



VOICE under the SEA

Relies on **ALSiMAG[®]**

For dependable service on the ocean floor *ALSiMag* precision insulators are used in the new Transatlantic Voice Cable

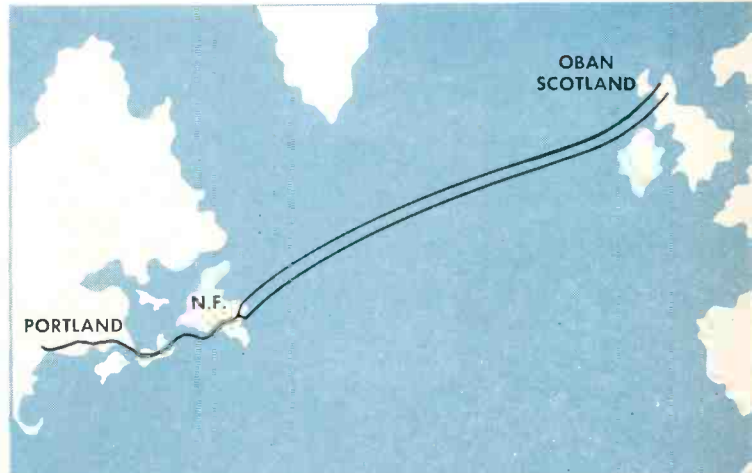
For 25 years communications engineers have studied the problems of laying a voice cable under the Atlantic Ocean to link the Americas with Europe. Today, the "voice" is nearing reality. The new link, a twin cable system, will be completed this year.

The almost incredibly exacting standards involved in making parts of the transatlantic cable have produced some truly remarkable engineering—engineering that accepts results no less than perfect. A select group of suppliers share in the achievement and *ALSiMag* is proud to be among them.

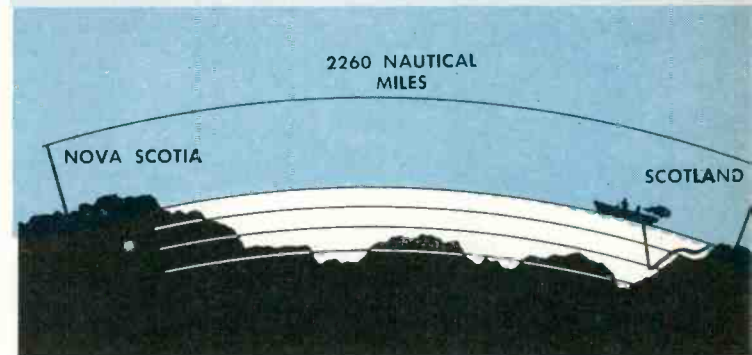
Men who perform "impossible" tasks stake their success on their creative ability plus the quality of their products. When technical ceramics are required on such critical applications, almost without exception the choice is *ALSiMag*. There are many reasons for this: One is the wider choice of materials available in *ALSiMag*. The exact composition for the required performance may be chosen from the many available . . . right in physical characteristics, right in electrical characteristics, right in every way!

ALSiMag performs at higher temperatures . . . withstands greater thermal shock . . . is stronger, more durable . . . permanently rigid . . . chemically inert . . . thoroughly dependable! *ALSiMag* can be fabricated in intricate designs to tolerances that compare favorably with precision metal work. *ALSiMag* will not rust, corrode or deteriorate with time. *ALSiMag* is the product of fifty-five years of specialized experience plus the finest production equipment . . . high speed presses, high temperature, continuous-fire kilns . . . every possible facility for the finest possible ceramics. In a wide range of shapes and sizes. Volume production or small quantity lots.

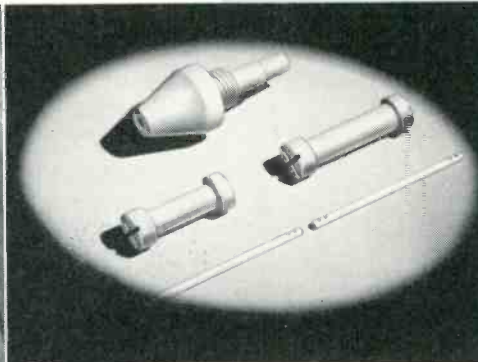
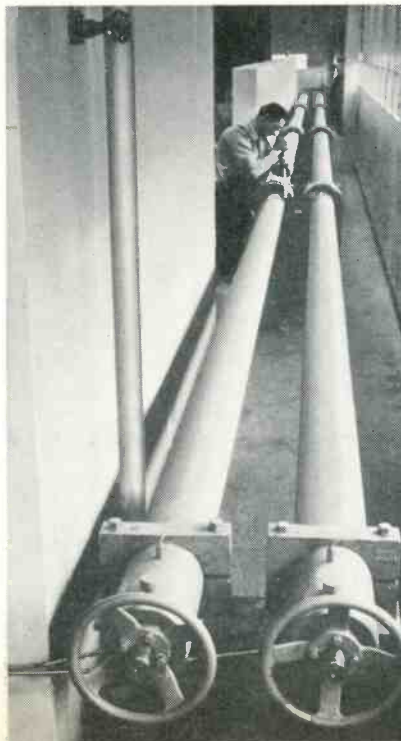
Highly technical applications, however, are not the end of the service story. *ALSiMag* is entirely practical . . . and vastly superior . . . for everyday industrial use. Economical, too! For any ceramic requirement, your best buy is *ALSiMag*. Send blueprint or sketch for full details.



Route of transatlantic telephone cable system between Portland and Oban.



Profile of the ocean bottom on which the cable will rest.



Dependable service on the ocean floor . . . not for years but for decades . . . calls for the most careful selection of components. To be economically feasible, the repeater units must have an exceptionally long life, since to raise the cable for replacing just one repeater would be a very costly operation. In the new transatlantic cable, impulses will be relayed by a series of repeaters, built by Western Electric Co., spaced some 40 miles apart. These rugged, low-cost *ALSiMag* parts are components of these repeaters.

AMERICAN LAVA

CORPORATION
CHATTANOOGA 5, TENN.
55TH YEAR OF CERAMIC LEADERSHIP



A subsidiary of
Minnesota Mining and
Manufacturing Company

AMERICAN LAVA SALES OFFICES IN PRINCIPAL CITIES

Finished repeaters, with cable leads at each end, are tested at up to 7,500 pounds a square inch in these long cylinders.

*indispensable for
measurement and reception*

MICROWAVE



MODEL R

*with these
special features:*

EXCELLENT GAIN STABILITY—Equipped with automatic gain control, as well as "signal-lock" Automatic Frequency Control. Performance stable over entire frequency band.

HIGH SENSITIVITY—Achieved with unique double-tuned cavity pre-selector which tracks automatically with local oscillator. Efficient wideband microwave input coupler and crystal mixer maintains sensitivity.

SELF-CONTAINED—Complete with electronically regulated low and high voltage power supplies; signal metering circuits; IF, local oscillator, audio-video, and FM plug-in sub-units. Four interchangeable, plug-in microwave tuning units cover frequency range 950-11,260 mc.

ALL-PURPOSE—Receives AM, FM, CW, MCW and pulse-modulated signals. Equipped with recorder output, trigger output (constant amplitude), video and audio outputs. Meter reads directly in db.

UNI-DIAL CONTROL—Automatically tracks klystron voltages, double tuned pre-selector, oscillator, and linear direct reading frequency dial — all simultaneously.



ELECTRONICS CORPORATION 43-20 34th STREET, LONG ISLAND CITY 1, N. Y.

**BROADBAND
950-11,260 MC**

FIELD INTENSITY RECEIVER



One of the most complete and versatile measurement instruments ever designed for reception and quantitative analysis of microwave signals in the range 950-11,260 mc.

The Polarad Model R Microwave Receiver is ideal for the reception and monitoring of all types of radio and radar communications within its range. It permits comparative power and frequency measurements, by means of its panel mounted meter, of virtually every type of signal encountered in microwave work.

It is compact and functional, featuring four integrally designed plug-in, interchangeable RF microwave tuning units to cover 950-11,260 mc; non-contacting chokes in pre-selector and microwave oscillator to assure long life and reliability; and large scale indicating meter for fine tuning control.

Call any Polarad representative or direct to the factory for detailed specifications.

SPECIFICATIONS:

Basic Receiver: Model R-B
Tuning Unit Frequency Ranges:
Model RL-T: 950 - 2,040 mc
Model RS-T: 1,890 - 4,320 mc
Model RM-T: 4,190 - 7,720 mc
Model RX-T: 7,260 - 11,260 mc

Signal Capabilities:
AM, FM, CW, MCW, pulse

Sensitivity:
-80 dbm or better throughout range on all models

Frequency Accuracy:
±1%

IF Bandwidth: 3 mc

Video Bandwidth: 1.5 mc

Image Rejection: Greater than 60 db

Gain Stability with AFC: ±2 db

Automatic Frequency Control
Pull-out range 10 mc off center

Recorder Output: 1 ma full scale

Trigger Output:
10 v. pulse across 100 ohms

Audio Output:
5 v. undistorted across 500 ohms

FM Discriminator
Deviation Sensitivity: .7 v./mc

Skirt Selectivity:
60 db - 6 db bandwidth ratio less than 5:1

IF Rejection: 50 db

Input AC Power:
105-125 v., 60 cps, 440 watts

Input Impedance: (ANT) 50 ohms

VSWR: Less than 4:1 over band

Range of Linearity: 60 db

Receiver Type: Superheterodyne

Maximum Acceptable Input
Signal Amplitude: 0.1 v. rms without external attenuation

Video Response: 20 cps to 1.5 mc

Size: 17" w x 23" d x 19" h

Weight: 180 lbs.

Price:
Model R-B (Basic Unit): \$1,500
Model RL-T: 2,500
Model RS-T: 2,500
Model RM-T: 2,500
Model RX-T: 2,500

Note: To the basic cost of \$1,500 add cost of tuning units required.

Prices subject to change without notice

AVAILABLE ON EQUIPMENT LEASE PLAN

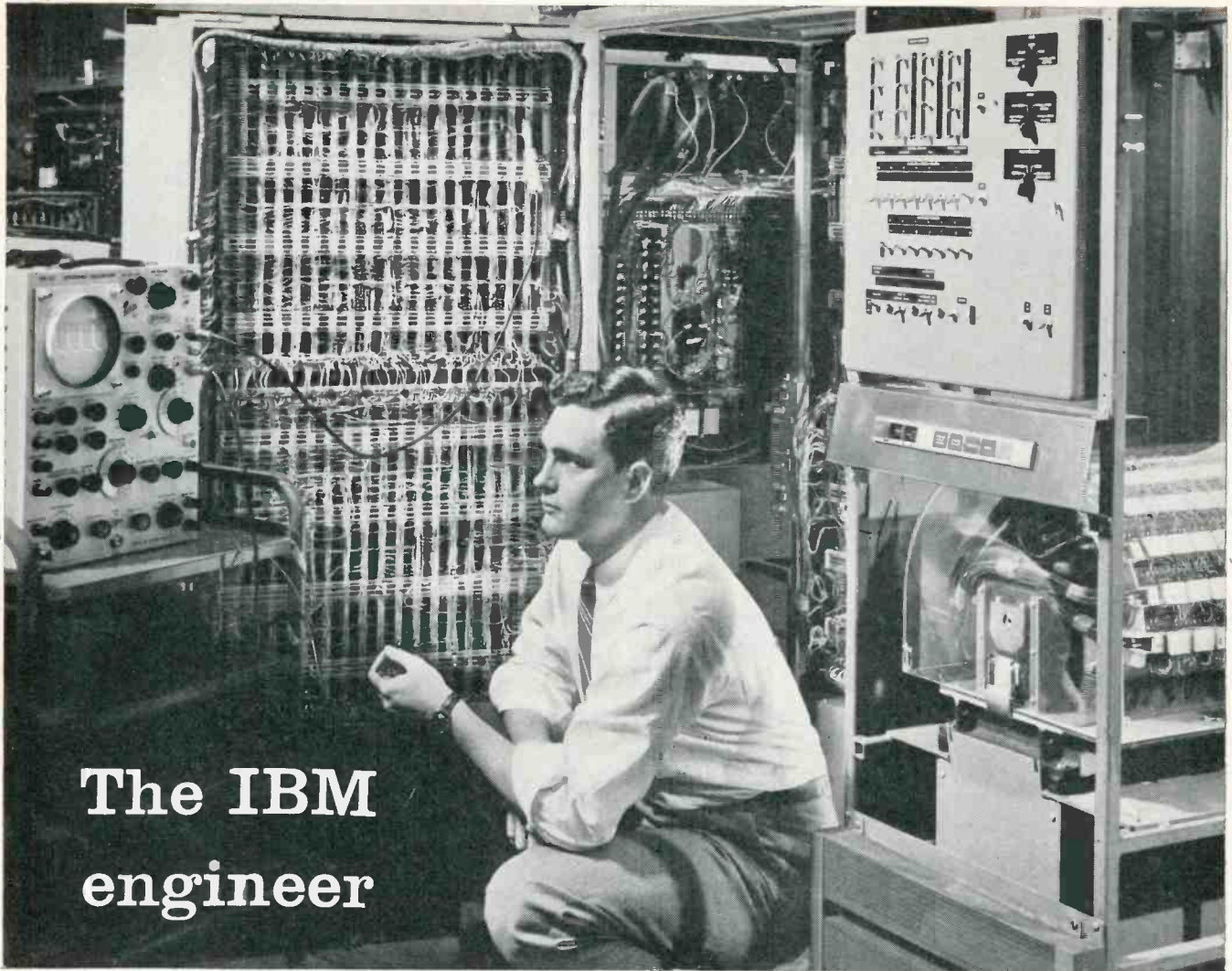
FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

CONSULT US ON YOUR MICROWAVE RECEIVER PROBLEMS.

for these
applications:

- Broadband receiver for AM, FM, CW, MCW, and Pulse Modulated signals
- Field intensity meter
- Frequency measurements
- Leakage, interference and radiation measurements
- Bandwidth measurements
- Measurement of relative power of fundamental and harmonic signal frequencies
- Trigger pulse amplifier
- Noise figure measurements of r-f amplifiers
- Antenna field patterns
- Attenuation measurements
- Propagation studies
- Microwave relay link site selection
- Direction finding
- Filter measurements
- Standing wave measurements

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



The IBM engineer

...creates electronic giants

Some men spend their working lives filling in the details of other men's ideas—and never know the satisfaction of doing something no one else has ever done before.

The IBM engineer, however, originates new ideas, new concepts, new applications, for he operates on the frontier of a field that is still in its infancy. Last year, for example, engineers enabled IBM to announce a major data processing improvement on the average of once every two weeks. It is this creative energy, we feel, that explains IBM's acknowledged leadership in the computer field . . . and accounts for the dramatic personal progress enjoyed by engineers at IBM.

Today, there is more room than ever at IBM for engineers who have the ability and the desire to be leaders, rather than followers, in their profession.

See the IBM Exhibit during the Wescon Show.

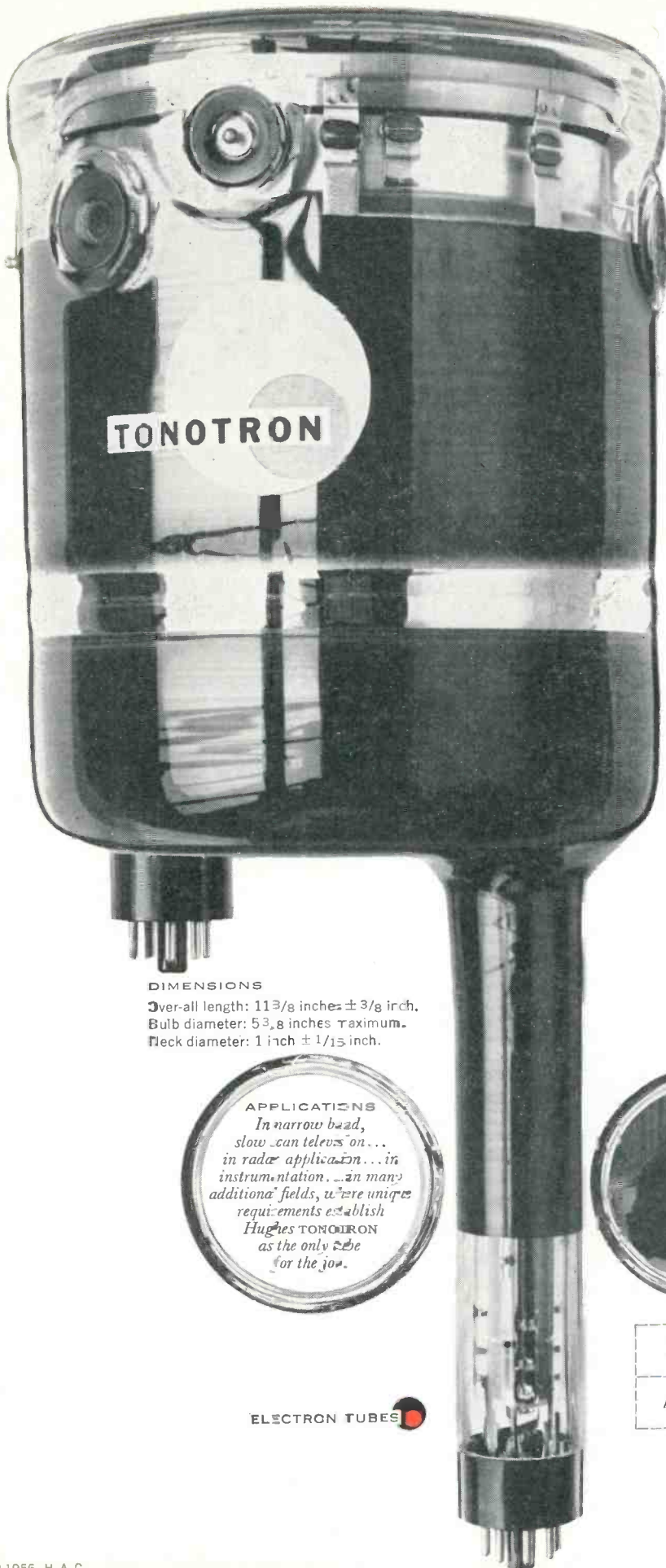
For all the details that we can't possibly include here, **write**, giving details of your background and interests, to: W. M. Hoyt, IBM, Dept. 4608, 590 Madison Avenue, New York 22, N. Y.

Plants and laboratories located at **Endicott, Owego, Poughkeepsie and Kingston, N. Y.; and San Jose, Calif.** Moving expenses paid.

IBM
®

INTERNATIONAL
BUSINESS MACHINES
CORPORATION

DATA PROCESSING • ELECTRIC TYPEWRITERS • TIME EQUIPMENT • MILITARY PRODUCTS



TONOTRON

DIMENSIONS

Over-all length: $11\frac{3}{8}$ inches \pm $\frac{3}{8}$ inch.
 Bulb diameter: $5\frac{3}{8}$ inches maximum.
 Neck diameter: 1 inch \pm $\frac{1}{15}$ inch.



APPLICATIONS

*In narrow band,
 slow scan television...
 in radar application... in
 instrumentation... in many
 additional fields, where unique
 requirements establish
 Hughes TONOTRON
 as the only tube
 for the job.*

ELECTRON TUBES



Hughes Products proudly announces

TONOTRON

Full circle persistence • New brilliance

Defies sunlight

Hughes Products introduces the TONOTRON, another in its series of new, direct-display cathode ray tubes designed for commercial, industrial, and military applications.

FEATURES

With TONOTRON, high-fidelity picture reproduction is possible for the first time. This new tube displays black, white, and all intermediate shades—with persistence which can be adjusted to maintain nearly maximum brilliance throughout the major portion of a 360-degree sweep. Both persistence and rate of decay can be controlled to suit a variety of specific applications. And TONOTRON's extreme brilliance makes observation possible in the brightest sunlight without a hood.



HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

For additional information, please write:

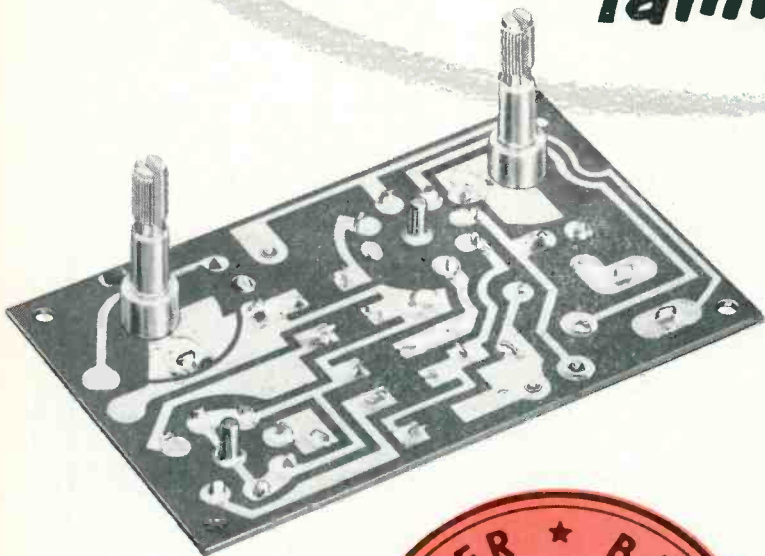
HUGHES PRODUCTS
 ELECTRON TUBES

International Airport Station, Los Angeles 45, California

Taylor Fibre Co.

says...

**"Using
Revere Rolled Copper
we are able to produce
superior copper-clad
laminates!"**



At the top of the page opposite is a section of an etched printed circuit enlarged 10 times. These particular lines are of .008 thickness, spaced .012 apart. They show the kind of printed circuits obtainable by combining Revere Rolled Printed Circuit Copper and Taylor laminates. Note the fine line etching, the close spacing and the sharp definition of the edges . . . the smoother surface (freer from pits, pinholes and imperfections) . . . the more uniform thickness with no sacrifice of conductivity. Results—consistently satisfactory etching at better production rates.

Laminators and users alike also have found that Revere Rolled Copper produces no peaks or valleys, that its smooth, hard surface of uniform density permits resist to clean off easily for there are no pores to hold resist and cause trouble when soldering.

They have noted, too, that Revere Rolled Copper is free from oxidation as it comes from the mill and is without lead inclusions. And because of its clean surface, fluxes wet readily, while in the automatic soldering operation it makes possible a uniform solder coat every time free of skips or bald spots.

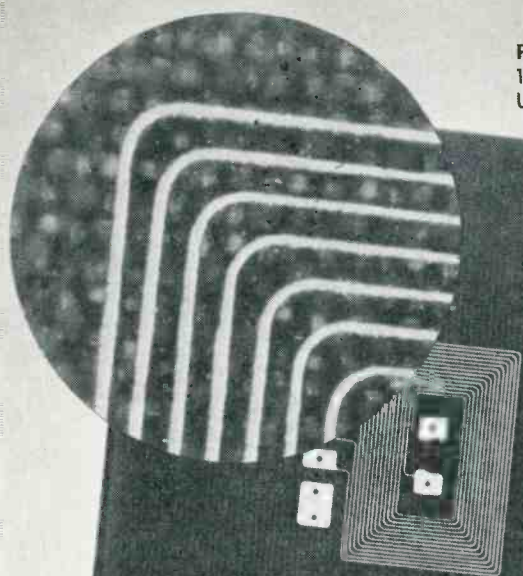
Those are the very reasons why you should insist that Revere Rolled Copper be used when ordering blanks from your laminator. It is available in unlimited quantities in standard coils of 350 lbs. in widths up to 38" and in .0015 and .0027 gauges, weighing approximately 1 oz. and 2 oz. per square foot. Revere Rolled Copper exceeds requirements of standard specifications and meets ASTM B5 specification for purity with 99.9% minimum.

REVERE
COPPER AND BRASS INCORPORATED
Founded by Paul Revere in 1801
230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Brooklyn, N. Y.; Chicago, Clinton and Joliet, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Newport, Ark.; Rome, N. Y.
Sales Offices in Principal Cities, Distributors Everywhere.

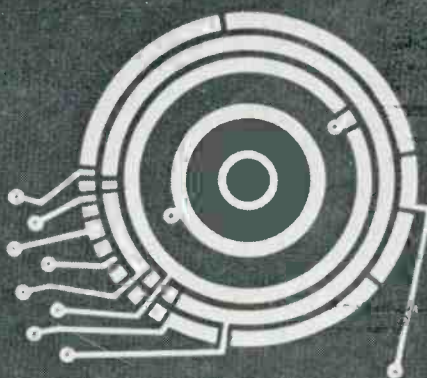


PHOTO SHOWING SECTION OF CIRCUIT enlarged 10 times was made directly from panel and is UNRETOUCHED.

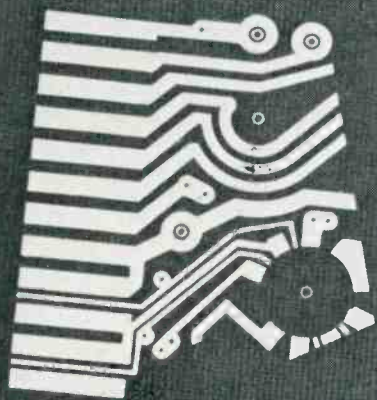


SECTION OF CIRCUIT ENLARGED 10 TIMES to show how even finest lines are freer from pits, pinholes and other imperfections when Revere Rolled Copper is used in copper clad laminates. Note sharp definition of edges of the fine line of .008 thickness spaced only 012 apart

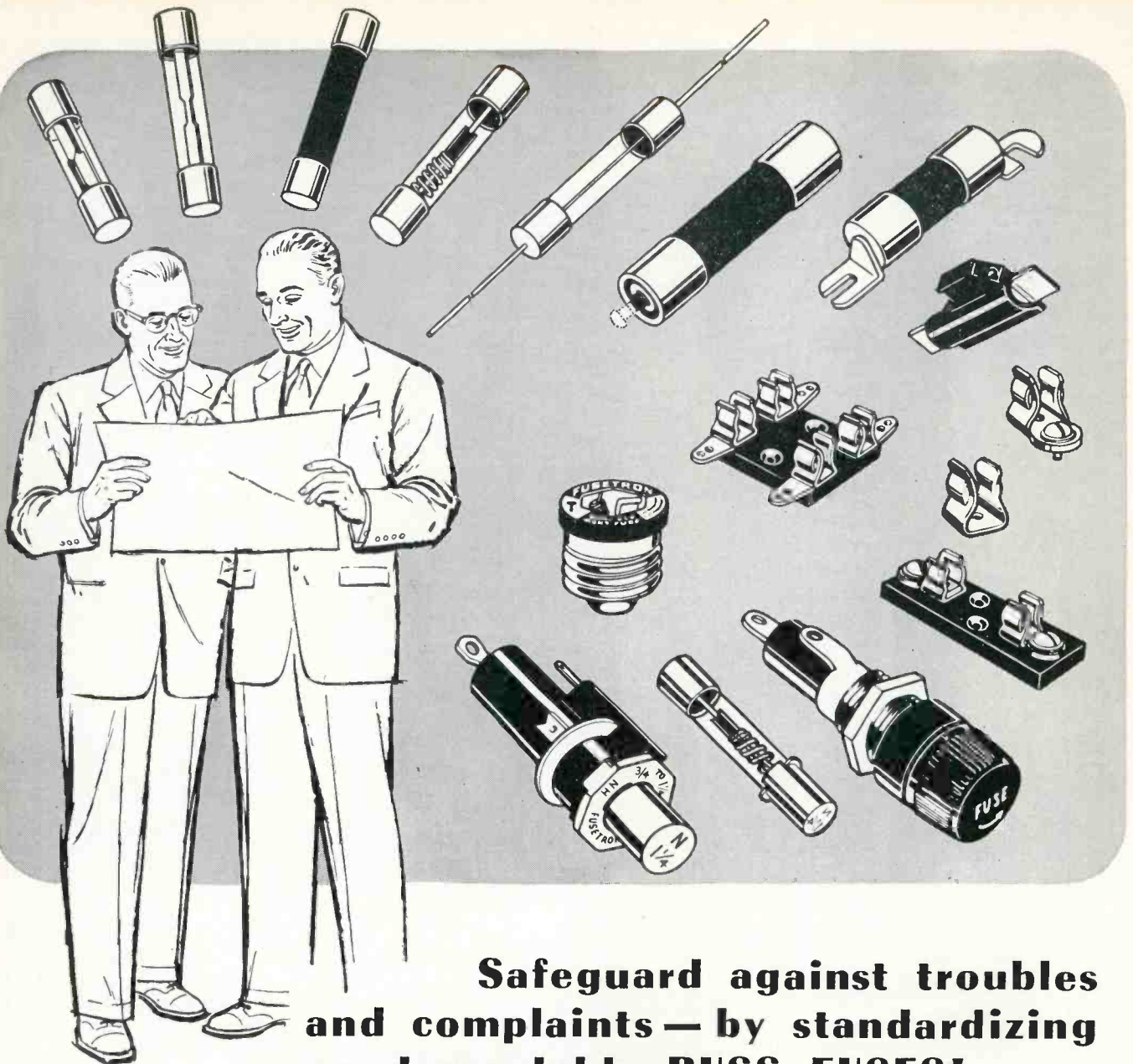
REVERE ROLLED COPPER assures a hard, wear-resistant surface for sliding contact spots such as this switch. Takes plating if needed



WITH REVERE ROLLED COPPER smoother, more uniform surfaces of the most intricate patterns are assured. This means continuous positive contact without sacrifice of conductivity.



ABOVE PANEL IS ACTUAL PHOTO OF LAMINATE BY TAYLOR FIBRE CO., Norristown, Pa. and La Verne, Calif., using Revere Rolled Printed Circuit Copper.



Safeguard against troubles and complaints — by standardizing on dependable **BUSS FUSES!**

BUSS fuses give you double protection against loss of customer goodwill because . . . BUSS fuses blow only to protect — never needlessly. To make sure of proper operation, BUSS fuses are tested in a sensitive electronic device that automatically rejects any fuse not correctly calibrated, properly constructed and right in all physical dimensions.

By specifying BUSS fuses, you are safeguarding users of your equipment against irritating useless shutdowns due to faulty fuses blowing needlessly. And you are providing them with maximum protection against damage caused by electrical faults.

Most important, the reputation of your product for service and quality

is not harmed by the faulty operation of poor quality fuses.

To meet your needs, a complete line of BUSS fuses is available, plus a companion line of fuse clips, blocks and holders.

If your protection problem is unusual, BUSS places at your service the world's largest fuse research laboratory and its staff of engineers to help you select the fuse or fuseholder best suited to your application.

For more information available 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.



Power where it's Needed!



This new ANDREW 450 MC base station antenna has been designed for the many base stations that are not in the center of their desired coverage area. Such stations, placed to take advantage of mountain tops, or located at operations headquarters, can now concentrate their highest gain in the direction where the need is greatest.

In planning a new radio system or improving an existing system, consider the advantages of an integrated ANDREW antenna system. The following example shows how an ANDREW system, using the Type 201, can give improvement over ordinary equipment in all directions and more than 9 db improvement in the best direction.

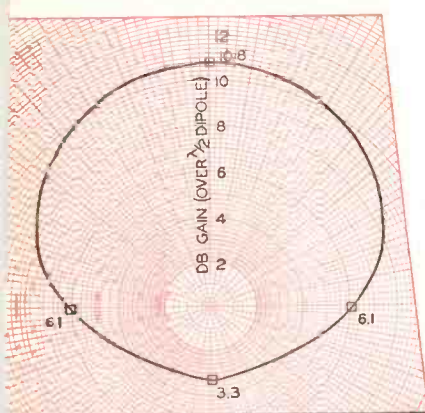
Typical Existing System	Relative Gain, db		
	Front	Side	Back
Base Station Antenna (Typical)	5.0	5.0	5.0
Station Cable Loss, 100 feet RG-17/U	(2.5)	(2.5)	(2.5)
Mobile Antenna, $\frac{1}{4}$ λ Whip (RG-58)	0*	0*	0*
Combined Antenna System	2.5	2.5	2.5
ANDREW Type 201 System			
Base Station, Type 201	10.8	6.1	3.3
Base Station Cable Loss, 100 feet Type HO HELIAX	(1.0)	(1.0)	(1.0)
Mobile Antenna, Type 233 (RG-8)	1.8*	1.8*	1.8*
Combined Antenna System	11.6	6.9	4.1
IMPROVEMENT, db	9.1	4.4	1.6

*Gain of Type 233 is relative to assumed 0 db gain of $\frac{1}{4}$ λ whip with RG-58/U, and includes allowance for lower loss of RG-8/U feed cable.

Write for Bulletin 8417 giving complete information on Type 201. Also, be sure your library contains ANDREW Catalog 21, a complete, 100-page guide to antenna and transmission line systems.

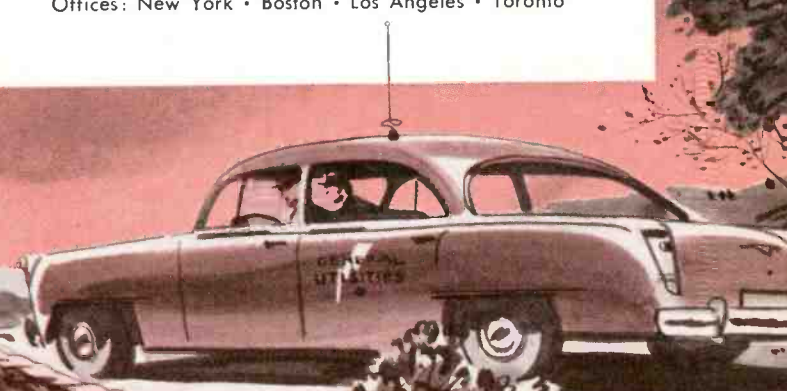
Andrew
CORPORATION
363 EAST 75th STREET • CHICAGO 19

Offices: New York • Boston • Los Angeles • Toronto



Gain Pattern, Type 201

ANTENNAS • ANTENNA SYSTEMS • TRANSMISSION LINES





Consolidated

...recognized leader

in the fields of:

Chemical Analysis

Process Monitoring and Control

Dynamic and Static Testing

Automatic Data Processing

Whenever you need high-accuracy, high-speed data for new product development, product improvement, or quality control, CEC can help you. The instruments, equipment, and systems available through Consolidated will place you in command of any analytical or control problem.

**LEADING MANUFACTURER of
ELECTRONIC INSTRUMENTATION
and HIGH-VACUUM EQUIPMENT
in the UNITED STATES**

Recording Oscillographs
Analog-to-Digital Converters
Direct-Writing Oscillographs
Oscillogram Processors
Magnetic Tape Equipment
Galvanometers
Data Amplifiers
Power Supplies
Vibration Meters
Vibration Pickups
Hyge Shock Testers
Pressure Pickups
Electromanometers
Mass Spectrometers
Gas Chromatographs
Process Refractometers
Oxygen Analyzers
Ultraviolet Analyzers
Titrilog Sulfur Recorders
Leak Detectors
Analytical Service
Systems Engineering



**See
Consolidated at
WESCON**

**Analytical & Data Processing
Instruments: Booths 841-842**

**High-Vacuum
Equipment: Booth 826**

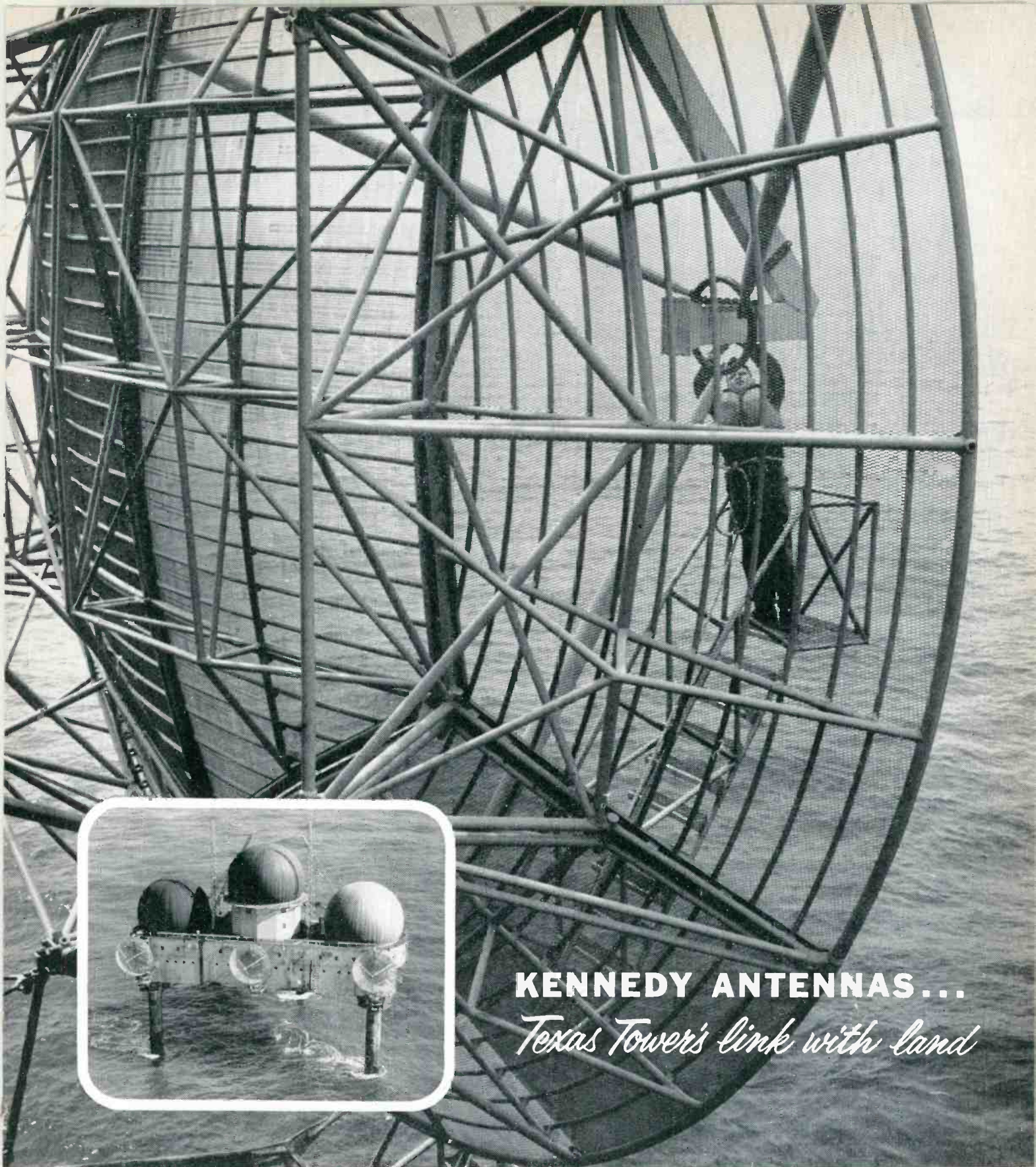
Consolidated Electrodynamics

CORPORATION



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KENNEDY ANTENNAS...
Texas Tower's link with land

Perched high above the Atlantic, an Air Force technician makes an adjustment on a 28' scatter antenna — one of three standard Kennedy antennas assigned to a very special job on Texas Towers. These silent sentries relay incoming signals to the mainland, where the message can be read the same instant it is received off shore. Like the many mighty Kennedy antennas performing defense duty all over the free world, they're solid evidence that Kennedy is the name to remember when you are faced with antenna problems.



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Electronic Industries News Briefs

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

EAST

ACOUSTICA ASSOCIATES, INC., Glenwood Landing, L. I., N. Y., has been awarded a substantial Air Force development contract in the guided missile field for ultrasonic cleaning equipment.

ALTEC SERVICE CORP. has changed its name to **ALTEC COMPANIES, INC.** There are no changes in the names of activities of the subsidiary companies.

AMERICAN BOSCH ARMA CORP. recently dedicated a new \$1,164,000 addition to their Columbus, Miss. plant of its wholly-owned subsidiary, American Bosch Arma Mississippi Corporation.

BENRUS WATCH CO. proposes the purchase of **PIC Design Corp.**, Lynbrook, N. Y., manufacturer of precision instrument components. Plans for an expansion of **PIC Design** include a new plant in the Lynbrook-East Rockaway Area.

COMMUNICATION EQUIPMENT SECTION, GENERAL ELECTRIC, will transfer its activities to a new plant soon to be constructed at Gainesville, Florida. Approximately 1700 personnel will be employed in the new plant.

CONSOLIDATED VACUUM DIV., CONSOLIDATED ELECTRODYNAMICS CORP. has changed its name to **Consolidated Electro-dynamics Corp.**, Rochester Division, effective June 1, 1956.

CONSOLIDATED ELECTRONICS INDUSTRIES CORP.'S Board of Directors has approved the acquisition of **Technical Electronics Corp.**, Culver City, Calif., manufacturers of motors, system analyzers, and packaged electronic circuits.

DAYSTROM NUCLEAR DIVISION, DAYSTROM, INC. will supply and install a new nuclear reactor at Brookhaven National Laboratory, Long Island. Contract includes the core, process instruments, console and wiring, work to be concluded by 1958.

EMERSON RADIO & PHONOGRAPH CORP. has developed and built for the Air Force a trainer for teaching radar operators to guide aircraft to a target, bomb the target and return—solely through the use of **SHORAN** radar.

FEDERAL ELECTRIC CORP., Lodi, N. J., subsidiary of International Telephone and Telegraph, has been awarded the operation and maintenance contract for the "White Alice" communication network in Alaska by the USAF.

FEEDBACK CONTROLS, INC., has completed a consolidation of its Alexandria, Va. plant and its Cambridge, Mass. engineering office into new quarters in Waltham, Mass.

FENWAL ELECTRONICS, Framingham, Mass., affiliate of Fenwal Inc., has entered the field as manufacturer of precision thermistors.

GENERAL ATRONICS CORP., 125 City Line Ave., Bala-Cynwyd, Pa., has been established for the purpose of developing new products and techniques in electronics and in the physical and mathematical sciences. President of the new firm is David E. Sunstein, formerly head of the Government Research Dept., Philco Corp., Philadelphia.

INTERNATIONAL TELEPHONE AND TELEGRAPH CORP. and **UNDERWOOD CORP.** have announced that discussions with

respect to a possible association of interests have been terminated.

GLENN L. MARTIN CO. of Baltimore, has been awarded a contract by the Dominican Republic for a nuclear-powered electrical generator system.

NORDEN LABORATORIES, White Plains, N. Y., division of the Norden-Ketay Corp., has been elected to membership in the Radio Technical Commission for Aeronautics.

RCA DEFENSE ELECTRONIC PRODUCTS has established a new department to handle administration, sales, and details of **RCA** custom-built spares for military electronic equipment. Heading the new activity is Herbert C. Elwes as Manager, **RCA** Defense Spares Marketing.

SOCIETY OF TECHNICAL WRITERS (STW) and the **ASSOCIATION OF TECHNICAL WRITERS AND EDITORS (TWE)** are working on plans for a merger of the two into a single organization. Initial plans call for a joint National Convention of **STW** and **TWE** on Nov. 15 and 16 at the Hotel Statler, New York.

SPERRY RAND CORP. will construct a new \$1,250,000 research and development facility at Salt Lake City, to be known as the **Sperry Utah** Engineering Laboratory.

F. J. STOKES MACHINE CO., Philadelphia, has changed its name to **F. J. Stokes Corp.**

SYLVANIA ELECTRIC PRODUCTS INC. has acquired a new plant in Hillsboro, N. H., to be used in the manufacture of transistors and crystal diodes. **Sylvania** has also established a new Microwave Physics Laboratory at Mountain View, Calif.

ULTRASONIC MANUFACTURERS ASSOC. has formed an engineering standards committee composed of members from seventeen leading ultrasonic manufacturers in the U. S.

MID-WEST

A.C. SPARK PLUG DIV., GENERAL MOTORS, has changed its name to **A.C. Electronics Division Corp.**

AMERICAN PHENOLIC CORP., Chicago, announces a change of name to **Amphenol Electronics Corp.**

CARBOLOY DEPT., GENERAL ELECTRIC CO., will now be known as the Metallurgical Products Department, General Electric. Department headquarters remain in Detroit.

COOK RESEARCH LABS., Skokie, Ill., division of Cook Electric Co., will occupy a new plant now under construction in Morton Grove, Ill. The new 31,000 square foot structure will be utilized mainly for Radar Research.

EDUCATIONAL TELEVISION & RADIO CENTER, Ann Arbor, Mich., will acquire a new \$200,000 home on or about October 1. The two-story L-shaped building will provide more than 8500 square feet of floor space.

MAGNAVOX CO. of Tennessee has initiated a major building program which will add approximately 70,000 square feet to the company's facilities in Greeneville.

SHURE BROTHERS INC. has moved into a new \$1,000,000 building at 222 Hartrey Ave., Evanston, Ill.

TEXAS INSTRUMENTS, INC., Semiconductor Products and Components Divisions, have combined their engineering, manufacturing and marketing operations.

WEST

BERKELEY DIV., BECKMAN INSTRUMENTS, has been awarded a contract by General Motors Allison Division for analog computer to be used in designing advanced jet engines at the Allison plant, Indianapolis.

JACQUES BIALEK has opened an office as Management Consultant to the Electronics Industry at 3631 W. Slauson Avenue, Los Angeles 43.

BJ ELECTRONICS, subsidiary of Borg-Warner Corp. has moved to new quarters at 330 Newport Blvd., Santa Ana, Calif.

CAL-TRONICS CORP., Los Angeles manufacturer of electronic test equipment, has formed a new Photo-Etch Circuits Division to develop and produce printed circuits. General Manager is W. G. Weigel. The plant is located at 2631 Southwest Drive, Los Angeles.

CONSOLIDATED ELECTRODYNAMICS CORP. has completed the construction of a \$1,500,000 3-story research, engineering and marketing building in Pasadena, Calif.

ELECTRO ENGINEERING WORKS, INC., transformer manufacturer, has completed the move to their new 20,000 square foot building at 401 Preda Street, San Leandro, Calif.

G. M. GIANNINI & CO., INC. has opened a new electromechanical division at Sherwood Lane, Caldwell Township, N. J.

MARVELCO ELECTRONICS DIV., NATIONAL AIRCRAFT CORP. has established an electronic research and development center at 5063 Harbor Drive, San Diego, to handle projects in telemetering, data-handling and display, guidance-navigation, and computer research.

McCOLPIN-CHRISTIE CORP. announces the change of name to **Christie Electric Corp.** Organization and personnel remains the same.

PCA ELECTRONICS INC. has moved its Santa Monica factory to new quarters at 16799 Schoenborn Street, Sepulveda, Calif.

PERKIN ENGINEERING CORP., El Segundo, Calif., has opened a new regional Sales-Engineering office at 1060 Broad Street, Newark 2, N. J.

TELEMETER MAGNETIC INC., subsidiary of International Telemeter Corp., has moved to new quarters at 2245 Pontius Avenue, Los Angeles 64.

FOREIGN

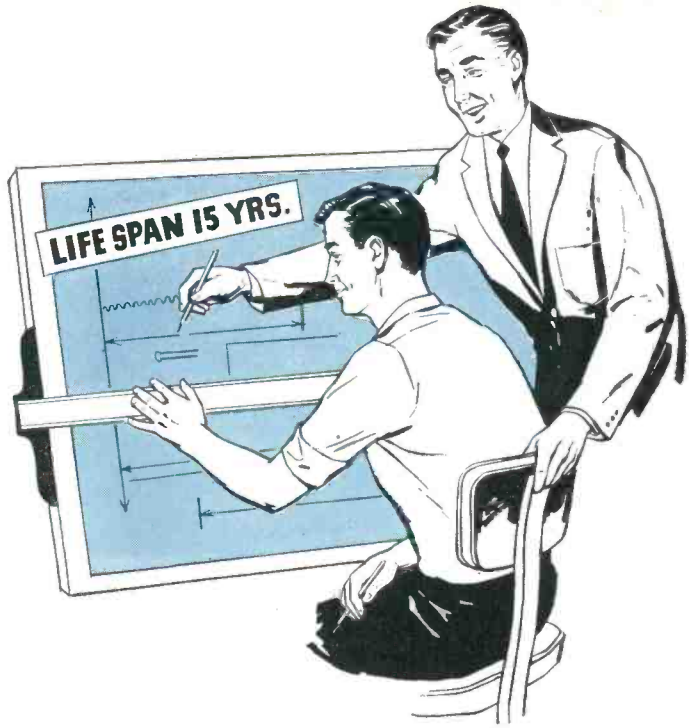
KEARFOTT CO., INC., subsidiary of General Precision Equipment Corp. has arranged with R. B. Pullin & Co. Ltd., London, England, for manufacture of **Kearfott's** products in the United Kingdom. Equipment to be manufactured overseas will include servomotors, synchros, tachometer generators and servomotor-tachometer combinations.

PSC APPLIED RESEARCH LTD., Toronto manufacturer of instrumentation, has opened a new environmental test laboratory to test to aeronautical standards.

SUN LIFE ASSURANCE CO. OF CANADA has ordered a Univac tube computer from Remington Rand to be installed in its head office in Montreal.

TELESISTEMA MEXICANO S.A., Mexico City, has purchased a Philco, VHF, one-kilowatt TV transmitter with associated studio equipment to be installed at Guadaluajara.

planning
on
**LONG
LIFE?**



El-Menco DUR-MICA Capacitors will match your equipment's life expectancy to at least 15 years!

A recent series of the toughest trials has proved El-Menco DM15, DM20 and DM30 Dur-Mica Capacitors outlast all others. Accelerated conditions of 1 1/2 times rated voltage at ambient temperature of 125° centigrade found El-Menco capacitors still going strong after 10,000 hours. Similar conditions obtaining under normal usage would equal a lifetime of over 15 years!

Tougher phenolic casing means longer life, greater stability, over wide temperature range.

Meet all humidity, temperature, and electrical requirements of both civilian and MIL-C-5 specs.

Parallel leads simplify use in television, electronic brains, miniature printed circuits, computers, guided missiles, and other civilian and military applications.

DM15



Actual Size

DM20



El-Menco Dur-Mica DM15, DM20, and DM30 Capacitors Assure:

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|-----------------|--------------------------------------|
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| 2. POTENT POWER | 5. PEAK PERFORMANCE |
| 3. SMALLER SIZE | |

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WILLIMANTIC, CONNECTICUT

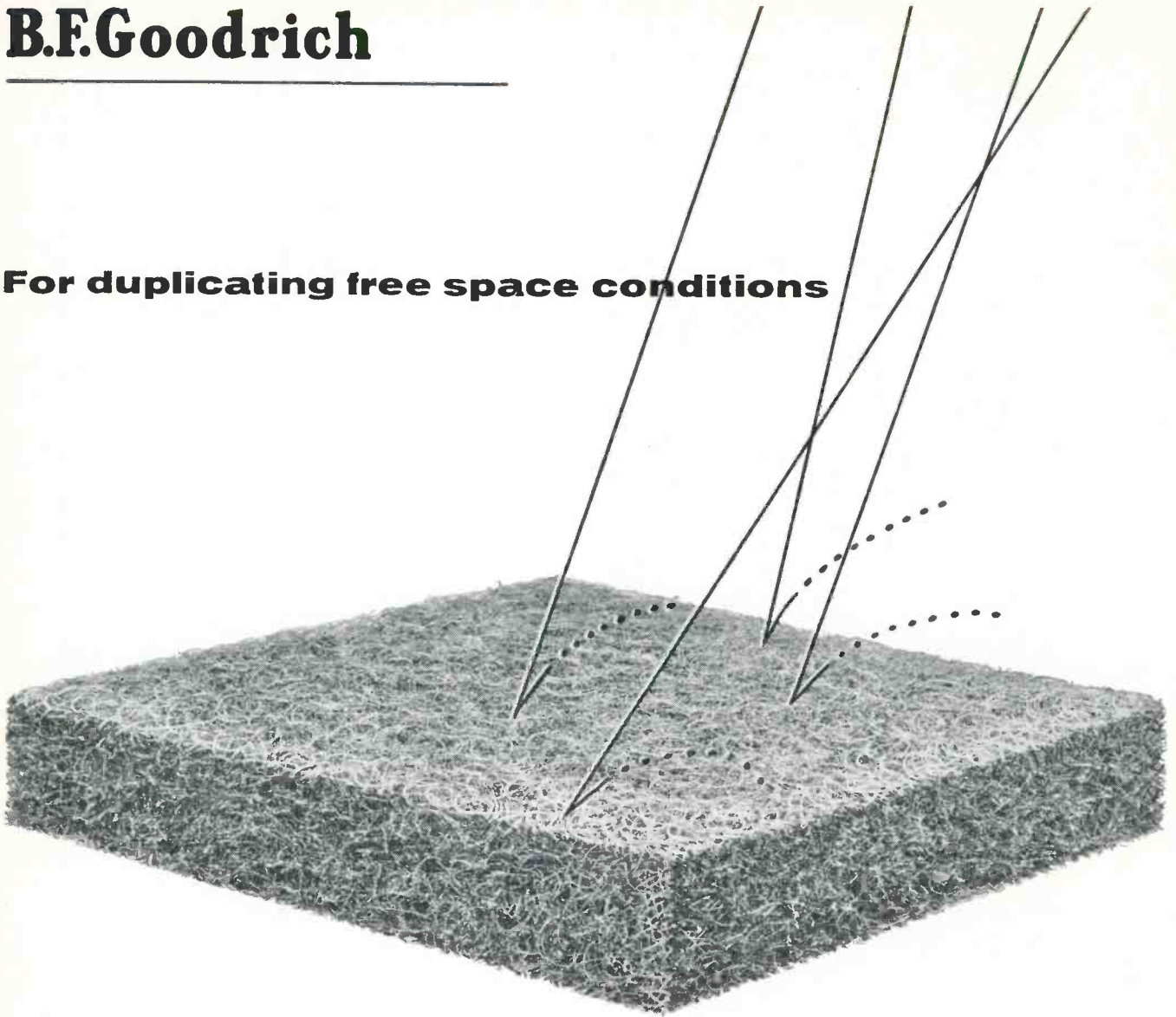
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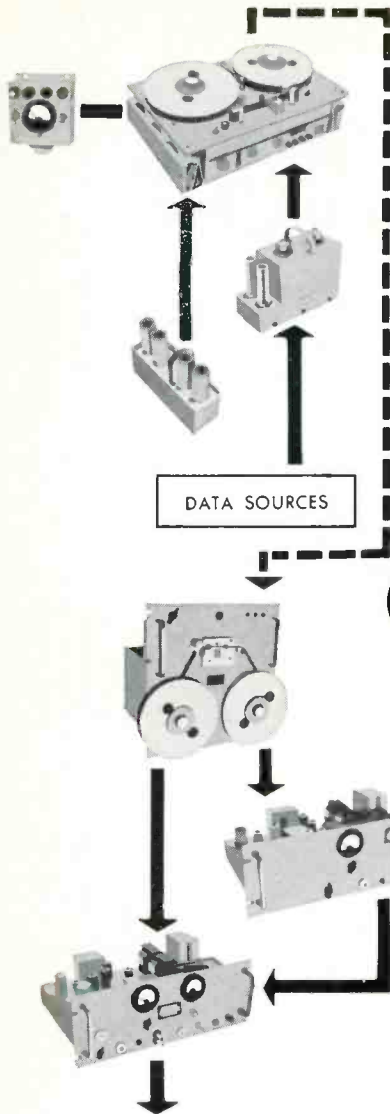
absorbs 99% incident energy
... 4% to 5% more
than any other
microwave absorbent.

*Write today for samples and booklet on this durable,
economical and easy-to-install absorbent.*

SPONGE PRODUCTS DIVISION

B.F. Goodrich

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In choosing data recording equipment, it is now feasible to tailor the equipment to present and future data handling needs. It is no longer necessary to tailor your entire program to equipment limitations.

Choosing A System

for magnetic tape DATA recording

When magnetic recording was in the audio phase of its development, there was just one recording method—direct recording. But today, several methods are available. And while direct recording is still common in audio work, it has taken a back seat to modulated carrier techniques in the more critical field of data recording.

To take advantage of the broad range of equipment and techniques now available, start with a thoroughgoing analysis of your own present and future data handling . . . data processing needs. Then, match the techniques and individual components to those needs.

Choose the recording method first: Direct recording is limited in data work by its poor amplitude reproduction and poor low frequency response on playback. Pulse width modulation (PWM) recording is excellent for recording a large number of channels with limited frequency response. Digital recording offers extremely high data accuracy, but relatively low information capacity.

FM recording, electronically compensated for wow and flutter, offers

a combination of high overall system performance, frequency response, and information capacity, suiting it for most analog recording applications. Any or all of these methods can be supplied in the same recording system by inserting the proper plug-in circuitry.

Consider physical requirements next: Where you plan to use a system is an extremely important factor. To record data in a missile or jet, you will obviously need different equipment than would be used in a laboratory. But reel size, tape width, tape speeds, must also be selected. And heads, available for recording from 2 to 24 data tracks or even more, should be specified early. Keep in mind also the planned final disposition of the data, whether to a computer, direct writing recorder, or other equipment.

Finally, select system components and accessories: In FM carrier recording alone, you can choose from at least three recording oscillators, two reference generators, and several signal and compensation discriminators. Speed control servos, power supplies, and remote controls also require attention.

Needless to say, much of this process of selection requires special experience, and should be placed in the hands of the competent data recording systems manufacturer. But the important thing to remember is that data recording on tape is a field in itself, with special techniques and special equipment that can be matched to virtually any recording need. The day when the problem had to be tailored to the equipment is long past.

More detailed information on recording systems and equipment, and how to select them, is provided in "The Role of Magnetic Tape In Data Recording," available on request to Davies Laboratories, Inc.



LABORATORIES, INCORPORATED
4705 QUEENSBURY ROAD • RIVERDALE, MARYLAND



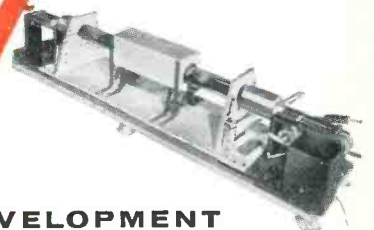
RESEARCH

Solid state devices for not-so-distant future applications command continuous study by Tung-Sol engineers. In this instance the purifying of silicon is under close scrutiny.



DESIGN

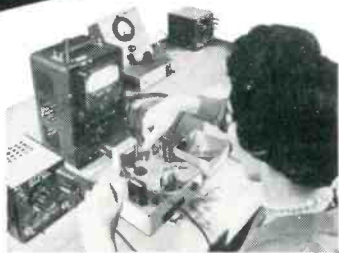
Efficiency and utility are among the foremost considerations of all Tung-Sol semiconductor blue-printing. Here the resistivity of single germanium crystals is being measured.



DEVELOPMENT

Ever alert to the intensified and varied demands made by transistorizing, Tung-Sol provides full-scale development of new semiconductor types. Here the latest techniques of germanium diffusion are explored.

New Production Facilities for Tung-Sol Semiconductors



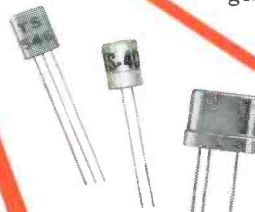
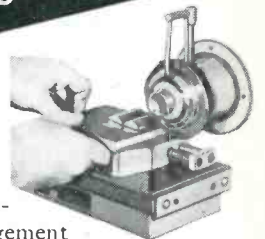
TESTING

100% testing—life, mechanical and electrical—characterizes the Tung-Sol manufacturing program. In this illustration, transistors are 100% checked for noise factor.



PRODUCTION

A complete manufacturing division—with its own full-time engineering and management staffs—handles every phase of the critical production process from metal refining to finished product. Here germanium ingots are being sliced into 15/1000" blanks.



QUALITY CONTROL

Every step of Tung-Sol semiconductor manufacture is subjected to intensive quality control that permits no compromise with premium quality. Here transistors are life-tested under conditions in excess of their ratings.

ts TUNG-SOL[®] SEMICONDUCTORS



For technical information write to Commercial Engineering Division

TUNG-SOL ELECTRIC INC., Newark 4, N. J.

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Semiconductors



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DIRECT HITS REQUIRE PERFECT CONTROLS



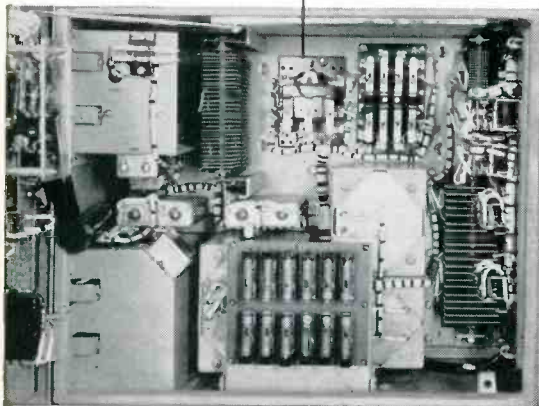
*...and Radio Receptor Selenium Rectifiers
help make that accuracy possible!*

Power supply and
amplifier cabinet made by
Belock Instrument Corp.,
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gun fire control systems.
Five Radio Receptor
rectifiers are utilized
in this unit.



The timing and precision of U. S. Naval gunfire depends on complex fire control systems for which Radio Receptor's customer, **Belock Instrument Corp.** manufactures power supply and amplifier cabinets. Five Radio Receptor power rectifiers are included in each unit because the manufacturer knows that ruggedness, long life and reliability are always prime features of every RRco. stack.

On target with the fleet — and in hundreds of other applications for government and industry, RRco. rectifiers constantly prove they can pass the stiffest requirements with flying colors. If *you* have a problem involving rectification, submit your specs to our engineering department. We'll be glad to make recommendations, without obligation of course.



Semiconductor Division

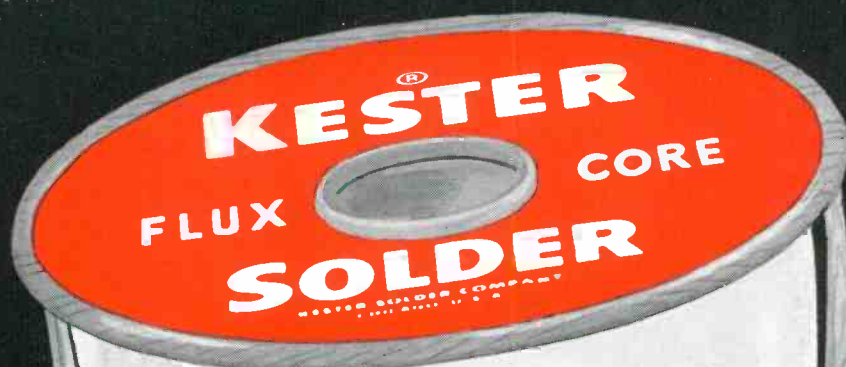
RADIO RECEPTOR COMPANY, INC.

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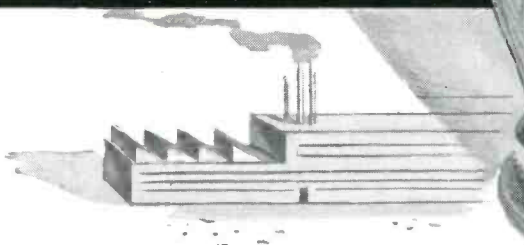
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New Grant 3400

thinslide

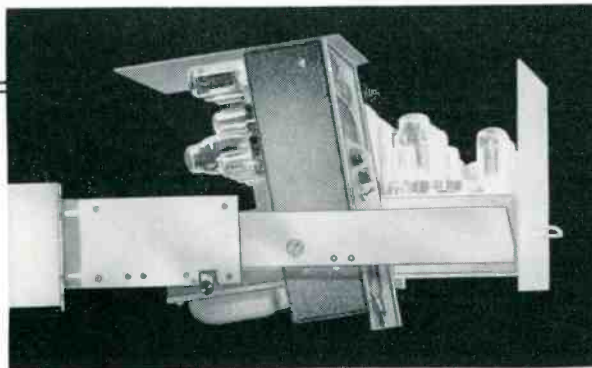
*mounts standard 17" chassis
in standard 18" rack or cabinets*

REQUIRES ONLY 19/64" SPACE PER SIDE—

YET HAS

FULL ROLLER ACTION

(fits RETMA rack hole spacing)



The Grant 3400 Thinslide requires only 19/64" space per side—installs readily in standard racks and cabinets. Allows instant access to chassis measuring from 10" to 16" deep. Tilts through 100° for under-chassis servicing. Positive lock in "out" position. Lock has finger-tip release for instant return or removal of chassis. Eight hardened steel rollers carry the rated load of 100 lbs. smoothly and easily—durability insures frictionless rolling for thousands of cycles of use.

Slide mounting not only provides for quick access—it usually eliminates need for rear access doors and rear aisles—a very important saving of space.

The Grant 3400 is a versatile slide, suited for use in your *product*, in *plant equipment*, *prototype* and *breadboard* work, and in *production line* or *field test equipment*. Very moderate cost allows a wide range of applications in original equipment.

Write today for Grant 3400
Thinslide Technical Bulletin—contains
full data and specifications.

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Robert Oakes Jordan

In the article reproduced here, just as it appeared in the May 16 issue of "Down Beat", Mr. Robert Oakes Jordan reports his completely unbiased and impartial findings on the vitally important subject of tape quality. A leading authority in the high-fidelity field, and tape recording in particular, his comments are of interest to all users of tape recording equipment, professional and amateur alike.

High Fidelity

DOWN BEAT

By Robert Oakes Jordan

IT LOOKS AS though 1956 will be a year for magnetic tape recording. Perhaps it might be wise to review the subject of tape.

Looking back over the recent history of magnetic recording and its plastic tape medium, it is easy to see the progress in both.

Factors, more often than not overlooked, which are concerned with the use and storage of tape should be known and used by every person having a tape recorder.

During the last year, one of the long-term projects at our laboratory in Highland Park, Ill., has been the independent study of magnetic recording tape. We are interested in finding out just which practises in its use must be observed and how the user can best assure the safekeeping of his recorded tapes.

SEVERAL HUNDRED reels of magnetic tape from all the tape manufacturers were studied. Not more than 5 percent of this tape was submitted by manufacturers as samples. The bulk was bought by the laboratory.

In this a nontechnical report, we will tell of those factors considered most important for the tape user. It is our opinion that output consistency is the single most important factor governing the choice of any recording tape. Output consistency means that the tape must produce the same quality of sound as it is played back, month after month, year after year.

If the manufacturer has complete control of his tape production processes, then serious variation should not occur. If there are variations in the thickness of the oxide, its composition, or its method of application to the plastic base, then there will be a variation in the performance of the tape. If the user gets too little signal in playback or too much, either is a serious tape fault.

IT IS SELDOM possible for the tape user to judge the quality of the tape he uses because faults and inconsistencies identical to tape failures may be caused by poorly adjusted or maintained tape recorders. Virtually any brand of tape will provide adequate results from the majority of nonprofessional recorders now on the market. However, if you want professional results, then reel-to-reel, batch-to-batch output consistency is important.

In the tests, we found some remarkable variations in marketed tapes for consumer use. Among those faults found most often are these:

- *Nonuniformity of oxide coating*, causing signal-level variations or "dropouts" in which little or no signal was recorded.

- *Pits or pocket voids*, where air bubbles or dirt have caused very small pits in the oxide coating. In some cases the ring magnetization of the rim of these pits or holes will cause playback signal variation.

- *Nonuniformity of plastic base surface*, in which, if the plastic base has microscopic hills or valleys in its surface, the oxide coating, though perfectly smooth at the playing surface will vary in depth along the tape. This can cause that noise-behind-the-signal, perplexing to professional recording engineers as well as amateurs.

- *Uneven slitting*, in which the magnetic tape is processed and coated in wide rolls and must be slit to whatever marketable width is desired. Large roller knives must be employed in the slitting process. If these knives get dull or exhibit any heat change one to another, the tension of one slit edge of the tape varies from that of its other edge. This change of edge tension over the length of a reel of tape will cause erratic travel of the tape over the recording and playback heads.

- *Poor oxide adhesion to the plastic base*. While this fault is becoming more and more rare, it is still a factor to consider when buying "bargain" or used bulk tape. The drawbacks to good recordings are evident in the clogging effect of the loosened oxide powder.

After the tests, we chose Audio Tape Type 51, made by Audio Devices, which through two years of tests and use, proved to be the most consistent of all the major tapes.

audiotape

TRADE MARK

WINS INDEPENDENT TAPE TEST BY LEADING HI-FI AUTHORITY

... as reported in



magazine

The tape test described by Mr. Jordan emphasizes two very important facts. (1) Different brands of recording tape vary widely in output uniformity. (2) Of all the leading brands tested, standard plastic-base Audiotape rated highest in consistent, uniform quality.

This outstanding Audiotape performance is the calculated result of extra care and precision in every step of the manufacturing process, from selection of raw materials to final coating, slitting and packaging. And this same uniformity extends throughout the entire Audiotape line.

Now there are 5 DIFFERENT TYPES of Audiotape, with base material and thickness to meet the exact requirements for every recording application. But whatever type you select, there's only one Audiotape quality—the very finest that can be produced. Ask your dealer for our new Bulletin No. 250, describing the newly-expanded Audiotape line. Or write to Audio Devices, Inc., 444 Madison Ave., New York 22, N. Y.

AUDIO DEVICES, Inc.

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

In Hollywood: 1006 N. Fairfax Ave. • In Chicago: 6571 N. Olmsted Ave. • Export Dept: 13 East 40th St., New York 16, N. Y., Cables "ARLAB"

Styroflex Coaxial Cable

Goes to Sea With the U. S. Navy!

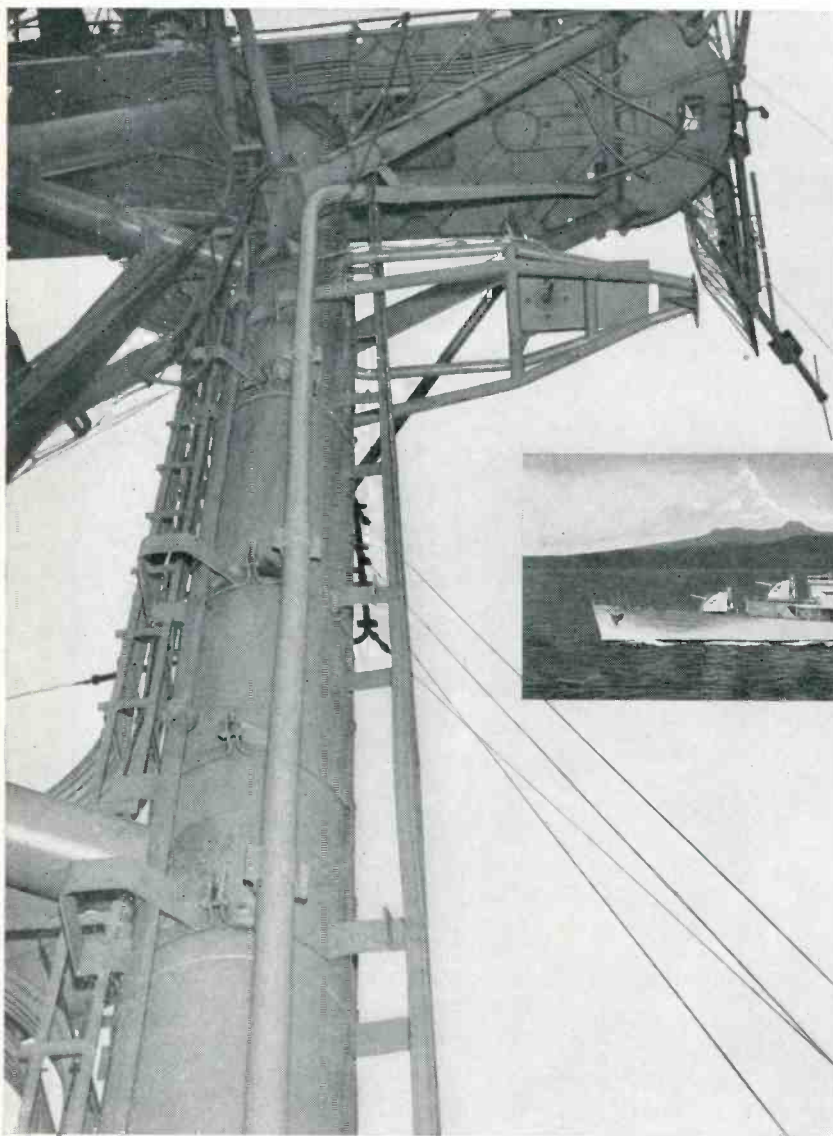


PHOTO COURTESY OF U. S. NAVY

Perhaps Styroflex can answer your particular transmission problem, too. Inquiries are invited by our engineering staff. See us in Booth 406 at the WESCON Show

During the overhauling of the U. S. S. Hank, the Navy Department installed 3 1/8" 50 ohm Styroflex coaxial cable as the transmission line in the ship's SRA air search radar system.

Since this installation, results show that positive identification of air targets has been made at *twice the distance* possible before Styroflex was put into service on the ship.

Other Styroflex qualities which helped determine its selection by the Navy include its ease of installation, resistance to shock from gunfire and stable electrical characteristics.



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CORPORATION**

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High Pressure Salesman

If you measure "pressure" by the amount of force brought to bear on a specific object, this man is truly a "high pressure" salesman. The problem he is considering is a typical one: how to modify the performance of an electronic component manufactured by a company he represents to meet the special requirements of a customer. Ordinary salesmanship cannot solve this problem. It calls for the combination of engineering thinking and sales-sense that has permitted electronic manufacturers representatives to make significant contributions to the entire electronic industry.

This man is thinking how he can render a service to both his principal and his customer. His credo is: the most important line carried by any manufacturers representative is his own reputation.

Kittleson Company, Electronic Manufacturers Representatives

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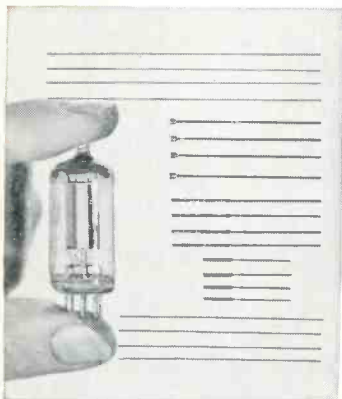
Denver, Suite 7, 1460 Pennsylvania Street, ALpine 5-2777



G-E QUALITY IN RADIO AND ELECTRONIC COMPONENTS—AT A PRICE YOU WANT TO PAY!

THE Lamp Leads and Bases Department of General Electric is one of the true pioneers in the electronics industry. We were solving design and production problems at a time when only a handful of companies recognized its potential. Today we

stand ready to furnish you with the highest quality radio and electronic components you can buy—as we continue to develop new processes and better materials to insure the best products at the lowest possible price.



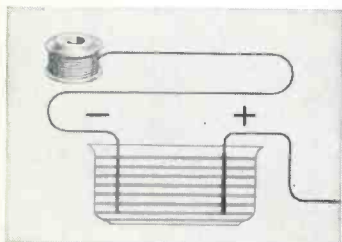
Leads

General Electric is the largest manufacturer of all types of lead-in wires for electronic devices, radio tubes and other applications.



Dumet

To successfully seal lead wire to soft glass, the expansion coefficients must be reasonably close. Dumet, a General Electric development, meets this requirement. It is made of copper tubing, and iron-nickel core rod—and is used for sealing to lead or lime glass.



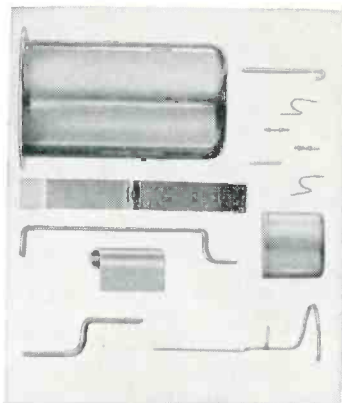
Plated Wire

General Electric produces Nickel Plated Iron Wire and Nickel Plated Copper Wire from low carbon (Armco or Low Basic) iron wire and oxygen-free high conductivity copper wire—in a variety of diameters and plate thickness.

RANGE OF SIZES

Symbol	Base Material	% of Plate	Diameter Range
Cu (NP)	Copper	*	10—50
Fe (NP6)A	Armco	2—8	20—70
Fe (NP6)B	Low Basic	2—8	20—70

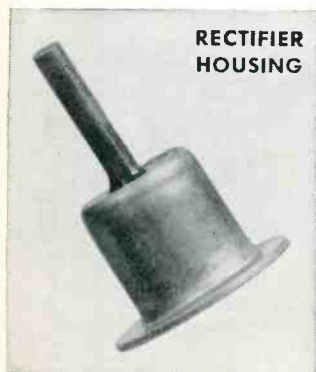
*Plate thickness for all sizes of (CuNP) wire approximates .0001"



Metal Parts

Our development laboratory and fabricating facilities are offered to electronic manufacturers to design, test and produce parts from many types of metals to meet your requirements.

TWO NEW G-E PRODUCTS NOW AVAILABLE!



RECTIFIER HOUSING



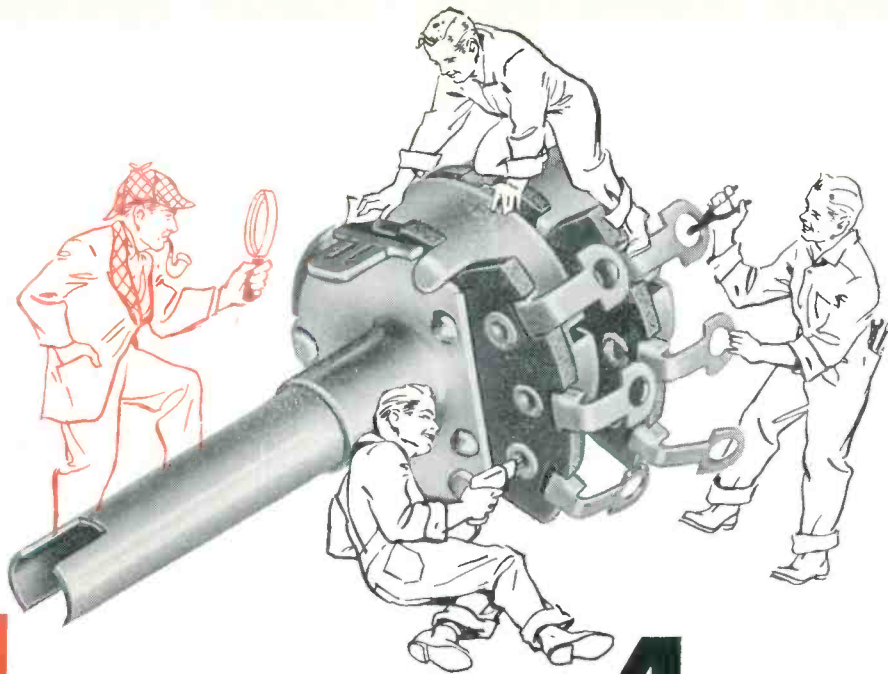
TRANSISTOR HEADER UNIT

BOTH THESE FINE NEW PRODUCTS are offered with full assurance that quality craftsmanship and precision assembly are used throughout. Both are made to G-E's strict quality standards—and you get all the price benefits of high volume production.

TO GET THE FULL STORY on all our radio, television and electronic components, write: General Electric Company, Lamp Leads and Bases Department, Nela Park, Cleveland 12, Ohio.

Progress Is Our Most Important Product

GENERAL  ELECTRIC



1 OUT OF EVERY 4 WORKERS ON STACKPOLE CONTROLS IS AN Inspector!



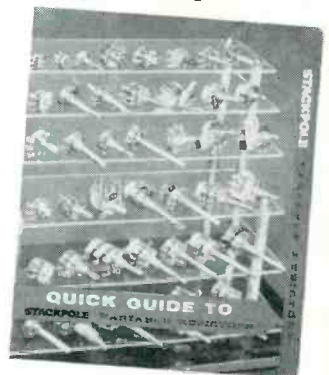
Few components call for greater manufacturing care and precision than variable resistors.

That is why approximately every fourth worker on Stackpole tone and volume controls is an inspector.

This, in turn, is why leading users report that Stackpole Controls not only minimize their incoming inspection problems but reduce subsequent field service as well. Full quality control from raw materials through every step of manufacture, is a feature of *all* Stackpole electronic components.

A COMPLETE SELECTION OF VARIABLE RESISTOR TYPES

write for your copy of this latest QUICK GUIDE to Stackpole variable composition types and adaptations. Provides essential data in handy condensed form for wall, desk or file use.

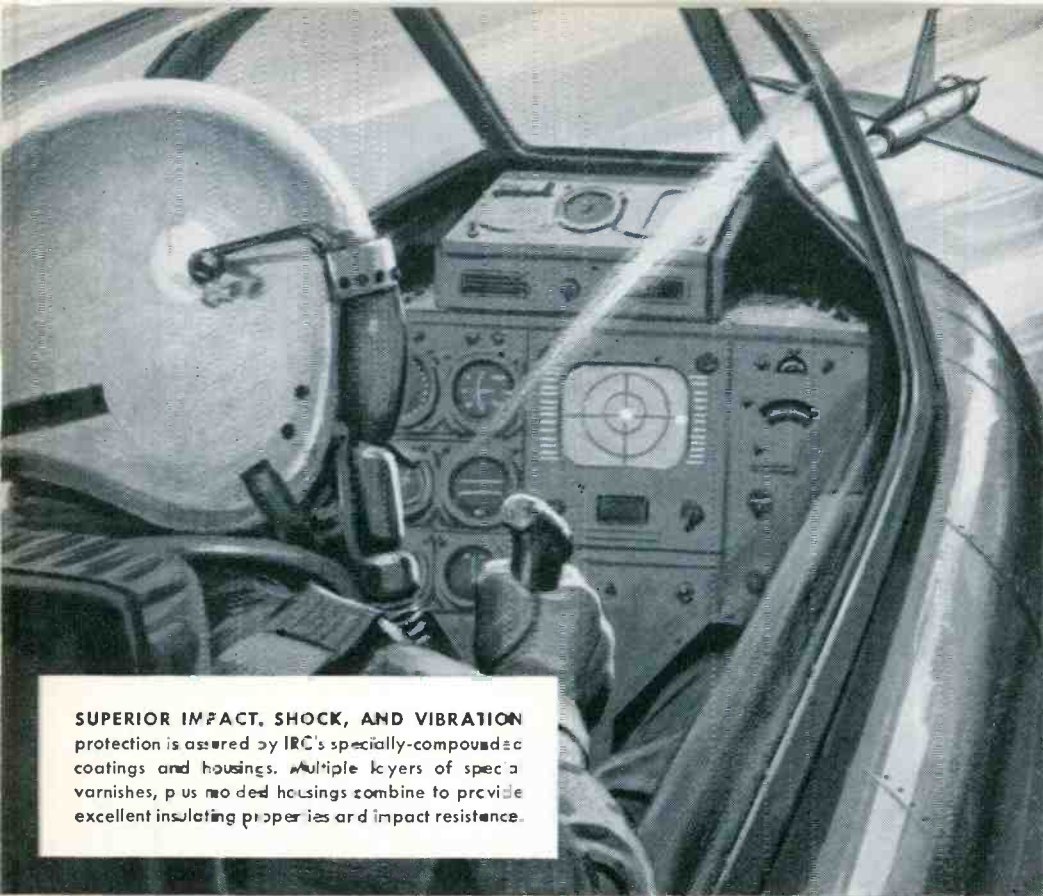


Electronic Components Division
STACKPOLE CARBON COMPANY
 St. Marys, Pa.



STACKPOLE

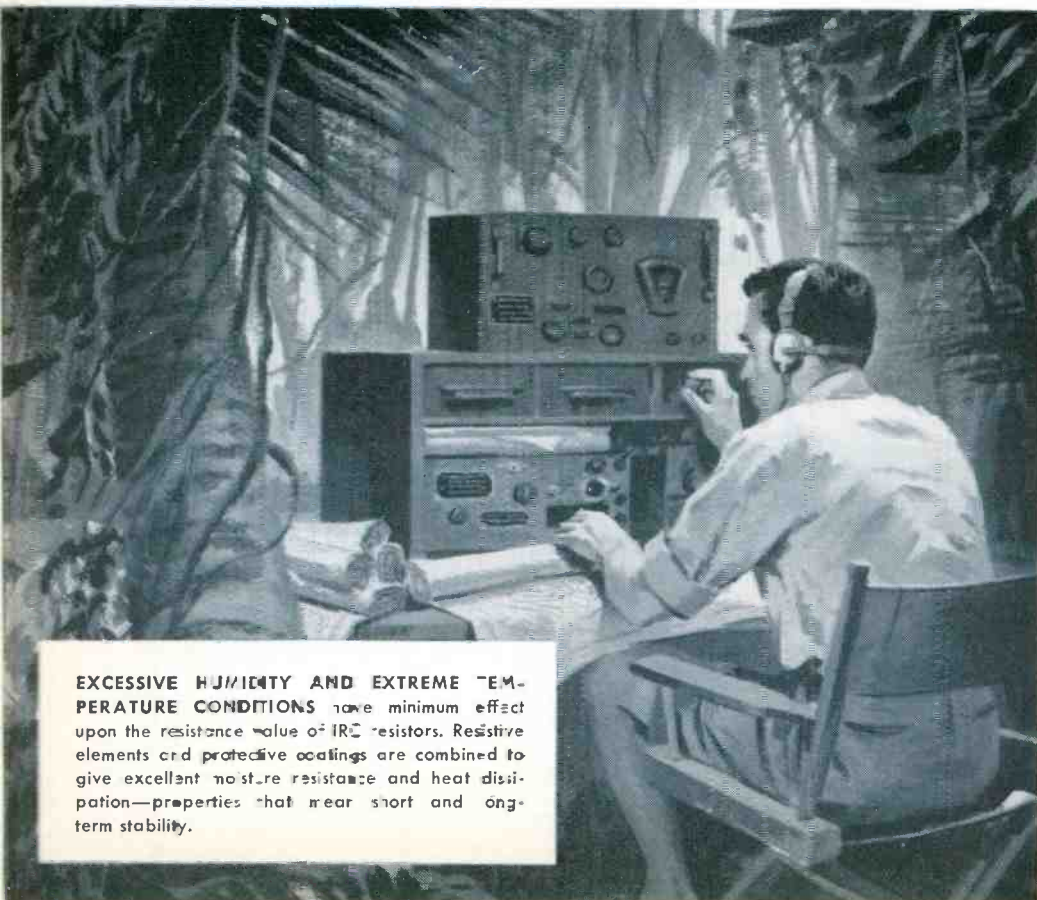
FIXED AND VARIABLE COMPOSITION RESISTORS • MOLDED IRON CORES • CERAMAG®
 FERROMAGNETIC CORES • MOLDED COIL FORMS • LOW VALUE GA CAPACITORS
 LINE SWITCHES • SLIDE SWITCHES • CERAMAGNET® CERAMIC PERMANENT MAGNETS



SUPERIOR IMPACT, SHOCK, AND VIBRATION protection is assured by IRC's specially-compounded coatings and housings. Multiple layers of special varnishes, plus molded housings combine to provide excellent insulating properties and impact resistance.

In a sense, a resistor is simply a mechanical device for packaging ohms. So it's easy to see why the materials entering into the mechanical package are extremely important to resistor performance. That's why more than one-third of the 200 technicians at IRC are occupied in developing insulating coatings and housings that give *extra* protection

Extra **IRC**[®] resistor protection pays off ...but you pay no more for it!



EXCESSIVE HUMIDITY AND EXTREME TEMPERATURE CONDITIONS have minimum effect upon the resistance value of IRC resistors. Resistive elements and protective coatings are combined to give excellent moisture resistance and heat dissipation—properties that mean short and long-term stability.

against mechanical damage, humidity effects, and temperature variations.

Out of this never-ending activity come coatings and molding compounds that are custom-tailored for each and every type of resistor. As a result, every IRC resistor gives far more protection from damage and ambient conditions than any other of its type!

SEE NEW IRC COMPONENTS
AT WESCON
BOOTH 1023

How **IRC** resistors give added protection

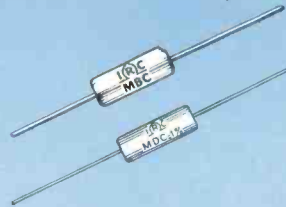
molded resistors



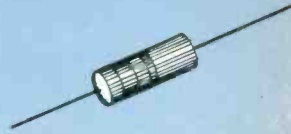
TYPE BT Fixed
Composition Resistors



TYPE PW TYPE BW
Insulated Wire
Wound Resistors



TYPE MB TYPE MD
Molded Deposited and
Boron Carbon Resistors



TYPE CL
Insulated
Wire Wound Chokes

Plastic compounds used in IRC molded resistors are all specified by IRC to combine excellent insulating properties, moisture resistance, and impact resistance.

varnish coated resistors



TYPE DC TYPE BO
Deposited and Boron
Carbon Resistors



TYPE MV High
Voltage Resistors



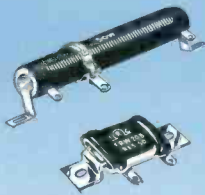
TYPE MP High
Frequency Resistors



TYPE HFR High
Frequency Resistors

Where mechanical damage isn't a major problem, IRC resistors give excellent protection at lower cost through the use of IRC-developed varnish coatings. Because several layers are applied and cured under specially controlled conditions, these resistors offer superior humidity and temperature characteristics.

cement insulated resistors



TYPE PWW TYPE FRW
Power Wire
Wound Resistors



TYPES PW-5, 7 and 10
Small Insulated
Power Resistors

The special cement coatings used to insulate IRC power resistors give excellent mechanical protection. Type PWW Resistors, for example, withstand a transverse pressure of 25 pounds. These exclusive IRC cements also permit maximum heat dissipation and give superior moisture protection.

impregnated and encapsulated resistors



TYPE WWJ Precision
Wire Wound Resistors



SERIES "PH"
Encapsulated Precision
Wire Wound Resistors

Type WWJ Resistors feature a special compound that thoroughly impregnates the winding and remains stable at varying temperatures. This compound not only gives maximum mechanical protection, but also serves as an insulating barrier and minimizes moisture effects. In IRC encapsulated resistors, the same epoxy resin is used for both the core and the outer housing, thus minimizing the effects of expansion and contraction due to various temperature conditions. This epoxy resin also imparts excellent insulating and moisture-resistant properties to the housing.

Insulated Composition Resistors • Deposited and Boron Carbon Resistors • Power Resistors • Voltmeter Multipliers • Ultra HF and Hi-Voltage Resistors.

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Low Wattage Wire Wounds • Resistance Strips and Discs • Selenium Rectifiers and Diodes • Hermetic Sealing Terminals • Insulated Chokes • Precision Wire Wounds.



HYCOR, Division of International Resistance Co., Sylmar, Los Angeles County, California

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Hycor Company, Inc., Vega Baja, Puerto Rico

INTERNATIONAL RESISTANCE COMPANY

Dept. 234, 401 N. Broad St., Philadelphia 8, Pa.

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

Please send technical bulletins describing Fixed Compositions Deposited and Boron Carbons Low Power Wire Wounds Power Wire Wounds High Voltage Types High Frequency Types Insulated Chokes Precision Wire Wounds Encapsulated Precisions

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Company _____

Address _____

City _____ State _____

CAN *Ampli*FILM DO THIS?

Many times we have been asked if Ampli-Film Dielectric can be curved. We had anticipated applications in which Ampli-Film would be made in shapes other than flat . . .

Yes, *Ampli*FILM can be formed in unusual shapes

The size and shape of some electronic gear require that components be manufactured in unusual shapes. Dielectrics must, in turn, be formed to fit. Ampli-Film meets the requirement. The curved Capitron® Wafer Capacitor pictured is an example. A truly remarkable versatility in a dielectric.



*Ampli*FILM the all-purpose dielectric, is insoluble, incompressible and inert . . . undergoes no distortion from heat or pressure . . . can be bonded by adhesives . . . is free from pinholes and flaws . . . is easy to handle and fabricate.

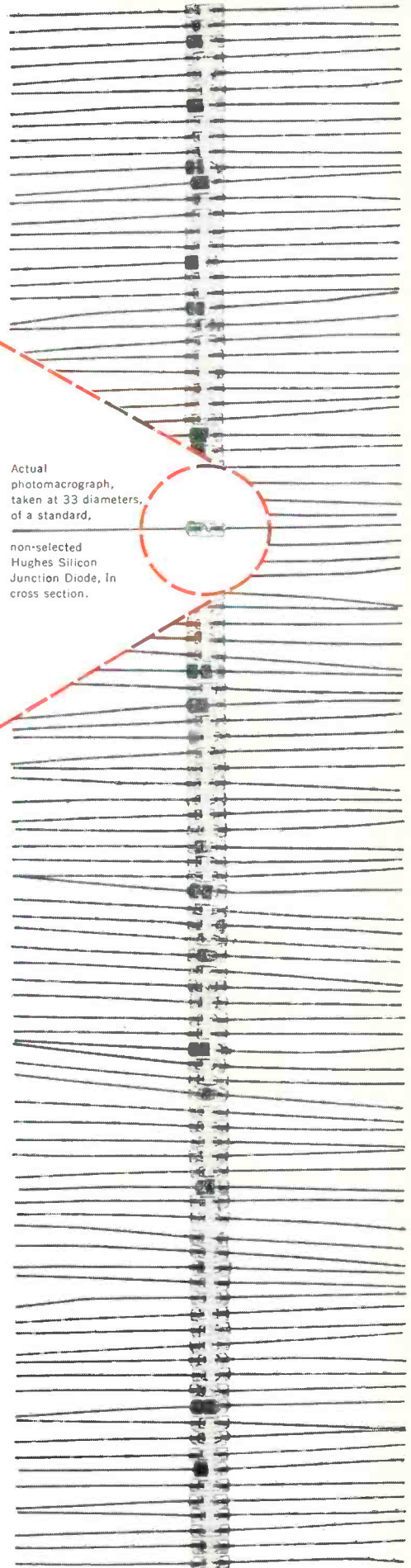
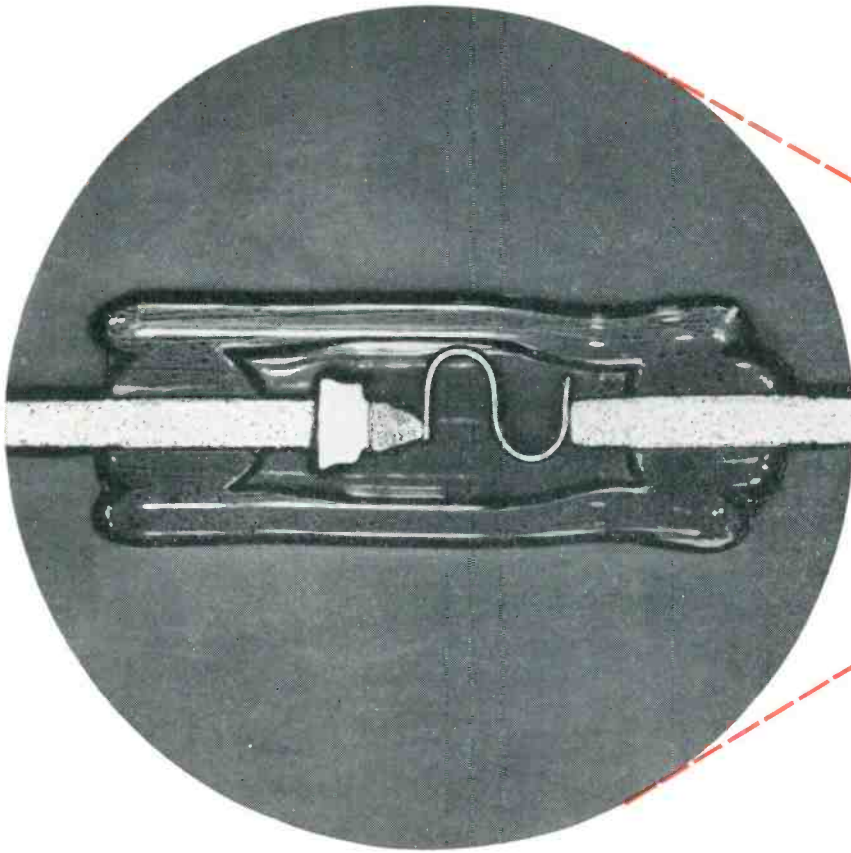


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Chemicals and Dielectrics Division 155 Park Street, Elizabethtown, Pa.



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

**INSIDE, WHERE IT COUNTS,
HUGHES DIODES LOOK LIKE THIS**



Actual photomicrograph, taken at 33 diameters, of a standard,

non-selected Hughes Silicon Junction Diode, in cross section.

With a microscope, you can see many of the physical qualities which distinguish a *Hughes* diode from ordinary types:

- The positive spring contact between the whisker and the aluminum button fused to the silicon crystal. (Our use of a spring contact prevents damage to the crystal at the junction, even if the diode is exposed to extreme shock.)
- The silicon crystal, free from cracks or blemishes.
- The clean, sharp, straight rectifying junction.

Such meticulous physical construction is a vital factor in ensuring the excellence of Hughes diodes' electrical characteristics (which you *can't* see through a microscope!). All characteristics—physical and electrical—are protected by a series of thorough, rigorous tests. So, specify Hughes, and make sure that you are using the diodes made First Of All . . . For Reliability!

HUGHES PRODUCTS

A DIVISION OF THE HUGHES AIRCRAFT COMPANY

For descriptive literature please write: HUGHES PRODUCTS

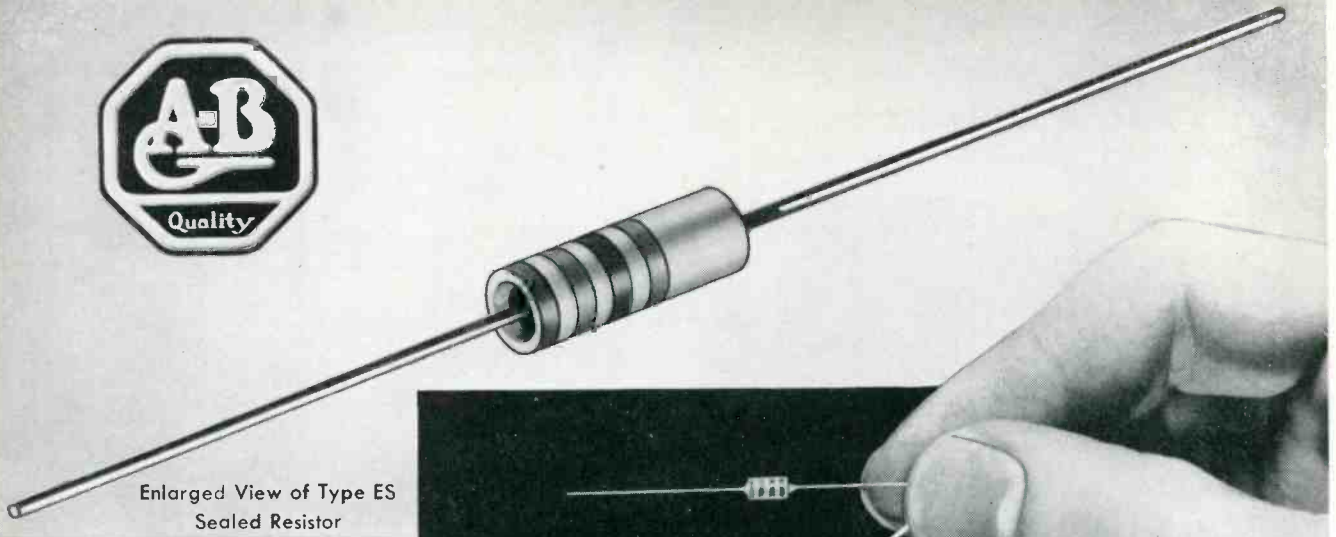
SEMICONDUCTORS
International Airport Station
Los Angeles 45, California

HUGHES



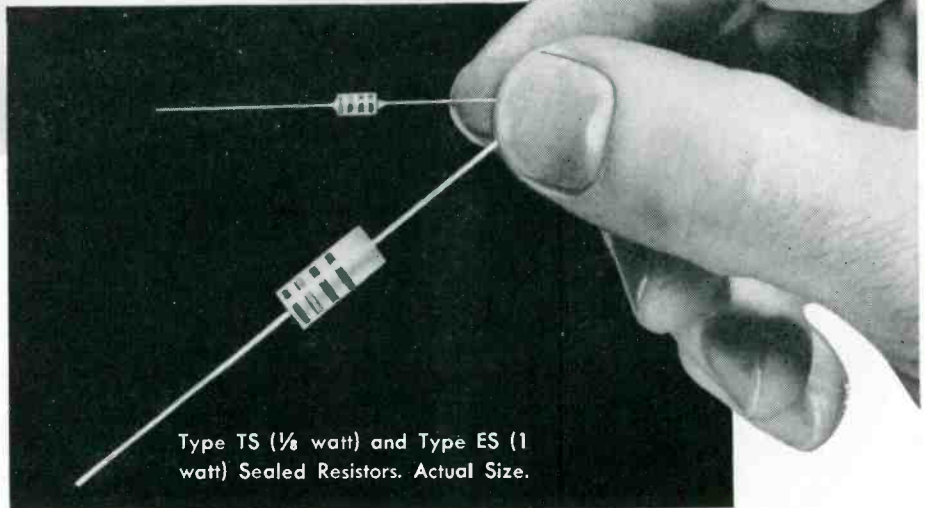
SEMICONDUCTORS

© 1956, H. A. C.



Enlarged View of Type ES Sealed Resistor

It cannot be true — But,



Type TS (1/8 watt) and Type ES (1 watt) Sealed Resistors. Actual Size.

Here is what the new A-B hermetically sealed composition resistors will do!

Unaffected by humidity or moisture

Humidity and moisture have been nuisance factors to all composition resistors. The type of hermetic sealing built into the new A-B Type TS and Type ES resistors entirely eliminates this possible objection.

Higher temperature rating

Special techniques have made it practical to increase the operating temperature beyond the rating heretofore considered "safe" with composition resistors.

(Type TS: .125 Watt... 70°C, 0-derating at 110°C)
(Type ES: 1 Watt... 70°C, .5 Watt... 120°C, 0-derating at 165°C)

2% and 5% tolerances

The amazing stability incorporated in Allen-Bradley composition resistors has made a 2% tolerance a realistic and usable circuit design possibility.

Extremely low noise level

All microphonic noise, occasionally encountered in composition resistors due to shock and vibration, has been eliminated.

From 10 ohms to 500,000 megohms

Although normally supplied in the standard ranges from 10 ohms to 22 megohms, these resistors are also available for special applications in extremely high resistance values, the

limits being determined largely by the capability of the measuring equipment.

Catastrophic failure impossible

For the first time a resistor is now available having characteristics approaching wire-wound "precision," plus the established reliability of the A-B hot-molded composition units, assuring complete freedom from catastrophic failure.

Designed for manhandling

The hot-molded Allen-Bradley composition resistor in its ceramic enclosure and high temperature end seals results in an unusually rugged construction, possessing uniformity of size and configuration, making these resistors ideal for mechanical handling.

Allen-Bradley quality and uniformity

Experience gained from the production of hundreds of millions of hot-molded resistors, combined with typical Allen-Bradley quality control, has produced a resistor unique in performance and especially adaptable for the always increasing critical applications of military and computer circuitry. You will want to become better acquainted with this new development in resistors! Representative values can be furnished for test.



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

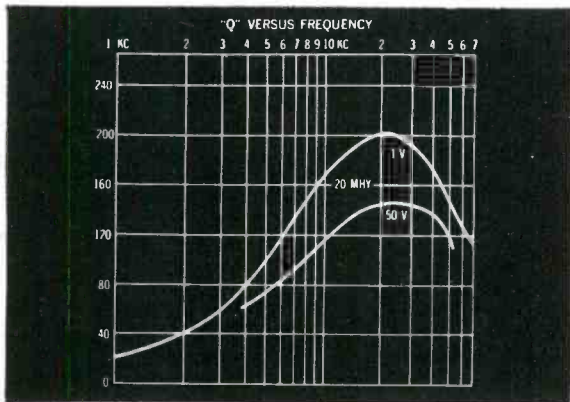
Please send me technical data on the A-B hermetically sealed resistors.

Name _____

Address _____

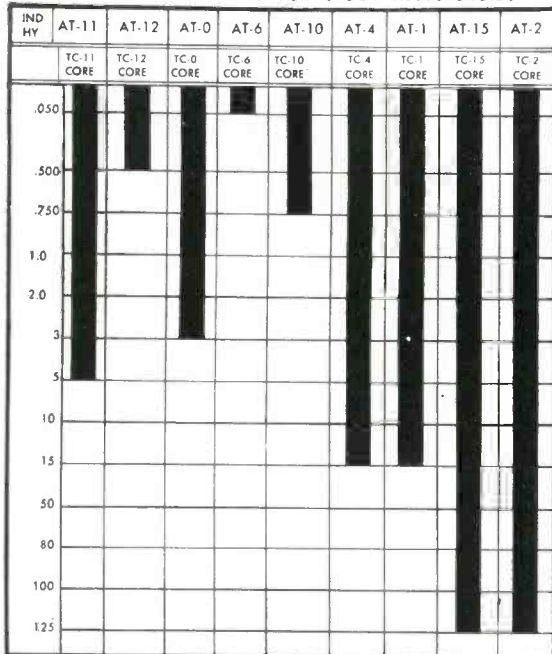
City _____ State _____

variable "L" by BURNELL



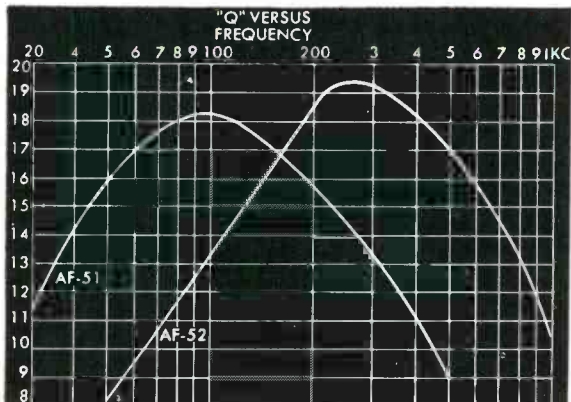
Typical Q vs. frequency characteristics of AT-10.

RANGE OF INDUCTANCES FOR STOCK ADJUSTORIODS



For nominal D. C. R. values refer to Burnell catalog No. 103.

COMPLETE TECHNICAL INFORMATION UPON REQUEST.
© copyrighted, patent applied for.



Typical Q vs. frequency characteristics of Variable Inductors.

ADJUSTORIODS

The Adjustoroid, a low cost adjustable toroid, exclusively developed by Burnell & Company, Inc., contains an actual complete toroid which relays all the excellent characteristics of the non-adjustable types. Adjustment is obtained by a completely stepless function with magnetic biasing.

The nominal inductance value for an Adjustoroid is the maximum value, and the inductance range is the nominal value minus approximately 10%.

Hermetically sealed to meet Government MIL specifications. Many types of networks in tuned circuits are being produced which employ the Adjustoroid in completely hermetically sealed packages.

Intermediate inductance values as well as special taps and extra windings available on special order with minimum delay.

For additional technical data on Adjustoroids, refer to equivalent toroid in catalog.



AT-0, AT-6, AT-10, AT-4



AT-1, AT-2, AT-11, AT-12

ADJUSTOROID & VARIABLE INDUCTOR DIMENSION CHART

	LENGTH/DIA	WIDTH	HEIGHT
AT-0, AT-6	1-1/16"		1"
AT-10, AT-4	1-19/64"		1-1/4"
AT-15	1-31/32"		1-7/8"
AT-11, AT-12	45/64"	45/64"	3/4"
AT-1	1-3/4"	1-3/4"	1-1/4"
AT-2	2-3/4"	2-3/4"	2-1/4"
AF-51, AF-52	1-19/64"		2"

You are cordially invited to inspect these and other Burnell products at Booth 1308 at the Wescon Show, and to discuss your network problems with us.

and now ...

VARIABLE INDUCTORS

AF-51 AF-52

(30-500 cycles)

Maximum Q at 100 cycles

(50-1000 cycles)

Maximum Q at 250 cycles

Burnell Variable Inductors have the similar characteristics to the Adjustoroid except they are especially designed for low frequency applications or for conditions where high inductance values are required. Variable Inductors are available in all inductance values up to 1000 Hys. With variation of -10% from nominal.

BURNELL & CO., INC.

YONKERS 2, NEW YORK Teletype: Yonkers, N. Y. 3633

Pacific Division: 720 Mission St., S. Pasadena, Calif.



BOOKS



Transistors Handbook

By William D. Bevitt. Published 1956 by Prentice-Hall, Inc., 70 Fifth Ave., New York 11. 410 pages, price \$9.00.

This book sums up, in a practical manner, the most recent information on transistors, their circuits, and their applications in modern industry. The beginning chapters deal with fundamental concepts, and present the characteristics, measurements, circuit properties, and behavior of the different types of transistors. The last half of the book deals with circuits and applications, along with methods for circuit analysis.

Typical values of circuit elements are given wherever possible to exemplify good practice in circuit design. Included among the circuits covered are transistor radio and television receivers, as well as such items as relaxation oscillators, a-f and r-f amplifiers, modulators and demodulators, and many others. The appendix gives standard definitions of semiconductor terms and essential characteristics of the latest transistors.

Mr. Bevitt, himself a transistor application engineer, has done a capable job of presenting transistor information for design and development engineers in a most useful form. The presentation is clear and logical, and the complete index aids in locating desired information with a minimum of delay.

Handbook, Preferred Circuits Navy Aeronautical Equipment NAVAER 16-1-519

By J. H. Muncy. Published 1955 by Government Printing Office, Washington 25. 204 pages, loose-leaf bound. Price \$1.75.

The main purpose of this handbook is to encourage reduction of unnecessary circuit variations in military equipment. If standardization of electronic circuits, even in part, is realized, substantial economies will be achieved by both the manufacturer and the military services.

Made available by the National Bureau of Standards and the Navy Bureau of Aeronautics, the book consists of two parts: the Preferred Circuits Manual, and Notes to the Preferred Circuits Manual. The manual presents 32 circuits, complete with schematics, characteristics, and other information. The preferred circuits were derived after experimental measurements had been made on a large number of examples taken from both commercial and military equipment. The Notes, explaining the steps which led to the selection and design of each

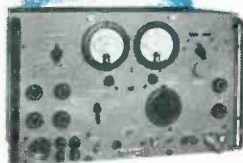
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Prescription
for
Precision...

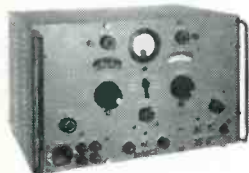
ARC Test Equipment



Type H-14A
Signal Generator



Type H-16
Standard Course Checker



Type H-12
UHF Signal Generator

Radio technicians and pilots trust ARC test equipment to keep airborne instruments in tune for precision navigation and communication.

The **Type H-14A Signal Generator** has two uses: (1) It provides a sure and simple means to check omnirange and localizer receivers in aircraft on the field, by sending out a continuous test identifying signal on hangar antenna. Tuned to this signal, individual pilots or whole squadrons can test their own equipment. The instrument permits voice transmission simultaneously with radio signal. (2) It is widely used for making quantitative measurements on the bench during receiver equipment maintenance.

The **H-16 Standard Course Checker** measures the accuracy of the indicated omni course in ARC's H-14A or other omni signal generator to better than $\frac{1}{2}$ degree. It has a built-in method of checking its own precision.

Type H-12 Signal Generator (900-2100 mc) is equal to military TS-419/U, and provides a reliable source of CW or pulsed rf. Internal circuits provide control of width, rate and delay of internally-generated pulses. Complete specifications on request.

Dependable Airborne Electronic Equipment Since 1928

Aircraft Radio Corporation

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Omni/ILS Receivers • Course Directors • UHF and VHF Receivers and Transmitters • LF Receivers and Loop Direction Finders • 10-Channel Isolation Amplifiers • 8-Watt Audio Amplifiers • Interphone Amplifiers • Omirange Signal Generators and Standard Course Checkers • 900-2100 Mc Signal Generators





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Sel-Rex BRIGHT RHODIUM meets the need of today's precise engineering applications with A.S.C. — Automatic Stress Compensation — a special technique which counteracts the high stress characteristics of conventional precious metal electroplates. Non-dusting Sel-Rex Silver SOL-U-SALT is added directly to the plating bath, eliminating time consuming filtering or mixing—a cost cutting advantage exclusive with Sel-Rex.

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Sprague on request will provide you with complete application engineering service for optimum results in the use of electrolytic capacitors.



Sprague

LITTL-LYTICS*

for

transistor circuitry

HERE ARE THE SMALLEST *aluminum electrolytic capacitors ever made to Sprague's rigid quality standards.* Add to that their low leakage current, high reliability, and moderate price, and you have a new series of *miniature* electrolytic capacitors ideal for use in transistorized pocket radio receivers, wireless microphones, personal-style wire recorders, and similar equipment.

Their ultra-low leakage current is particularly important for it means minimum drain and long battery life when used in filtering applications across a battery, and excellent circuit performance when used in coupling applications.

Sprague Littl-Lytics are available in a full range of capacitance ratings from 1 to 110 mf, and in standard working d-c voltages of 1, 3, 6, 10, 12, and 15. Sizes range from $\frac{3}{16}$ "D x $\frac{1}{2}$ "L to $\frac{3}{8}$ "D x $\frac{3}{4}$ "L. Maximum operating temperature of the new Type 30D capacitors is 65°C.

Performance and size data on metal encased, hermetically sealed Littl-Lytics, in more ratings than ever before, are all provided in NEW Engineering Bulletin 320A, available on letterhead request to the Technical Literature Section, Sprague Electric Company, 233 Marshall Street, North Adams, Massachusetts.

typical ratings

Cat. No.	30D6	30D16	
WVDC	6	6	
μ F	3	60	
Leakage Current (μ A Max.)	2.0	3.0	
Can Size	D"	$\frac{3}{16}$	$\frac{3}{8}$
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TELE-TECH & ELECTRONIC INDUSTRIES

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

Transistors and Low-Fidelity Portables

The transistor, which in the years to come is destined to be the heart of nearly all radio, might be getting an undeserved "black-eye" in today's portable radio receivers. Sort of a "guilt by association" condition—because neither the audio volume nor quality is as good on the average as in the vacuum-tube portables. This is the recent finding of the radio testing laboratories of consumer research organizations.

After testing a number of well known makes of transistorized portable receivers, the consumer research laboratories have published reports that, in the majority of sets, the maximum output without intolerable distortion is only about 0.06 watts. Background hiss and noise also cause difficulties. These latter factors are directly chargeable to the transistor, but the audio reproduction limitation is mostly chargeable to the small loudspeakers employed. Transistorized portables can be considered as falling into two groups:

1. MEDIUM-LARGE, weighing over two pounds with speakers of more than three inches in diameter. (Even those in the medium-large group were not equal in fidelity to the average tube equipped portable—not a very high standard.)
2. POCKET-SIZED, weighing under two pounds, equipped with speakers under three inches in diameter.

Such consumer reports can upset public impression of the capabilities of transistorized equipment and even retard future sales. Every effort should be made to improve the deficiencies found in these designs. Further transistor and transistor circuitry developments could improve the hiss and noise problem. However, the invention of a new type of small but efficient sound radiator is sorely needed. Possibly bringing into use some of the newer permanent magnetic materials that can be molded or machined will be of assistance here.

At any rate, while small size and low-energy demands of transistorized portables do interest the public, it is important, too, to realize that performance comparable to vacuum tube design should be the ultimate goal.

Foreign Imports of Radios

The recent newspaper reports describing the spiralling increases in imports of Japanese portable radios for sale in the United States are extremely disturbing.

In 1955, for example, total Japanese exports of radio sets is reported at 212,000 units with a value of \$1,880,000. About 80 per cent of this total were portable receivers sent to the U. S. For 1956, totals of 25,000 sets in January, 24,000 in February, and 40,000 in March are reported. Japanese industrial leaders are aware of these increases and are said to be considering the possible imposition of a voluntary quota to forestall American complaints. On the other hand, reports also indicate that Japanese manufacturers are now competing with quality products in contrast to the low-cost, low-quality goods produced for the American markets prior to World War II. West European imports are also on a high level, and these, of course, add to the competition that an American manufacturer finds at the market place.

We have attempted to confirm the above-mentioned figures through official U. S. sources, but so far have been unsuccessful. Government statistical figures do not reflect the current conditions. Surprisingly, no RETMA member has yet complained, although their International Department is aware of the situation. This is also a time when several of the larger radio-TV manufacturers are going through major financial retrenchments.

Close watch on future imports of foreign products should be kept, lest we find some of our electronic industries going the way of the American watch manufacturers.

RADARSCOPE

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

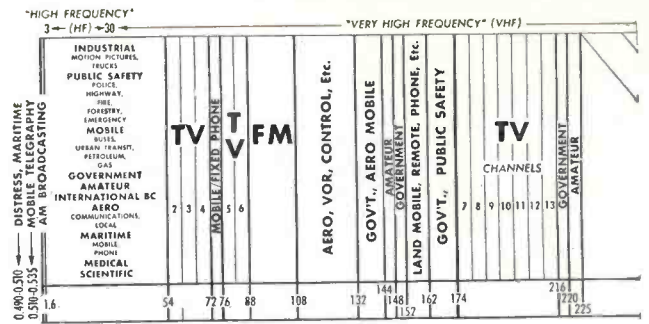
NEW APPROACH to the full utilization of their engineers' abilities goes into force at Sylvania as part of the program for their new Univac Data Processing Center. Full information on their engineers' education, experience, and other pertinent data will be kept on file for emergency situations requiring certain skills. In practice, an immediate need at any one of the 71 Sylvania locations would be flashed to the Processing Center at Camillus, New York, and through the facilities of Univac, the particular Sylvania engineer best qualified to handle the job would immediately be singled out. Company officials are extremely enthusiastic about the added engineering flexibility provided by the service.

FIRST MOVE to establish a new operating council of the West Coast Manufacturers' Association was made recently at a meeting attended by representatives of 12 companies in the San Diego area.

SAGE DISPLAY CONSOLE



Picture of the air defense situation as picked up by SAGE network and analyzed by IBM computer, is flashed on this screen. With buttons and switches at sides, Air Force personnel make tactical decisions which are in turn carried out by the computer.

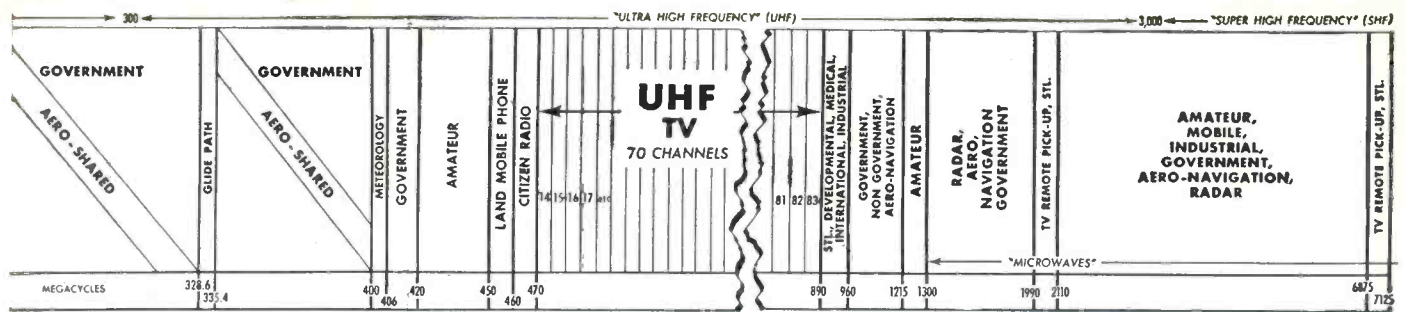


PRICE OF SILICON has been reduced \$30.00 a pound, bringing the price to \$350.00 per pound.

MAJOR BREAKTHROUGH in the field of semi-conductors is in sight as a result of recent investigations at Bell Labs. New intermetallic compounds are now being made which have a wider range of electrical properties than is obtainable with either silicon or germanium, making possible more versatile transistors and other semi-conductor devices. One of the most promising compounds being investigated at the laboratory is indium antimonide.

WOMEN ENGINEERS are getting more and more consideration as a partial answer to the engineer shortage. Dr. Charles J. Jolliffe of RCA recently pointed out that about 20 per cent of all the engineers in Russia are women, compared with less than 1 per cent in the United States. Women, he said, could make a very significant contribution in our life or death struggle for supremacy as laboratory technicians, and as graduate engineers.

INDICATIONS ARE that the long standing barriers to the interchange of technical information between Western and Iron Curtain countries are being removed. Within a few short months after Tele-Tech & ELECTRONIC INDUSTRIES initiated its program of abstracting Russian technical journals, the Russians themselves included in one of their top ranking publications an English language abstract of the editorial content. This would seem to indicate that Russian technical journals are getting increasing dissemination outside the Iron Curtain. A noted German publication has been including for some time both English- and French-language abstracts of their technical articles. And as the latest step in this world wide program the Nation Science Foundation now announces a stepped up program for the translation into English of Russian Research literature. The new journals to be translated will be the Journal of Technical Physics, approximately 4,000 pages per year for which the subscription price will be \$90.00; the Acoustics Journal, approximately 500 pages per year, \$20.00; and proceedings of the USSR Academy of Sciences (physics articles only), approximately 900 pages per year, \$25.00.



RETMA has started a determined drive to collect accurate and timely data on the number of employees in the electronic industry, and their hours and earnings. The lack of information on these items was embarrassing to the RETMA Tax Committee recently in their request for relief from the excise tax, and an emergency survey had to be made within the space of a few days. To avoid a recurrence, and to provide industry in general with timely facts and figures, RETMA's statistical department is now distributing reporting forms which firms are being asked to forward on a regular basis to RETMA.

LABOR MANAGEMENT

FRINGE BENEFITS are increasingly in the news, and are being increasingly misinterpreted. To clear the air, the Bureau of Labor statistics has come up with a list of ten items which are to be considered as fringe benefits. These are as follows:

1. Paid vacations.
2. Holidays and sick leave.
3. Premium pay for overtime.
4. Shift premium.
5. Pension program.
6. Insurance, health and welfare plan.
7. Old age and survivors insurance.
8. Unemployment compensation.
9. Workmen's compensation.
10. State temporary disability insurance.

MILITARY CONTRACTS

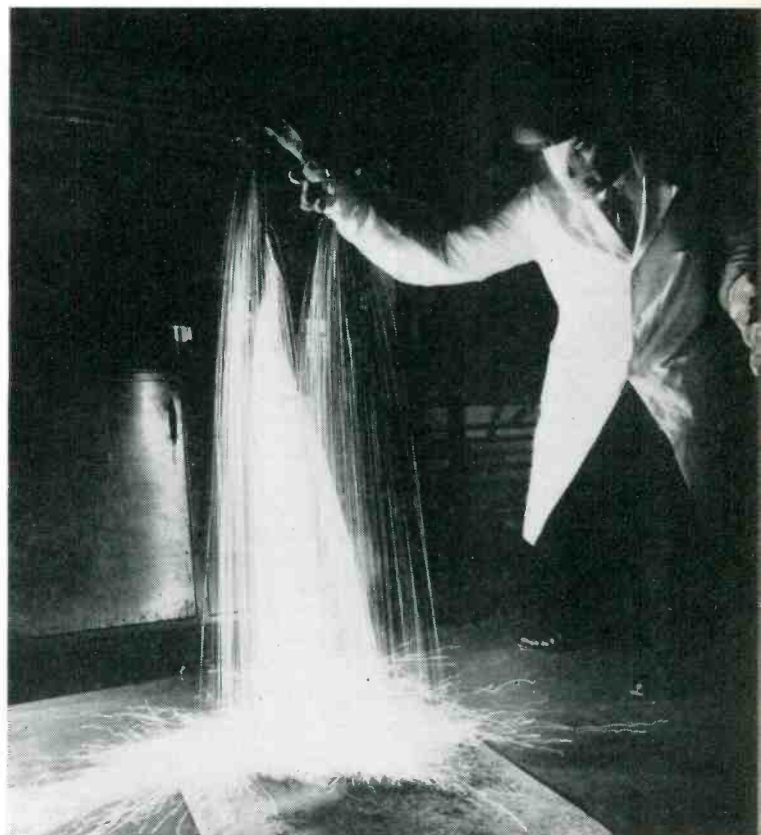
THE DEPARTMENT OF DEFENSE is initiating a new program designed to encourage large military prime contractors to subcontract to small business concerns. Semi-annual reports will now be submitted by large business concerns participating in the program to show DOD funds received by these prime contractors and the payments made by them to small concerns for materials or services furnished in connection with the prime contract. The report will include both sub-assemblies fabricated to the prime contractors specification and "off the shelf" items purchased by the prime contractor for use in the performance of the contract.

Each military department will have the responsi-

bility for initiating the procedure with their own prime contractors. The prime contractors will be under cognizance of the military department which has Armed Services Procurement Planning Responsibility for the contractor. The first reports are to be made in February, 1957, to cover the last half of the calendar year 1956.

Military contract awards to small business concerns in the fiscal year 1955 were \$3,214,000,000. What is not known is the total value of business reaching small concerns through sub-contracts. There are indications that it may amount to \$2,000,000,000. The new reports will furnish information on this important area.

SUPER-MAGNETIC 'WATERFALL'



Highly purified manganese-bismuth powder bursts into a fiery cascade when exposed to air at Westinghouse Research Lab. Magnets made of the new material have more than 10 times the resistance of ordinary magnets to demagnetization.

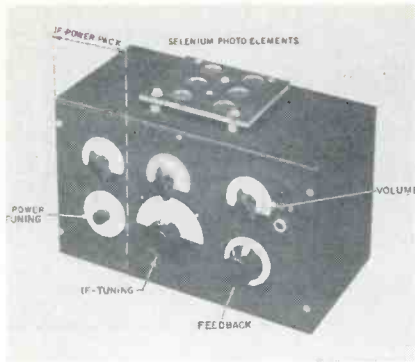


Fig. 2: Lab model of light-powered receiver



Fig. 3: Miniaturized transmitter for 250 kc.

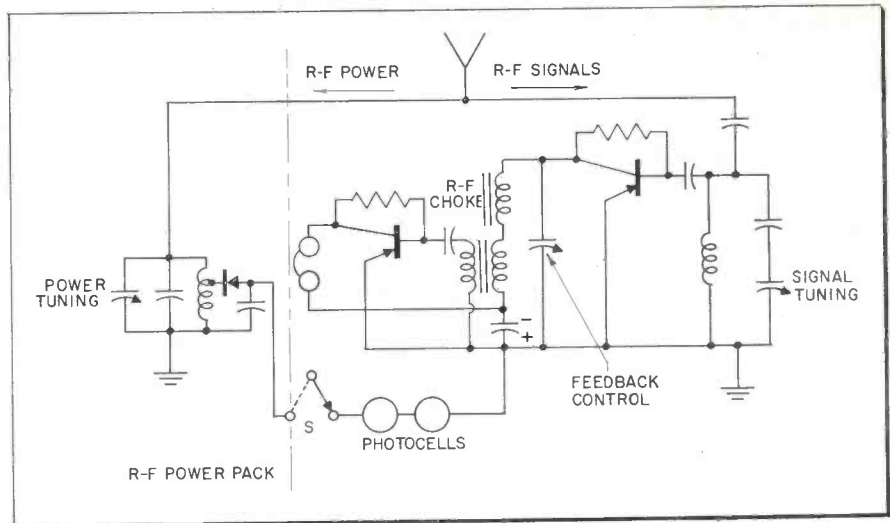


Fig. 1: Schematic of light-powered transistorized regenerative receiver

Designing "Free-Power" Transistor Apparatus

THE first practical applications of the transistor followed fields which until then had been reserved exclusively for the vacuum tube. The competition of both active elements occurs mainly when space, weight, maintenance, and supply energy are limited, as, e.g. in the case of hearing aids which, limited in size and weight, are supposed to guarantee maximum battery efficiency, or as in the case of the giant electronic computers where thousands of tightly packed vacuum tubes require such a large amount of supply power that an extensive and expensive refrigeration system is required to prevent overheating.

In this competition between transistors and vacuum tubes, the transistor art is directed toward the development of improved transistors, with better power handling capacity, frequency response, temperature stability, and the like. On the other hand, it requires a little step to look for applications which, because of their minimum demand for driving energy, have become the sole domain of transistors.

In this direction, one finally arrives at various types of transistor apparatus which require no battery

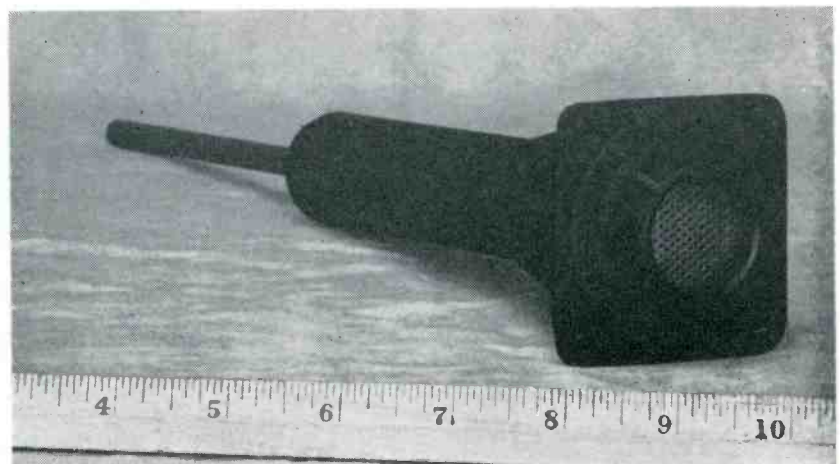
or power supply whatsoever. Naturally, each active element needs some driving energy but this can be derived from natural or artificial energy fields around us and thus is freely available or at least without extra cost. Transistor apparatus fed by free energy, in this meaning of the word, is the topic of this article.

Free Energy

Before turning to the transistor apparatus itself, the term "Free Energy" may be defined somewhat more accurately. As is well known, the sun is the most important source

of energy for our planet. As an average, the sun's radiation energy totals roughly 1 kw for each sq. yd. of the earth's surface. By the use of ordinary photovoltaic cells or photoelements, less than 1% of this energy is converted into electricity. The new "Solar Battery" developed by the Bell Telephone Co. boosts this poor efficiency up to 15% and more. In conjunction with wet cells which are charged via a rectifier to prevent discharging during the night, twilight, and dim daylight, a continuous supply of driving energy is obtained. In this way, a portable radio receiver may be fed by a

Fig. 5A: Voice-powered phone transmitter, requires no power source



H. E. HOLLMANN, Director of Research, Marvelco Electronics Div., National Aircraft Corp., 3411 Tulare Ave., Burbank, Calif.

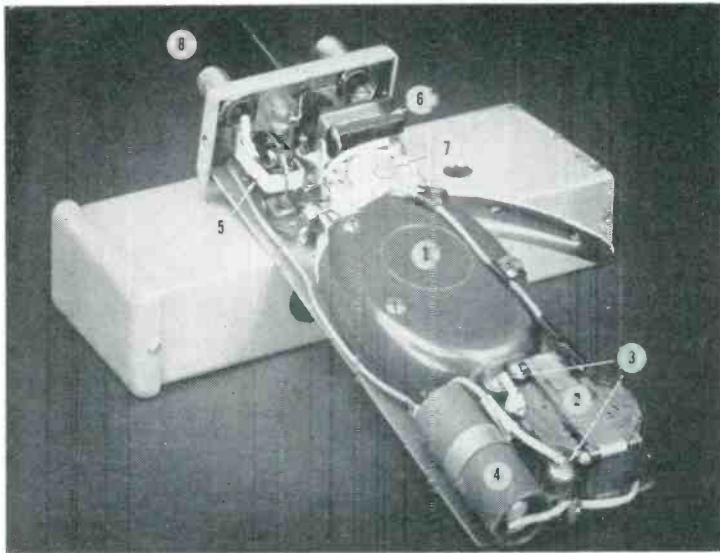


Fig. 4: Hand-powered phone transmitter. Complete unit is at right

Low power requirement of transistors makes possible the design of receivers that utilize the electromagnetic radiation from broadcast stations, or solar energy, as operating voltages. Sound- and hand-powered transmitters are also described.

By H. E. HOLLMANN

multiplicity of silicon cells whereby nothing but the high cost of the solar cells prevents such a receiver from being available on the market.

Another form of energy which surrounds us is sound. Its level, however, is so low that even from the noise of heavy city traffic only a few $\mu\text{w}/\text{cm}^2$ can be recovered from the intercept area of an electro-acoustic transducer. A more favorable condition is encountered if the sound source is approached immediately without the terrific attenuation of propagation through free space. In this respect, a sound-power microphone when addressed rather

loudly is most interesting. Considering the articulation of speech, i.e. the distribution of the low energy consonants and the powerful vowels as well as the intervals between words and sentences, an average energy of approximately $\frac{1}{10}$ mw can be produced by talking directly into the mouthpiece of a sound-power mike.

The human voice is the manifestation of the strength of our body which, therefore, has to be included into the realm of "Free Energy." However, in the era of transistors, it is no longer necessary to crank

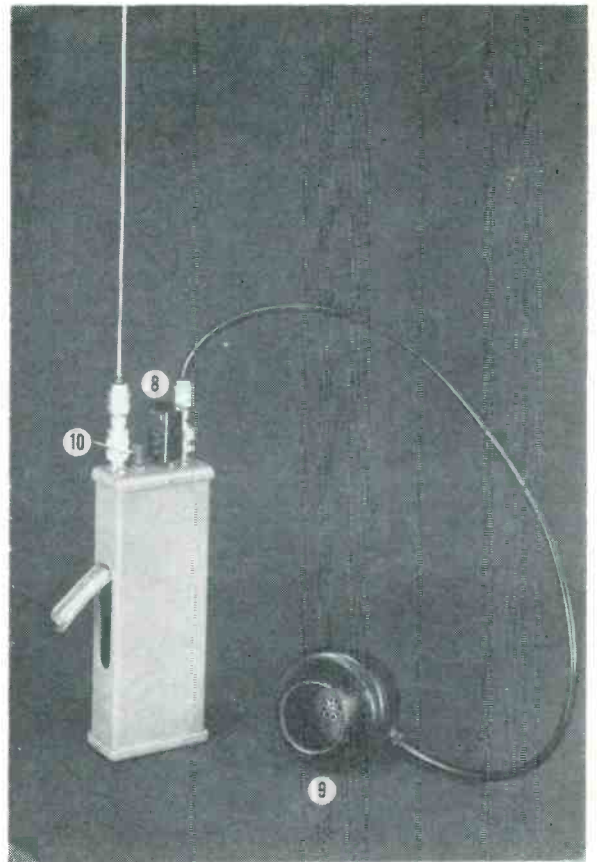
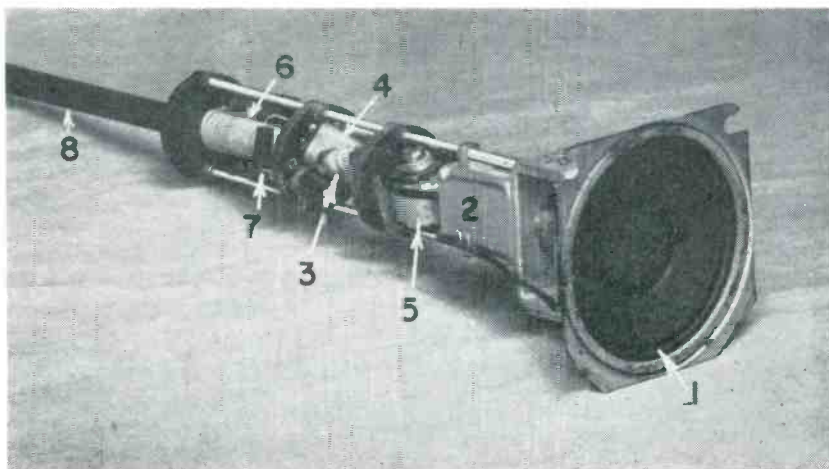


Fig. 5B: Interior of voice-powered unit. PM speaker is driver



the heavy generator of a tube-type transmitter. A mere touch of a small lever or push-button is sufficient to operate a sensitive transistor oscillator and thus generate short radio pulses.

The philosophy of free power is incomplete without the mentioning of another type, namely the electromagnetic radiation of telegraph, broadcast, TV transmitters and the like as they are found in all civilized countries. Up to now, this radiation energy has been utilized exclusively for the control of active and passive receivers. However, a preliminary study reveals that a powerful transmitter, in particular our local broadcast station, produces an electro magnetic field of sufficient strength to permit an antenna wire to recover enough energy to feed one or more transistors.

Having outlined the general topic, several laboratory models of small transmitters and receivers will be described whose characteristic is that they are fed by the described forms of free energy. Since we enter a new field, it can easily be understood that this first survey has to be confined to rather fundamental characteristics and circuits. In other words, the article discloses *what* can be done rather than *how* it must be done.

(Continued on page 150)

Vibrational Stability Tests for

Clapper type relays are evaluated under vibrational conditions of 3 to 2000 cps and accelerations to 35 g. Prime areas of relay improvement are in the design of contact springs, contact supports, and relay mountings

FAILURES of magnetic relays, when subjected to vibration in airborne applications has led to a vibration-evaluation survey of relays. (See Note.)

Based on airborne requirements, 3 to 2000 cps has been established as the frequency range for vibration tests. The low frequency portion of the vibration spectrum (3 cps to about 35 cps) generally includes occasional transient excitations, with a low-damping factor. The low frequency range is overlapped by a higher frequency vibration (from about 20 to 2000 cps) which is interpreted as a continuous complex wave with unpredictable peaks at various frequencies. The effect of such peak excitations on equipment is approximately similar to that of sinusoidal vibrations at discrete frequencies.

Acceleration

The maximum anticipated acceleration level is 15 g for most relays, although some relays are located where accelerations as great as 25 g may be expected. In anticipation of future requirements, acceleration effects beyond the present requirements have also been explored.

Test Methods

Contact chatter during vibration exposure is the first parameter for study. Tests are made to note repetitive contact chatter of 100 μ sec or more, duration. The method (Fig. 3) for vibration testing utilizes a low-voltage 60 cycle signal connected through a protective resistance to the series-wired closed contacts. The vertical input of an oscilloscope is connected across the series of closed contacts, and the oscilloscope sweep oscillator is synchronized with the

NOTE: Reported at the 4th National Conference on Electromagnetic Relays.

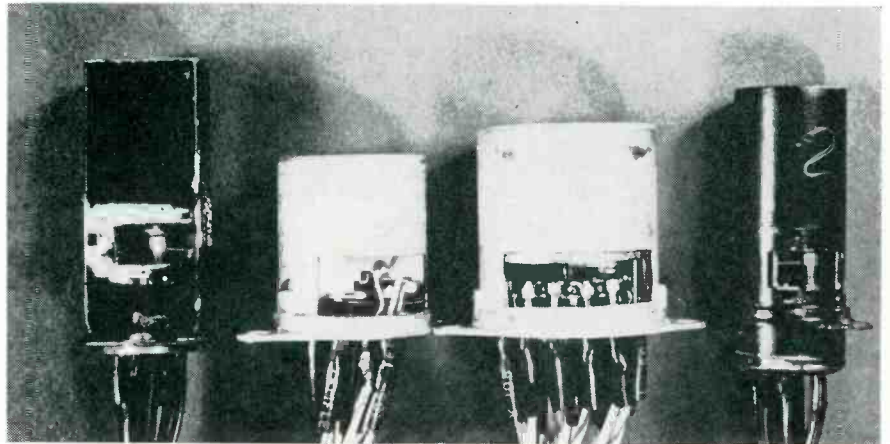


Fig. 1: Windows are cut to permit stroboscopic examination

60 cycle voltage source. Any opening of the closed contacts results in a voltage to the oscilloscope until all contacts are again closed. Contact chatter is evidenced by vertical lines extending above or below the horizontal line.

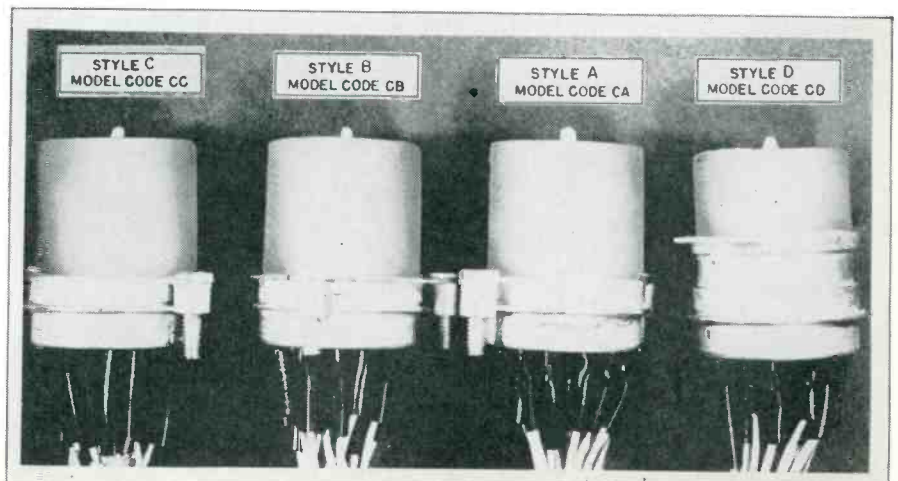
Vibration Modes

The relay is vibrated in each of its three mutually perpendicular axes with the coil energized to test the normally-open contacts, and with the coil de-energized to test the normally-closed contacts. The

frequency (3 to 2000 cps) is changed at the rate of 100 cps per minute. Eight sweeps of the frequency spectrum are made, each at different constant acceleration levels starting with 3 g and increasing to 35 g (Fig. 4). At the low frequencies, the acceleration is limited to maintain a 0.375 in. total constant displacement.

During tests, the frequencies which excite contact chatter are noted and recorded. When chatter is observed during two acceleration level sweeps for an axis and

Fig. 2: Styles CC and CD showed improved operation



Magnetic Relays

By A. H. MASCHMEYER

Autonetics Division,
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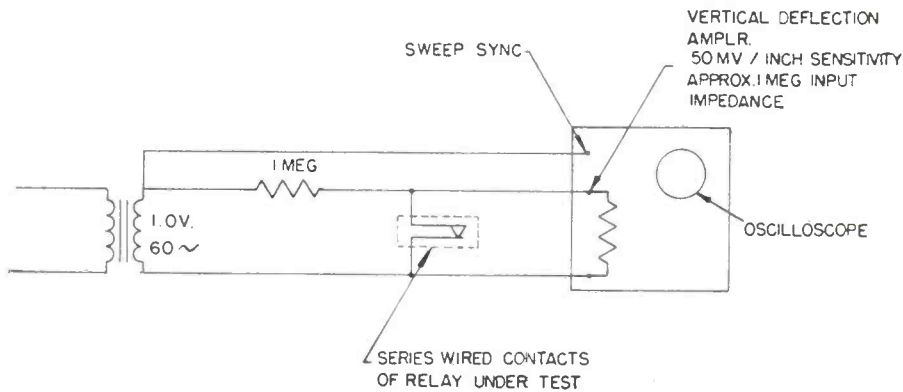


Fig. 3: Contact chatter is evidenced by vertical lines on the oscilloscope

a coil condition (energized or de-energized), the test for that axis and coil condition is concluded.

Monitoring Acceleration

Monitoring the acceleration with the use of three accelerometers mounted in the three mutually perpendicular axes has been found necessary, since any unbalance of the mass on the shake table causes transverse acceleration forces to develop. The output of the accelerometer measuring the acceleration in the direction of the motion of the vibration table is used to maintain the acceleration level within ± 1 g. The remaining two accelerometers are read separately and indicate the magnitude of transverse acceleration vectors occurring in the two axes perpendicular to the motion of the table. The accelerometers are secured as close as possible to the relay attach points to avoid erroneous inputs caused by fixture or shaker resonance.

Transverse Vectors

When chatter is observed, the magnitudes of the transverse acceleration vectors are noted. If the transverse force is greater than 30% of the acceleration in the axis of the motion of the vibration table, the balance of the

mass on the table is adjusted to reduce the magnitude of the transverse forces to 30% or less. The 30% limitation is established by the apparent optimum obtainable from present vibration equipment when a resonant free mounting fixture is used.

Dynamic Analysis

For dynamic analysis, sample relays are frequently obtained with observation windows cut into the sides of the relay cases to view the switching mechanism (Fig. 1) during testing. A stroboscopic light source is synchronized with the motion of the shake table to illuminate the switching mechanism, and a 25-power microscope is used to observe the mechanism.

By making discreet changes in frequency and acceleration on the relay, contact chatter is produced and analyzed.

Contact Springs

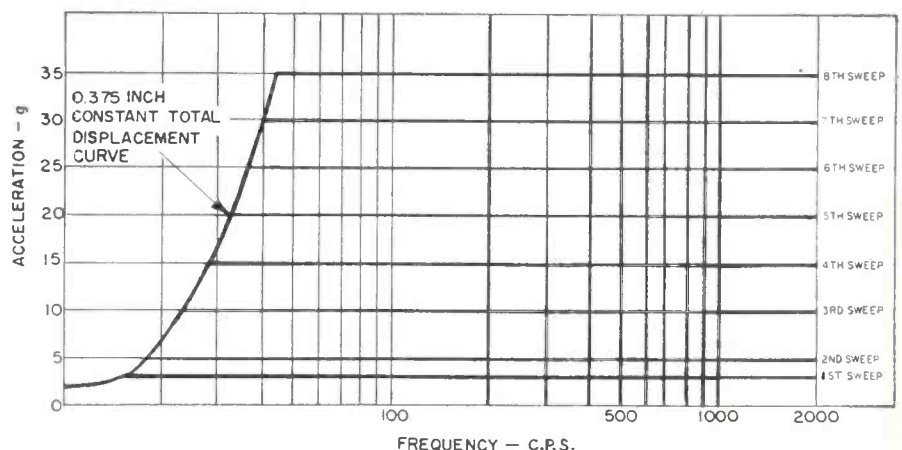
One design, recently observed by the stroboscopic technique, was a mechanism with the normally closed contact mounted on an ear bent from one side of the moving contactor as shown in Fig. 5. During vibration in the "V" axis, the mass of the normally closed contact imparted an off-center loading to the moving contactor and produced a twist which intermittently opened the normally closed contact. The manufacturer has been advised of the design inadequacy, and the resultant improvement is shown in Fig. 6.

Another design which has been studied is the conventional contact springs and arms in the general form of a cantilever beam with the contact at the free end. In such an arrangement, it is noted that rectangular contact springs appear to be more susceptible to vibration than tapered contact springs. The following analysis confirms the susceptibility:

Deflection Force

The force acting to deflect the contact spring during vibration results from the weight of the spring and contact assembly act-

Fig. 4: Vibration caused closed contact to open intermittently



Magnetic Relays (continued)

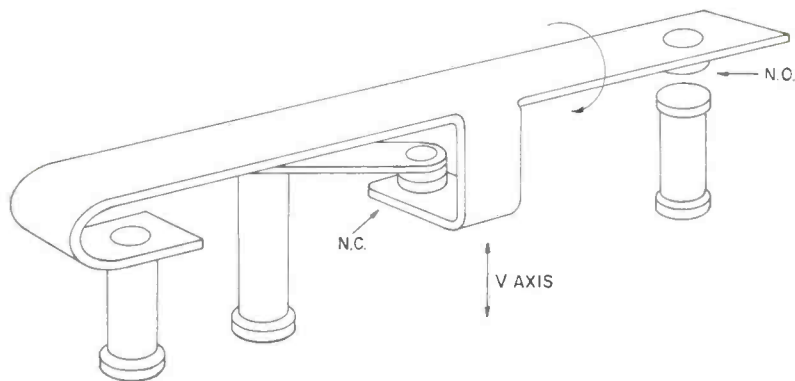


Fig. 5: Redesign eliminated torque of off-center mass

ing on its center of gravity. Accordingly, the energy is applied as a force-moment where the load is a function of the weight of the contact spring assembly, and the moment-arm is the distance from the center of gravity to the point where the contact spring is fixed. The center of gravity of a rectangular contact spring in contrast to a tapered contact spring is shown in Fig. 7.

Spring Shape

Analysis of the deflection from acceleration forces shows that a rectangular spring deflects 2.252 times as much as a tapered contact spring of equal base width. Further analysis shows that the armature force required to deflect the tapered spring is only 2/3 the force required to deflect the rectangular spring. Thus, the tapered contact spring not only has greater resistance to vibrational

deflections but also results in decreased coil power requirements. In one instance where this change was made, contact chatter which previously occurred at a 10 g acceleration level did not appear until a 17 g acceleration was applied.

Mountings vs Chatter

The effects of various relay mounting designs contributing to contact chatter are also being evaluated. Among those under consideration are the four different mounting styles shown in Fig. 2.

Style CA — Manufacturers' standard in accordance with MS24115 (USAF) dimensions except shouldered studs are used in place of clearance holes. The relay is supported on the shoulders of the studs only.

Style CB — Manufacturers'

standard in accordance with the triangular mounting per MS24115T (USAF) dimensions except shouldered studs are used in place of clearance holes and thru-bolts. The relay is supported on the shoulders of the studs only.

Style CC — Suggested modification of Style CA. This modification is identical to Style CA except the height of the shoulder of the stud is reduced to permit the relay to seat on the annular flange instead of on the two studs.

Style CD — Another modification of Style CA. Here, an annular two hole mounting flange is located near the center of gravity of the relay.

Four relays of each style (selected from a single production lot of the type) have been vibrated. Styles CC and CD (with the modified mounting flanges) did not exhibit contact chatter when tested at accelerations up to and including 35 g through the frequency range of 3 to 2000 cps;

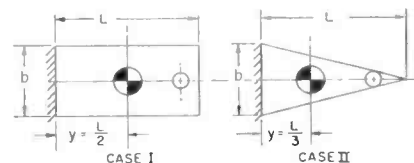


Fig. 7: Center of gravity, rectangular and tapered springs

chatter was observed with six of the eight relays tested of type CA and CB relays. These tests indicate that mounting designs may contribute to chatter and, accordingly, further investigation appears warranted.

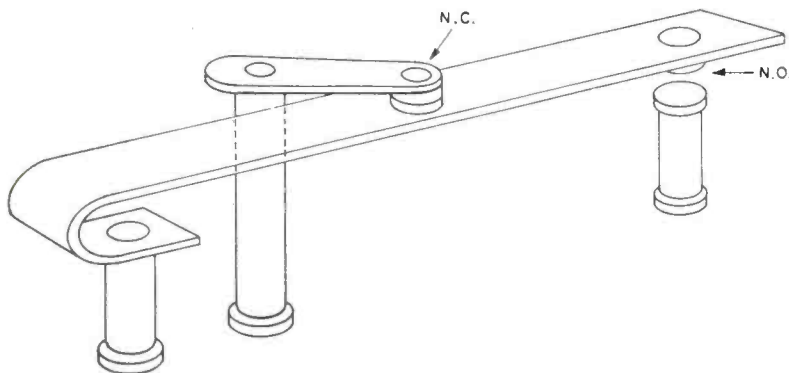
chatter was observed with six of the eight relays tested of type CA and CB relays. These tests indicate that mounting designs may contribute to chatter and, accordingly, further investigation appears warranted.

Proposed Dynamic Testing

Since the majority of relay failures occur in a dynamic environment, instrumentation for evaluating relays under such conditions should be used. The instrumentation should incorporate an adjustable time measure so that only contact chatter with a separation time greater than a pre-

(Continued on page 113)

Fig. 6: Contact spring design affects vibrational reliability



Simplified Cascode Design

The characteristics of a given cascode unit can be quickly approximated from the $E_b - I_b$ curves of the triode employed

By F. EVANS

Radiation Laboratory
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THE test circuit shown in Fig. 1 could be used to obtain equivalent static characteristics of a cascode circuit. Given a value of the upper grid voltage, E_{c2} , a family of $E_b - I_b$ curves could be found with E_{c1} , the bias voltage, as a parameter. It is possible, however, to approximate these curves directly from the triode characteristic curves provided by the manufacturer.

Assume E_{c1} and E_{c2} fixed for the moment. As E_b is increased to sufficiently large values, E_{b1} will increase until it approaches E_{c2} , at which time it will level out to a value very near E_{c2} because of the clamping action of the upper triode. I_b will also level out to a saturation value I_b' corresponding to

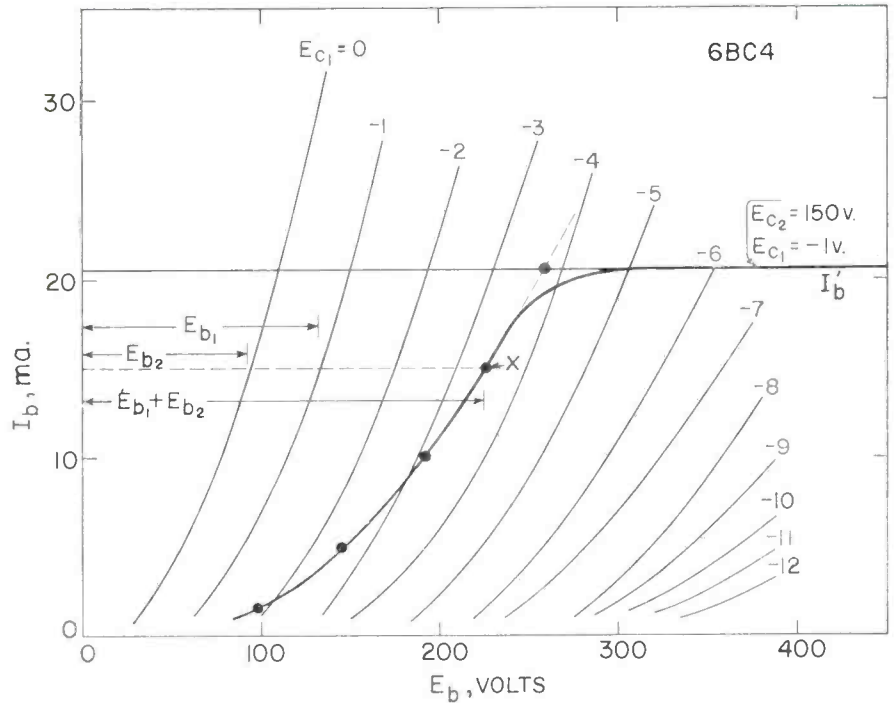


Fig. 2: Cascode characteristics are derived from triode curves

$E_{b1} = E_{c2}$. As E_b is reduced to sufficiently low values, the upper triode goes into grid conduction and the voltage E_{b2} is determined from the zero bias curve for the particular I_b . Once E_{c2} is set, then the cascode characteristic corresponding to a particular E_{c1} can be derived by determining E_{b1} on the E_{c1} bias triode line, and E_{b2} on the zero bias triode line, both as a function of I_b up to the saturation level I_b' .

An example is given in Fig. 2 for the 6BC4. E_{c2} is given as 150 v. For the particular curve shown in detail $E_{c1} = -1$ v. $I_b' = 20.5$ ma is shown as the value of I_b when $E_{b1} = E_{c2} = 150$ v. The point "x" is obtained for $I_b = 15$ ma. E_{b1} is defined by the triode curve to be 132 v. at this point. Since the upper triode is in grid conduction, E_{b2} from the zero bias curve is 93 v. $E_b = E_{b1} + E_{b2}$ then is shown on

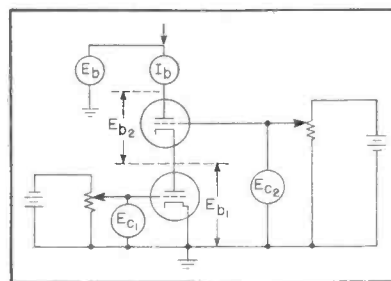
the point "x" as 225 v. Other points obtained in the same manner are shown and a continuous line is drawn through these and folded over at the knee to meet the I_b' line. Other curves for the family $E_{c2} = 150$ v. can be drawn but are not shown here.

Characteristics obtained in this manner are not precise but should be well within the limits of the manufacturer's tolerances on g_m , etc. The upper grid circuit may act as a plate load for the lower tube and tend to shift the lower part of the cascode curve in Fig. 2 to the left. In addition I_b should approach I_b' gradually—more so with low- μ tubes.

Increasing E_{c2} has the effect of spreading out the cascode curves vertically and thus increasing the g_m ; however, the knee will be shifted to the right and higher plate-supply voltages are required to get into the "pentode" region.

The I_b' saturation lines are usually the ones of primary interest. These can be found quickly by the intersection of the $E_b = E_{c2}$ line with the triode curves. The knee can be located approximately by assuming grid conduction at I_b' and marking off $E_b = E_{b1} + E_{b2}$ as before. Determining one knee should be sufficient, as the others occur at about the same voltage.

Fig. 1: A cascode test circuit



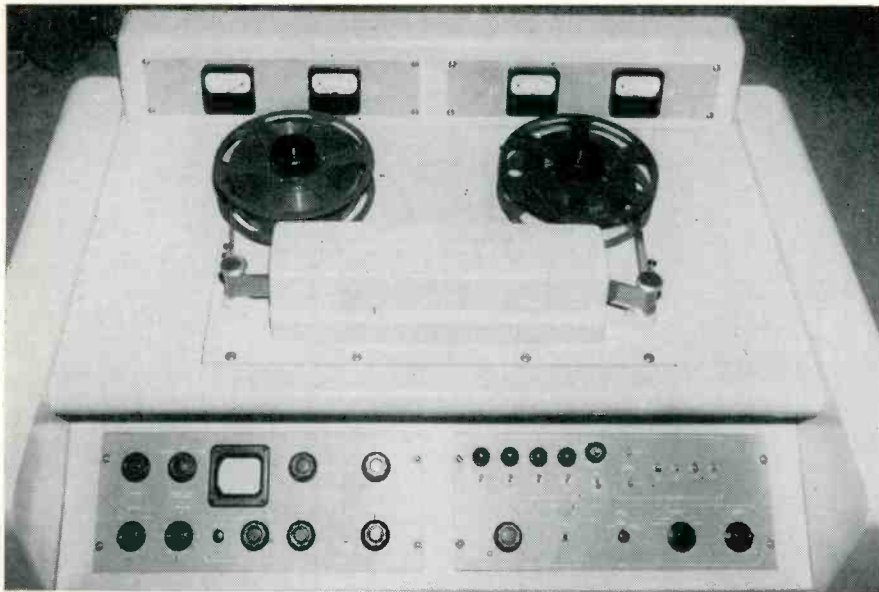


Fig. 1: Top view of video tape recorder. Unit records 1 hr TV show on 14 in. reel of 2 in. tape

By R. Snyder

Manager, Videotape Equipment Dept.
Ampex Corporation
Redwood City, Calif.

Ampex's New Video Tape Recorder

Multi-headed disc, spinning at 14,000 rpm, records bandwidths up to 4 mc on a two-inch magnetic tape traveling 15 ips. Immediate application is program delay service for East-West TV; future applications include color TV and high-speed data recording

LOOKING at the advantages which magnetic tape recording had brought to the radio broadcast industry, many engineers visualized its application to TV, when a means might be found of recording the 4 mc video signal.

Several approaches were open to them, and each had its adherents. Basically, the problem involved packing enough information onto a reel of magnetic tape of manageable size to reproduce all the video information in a program of a half-hour or an hour in length. The rate information transmission is proportional to the complex product of the bandwidth and the signal-to-noise ratio. In TV, a satisfactory signal must be at least 4 mc-wide and over 30 decibels "deep."

High-Speed Tape System

The maximum recordable frequency with a magnetic tape recorder is set by the effective gap width and tape velocity. The magnetic head "sees" substantially only that part of the tape which, at any

given instant, is in the head gap. So long as only a small part of a single cycle is in the gap at any moment, the head will "see" a changing flux, and its output will be proportional to the rate of that change.

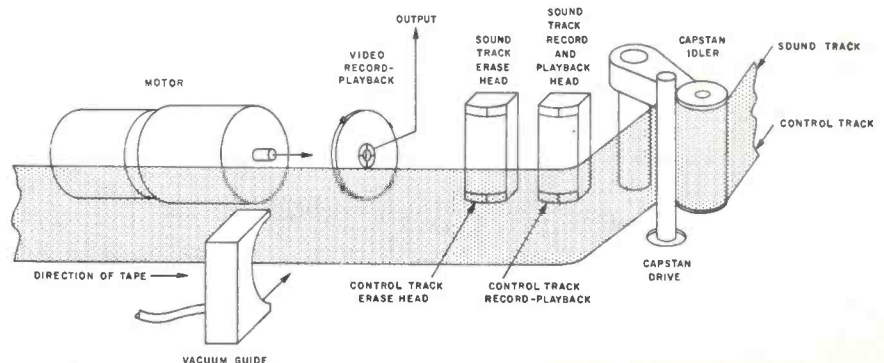
But when one whole cycle appears in the gap, the average value of the positive and negative half cycles equals zero, and the output of the head is zero. Thus, the narrower the gap, the shorter the wavelength which that head can

reproduce effectively, or, the higher the frequency it can reproduce at a given tape speed.

In audio recorders a magnetic head of .005 in. gap width can reproduce a wavelength as short as .001 in. along the tape, or 7,500 cps at 7½ ips. A quarter-mil head, on the other hand, will effectively reproduce a half-mil wavelength, or a 15,000-cycle signal at 7½ ips.

If we used a quarter-mil head gap, then, we might expect that we

Fig. 2: Diagram of multi-function head



would require a tape speed of 2,000 ips to reach an upper frequency limit of 4 mc. At that rate, a reel of magnetic tape 14 inches in diameter and 4800 feet long would record a little less than 29 seconds of program material.

The precision required to manufacture a magnetic head so that the entire length and depth of the two gap faces are separated by exactly .000125 in. is very great. Even so, with utmost care, under conditions of precisely controlled light, temperature, and machinery, heads with this effective gap can be made. Any improvement made in this direction, however, leads not only to exceedingly knotty production problems, but also in the direction of great delicacy of equipment, where ruggedness is greatly to be desired.

Furthermore, substantial reductions in the gap width must be accompanied either by decreased signal, with consequently decreased signal-to-noise ratio, or by decreased head life. This is because signal output is approximately proportional to gap width, and inversely proportional to gap depth. Therefore, if gap width is decreased, the signal must either decline, or the gap depth must be decreased, leaving less and less head material to be worn away in use.

Multi-Channel Systems

This impasse led to experiments with the possibility of "chopping up" the video signal into 2, 4, 6, or more blocks, of proportionately narrower bandwidth, and then recording these on wider tape, using multi-channel heads. There are a number of ways in which this approach might be implemented, either with filters or with a synchronized sampling system. Only an exceedingly complex breakdown system gave any hope of reducing the tape speed to a conventional speed for magnetic recorders.

Transverse Recording

A third approach attains high relative speed between heads and tape by rotating the heads at high speed across the tape, and moving the tape itself only fast enough to avoid interference between successive tracks. The longitudinal tape speed required now depends

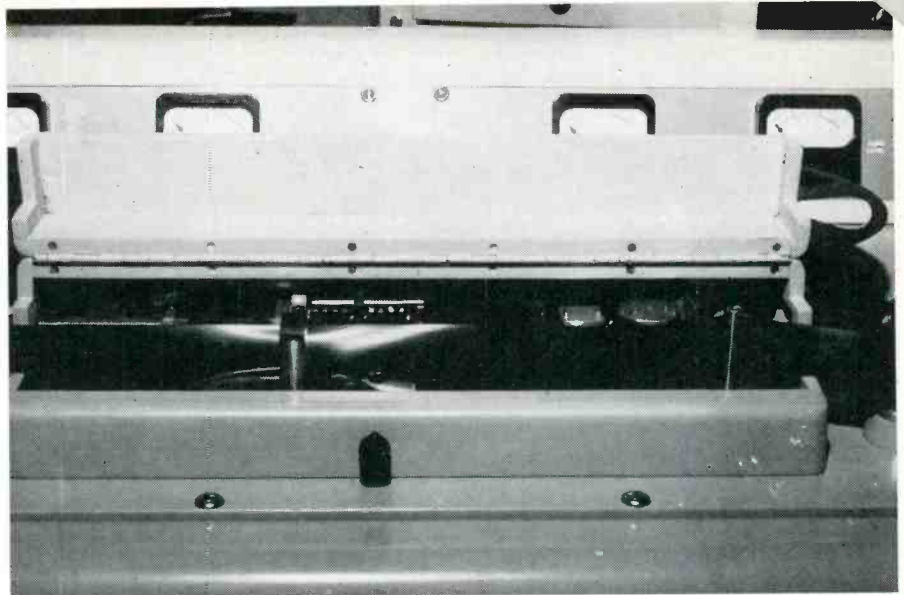


Fig. 3: Vacuum contours the tape to the curved recording head

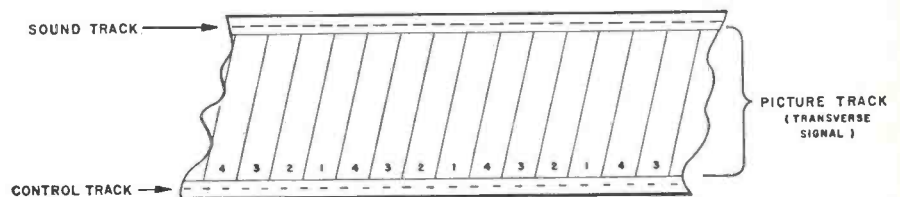


Fig. 4: Transverse video signal gives net 1500 ips for actual 15 ips tape speed

upon the required width of the individual tracks, the rotational speed of the head drum, the minimum spacing between adjacent tracks as determined by the effects of crosstalk, the stability of longitudinal tape speed control, and the effects on the output signal of errors in tracking. It proved possible, by this means to adopt a tape speed of only 15 ips, thus obtaining more than an hour of recorded program on a 14-inch reel of two-inch Mylar polyester based tape.

The equipment developed exceeds the FCC maximum rate of change of information standard of 0.15% per second. It is capable of holding the maximum horizontal line error to 0.1 msec, with only occasional minor adjustment during operation. The 15 ips tape speed is made possible by a special FM carrier system, a precision transport control system, and a unique head construction.

Head Assembly

Four heads are mounted on a drum which rotates at approximately 14,000 rpm and is precise-

ly synchronized with the tape drive capstan. The net resultant speed for the application of video signals is approximately 1500 ips.

The two-inch-wide tape is held in conformity to the circular shape of the head drum by means of a vacuum system. During operation, one head is always in contact with the tape. Each head, in its turn, is connected to the electronic elements of the system by commutation, its timing under strict control. During the playback process, the relation between the rotational velocity of the head drum and that of the capstan drive is maintained to within very narrow limits through the use of a control track along the lower edge of the tape. A reference signal is recorded on the control track and, during the playback, is amplified and used to control relative speed of the drum and capstan.

Monitor Facility

After the incoming video signal has been amplified and used to modulate the signal to the heads, it

(Continued on page 108)

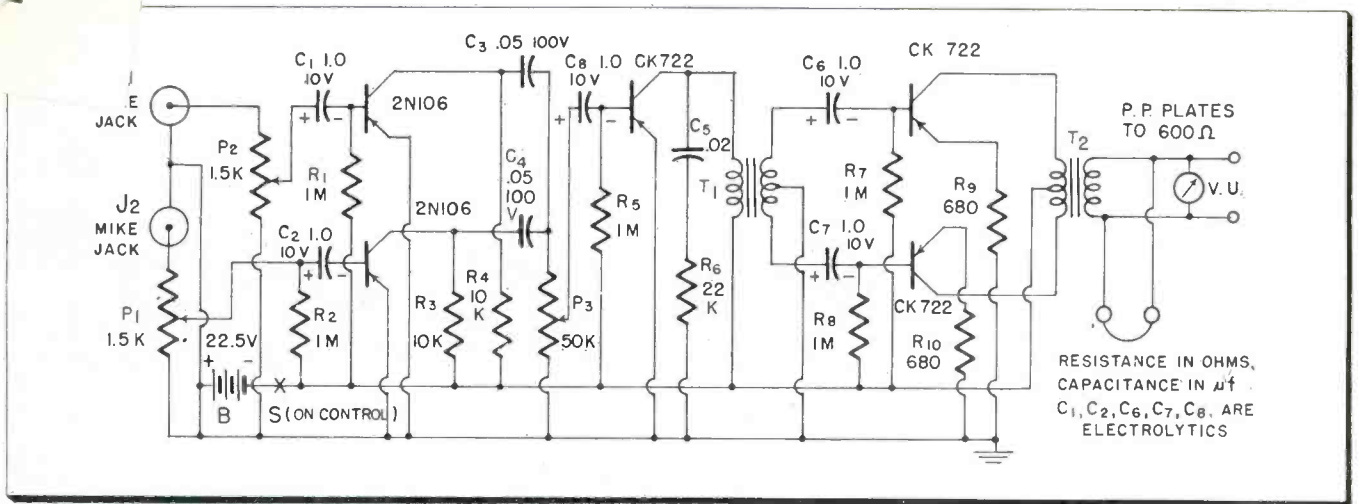


Fig. 1: Schematic of unit. Mikes are connected directly to the inputs of transistor pre-amps through gain controls

Transistor Remote Amplifier

Small, battery-operated 4-transistor channel amplifier has two independently controlled mikes. Low-level mixing is employed. The noise level is 50 db down

By E. C. SMITH

THE small, self-contained transistor amplifier described in this article contains two microphone channels and is used for remote broadcasting of sporting events here at WFIN. Figs. 4 and 5 show the size and appearance of the unit, and Fig. 1 is the circuit diagram.

Two independently controlled mikes were considered necessary. Dynamic mikes with 250 ohms output were available and these are connected directly to the inputs of the transistor preamplifiers through the gain controls. The gain controls contribute very little mismatch, due to the high value of resistance. Low level mixing was decided upon because of the simplicity of the circuit. Two extra transistors or a bulky transformer type mixer would be required for high level mixing. Most



E. C. SMITH
Chief Engineer,
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controls will function very smoothly in the low level mixer.

Design

Miniature transformer coupling was discarded because of poor low frequency response of these units, so the preamplifier transistors are resistance coupled to the second

stage. Difficulty was also encountered in trying to use miniature electrolytics for coupling the pre-amplifiers to the second stage, and we finally decided to use the .05 μ f. miniature paper type. Frequency response is corrected by C5 and R7 connected from collector to ground of the second stage.

The second stage is coupled to the push pull output stage by means of T1. This is a plate to 600 ohm line transformer, center tapped. The frequency response of this small transformer is adequate, and performance is very good when used in this way. The 300 ohms each side of the center tap to drive the final stage proved very satisfactory.

For the final stage we decided upon a push pull arrangement with
(Continued on page 125)

Fig. 2: Response—250 Ω input, 600 Ω resistive load, 1000 CPS

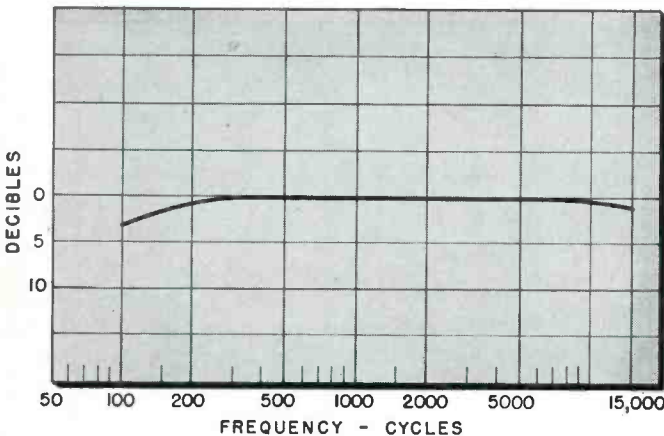
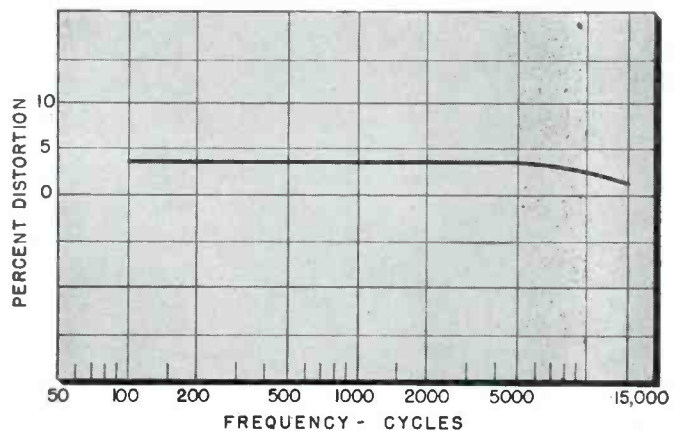


Fig. 3: % distortion—250 Ω input, 600 Ω res. load, normal level



CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

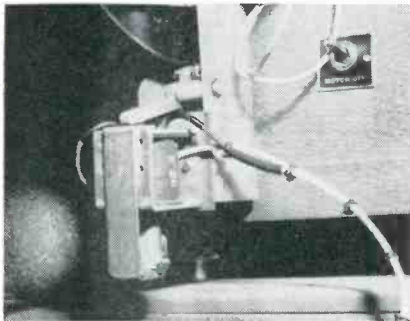
Booster Solenoids For Turret Rotation

GEORGE PEPIN

WMT-TV, Cedar Rapids, Iowa

THIS item will be of interest to TV stations listing among their equipment a Gray model 3A or 3B Telojector.

For some time we have had trouble with slide turrets failing to rotate in sequence. The trouble was caused by failure of the release



solenoid to pick-up sufficiently to release the turret allowing the next slide to move into position. Replacement of the solenoid and release pawl did not cure the trouble, but this idea did.

Another pair of solenoids was

ordered from the manufacturer and mounted in an inverted position on the case of the original solenoid just below the level of the manual release lever. This is shown in the photograph.

An armature was fashioned out of brass and mounted to connect from the solenoid plunger running along the outside frame and resting just below the manual release lever.

Electrically the two solenoids are in parallel so that, when the slide change button is pushed, both coils are energized and the release lever gets an added kick upward from the second solenoid as well as the downward pull from the original.

This has been in operation for about six months and has yet to fail.

Another addition to the Telojector is the removal of the momentary start switch on the projector and replacing it with a foot switch. This eliminates the necessity of holding the switch, checking copy and pushing the slide change button all at the same time. The switch can be mounted back under the pedestal out of the way to prevent stepping on it accidentally.

Adjusting Spark Gaps

DENNIS C. LONG, Ch. Engr.

WLON, Lincolnton, N. C.

WHEN adjusting several spark gaps that activate an overload relay, such as used in the Collins 20-V, it is usually difficult to determine which one is arcing and causing the overload action. To make this adjustment easy, and to know which spark gap is set correctly, tape a piece of thin porous paper, such as cleansing tissue, in the spark gap areas. When an arc then occurs a hole will be burned through the paper indicating where the arc has occurred. When one gap has been correctly adjusted it may be temporarily blocked by carefully taping a small sheet of good insulating material between the spark gaps. This will make the other adjustments easier. When all adjustments are completed all insulation or paper will, of course, be removed.

at right angles to the edge of the case when the switch is ON, and offset from the hole so that it does not interfere with the shaft. A plastic rod, approximately $2\frac{1}{4}$ in. long is obtained (we used the pointed handle of a cheap curler type comb bought at the five and ten). The groove should be deep enough so that the rod is flush with, or slightly above the back surface of the knob. The groove was then coated with service cement, the rod positioned in the groove and liberally covered with cement. A washer, having the same or smaller outside diameter than the knob but with a hole large enough to pass the shaft was then cemented to the back of the knob. When replacing the knob on the shaft push the knob back so that the washer is held firmly against the back of the knob by pressing against the switch hub or nut.

If the groove has been located properly the rod will extend over the edge of the case when the switch is ON, as shown in the photo, effectively preventing the cover from being assembled. When OFF the rod swings down out of the way.

Battery Protective Switch

GORDON V. N. WILEY, Ch. Engr.
WGAW, Gardner, Mass.

PROBABLY most engineers and operators have had the unhappy experience of preparing to set up a remote pickup where there is no regular power available, and discovering, when the cover is taken off the remote, that the last operator neglected to turn off the battery switch, and the batteries are either dead or very weak.

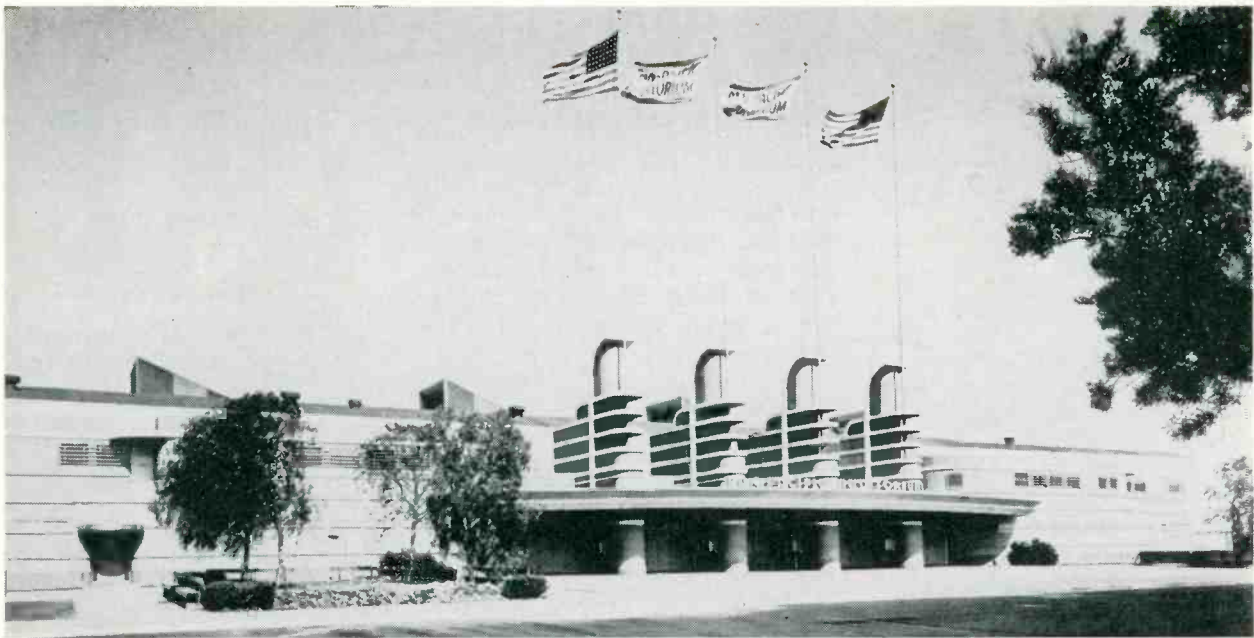
After this happened at WGAW a few times, we decided that something should be done to prevent its happening again. The following method makes it impossible to assemble the cover to the remote unless the switch is OFF, and since making this change we have saved considerable money on batteries as well as a lot of worry.

We use a Collins Remote Amplifier Type 12Z, but the same idea

could be used on other types having rotary switches.

The power switch knob was removed from the shaft and a deep groove filed into the back side of the knob, using a round file. This groove should be filed so that it is





Pan Pacific Auditorium, Los Angeles—Site of the 1956 WESCON

STARTING its second decade this year, WESCON (Western Electronic Show and Convention) is scheduled for Los Angeles' Pan Pacific Auditorium on August 21, 22, 23 and 24.

Some 30,000 engineers, scientists and business representatives are expected to attend the 1956 WESCON, which will show more than 700 exhibits and present at least 150 technical papers. C. Frederick Wolcott, of Gilfillan & Bros., Inc., Los Angeles, heads this year's eight-man board which administers the event.

The West Coast Electronic Manufacturers' Association and the Los Angeles and San Francisco sections of IRE, representing the 7th Region, are sponsors of WESCON, which is held alternately in Los Angeles and San Francisco.

Five field trips are scheduled for the four-day 1956 WESCON, including a cruise aboard the *USS Bremerton* during which there will be an opportunity to inspect this aircraft carrier's electronic gear. Other trips include: medical electronics facilities at UCLA; a visit to the Pacific Semiconductors plant, where miniature diodes and transistors are made; a tour of the Radio Division of Hoffman Electronics Corp.; and a visit to the color studios of CBS-TV, featuring a special closed-circuit color telecast.

The All-Industry Luncheon is set for August 24 in The Ambassa-

dor, the headquarters hotel, which will also be the site of the All-Industry Cocktail Party on opening day, August 21, starting at 5:30 p.m.

Special activities have been planned for wives and other guests of those attending the show and convention, including a get-acquainted tea at the Beverly-Hilton Hotel and various events and tours.

American and Western Air Lines are cooperating in getting WESCON delegates and visitors to Los Angeles via "Operation Air-lift." Special attention is being paid to travelers from East of the Rockies, and these airlines have promised priority for WESCON traffic.

TECHNICAL PROGRAM

EARTH SATELLITE

Chairman: Capt. D. P. Tucker, USN, Office of Naval Research.

WESCON 1956

Over 700 exhibits and more than 150 technical papers will highlight the Los Angeles Show; some 30,000 are expected to attend the event

"The Professional Group on Military Electronics," Capt. C. L. Engleman, USN.

"The U. S. Earth Satellite Program Project Vanguard," M. W. Rosen, Naval Research Lab. D. J. Markcarian, Glenn L. Martin Co.

MICROWAVE THEORY AND TECHNIQUES

Chairman: Charles Chandler, Gilfillan Bros. "Applications of a Waveguide Slot Coupler with Unity Coupling," R. W. Clapp, Hughes Aircraft Co.

"The Effect of Mode Filters on the Circular Electric Wave Transmission Properties of a Long Multi-mode Circular Waveguide," W. D. Warters, Bell Telephone Labs.

"Equivalent Circuits for Thin Waveguide-Coaxial Junctions," Curt A. Levis, Ohio State Univ.

"Exponential Transmission Lines as Transformers and Cavities," Rabindra N. Ghose, Radio Corp. of America.

ENGINEERING MANAGEMENT

Chairman: E. Finley Carter, Director—Stanford Research Inst.

"Management of Large Research and Development Organizations," N. I. Hall, Vice President, Hughes Aircraft Co.

"People, Things and the Engineer," James F. Gordon, Chief Development Engineer, Helipot Div., Beckman Instruments, Inc.

"Future of Engineers in the Management of Industrial Enterprise," A. C. Fontaine, Vice President, Bendix Aviation Co., Inc.

"Situations that Affect the Productivity of Engineers," M. C. Batsel, Chief Technical Administrator, Defense Electronic Products, RCA.

MEDICAL ELECTRONICS

Chairman: Alexander Kolin, Univ. of Calif., Los Angeles.

"Exposure Hazards from Cosmic Radiation in Flight in Extra-Atmospheric Regions," Hermann J. Schaefer, Naval School of Aviation Medicine, Pensacola, Fla.

"Progress in the Field of Xerography," Speaker from General Electric.

"Methods of Measuring Blood Pressure and Blood Flow," John P. Meehan, Univ. of S. California.

TUBE TECHNIQUES

Chairman: M. C. Long, Hughes Aircraft Co. "Development of a Line of Microminiature Ceramic Tubes," R. E. Moe, G. E. Co., Owensboro.

"Noise Performance of a Microminiature Triode," J. W. Rush, G. E. Co., Owensboro.

"Flat Display Device with Matrix Display Selection," B. A. Findeisen, G. E. Co., Syracuse.

"A Flash Coding Tube," R. W. Sears, BTL. "Ceramic Seals for Microwave Tubes," Curtis Ward, Varian Associates.

"New Techniques Used in The Development of a 40 Watt Ceramic UHF Power Tetrode," M. B. Shrader, RCA, Lancaster, Pa.

PROPAGATION

Chairman: R. B. Muchmore, The Ramo-Wooldrige Corp.

"Reflection of a Transient Electromagnetic Wave from a Conducting and Anisotropic Medium," James R. Wait, National Bureau of Standards, Boulder.

"The Prediction of Tropospheric Propagation from Meteorological Data," L. J. Anderson and J. B. Smyth, Smyth Research Associates, San Diego.

"Some Observations of Antenna-Beam Distortion in Trans-Horizon Propagation," A. T. Waterman, Jr., N. H. Bryant, and R. E. Miller, Stanford Univ.

"A Study at 1046 Megacycles of the Reflection Coefficient of Irregular Terrain at Low Angles of Incidence," R. E. McGavin and L. J. Maloney, National Bureau of Standards, Boulder.

"Radar Terrain Return at Near-Vertical Incidence," R. K. Moore and C. S. Williams, Jr., Univ. of New Mexico.

MICROWAVE THEORY AND TECHNIQUES—ACTIVE ELEMENTS

Chairman: Kiyo Tomiyasu, General Electric Microwave Laboratory.

"Recent Developments on Transmit-Receive Switch Tubes," Louis W. Roberts, Bomac Labs.

"Characteristics of Crystal Video Receivers Employing R-F Pre-Amplification," William E. Ayer, Applied Electronics Lab., Stanford University.

"Coupled-Cavity Stabilization of Klystrons," Maurice St. Clair, Varian Associates.

"Burnout Experiments on S-Band and X-Band Crystals," Ben Hecht Bomac Labs., Inc.

CIRCUIT THEORY—FREQUENCY DOMAIN TECHNIQUES

Chairman: Louis Weinberg, Hughes Aircraft Co.

"Realization of Driving Point Impedance Functions Without Mutual Inductance," R. H. Pantell, Stanford Univ.

"RLC Transfer Function Synthesis," E. C. Ho, Logistics Research, Inc. and Univ. of Calif., Los Angeles.

"Synthesis of Grounded Two-Element-Kind Symmetrical Networks," P. M. Lewis, MIT.

"Some Simplifications for Analysis of Linear Circuits," G. L. Matthei, Ramo-Wooldrige Corp.

"Network Design by First Order Predistortion Technique," C. A. Desoer, Bell Telephone Labs.

INSTRUMENTS

Chairman: Carl P. Spaulding, G. M. Giannini & Co.

"A Practical Application of Phase Measuring Techniques to Precision Angle and Distance Measuring Equipments," by William T. Thompson, Cubic Corp., San Diego.

"A Multi-Pressure Measuring and Recording System for Wind Tunnels," M. Bain, Jet Propulsion Lab.

"Electromagnetic Flowmeters — Operating

Characteristics and Applications," Eugene Mittelmann, Consulting Engineer, Chicago.

"3-D Magnetic Flux Meter," M. Muller and R. Feldt, Federal Telephone and Radio Co.

TELEVISION RECEIVERS

Chairman: William Milwitt, Industry Service Laboratory, Radio Corp. of America.

"Stagger-Tuned Transistor Video Amplifiers," Victor H. Grinich, Stanford Research Inst.

"Analytical Approaches to Local Oscillator Stabilization," W. Y. Pan and D. J. Carlson, Radio Corp. of America.

"Retrace Driven Deflection Circuit," Walter B. Gugli, Stanford Research Inst.

"Graphic Derivation of the Chromaticity Diagram," Edward L. Michaels, Hughes Aircraft Co.

MILITARY ELECTRONICS

Chairman: J. F. Byrne, Motorola Research Laboratory.

"Electronic Circuit Standardization," J. H. Muncy and G. J. Rogers, National Bureau of Standards.

"Application of Solar Furnaces to High Temperature Research," Lt. Col. R. H. May, Armed Forces Special Weapons Project.

"Nuclear Weapons Efforts on Communication Systems," Jack Eggart, Signal Corps Engineering Labs.

"Silicon Solar Cell," M. B. Prince, National Semiconductors Products, Evanston, Ill.

ANTENNAS I

Chairman: V. R. Rumsey, Univ. of Illinois.

"Radiation and Diffraction Problems Involving Wedges and Cones," L. B. Felson, Polytechnic Inst. of Brooklyn.

"External Fields Produced by a Slot on a Cone," G. Held and G. Hasserdjian, Univ. of Washington.

"A Slot Analog of the Loop-Dipole D-F Antenna," F. D. Clapp and H. Masuda, Univ. of California, Berkeley.

"The Effects of Thin Conductive Coatings on Low-Frequency Aircraft Antenna Performance," C. W. Steele, Stanford Research Inst., Menlo Park.

"The Tacan Antenna," A. Casabona, Radio Navigation Laboratory, Federal Telecommunication Laboratories, Nutley, N. J.

CONTROL THEORY AND METHODS

Chairman: Walter R. Evans, North American Aviation.

"Consideration Regarding Design of Stabilizing Elements for Control Systems," T. H. Chin, Univ. of Pittsburgh.

"Solution of Statistical Problems by Differential Operator Approach," R. L. Cosgriff, Ohio State Univ.

"Describing Function Technique Applied to the Analysis of a Non-Linear Control System Used in Space Stabilizing a Missile in Roll," Leonard Atran, Westinghouse Electric Corp.

"Statistical Theory and Analysis of Multiply-Instrumented Control Systems," R. M. Stewart, Jet Propulsion Lab.

"A Time-Domain Synthesis for Optimum Extrapolators," C. W. Steeg, Dynamic Analysis and Control Lab., MIT.

TRANSISTOR CIRCUITS — LINEAR, LOW AND H-F APPLICATION

Chairman: W. W. Wells, North American Aviation Co.

"Design of Negative Feedback Transistor Amplifiers for Hi Fi Equipment," (with demonstration of equipment), H. R. Lowry, General Electric Co.

"Silicon Transistor Video Amplifier," R. E. Leslie, Sperry Gyroscope Co., New York.

"Stability and Power Gain of Tuned Transistor Amplifiers," A. P. Stern, Electronics Lab., General Electric Co.

"High Frequency Equivalent Circuits for Junction Triodes," R. M. Scarlett, Stanford Univ.

"Some Circuit Applications of Silicon Tetrodes," R. R. Webster and R. F. Stewart, Texas Instruments, Inc.

CYBERNETICS

Chairman: Don Taylor, Univ. of California.

"Spatial Perception," Robert Tschirgi, UCLA.

"The Use of Digital Computers in the Study of Neural Networks Models," Stanley Frankel,

(Continued on page 155)



C. Fred'k. Wolcott
WESCON Chairman



Bruce S. Angwin
Vice-Chairman



Gramer Yarbrough
Secy.-Treas.



E. P. Gertsch
Vice-Chairman



Joseph Rodgers
Arrangements



Willard H. Fenn
Technical Program



Jeanne W. Jarrett
Recording Secy.



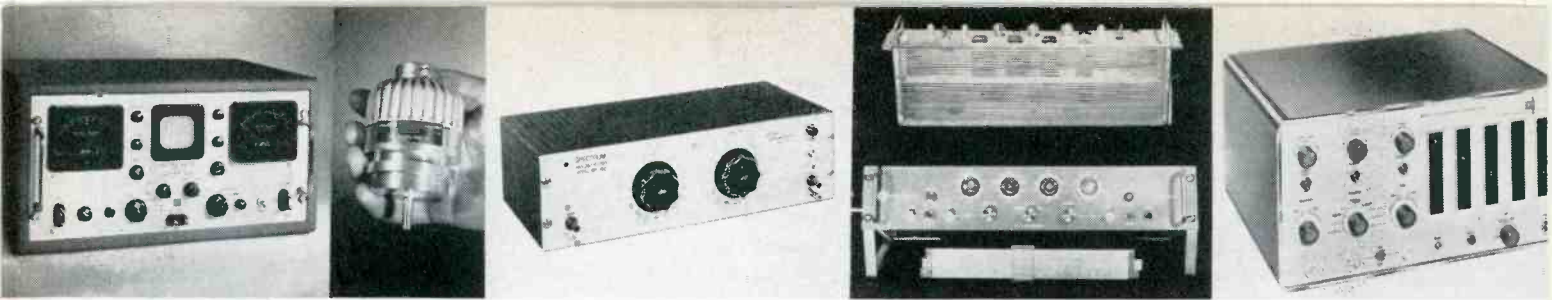
Mrs. F. A. Dunnigan
Women's Activities



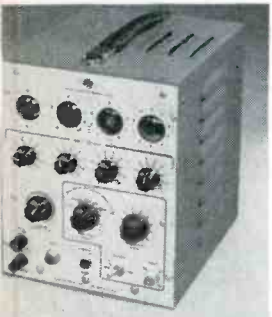
Elvin Feige
Advisory Committee



H. W. Jamieson
Field Trips



1 2 3 4 5



6 New Components & Equipment

1—D & R Ltd.

Model FL-4 Wideband Flutter Meter for studying flutter and wow content of tape transport mechanisms. Carrier frequency 14.5 kc. Internal crystal controlled osc. Booth 344.

2—Baldwin Piano Co.

Compact 13-digit and 16-digit optical encoders generate binary-parallel code signals to $\pm\frac{1}{2}$ part in 8192 (13-digit) and 65536 (16-digit). Booth 1330.

3—Spectrum Instruments Inc.

Analog Filters for sharp bandpass performance at audio and sub-sonic frequencies. Model BP-160 features independent control of high and low frequency band limits. Booth 1066.

4—Hupp Instrumentation Co.

Model 210 Digital Timer, compact, 4 decade, electronic counting instrument. Glow-tube decades and simplified circuitry. Rates as high as 60,000 cps. Booth 403.

5—Computer-Measurements Corp.

Model 225A Universal Counter-Timer, offers direct digital read-out. Features include: 3 direct-coupled inputs, quick time base alignment, 70 mv sensitivity. Booth 1047.

6—Electro-Pulse, Inc.

Model 7240A Preset Counter, utilizing cold cathode glow transfer tubes, counts and indicates the number of input events up to a number (from 1 to 9,999). Booth 1313-1314.

7—Tektronix, Inc.

Type 53/54C is a fast-rise dual-trace unit. Identical channels, operated independently or electronically switched. Sensitivity, 0.05 v/cm to 50 v/cm.

8—Abbott Instru. and Engr. Co.

Edin frequency spectrum analyzer. Continuously analyzes a broad band of frequencies, and integrates the individual bands, which may be as many as 24. Booth 307.

9—Burrhoughs Corp.

Magnetic Core Tester (BCT 301), designed expressly for testing tape wound bobbin cores. Allows accurate measurement of core switching time. Booth 133-134.

10—John Fluke Mfg. Co., Inc.

Model 801 precision potentiometric DC VTVM is substantially impossible to damage by overload. Voltage range is from 500 v. down into the microvolt region. Booth 603.

11—Non-Linear Systems, Inc.

New Digital Voltmeter, Model 1500, has mercury wetted contact relays that assure life expectancy of more than 1 billion accurate readings. Booth 941.

12—Electronic Control Systems, Inc.

"Digimatic" computer, consisting of a planning desk, high-speed decimal computer and tape recorder, and a machine control unit. Booth 136-137.

13—Shasta Div., Beckman Instruments

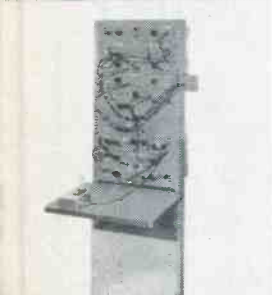
Model 605 wide range resistance bridge checks resistance to an accuracy of $\pm 0.15\%$ full scale. Seven ranges from 100 ohms to 100 megohms full scale. Booth 747.

14—Electronic Specialty Co.

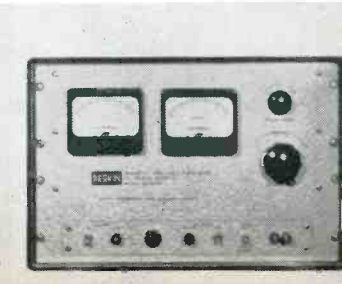
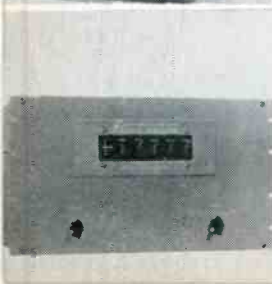
RY-426 series of voltage sensors provide reliable, exact sensing of the 400 cycle systems. Uses magnetic amplifier to actuate the output relay. Booth 103.

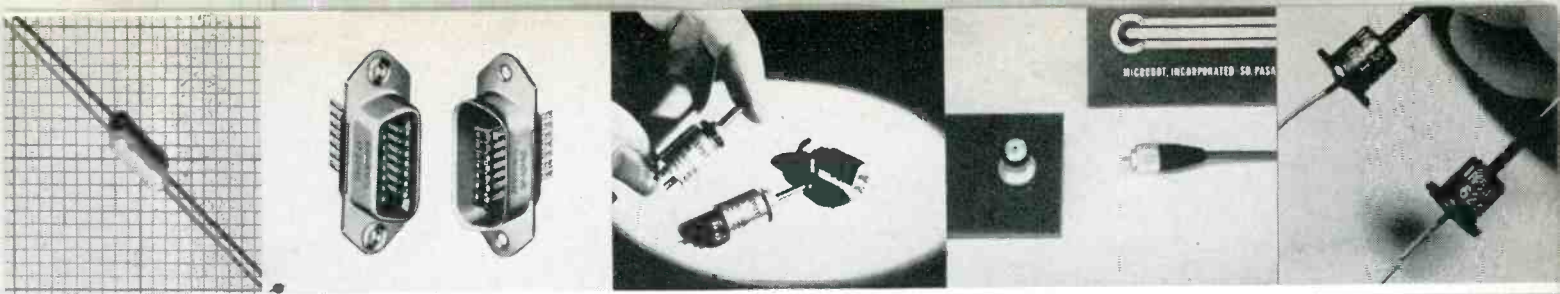
15—Perkin Engineering Corp.

Light weight Model MR532-15A magnetic amplifier regulated, 2 to 36 v. at 15 amp. power supply. Ranges—2-36 volts, and 5-32 volts. Booth 1409-1410.



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To See At WESCON

16—Ward Leonard Electric Co.

Miniature 3-watt power type resistor, AXI-OHM, for printed circuits and advanced miniaturization designs. Special alloy resistance wire of low temperature coefficient. Booth 727.

17—American Phenolic Corp.

Miniaturized connectors 'ribbon' contact design with self-wiping, self-cleaning, double-contact action. Booth 1019-1020.

18—Ace Electronics Assoc.

High temperature X-500 ACEPOT, sub-miniature precision wire-wound potentiometer, which operates from -55°C . to 150°C . 200 ohms to 250K ohms. Booth 1364.

19—Microdot, Inc.

Miniature printed circuit receptacles, and mating plugs, for all printed circuit boards from 1/16 in. to 3/16 in. thick, provide coaxial or shielded cable connections. Booth 1327.

20—General Electric

New silicon rectifiers, types 1N537 and 1N538, occupying a total volume of 0.03 cubic in. and weighs 0.07 oz. Axial leads. Booth 1218-1219.

21—Litton Industries

Model LA-09 10-turn potentiometer. All metal external construction, metal-to-metal stops, stainless steel ball bearings, and glass sealed terminals. Booth 1256-1257.

22—H. H. Buggie, Inc.

Miniature BNC type connectors for new type miniature coax. Quick "pressure correct" connect and disconnect, and complete moisture and dustproof sealing. Booth 104.

23—Burgess Battery Co.

New "wafer cell" smaller than a fingertip yet $\frac{1}{2}$ more powerful than conventional cells, made entirely by machine and sealed in airtight envelope. Booth 1009.

24—Control Products, Inc.

Light-weight Thermal Switch, sensitive and fast-acting. Made in single-wire and 2-wire designs. The single-wire unit weighs less than 1 ounce. Booth 1346.

25—National Vulcanized Fibre Co.

Printed circuits made from copper-clad phenolic in standard grades, new G-10-365 epoxy grade and circuits made by the new HNP (Houghton National) process. Booth 1052-1053.

26—Phillips Control Corp.

Phil-trol Type 8QA relay, available with multiple wound coils over a wide range of resistance values, features fast response time, unexcelled reliability. Booth 1039.

27—Alden Products Co.

New indicator light; tiny bulb, 1/6 the size of "miniature" bayonet bulbs. Filament is sealed high in lens, keeping all of the light in front of panel. Booth 1165.

28—Bowmar Instrument Corp.

Universal precision gear train, 107U, featuring 20 common lab. ratios from 20:1 to 1600:1. Single universal housing of anodized aluminum and 20 stainless steel gear clusters. Booth 824.

29—American Lava Corp.

AlSiMag metal-ceramic seals for high temperature applications. Close dimensional tolerances, low dielectric loss, high insulation resistance. Dependable bonding. Booth 926.

30—Indiana Steel Products Co.

Indiana Hyflux "One-Piece" Cores, used for the same wide range of applications as two-piece cores, and made of the finest, Armco oriented silicon steel. Booth 339-340.

31—Erie Resistor Corp.

Packaged Assembly Circuit module, PAC, for packaging electronic components consists of "pin" type resistors and capacitors $\frac{1}{8}$ in. x $\frac{5}{8}$ in. mounted in clips. Booth 1325.

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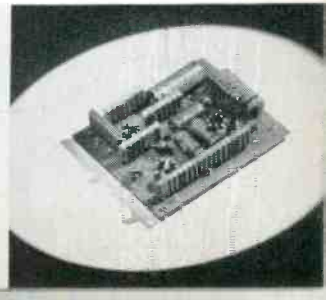
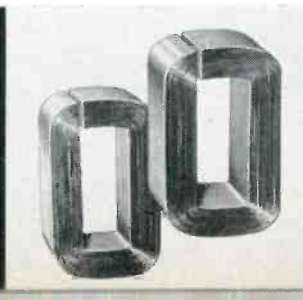
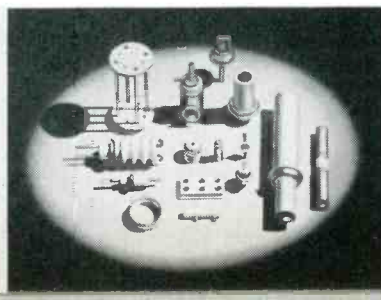
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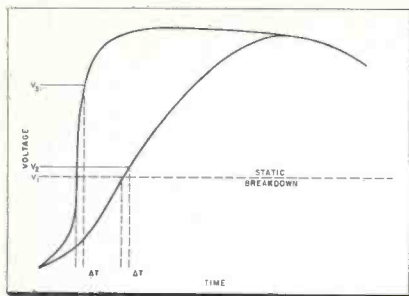


Fig. 1: Fast rise rates lead to higher breakdown voltages because of the avalanche effect

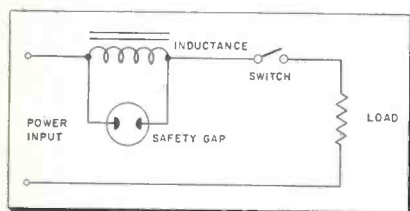


Fig. 2: Safety gap protects coil from surge damage

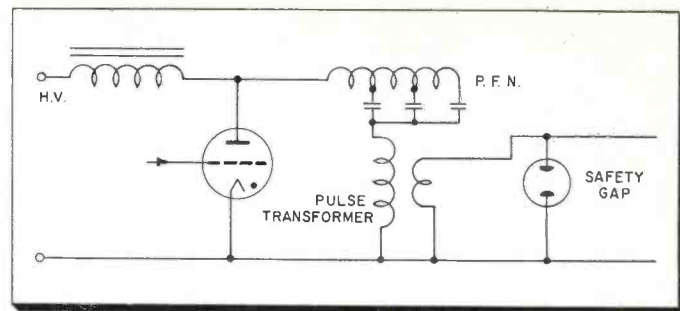


Fig. 3: Gap protects pulse transformer from damage in case of load failure

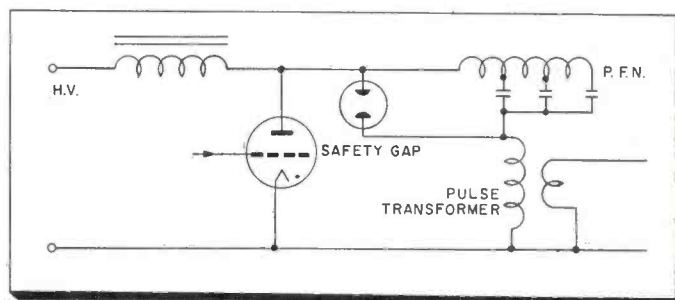


Fig. 4: Safety gap limits surge voltages across pulse forming network

The Spark Gap— New Circuit Component

By **J. H. JOHNSTONE**
Bendix Aviation Corp.
Electron Tube Plant
Eatontown, N. J.

ALTHOUGH the spark gap as an individual electronic device has been known longer than any other electronic item, little is known by equipment engineers about its uses. If the spark gap is considered to have the same characteristics as a voltage sensitive switch its use as a circuit element can be more readily understood. As a switch, spark gaps are able to pass extremely high currents with a relatively low voltage drop, can handle high voltages in a small space, and can be made insensitive to wide variations in ambient temperature. They are also normally not affected by changes in pressure, altitude, or humidity. They can be used in either stand-by or safety circuit service or as an operational circuit element.

The voltage at which the gap will break down can be easily specified if it is under dc or low frequency ac conditions. However, if the gap is subjected either to high frequency, pulse, or sharp wave front conditions the breakdown voltage is not as predictable.

Spark gaps used as voltage-sensitive switches can handle extremely high currents with low voltage drop. Requiring small space, units can be made insensitive to ambient temperature, pressure, altitude, and humidity

Passage of current through the gap requires the formation of a conductive path. Formation of the path requires creation of an "avalanche" of electrons from one electrode to another. Any statistical delay in creation of the avalanche will result in overvoltage being applied to the gap and a resultant

increase in the voltage at which breakdown occurs. In general the pulse or high frequency ac breakdown will be higher than the static or dc breakdown although this increase can be minimized for most applications by changes in the design of the gap.

Referring to Fig. 1, two pulse

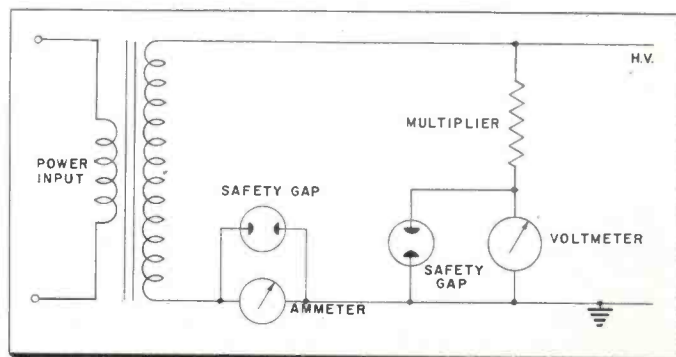


Fig. 5: Meter voltages are limited by shunt gaps

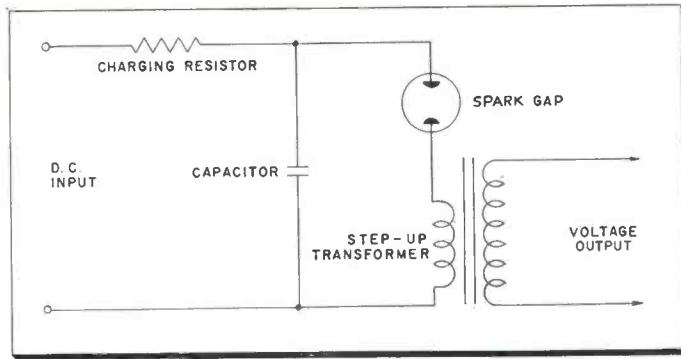


Fig. 6: Spark gap pulse-forming circuit

shapes are shown, one with a slow rate of rise and a second with a much faster rate of rise on the leading edge. If V_1 represents the static breakdown of a spark gap and T represents the delay in formation of the avalanche, the graph shows how, with a slow rate of rise the voltage, V_2 , at the breakdown is but slightly higher than the static breakdown, but with a rapid rate of rise, the voltage, V_3 , at breakdown is much higher than the static breakdown.

In case of repetitive pulses, this rise is not as pronounced. Specified applications of spark gaps in

typical circuits will serve to indicate the areas in which a spark gap can be used to advantage.

In protection service, spark gaps are designed to protect circuit components against damaging high voltage surges. Present operational and environmental requirements of modern electronic equipment do not always allow for a suitable safety factor in the design of components. As a result, transformers, capacitors, and other parts are often overstressed by unavoidable transients in the circuit. To protect operationally rated circuit elements from these tran-

sients, a safety spark gap should be included in the circuit.

The gap is designed to discharge at some point between the normal operating voltage to the circuit and the breakdown voltage of the component. The safety gap must have a stable voltage breakdown over a long period of time and a breakdown tolerance narrow enough to prevent firing during normal circuit voltage fluctuations, and yet allow the gap to fire before the voltage surge becomes damagingly high.

If the current through a choke or inductance is interrupted or changes rapidly, the collapse or rapid change in the magnetic field can cause excessively high voltages to appear across the winding. Insulation rupture may occur causing either a short to core, to case, or shorted windings. A safety gap as shown in Fig. 2, across the coil terminals can protect against the surge and maintain operation of the equipment.

Pulse transformers, modulation transformers, and other similar
(Continued on page 123)

The Selenium Diode in TV Design

By J. T. CATALDO

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WITH the advent of the selenium diode, the electronic design engineer has available a new series of semiconductor components that offer exceptional benefits for future circuit design. These selenium diodes are very rugged components, and offer many advantages over the conventional thermionic diodes. Selenium diodes are the smallest units in the selenium rectifier family. For example, the Types 1S1 and 1T1 measure only 0.120 in. in diameter x 0.210 in. long and are provided with pig-tail leads. Their small size makes them ideal for use where space is limited or where no vibration problems are encountered; no additional support is required because of their exception-

ally light weight. They are particularly suited for electronic applications^{1*} where low to medium voltage is required at low current.

The most recent commercial application for selenium diodes has been in various television circuits, such as the horizontal AFC circuits. Of the three horizontal AFC

circuits in general use today, the balanced phase detector type is the most common. Such a phase detector, Fig. 1, consists of two series-connected diodes. Positive horizontal sync pulses are applied to the free anode, negative horizontal sync pulses are applied to the

(Continued on page 149)

Fig. 1: Thermionic diode phase detector

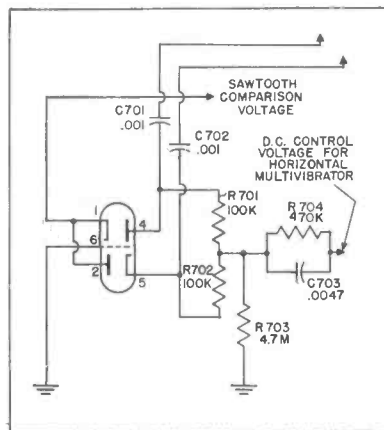
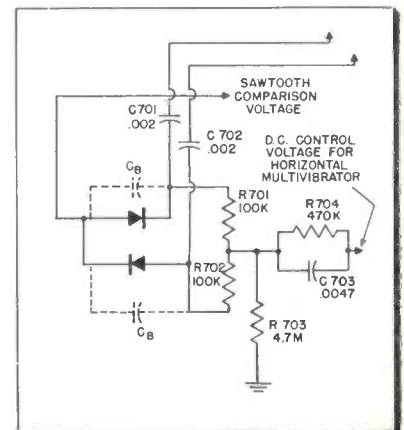


Fig. 2: Selenium diode phase detector



High-Powered C-Band Klystron Amplifiers

Integral-cavity klystron amplifier delivers 50 to 100 watts with high efficiency and wide frequency range by use of ceramics in seals, fittings, and tuner

THE rapid growth of microwave relay communication systems has brought with it the need for new microwave tubes to meet the demands of longer station to station hops, improved fade margins, and less critical antenna alignment for mobile units.

While remarkable success has been achieved with receiver type reflex oscillators in the transmitters of many existing relay systems, one or more of the above demands have now become a 'must' in newer systems. The answer to these demands, of course, is greater power. But the increase in power must be obtained economically and simply; and it must be enough times greater than existing 0.1 to 1.0 watt systems to make substantial improvements in one or more of the urgent areas of need.

The most economical method of achieving these ends would appear to be an efficient amplifier which could use existing equipment as a driver. Why not just a more powerful reflex oscillator instead of an amplifier? Huskier reflex tubes have already been used to raise the power level from 0.1 watt to 1.0 watt. However, with a beam efficiency of 1 or 2%, the reflex types have nearly reached their practical limit at 100 watts input and 1 or 2 watts output.

The tubes to be described here have been designed to deliver 50 to 100 watts CW power output with a beam efficiency of 25% yet require only 10 MW of driving signal. They are linear 4-cavity klystron amplifiers for C-Band requirements from 5300 to 8000 MC.

This frequency range has been covered with the three tubes pictured in Fig. 1.

Tube Description

The Eimac X563 series are integral cavity, magnetically focused klystrons having ceramic insulation throughout for the cathode and collector seals as well as for the r-f coaxial input and waveguide output fittings. The use of ceramic materials has been one of the keys to the success of the tube. The rugged, high temperature vacuum seals at the ceramic-to-metal joints permit simplified assembly techniques not possible with glass, and allow improved processing methods which insure cleaner, harder,

By R. W. Haegele

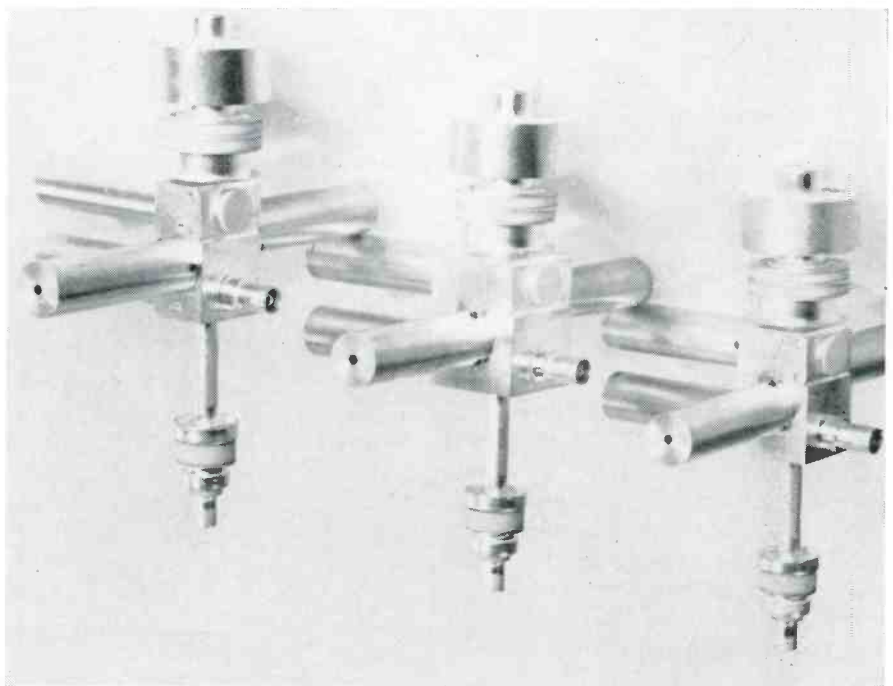
*Director of Microwave Research
Eitel-McCullough, Inc.
Salt Lake City*

longer-life tubes. In addition, the use of ceramic in the tuner mechanism has provided a novel method of tuning the tube which gives a much wider frequency range per tube than is usually found in integral cavity microwave tubes of this power level.

The tuner has no contacts within the cavity (the bearing surfaces are all outside the cavity) and hence it is free of noise or similar problems arising from contact plungers. Neither the walls of the cavities nor the gridless reaction gaps are moved or distorted by the tuning action, thus permitting them to be ruggedly built for excellent frequency stability.

The tuning rate of the ceramic tuner is low enough to insure ease in tuning the klystron to any desired frequency within the band covered. For example, the X563H

Fig. 1: C-band klystron amplifiers cover 6500-8000, 53-5800, and 5900-6500 mc



	300 Watts Beam Power Input	400 Watts Beam Power Input
Frequency	6400	6400 (MC)
Beam Voltage	2700	3050 (V.)
Beam Current	111	131 (ma)
Beam Transmission (with RF drive)	82	84 (%)
Bias Voltage	-16	-18 (V.)
Top Magnet Current	2.5	2.8 (Amp.)
Bottom Magnet Current	3.4	3.5 (Amp.)
RF Input Power	10	10 (mw.)
RF Output Power	67	101 (watts)
Gain	38.2	40.0 (db)
Beam Efficiency	22.3	25.2 (%)
Bandwidth (-3 db)	12	14 (MC)

covers the range from 5900 to 6500 MC in 13 revolutions of the tuning knob. By using high quality ceramic material for the tuner, relatively high cavity Q can be maintained over the entire tuning range. Values from 2500 to 3500 are typical for the X563 series with high alumina ceramics having a dielectric constant of 9.5 and a loss factor of 0.005 or less at these frequencies. Tuning curves in terms of ceramic plunger displacement are shown in Fig. 2 for the X563G, X563H, and X563F.

The cavities of the X563 contain gridless reaction gaps through which is focused a high density electron beam approximately .060 in. in diameter. This beam is initially formed by a Pierce-type electron gun and is confined within the drift tubes of the cavities by a magnetic field. The field is excited by two tape-wound aluminum foil electromagnets which are particularly economical both in space and power requirements. Approximately 80 watts to each coil will supply the required 850 gauss for proper beam focusing.

Tube Performance

The X563 series of tubes are rated for a maximum continuous beam input of 400 watts. Typical operating characteristics for the 300 and 400 watt input levels are tabulated above.

The above conditions represent the tube tuned for optimum power output. By stagger tuning the four cavities, the bandwidth may be substantially increased with a corresponding reduction of gain. For typical broadband operation,

the drive requirement is increased to 40 or 50 MW and the -3 db bandwidth obtained is about 17 MC. At 1 db down, the bandwidth is 13 to 14 MC which is adequate for most TV and communication relay systems using an FM signal.

In addition to CW operation, the X563 series may be pulsed up to about 10 times the normal CW rating. Fig. 3 illustrates the performance of a typical type X563H at voltages up to 6000 v. with a 1% duty cycle. Pulsed power output in excess of 600 watts may easily be obtained with these tubes.

Besides the large increase in power afforded to microwave systems by these tubes, there are other advantages offered by the use of an amplifier. The trouble-

some effects of load variations on the frequency and output of a reflex oscillator are well known. The amplifier, which isolates the driver completely from load changes, is as stable as the input signal itself, and power changes due to load variations are small compared to those encountered with reflex oscillators. The high gain of the amplifier permits the use of a low power reflex tube as a

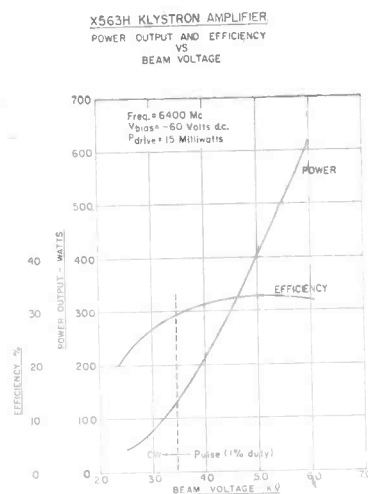
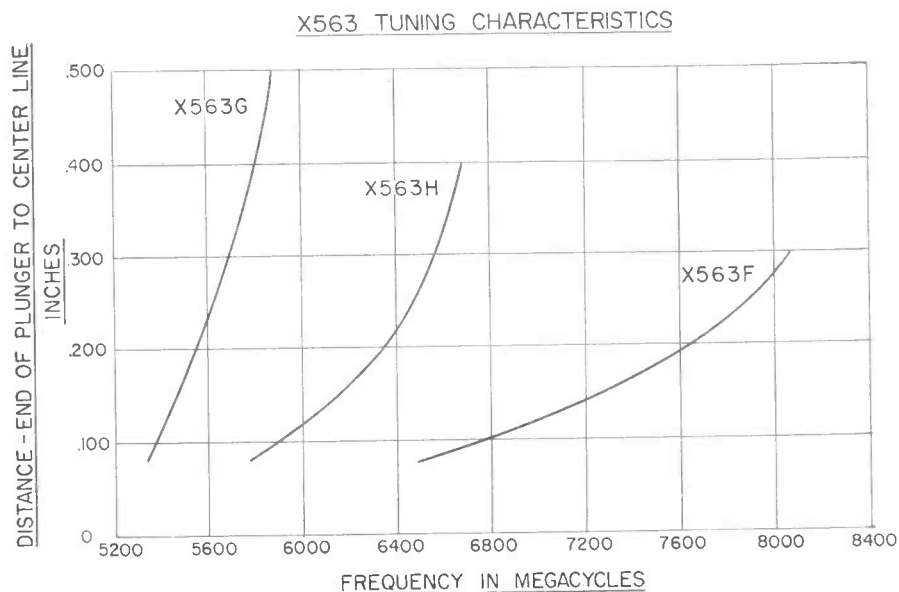


Fig. 3: CW and pulse performance of the X563H klystron

Fig. 2: Tuning curves for X563 klystron amplifiers



By **A. R. ELLIS**
 Head, Antenna Development Group,
 Stanford Research Institute,
 Stanford, California

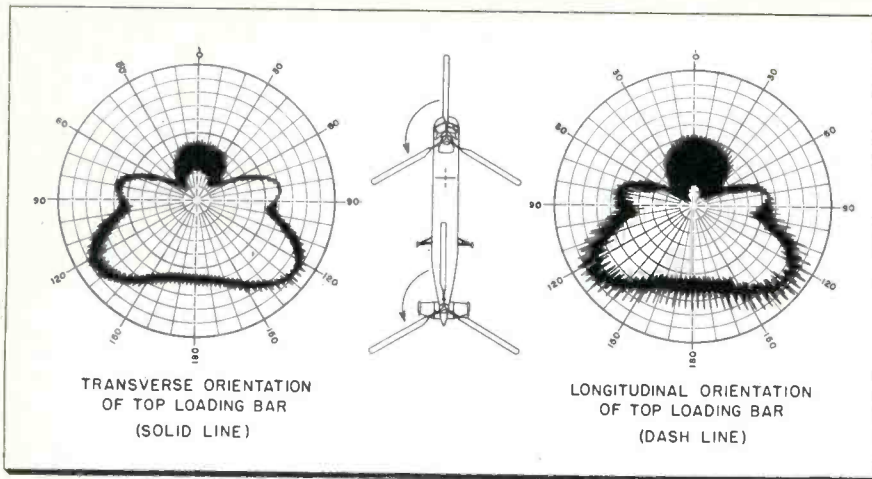


Fig. 1: Rotor modulation on H-21

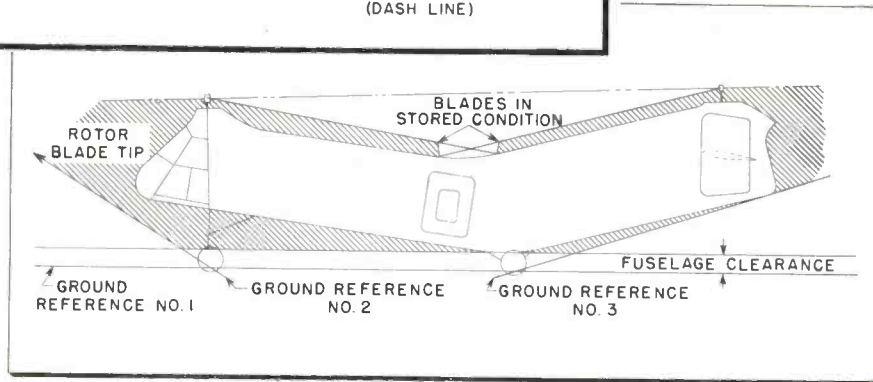


Fig. 2: (R) Location limits on H-21

Helicopter Antenna Design

Unique problems have arisen from the configuration and function of helicopters. New methods and equipment have been designed to study radiation shielding, rotor modulation and harmonic ratios, and airframe resonance.

ANTENNA design problems for helicopters differ in many respects from those for fixed-wing aircraft. Helicopters generally have slow speed, low ceiling, and short range. Typical design cruising speeds of today's rotary wing transports are in the order of 100 knots, 5,000 ft. altitudes, and operating radii of 100 nautical miles. Hence altitude, icing, and drag problems are not as serious as with fixed-wing airframes. As a consequence, flush-mounted antennas are not necessary and, in fact, may not be desirable on helicopters because of the associated weight penalty. One ton is a typical payload of a helicopter today and any increase in weight required to strengthen the aircraft structure for insertion of flush mounted antennas would result in degradation of the helicopter utility.

Height Limitations

Although zero-drag antennas are not required, the permissible vertical height of antennas is limited by factors peculiar to this type of aircraft. The space occupied by the moving rotor blades restricts the location and size of antennas on the top of helicopters. (See Fig. 2.) Further restraints on antenna positions on the upper surface are imposed by the requirement for folding and tying down the blades when storing the aircraft. Ground clearance is important also. Antennas located in some areas on the bottom of the fuselage will be subjected to extremely high forces if they contact the ground or other objects while operating from landing strips in rough terrain. Hence the antennas should be sufficiently small and mounted in those areas on the aircraft which are least vulnerable

to this type of damage. Antennas can also be mounted on the side of the fuselage if they do not cause unnecessary inconvenience or compromise the operation or ground-handling of the aircraft by being susceptible to damage.

Location

For UHF and VHF communication antennas, the major problems are those of location. The requirement for omnidirectional patterns in the horizontal plane are the same as those for fixed-wing aircraft with the additional limitations imposed by the restricted clearances. Although a location under the cockpit may be satisfactory, the non-retractable wheels and associated struts may cause serious lobing in area of interest. (See Fig. 4.) In discussing operational problems with helicopter pilots, shielding of

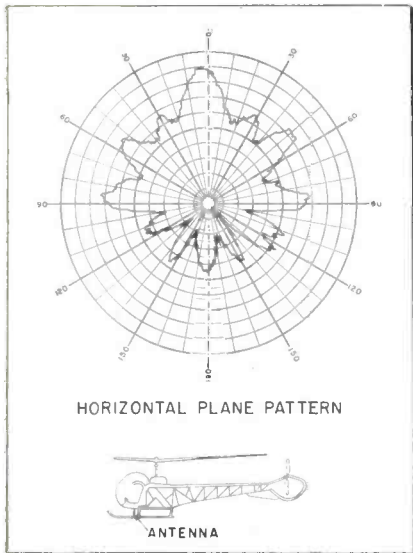


Fig. 4: Struts cause lobing

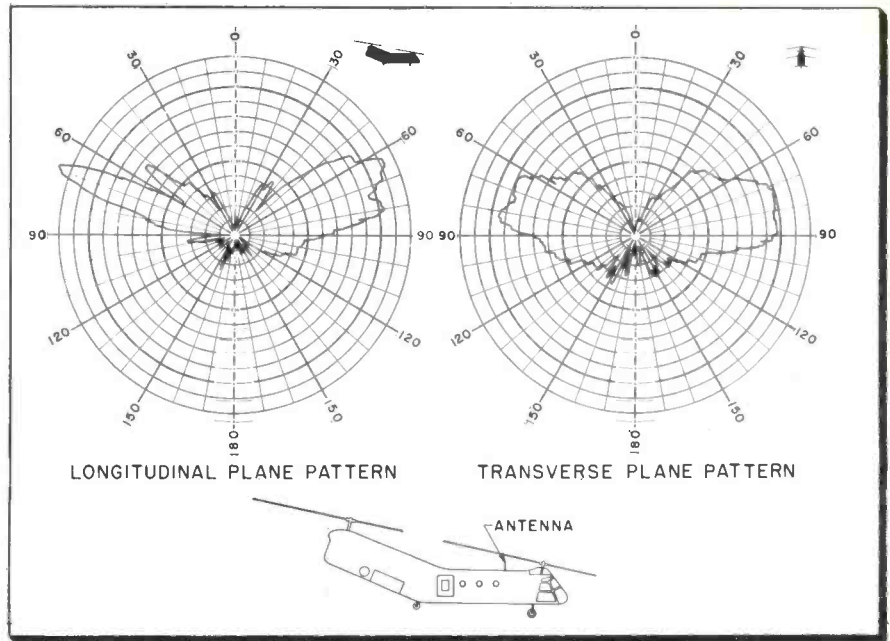


Fig. 3: Structural shielding of UHF

the UHF radiation by the aircraft structure frequently resulted in serious communication deficiencies. Sometimes this required flying the helicopter backwards while communicating. Although this was accepted more or less as a routine matter, it does leave something to be desired. Fig. 3 shows a typical example of shielding to the rear.

Although the small size of UHF stubs permit mounting in many positions where the clearance is restricted, the larger VHF antennas require additional consideration. One type of design which has proven satisfactory where the available vertical height is limited is the "L" or bent stub antenna. Pattern measurements show that the $E\phi$

polarized radiation from the horizontal portion of the antenna reduces the $E\theta$ signal in the horizontal plane by a maximum of about 1 db.

For lower frequencies (24-52 MC.), vertically polarized antenna design and location is more troublesome. Step impedance matching or ultimately automatic matching appears to be necessary for the required low-silhouette radiators to operate through this band, with efficiency, size, and weight being very important factors. In this frequency range, omni-azimuthal vertically polarized patterns are difficult to obtain, since many of the fuselages and rotor blades are of resonant lengths and therefore will

carry high radiation current densities, causing considerable power to be wasted in $E\phi$ polarization. This same effect occurs with larger fixed-wing aircraft at the lower hf frequencies but in that range the random polarization obtained from sky wave propagation permits utilization of both $E\theta$ and $E\phi$ components. The ionospheric reflection is a negligible factor in the 24-52 MC. range, however, and so any energy in horizontal polarization can be considered wasted energy.

For radiation resistances which permit step matching over 2 MC. steps, stub heights of at least $\frac{1}{8}$ wavelength are required. At the low frequency limit (24 MC.) this re-

(Continued on page 114)

Fig. 5: Bearing error on H-21

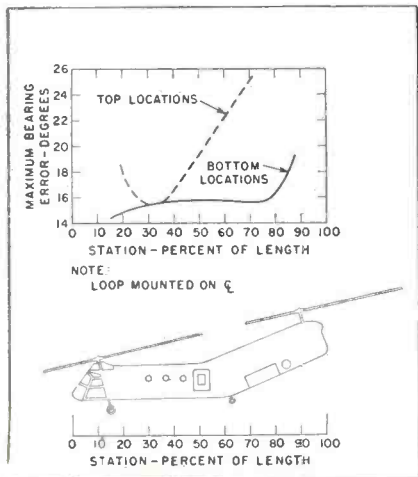
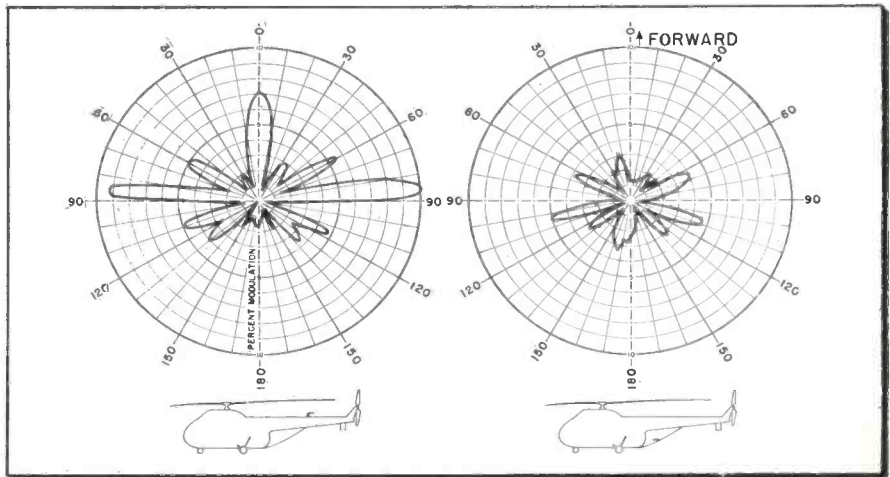


Fig. 6: H-19 rotor modulation - VOR



New Discriminator-Output



Fig. 1: Discriminator-output frequency meter measures 3 cps to 100 kc

WHEN information is recorded or transmitted in the form of frequency, transmission path configuration, path length, cable length, and frequency response all have diminished importance because amplitude changes which are likely to occur during handling become relatively unimportant. Partially for these reasons, many physical data such as airspeed, fuel flow, acceleration and control movement are commonly being converted into frequency variations for transmission purposes in FM/FM telemetering systems. In other cases it is often desirable to measure the magnitude of residual and incidental f-m in signals.

Analysis of such information is facilitated by a new electronic frequency meter which, in addition to indicating a measured frequency directly on a panel meter, converts the frequency into a proportional output current and voltage. This frequency-voltage conversion is accomplished in the instrument by using each cycle of the

Analysis of FM information is facilitated by triggered-pulse, frequency-to-voltage conversion system. New discriminator-output frequency meter measures 3 cps to 100 kc



By **DUANE MARSHALL,**

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input frequency to trigger a pulse-forming circuit. Since the resulting pulses are of standard length and amplitude, an average voltage is produced which is proportional to the input frequency. Variations in the frequency are then easily observed or recorded as variations in voltage or current. Frequency modulation on an input signal, for example, is converted to an a-c voltage whose amplitude is proportional to the peak-to-peak frequency excursion of the input signal and whose frequency is equal to the deviation rate of the input signal.

Fig. 1 shows the new discriminator-output frequency meter. The instrument measures frequencies

in nine ranges from 3 cps to 100 kc to a full-scale accuracy of within $\pm 2\%$. Its ability to measure f-m can be extended well into the microwave range through use of standard auxiliary equipment. An output for operating a strip chart recorder is also provided.

Frequency Shift Measurements

In addition to its discriminator output, the instrument has the ability to expand its scale readings by a factor of 3 or 10 times, i.e., the pointer movement caused by a change in input frequency can be magnified up to 10 times. This feature permits frequency shifts to be measured with increased accuracy.

Fig. 2: Shadow shows normal deflection for 600 cps downward shift of 8 kc signal

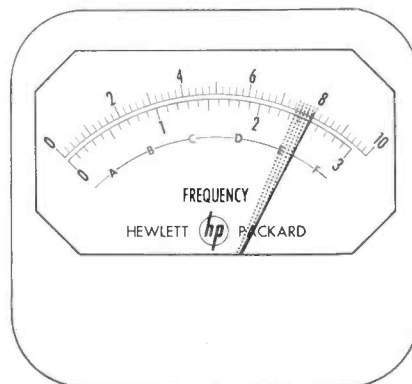
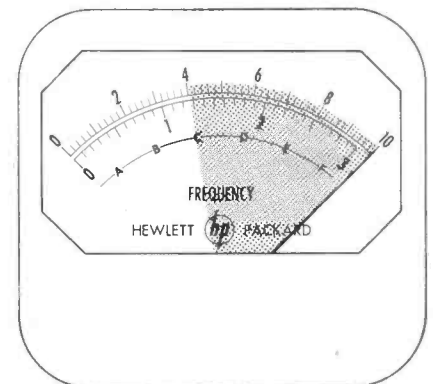


Fig. 3: Expanded operation gives movement over shaded area for conditions of Fig. 2



Frequency Meter

When the expanded scale feature is used, the meter is still direct-reading as far as the change in frequency is concerned. Expanded operation involves the use of a panel control that permits the meter pointer to be positioned to any desired point on the meter scale for the initial reference reading.

The expanded scale feature can perhaps best be illustrated by an example. If a 600 cps downward shift of an 8 kc frequency were to be measured in normal operation on the most suitable range (10 kc) of the instrument, the meter pointer would move through the shaded area shown in Fig. 2.

When such a measurement is made in expanded operation, the meter pointer would be positioned with a panel control to full scale in this example, since the shift is known to be downward. The meter pointer would then appear as shown in Fig. 3. When the frequency being measured now changes as before, the meter pointer will move through the 10 times larger shaded area indicated in Fig. 3. Since 10 times expansion is used with the 10 kc range, the full swing of the meter represents 1 kc. Since the pointer has dropped 60% of full scale, the frequency has dropped 600 cps.

Three times expansion operates in a similar fashion.

Expanded operation has two advantages over conventional operation for the measurement of frequency shifts. In addition to reducing parallax errors by having a magnified motion of the meter pointer for the frequency shift, the measurement itself has increased accuracy. Instead of a possible 4% error (the maximum possible difference between two $\pm 2\%$ measurements), 3 times expansion gives an accuracy within $\pm 1.4\%$ and 10 times expansion gives an ac-

curacy within $\pm 0.7\%$ of the full scale frequency.

Expanded operation does not affect the discriminator output but does expand the recorder output in the same manner that the meter reading is expanded. More detailed information can thus be recorded.

Microwave Measurements

Although the frequency meter itself has a maximum upper limit of 100 kc, this limit can be extended well into the microwave region by the use of standard auxiliary devices such as a transfer oscillator using the heterodyne method. Such an oscillator converts a signal anywhere in the range from 100 mc to 12.4 kmc into a low (below 100 kc) intermediate frequency which contains the same frequency excursion magnitude contained in the original signal. These excursions can then be extracted for external analysis

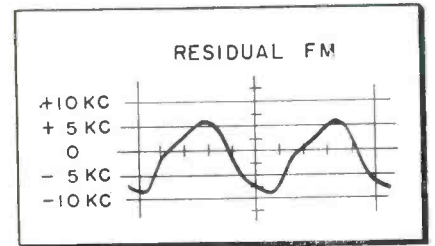


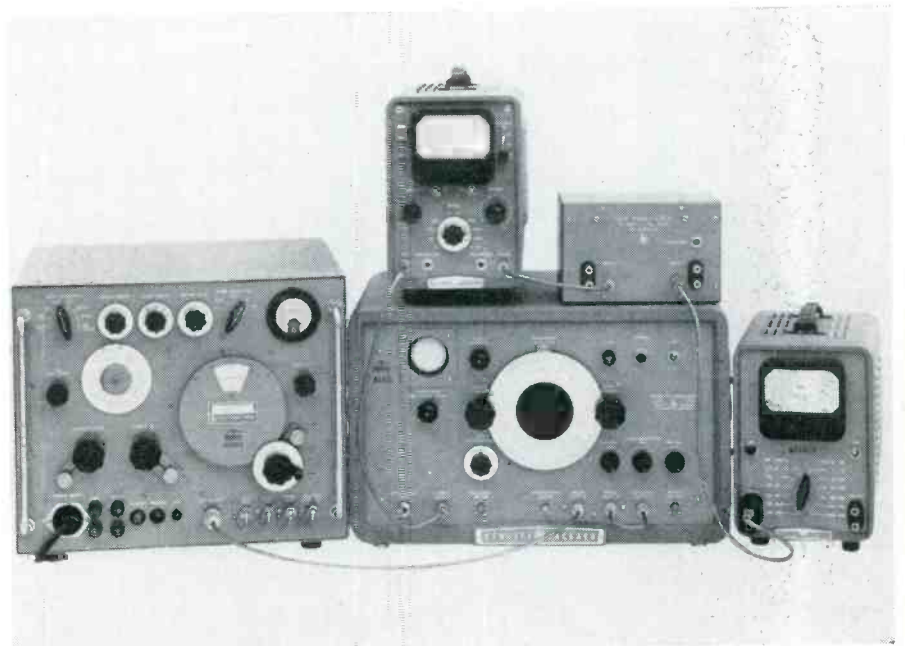
Fig. 4: Oscillogram of residual fm in klystron oscillator output

directly by the new frequency meter.

A typical example of the use of this feature of the frequency meter is shown in Fig. 4. This illustration is an oscillogram of the residual frequency modulation in a klystron oscillator caused by the use of a-c in its heater circuit. In making this oscillogram the oscilloscope gain was set so that each major vertical division on the graticule was equal to 5 kc of deviation. The peak deviation is thus seen to be equal to 15 kc. The fundamental component of this demodulated f-m is 60 cycles but there also exists a large amount of second harmonic. An accurate analysis of these components could be obtained by applying this waveform to a harmonic wave analyzer.

Fig. 5 shows the equipment arrangement used to view the modu-
(Continued on page 121)

Fig. 5: Test set-up using heterodyne oscillator to extend range of frequency meter



Designing Microwave Equipment

The requirements of a medium-route microwave system—handling up to 300 telephone channels—are examined with respect to installation costs, transmission quality and performance, reliability and compatability. Includes average installation costs and typical system characteristics

A microwave system for use in the telephone industry must be designed to permit its engineering, ordering, installation, and maintenance like any other telephone transmission system. This requires the incorporation of features and the provision of services which are often unfamiliar to the radio industry, but which are based on long established telephone engineering practices.

Medium-route microwave is the type of facility that is most applicable to the average telephone plant. (See Fig. 1.) There is no distinct division between medium- and heavy-route, or medium- and thin-route microwave; however, it is expected that the capacity of medium-route systems will eventually reach several hundred telephone channels. At least one system now in use can be expanded, in groups of 12 channels, to an

ultimate capacity of more than 350 channels.

Frequencies

Two frequency bands are most commonly used for common carrier service. These are from 890 to 940 MC and 5925 to 6425 MC. A distinct advantage of the former is the ability to use relatively inexpensive flexible r-f transmission lines. This permits physical separation of the antenna and the microwave equipment and the resultant versatility with regard to installation of the transmitter and receiver. The 900-MC equipment can always be installed indoors, and consequently gets the advantage of routine maintenance at the system terminals. An advantage of the 6000 MC band is the wider available bandwidth, which permits larger numbers of channels to be transmitted without interference.

Basic Requirements

Telephone companies are usually operated by men with long experience in the techniques of communication by open-wire and cable. Consequently, to prove-in and be accepted, medium-route microwave must meet the majority of the following requirements:

1. Installation cost should be below that of an open-wire or cable system capable of providing the same number of channels. Installation costs include all costs incurred up to the lineup of the microwave system.
2. Quality of transmission should be equal to or exceed that of an equivalent open-wire or cable system.
3. Reliability and life-expectancy should be comparable to that of other electronic equipment in the telephone toll plant, such as carrier telephone and telegraph equipment.
4. The microwave equipment must be mechanically and electrically compatible with other telephone equipment.
5. Maintenance cost should be equal to, or less than, that of an equivalent open-wire or cable system. Maintenance procedures should be simple enough that little extra training of maintenance personnel is required.

A microwave manufacturer, in attempting to meet these five requirements, must realize that the provision of microwave equipment is only the beginning in fulfilling a telephone company's needs. Many other factors concerned with the installation, operation, and maintenance of the system take on as much significance as the char-

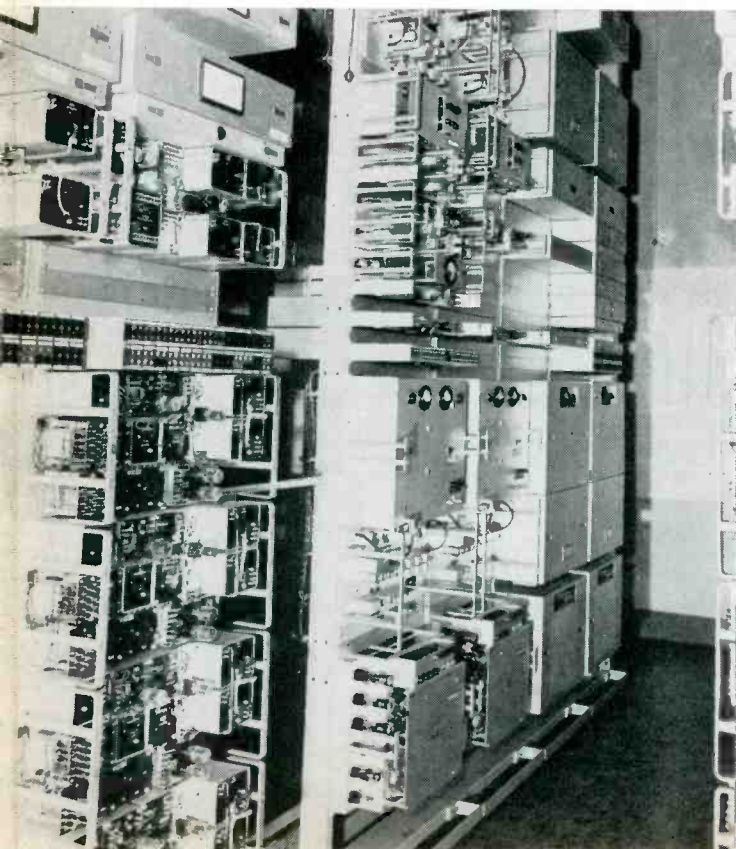


Fig. 1: Typical telephone office installation of medium-route microwave equipment.

For Telephone Companies



W. C. FISHER

*Lenkurt Electric Co.
San Carlos, Calif.*

acteristics of the basic radio equipment itself.

Installation Costs

Installation cost is one of the most important of the five basic requirements of microwave for the telephone industry. An important part of the total installation cost may be the cost of the microwave equipment. This is especially true for relatively simple installations. In many cases however, particularly where large antenna structures, emergency power supplies, power lines, access roads, and buildings are involved, the cost of the radio and carrier equipment may be only of incidental importance. Fig. 2 shows a typical remote repeater station in which the cost of the transmitting and receiving equipment was only a small part of the total installation



Fig. 2: Typical remote repeater station. Cost of transmitting and receiving equipment is only small part of total cost.

cost. Fig. 3 shows a simple pipe-mounted antenna for a relatively inexpensive microwave installation.

Of the many items contributing to the initial cost of a microwave installation, several factors under the control of the manufacturer are important in keeping the first cost as low as possible. These factors include the design of equipment especially for telephone use, the construction of equipment to promote ease of installation, and the provision of information and instruction material for telephone personnel.

Another factor which reduces initial cost is the availability of a completely engineered microwave system instead of component parts which then require expensive engineering coordination. Also, accurate and up-to-date engineering and ordering information supplied by the manufacturer saves time in writing specifications and requisitions, and assures complete delivery of the equipment.

An important reason for keeping the first cost of a microwave system to a minimum is to improve its competitive position with respect to open-wire and cable facilities. At present, the prove-in distance of a single-section microwave system may be as short as



Fig. 3: Simple pipe-mounted installation

15 miles. For distances less than this, cable and cable carrier still appears to be the most appropriate facility. In the future, however, improved and more economical microwave techniques can be expected to reduce the prove-in distance to even less than 15 miles.

An instance is known where a single-section 48-channel system was installed over a 17.5 mile path between two cities. At each end of the system antennas were mounted on pipe masts on top of the telephone company office buildings. In engineering the system, a comparison was made between the cost of the 48-channel microwave and an equivalent cable installation. It was determined that cable would have cost about \$4500 more than the radio and multiplexing equipment, installed and ready for service. In this particular case, the difference in cost was important; but the deciding factors were the expandability, reliability, and the ease and simplicity of installation of the microwave. Table 1 gives a comparison between the installation costs of an expensive and a simple installation.

Medium-route microwave usually is expected to provide transmission facilities for part of, or

Microwave (cont.)

all of, one link in the nation-wide toll network. It is therefore necessary that the microwave system have characteristics which maintain satisfactory toll-quality performance.

The four most important transmission characteristics of a microwave system are flat frequency response, level stability, frequency stability, and adequate signal-to-noise ratio. The first three usually are the least troublesome to the microwave manufacturer because they represent areas in which conventional radio engineering techniques are applicable.

The operational characteristic which gets the closest scrutiny by telephone engineers is the capability of the microwave to provide a transmission medium in which all carrier channels are within the noise limits prescribed by accepted toll standards. The noise contribution of the microwave is the factor which limits, more than any other single characteristic, the system's length and channel capacity.

In the engineering of links (toll trunks) for the nation-wide toll dialing system, a frequently quoted objective is the maintenance of total long-term¹ average noise below +31 dba;² The noise level per link may rise above this for small percentages of the time.

A link may be made up of combinations of cable, wire-line, and microwave in tandem. Therefore, the microwave system's noise contribution will be limited to a value which is the difference between the accepted standard and the added noise power contribution by the cable, wire-line, and channelizing equipment. Since each application of microwave involves different factors, it is necessary that the manufacturer provide accurate noise performance data to the telephone transmission engineer.

The noise contributed by the microwave system comes from three main sources:

1. The modulator of the transmitter (modulator noise).

Expensive Repeater Installation		Simple Terminal Installation	
Land and Building	\$25,000	Antenna Support	\$ 500
Access Road	\$18,000	Installation and Accessory Equip..	\$1,000
Antenna Supports	\$ 6,000	Radio Equipment	\$8,000
Installation and Accessory Equip.	\$90,000		
Radio Equipment	\$20,000		\$9,500
	\$149,000		

Radio Equipment Cost is 13.5% of Total Cost

Radio Equipment Cost is 84% of Total Cost

In an average installation, the microwave equipment cost amounts to less than 50% of the total installation first cost.

2. Intermodulation distortion due to nonlinearities in the microwave equipment.
3. The head-end of the receiver (receiver thermal noise—of principal interest during fading).

The importance of the noise contributions from these sources depends upon the number of repeater sections in a system, the section lengths, and the propagation path clearances. The noise produced by each source must be kept as small as design and manufacturing techniques will allow because individual noise contributions are additive on a power basis.

Modulator noise can be minimized by good equipment design, but can never be eliminated. A

typical microwave transmitter for telephone use will generate about +14 to +16 dba of such noise.

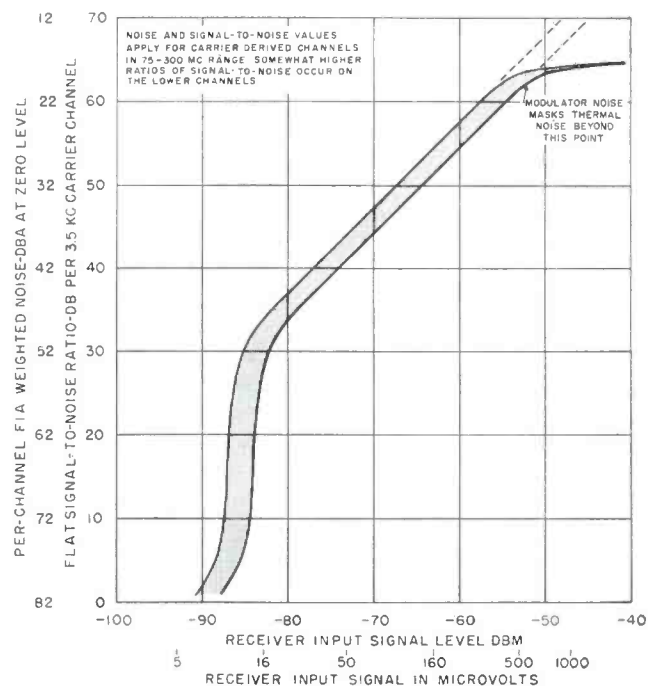
Intermodulation distortion is a more complex noise source. The linearity of the modulator, demodulator, and wideband amplifiers under peak load conditions determines the amount of noise contributed as intermodulation distortion. Loading depends upon the type of carrier system, the peak number of channels in use at one time, and the talker levels.

(1) Long term is considered to be more than 50% of the time.

(2) All noise measurements quoted are at a zero level transmission point with F1A weighting.

Complete and accurate information on the performance of the
(Continued on page 126)

Fig. 4: Thermal noise characteristic of a Lenkurt Type 72B 900 MC FM microwave receiver.



Page from an Engineer's Notebook

No. 37—VTVM High-Frequency Error

By J. F. SODARO

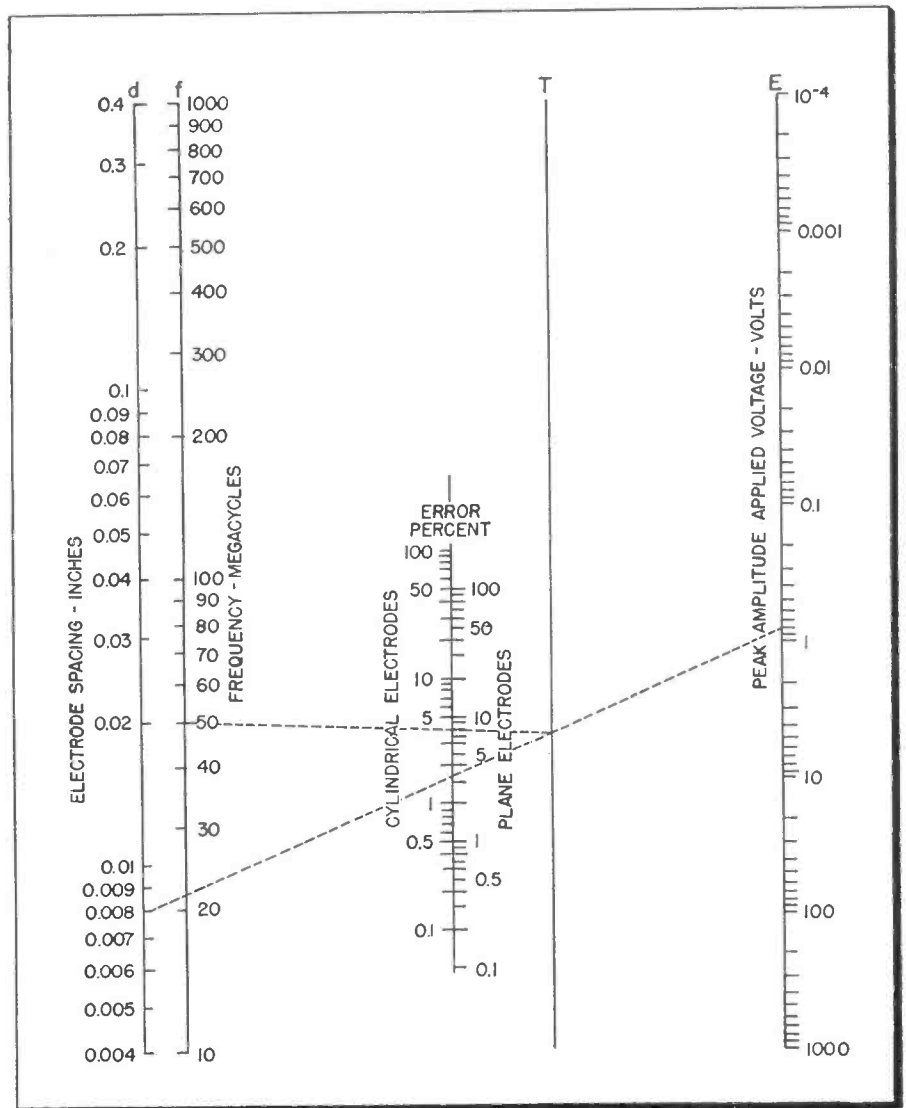
Nomograph provides a quick calculation of the error introduced by the transit-time effect in the input diode

AT very high frequencies the VTVM indicates less than the peak applied voltage because of electron transit-time effect within the input diode. When travel time is a large percentage of the input-voltage cycle-duration, some electrons may not pass from cathode to plate before plate potential falls below the value required to attract these electrons. The transit-time is proportional to the cathode plate spacing and to the shape of these elements. Furthermore, the error is inversely proportional to the square root of the applied peak voltage. For moderate to small errors the following relation applies^{1, 2}

$$\text{Error} = \frac{0.847 fKd}{\sqrt{E} \times 10^{10}} \quad (1)$$

in which f is in CPS, K is approximately 1050 for cylindrical electrodes and 2100 for plane electrodes, d is the cathode-plate spacing in inches, and E is peak applied volts.

Engineers designing or using diode-voltmeters for high-frequency measurements may find it desirable to estimate measurement error for such instruments. This error depends upon applied voltage, frequency, and diode characteristics as shown by Eq.1. Repetitive evaluation of Eq.1 is simplified by the use of the nomograph shown in Fig. 1. To use this nomograph, select the electrode spacing in inches on the d scale and peak applied voltage in volts on the E scale. Connect these points with a straight line and locate a turning point where this line intersects the T scale. Locate frequency in MC on



the f scale and connect this point with the turning point by a second straight line. Where this line crosses the ERROR scale, read the error in per cent using left side for diodes with cylindrical electrodes and right side for diodes with plane electrodes.

As an example, assume that the input diode has cylindrical electrodes spaced .008 in. For an input of .8 v. peak at 50 MC estimate the

instrument error. Draw a straight line from .008 on d to .8 on E and locate turning point where this line crosses T . From this turning point to 50 on f draw another line which crosses the left side of the ERROR scale slightly below 4%.

References

- ¹F. E. Terman and J. M. Pettit, "Electronic Measurements," p. 25-28, McGraw-Hill, New York, 1952.
- ²L. S. Negaard, "Electrical Measurements at Wave Lengths Less than Two Meters," *Proc. I.R.E.*, p. 1207, Sept. 1936.

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Shock-Resistant Graphic Milliammeter

Reliable operation under shock conditions up to 30 g. such as exist in aircraft, is achieved by using transistorized servo amplifiers and heated ball point pens.

By G. WALTERS

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Dalmo Victor Co.,
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to be designed specifically for such a purpose, and must combine accuracy, reliability, simplicity of operation, and small physical size with ability to operate under widely varying conditions of vibration and shock.

Electronic Section

Fig. 1 shows the electronic section of a recording milliammeter designed for airborne applications. Designed for a full scale range of .5 ma, the unit is composed of a regulated power supply, the circuitry required to provide internal test

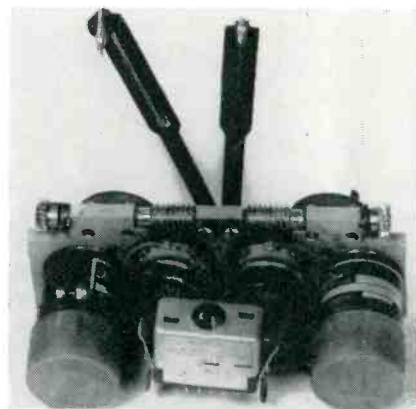


Fig. 2: Ball point pens are electrically heated at low temperatures

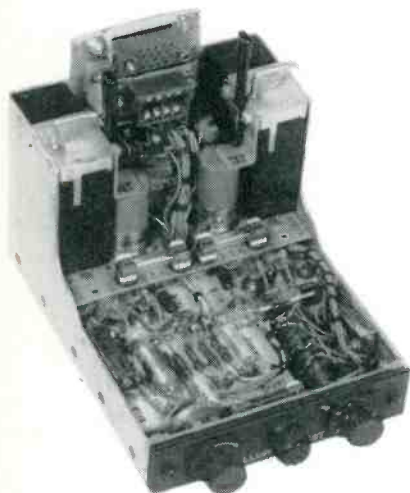


Fig. 1: Switch at right gives on-off and 6 test positions

THE increasing complexity of modern aircraft brings with it an ever increasing need to record numerous functions while in flight. Attempts to utilize existing lab type recorders have had only limited success because of the excessive bulk, weight, and vulnerability to shock and vibration usually exhibited by such instruments.

It has become evident that a successful airborne recorder needs

TABLE I

Sensitivity	± 0.5 ma for full scale deflection
Input Impedance	15,000 ohms
Frequency Response	Full scale to 3 cps 1/10 scale to 15 cps
Dual Pen Recording	Red and green channels completely isolated one from the other and from chassis ground
Paper Width	4.25 in. total 4 in. writing width
Paper Supply	1-15/16 in. diameter roll, 1,000 in. in length
Paper Speed	Manually set to 12, 3, or $\frac{3}{4}$ ipm
Case Size	5 $\frac{3}{4}$ in. wide x 7 in. high x 7 in. deep
Weight	8 lb.
Vibration	10-55 cycles— ± 0.030 in. excursion
Shock	30 g for 15 msec duration, 3 directions
Temperature	-50° to $+71^{\circ}$ C.
Writing Time	5.5 hr (at 3 ipm paper speed)
Power Input	115 v. 400 cps at .4 a. 28 v. dc at .25 a.

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Johnson Co Lou 1506 NW Irving CA 2-9551
North Pacific Supply 2950 NW 29 Ave CA 8-9576
Northwest Radio Supply 110 SE 8 Ave BE 4-9787
*Portland Radio 1234 W Stark ST AT 8647
Saelens Radio 1605 NW Everett CA 8-6395
*Stubbs Electric 33 NW Park Ave BR 5404
*Tracey & Co 937 NW Glisan ST CA 3-6263
TV & Radio Supply 720 SE Alder BE 2-1104
*United Radio Supply 22 NW 9 Ave CA 3-6323

SALEM

Eoff Electric P O Box 709 3-9251
Johnson Co Lou 935 S Commercial Hqrs Portland
United Radio Sup 697 S 12 Hqrs Portland

Washington

ABERDEEN

C & G Radio Supply Co Hqrs Tacoma

BELLINGHAM

Waitkus Supply 110 Grand Ave 274

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Geiger Radio W A 1101 Columbia 2-7701

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*Pringle Radio Whole 2514 Colby Ave

KENNEWICK

Wible Radio Supply Hqrs Tacoma

OLYMPIA

C & G Radio Supply Co Hqrs Tacoma

PASCO

Lay & Nord Hqrs Yakima

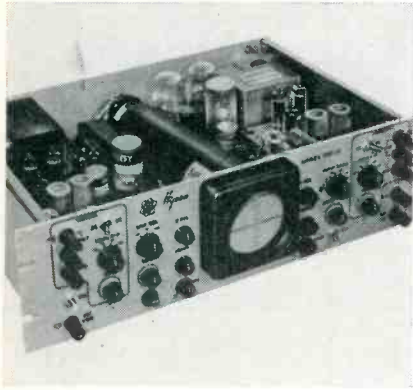
SEATTLE

Central Electronics 2023 7th Ave
Coast Radio 110 University ST MA 9133
(Continued on page 155)

New West Coast Products

OSCILLOSCOPE

Model 627R rack mounting 3 in. Oscilloscope, 5¼ x 11 x 19 in., responds from DC to 300 kc and is flat from DC to 150 kc. Horizontal and vertical amplifiers are



identical and balanced. All operating controls are grouped for maximum efficiency and flexible performance. The 3 in. CRT is flat-faced and a tight tolerance type with recurrent or triggered sweep. It expands 8 times tube diameter. Hycon Electronics, Inc., Pasadena, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-6).

READOUT INDICATORS

Three new in-line readout indicators, the 5910 Series, for counting instruments, feature all numbers in one plane to reduce operator fatigue and reading errors. Indicators retain the reading while the counter accumulates new data, permitting more samples per unit time. Each digit consists of a plug-in module formed



by a p-c board, 2 tubes, 4 p-c relays and a printed display panel. Berkeley Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond 3, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-22).

A-D CONVERTER

New eight-bit sine-cosine analog-to-digital converter consists of two disc-type commutators with pick-off brushes. The double-brush V-scan system is used to avoid



ambiguity. The input shaft is scaled at 360° rev. full-scale input. Coding is in continuous serial binary form in increments of 2-8 for values of the functions from zero to one. A ninth bit is included to enable the encoding of the value one. Librascope, Inc., Glendale, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-3).

TRIMMER POT

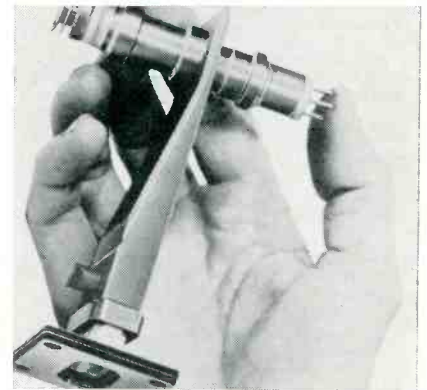
Sealed trimming potentiometer, Trimpot Model 230, subminiature in size, meets or exceeds Military Humidity Specifications (MIL-E-5272A). Furnished with wire-wound or carbon resistance element. Wire-wound unit operates at 135°C, and dissipate 0.4 watts



at 50°C. Screwdriver adjusted over 25 turns, with a self-locking shaft for stable settings. Allen, Dorsey & Hatfield, Inc., 5010 Sunset Blvd., Los Angeles 27. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-25).

BACKWARD WAVE OSC.

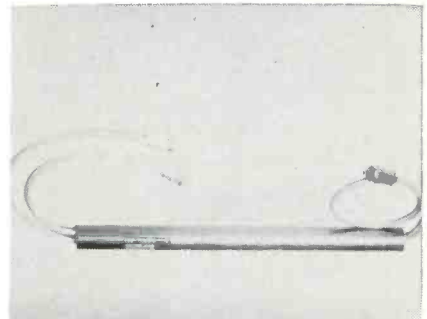
Model VA-161 miniature backward wave oscillator is designed for modern, miniaturized equipment. It is instantaneously tuned by changing voltage. Operates



over the normal 8.5 to 9.6 KMC radar band on less than 300 v. making possible the use of existing radar system power supplies. Contains a permanent magnet which weighs less than 5 lbs. Tube is approximately 4 x ¾ in. Metal and ceramic construction. Varian Associates, 611 Hansen Way, Palo Alto, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-19).

TRAVELING WAVE TUBES

HA-12 S-Band and HA-13 X Band traveling wave tubes feature broadband operation. Primary use for their pulsed power characteristics is in microwave measurements and in medium power driver applications. Positive grid control is provided for amplitude modulation and AGC. Characteristics (HA-12): power out—1 w.;

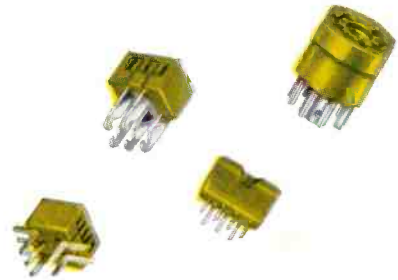


helix volts—950 v.; cathode current—35 ma.; grid volt—100 v.; magnetic field 600 gauss. Hugins Labs., Inc., 711 Hamilton Ave., Menlo Park, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-31)

CINCH ★ STANDARD COMPONENTS



AUTOMATION... automatically made, therefore made with precision metal and electrical components. CINCH automatically assembled parts assure the uniformity and quality mandatory for use in AUTOMATION in the end users equipment.



CINCH SUB-MINIATURE SOCKETS insure positive electrical control, hold tubes securely in place, permit easy maintenance replacement, yield maximum insulation and minimum high frequency loss.

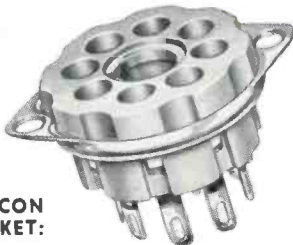
CINCH SOCKETS
CINCH MANUFACTURING CORPORATION
 AND
HOWARD B. JONES DIVISION

<p>TUBE (RECEIVER, TRANSMITTER AND SPECIAL): BATTERY, ALL TYPES</p> <p>C-R TUBE</p> <p>CRYSTAL</p> <p>ELECTROLYTIC</p> <p>GLASS TYPE; 4 TO 7 PRONG LAMINATED</p> <p>INFRA-RED RAY TUBE</p> <p>HIGH ALTITUDE AIRBORNE TYPES</p> <p>KINESCOPE; MAGNAL, DUODECAL, DIHEPTAL</p>	<p>LOKTAL-MINIATURE-MULTIPLUG-NOVAL-OCTAL (MOLDED BAKELITE, STEATITE, TEFLON, KEL-F AND LAMINATED)</p> <p>PLEXICON</p> <p>PRINTED CIRCUIT</p> <p>SPECIAL SOCKETS TO SPECS</p> <p>SUB-MINIATURE; HEARING AID TYPES</p> <p>TV; 110V CIRCUIT BREAKAWAY</p> <p>VIBRATOR</p> <p>PENCIL TUBE TRANSISTOR</p> <p>DIODE</p>
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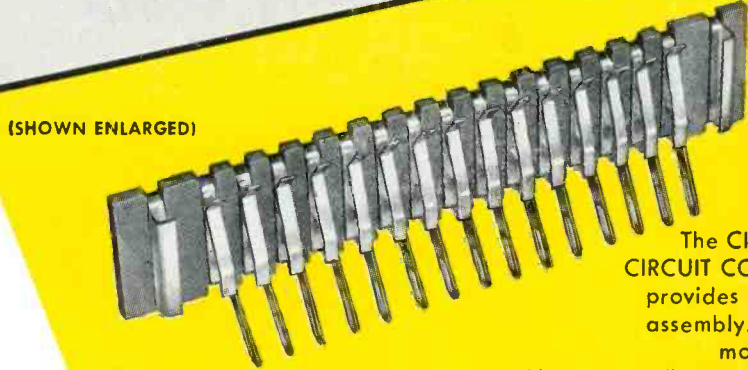
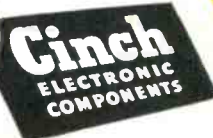
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With built-in ceramic condensers, Plexicon Tube Sockets, no larger than standard receiver socket, provide the most effective method of by-passing . . . with condenser close to tube element providing shortest path to the ground . . . capacity up to 1,000 MMF—the tube element may be coupled or by-passed as desired.



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NEW



Polystyrene Decade Capacitor

Range:
0.001 μf to 1.11 μf
in steps of 0.001 μf

Accuracy:
within $\pm 1\%$ for any setting

Insulation Resistance:
greater than 1 $\text{MM}\Omega$

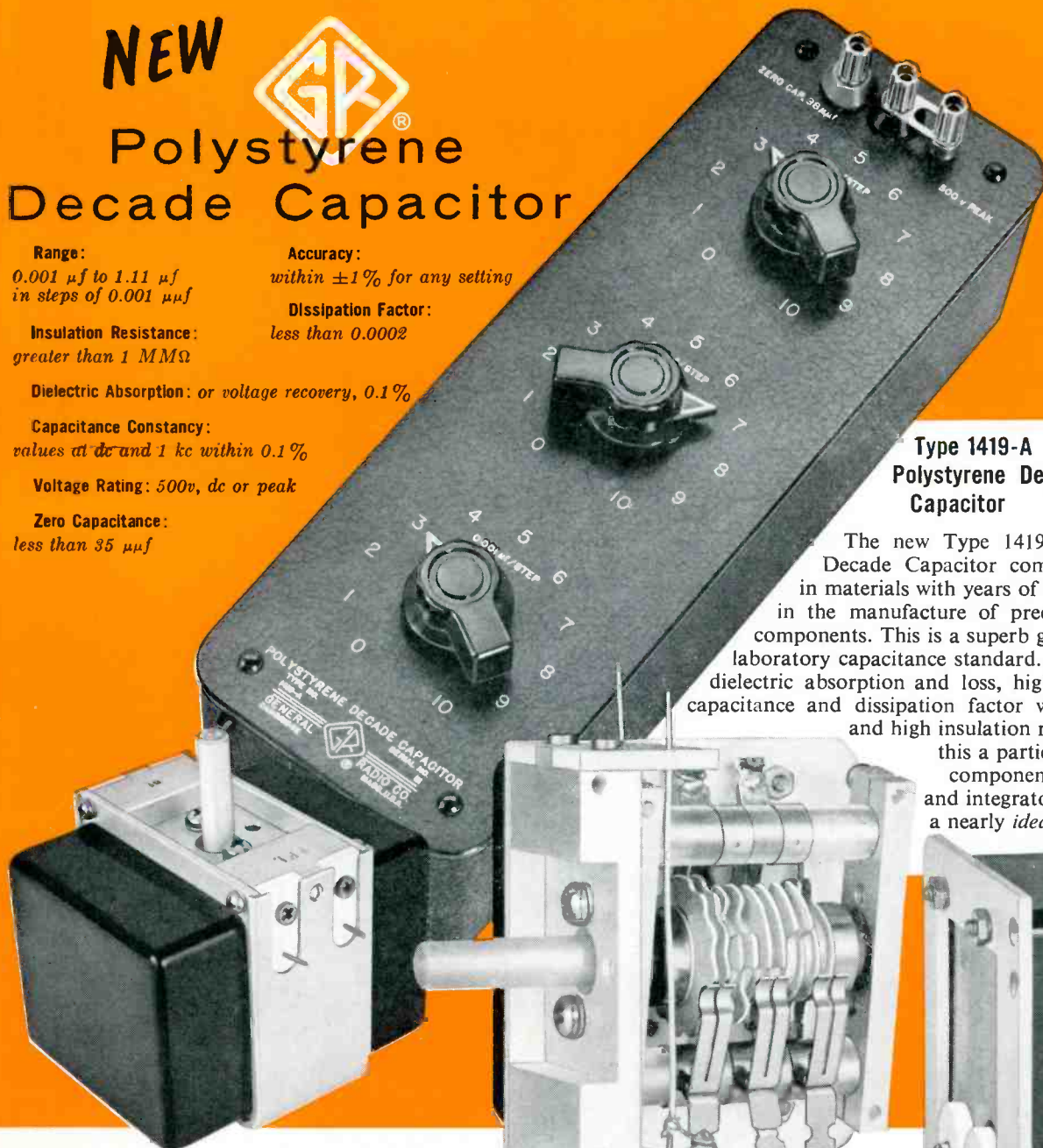
Dissipation Factor:
less than 0.0002

Dielectric Absorption: or voltage recovery, 0.1%

Capacitance Constancy:
values at dc and 1 kc within 0.1%

Voltage Rating: 500v, dc or peak

Zero Capacitance:
less than 35 μf



Type 1419-A Polystyrene Decade Capacitor \$195

The new Type 1419-A Polystyrene Decade Capacitor combines the best in materials with years of G-R experience in the manufacture of precision electrical components. This is a superb general-purpose laboratory capacitance standard. Extremely low dielectric absorption and loss, high constancy of capacitance and dissipation factor with frequency, and high insulation resistance make this a particularly suitable component for computer and integrator circuits. It is a nearly *ideal* capacitor for d-c work.

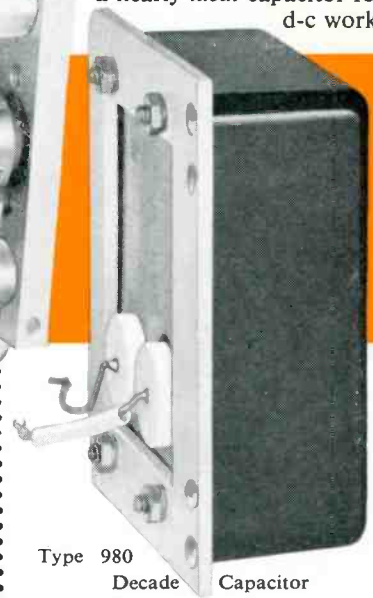
Each Type 1419-A Polystyrene Decade Capacitor contains three Type 980 Decade Capacitor Units. These basic Units are constructed to rigid electrical and mechanical specifications. They feature:

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Type 980
Decade Capacitor

Units may be bought separately to be built into tuned circuits, wave filters, oscillators, amplifiers, and other apparatus. Similar Units, with paper or mica dielectric for use where dissipation-factor requirements are not critical, are also available at lower cost.

Prices range from \$26 to \$128.
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GENERAL RADIO Company



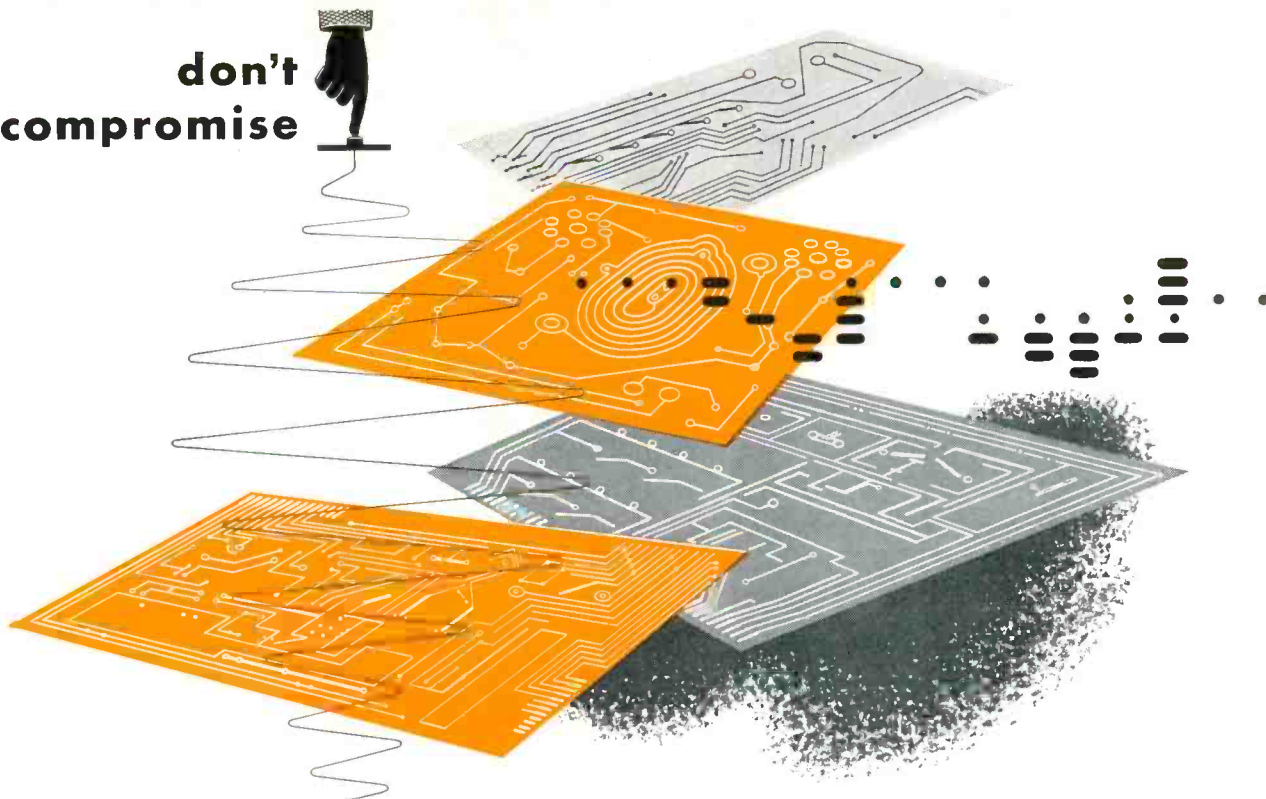
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ARE YOU, LIKE SYLVANIA,

*Pushing to Higher
Frequencies?*



Dr. R. G. Futter, manager of Sylvania's Physics Research Laboratories, under whose direction basic research in traveling wave tubes is carried on, discussing problems with engineer R. I. Harrison. Dr. Futter is holding a Sylvania low level 2000-4000 mc amplifier tube in his hands.

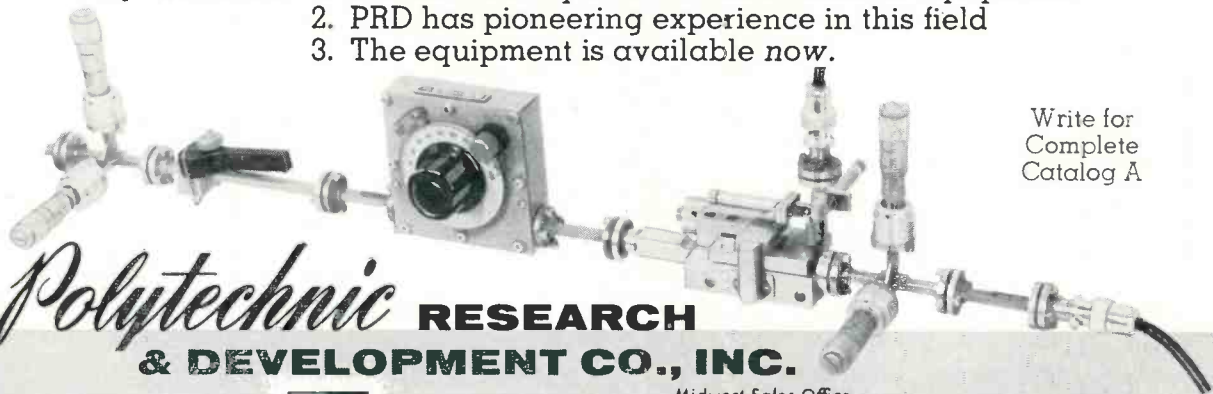
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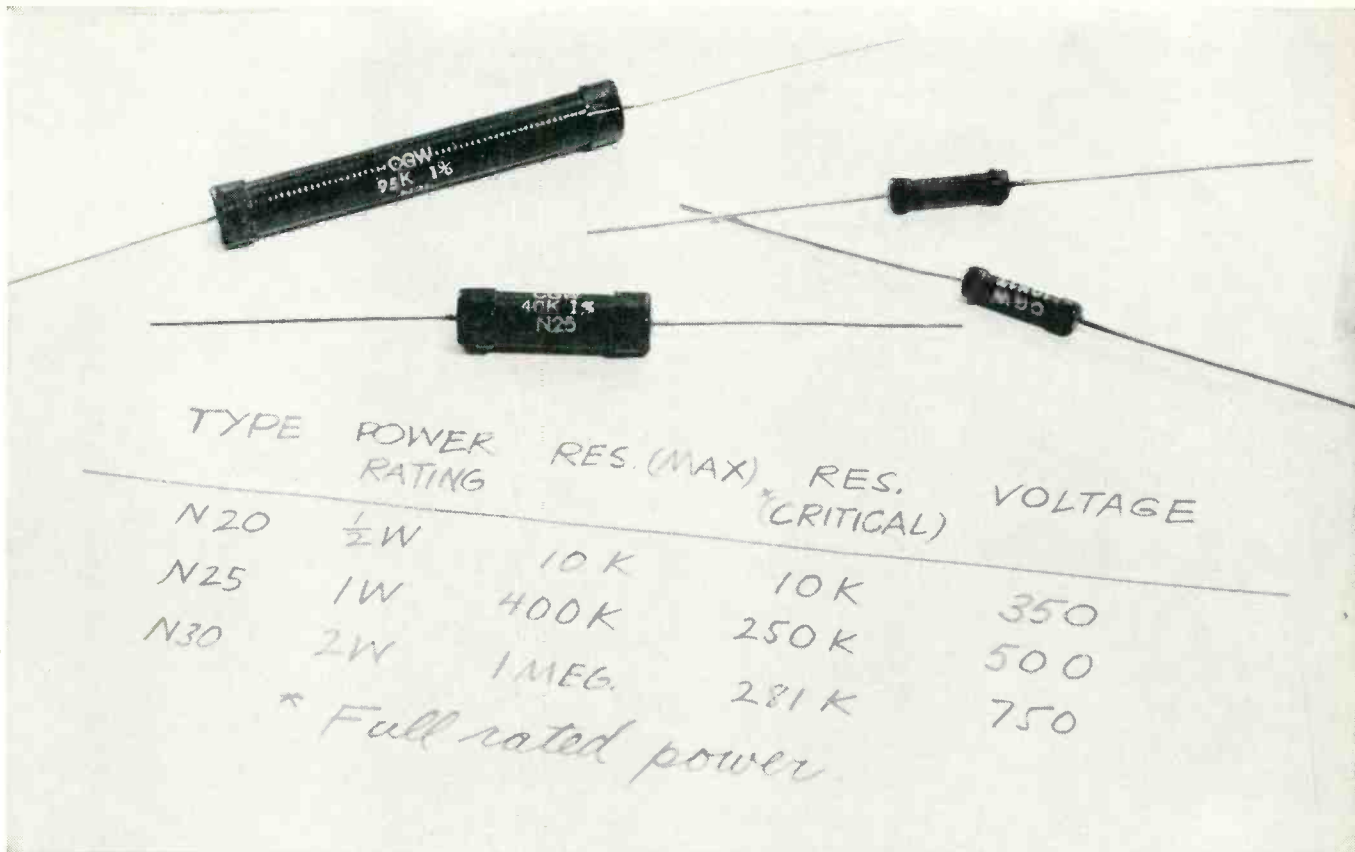
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New film multiplies Corning Type N resistance range 10 times on N 25 - N 30 types . . . closer tolerance TC now available

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With this development, you also get a much improved temperature coefficient. It can be guaranteed to ± 300 ppm/ $^{\circ}$ C. over the temperature range of -55° C. to $\pm 105^{\circ}$ C. referenced to 25° C.

You get these noninductive resistors in standard tolerances of 1%, or closer if you wish. They are stable, have low voltage coefficients and noise levels so low they are difficult to measure. The

film and the core are impervious to moisture. Even rough production handling and thermal shock of soldering will not alter values. Corning Type N Resistors meet or exceed MIL-R-10509A specifications.

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Our catalog sheet details complete information. We'll send it to you with samples and very interesting price lists at your request. Write us or circle this publication's reader service number.

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Type HP—High-power resistors. 17, 30, 70, and 150 watts DC. Tolerances of 2% or 5%. Range from 30 to 1/2 Megohm.

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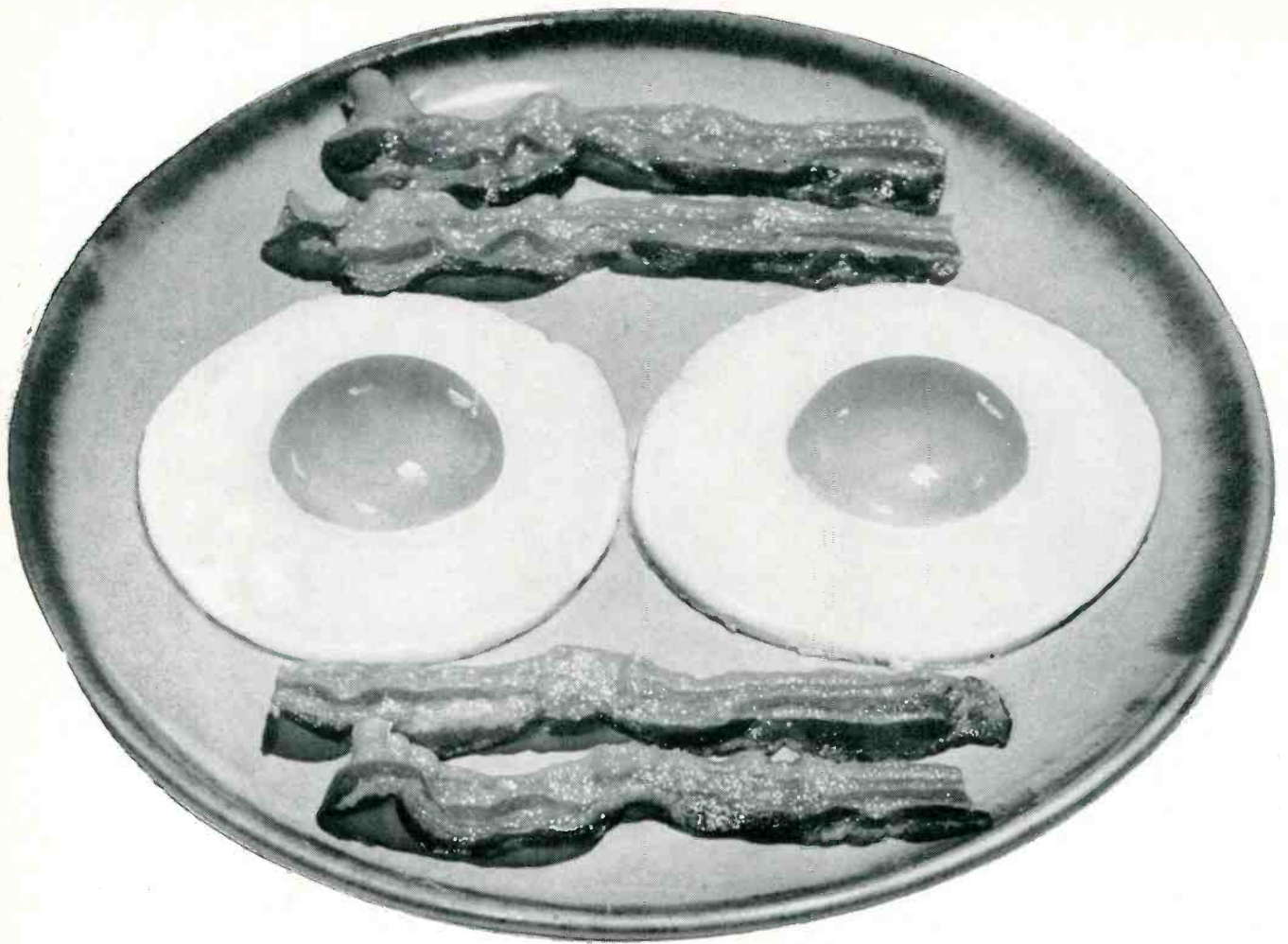
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* Motors are shown at same reduction as this photo of standard paper clip.

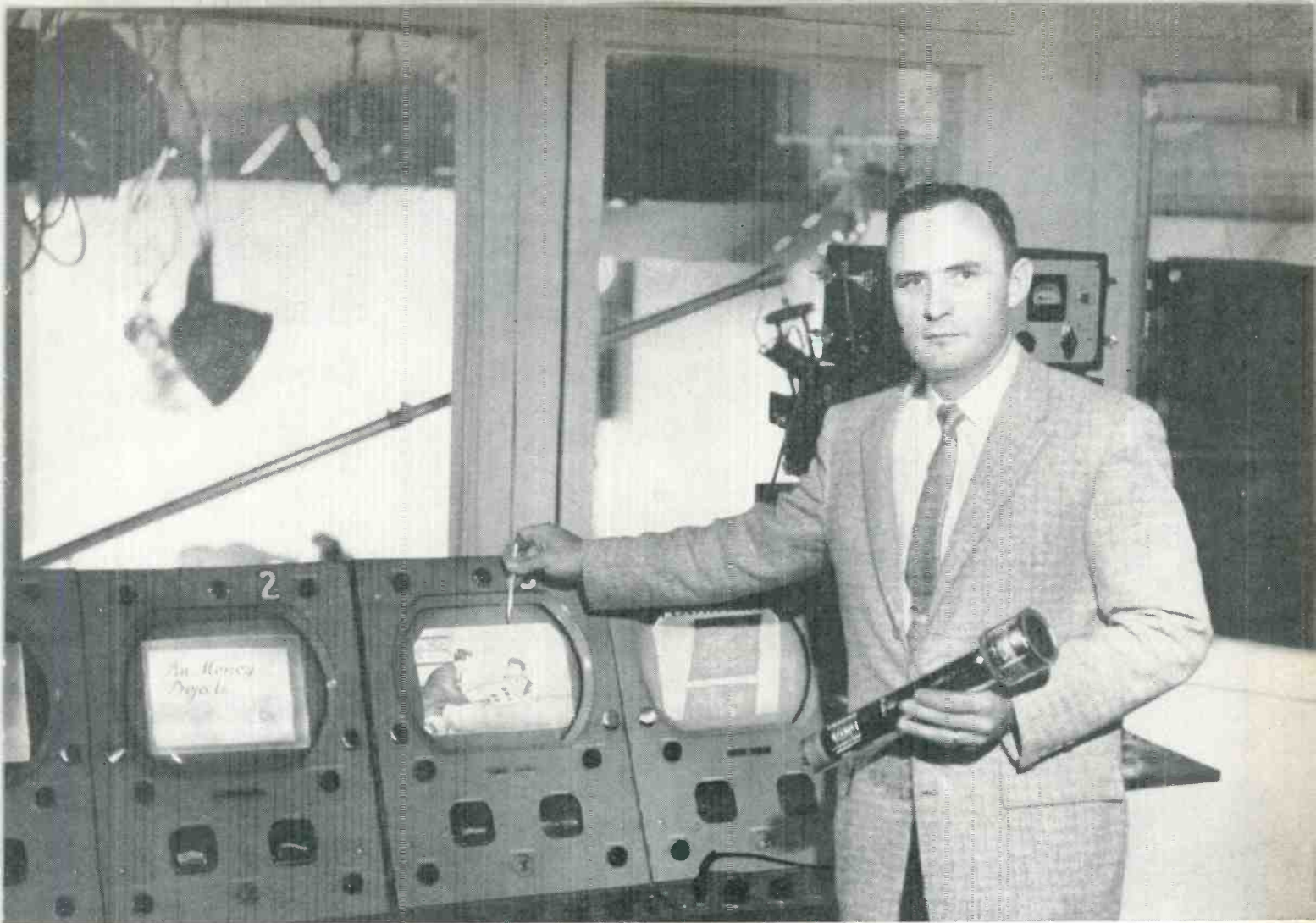
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Station KATV, Little Rock, Ark.:

The monitor picture I'm pointing to originates with a General Electric 5820 that has had over 1000 hours' studio service. I'm holding in my hand another tube we installed. Both are in regular use, and their reproduction stays sharp, clear, and uniform at all times.

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"It looks as if we will standardize on G-E camera tubes in both our Little Rock and Pine Bluff studios. They've proved to be a thrifty investment . . . and help us keep picture quality high!"

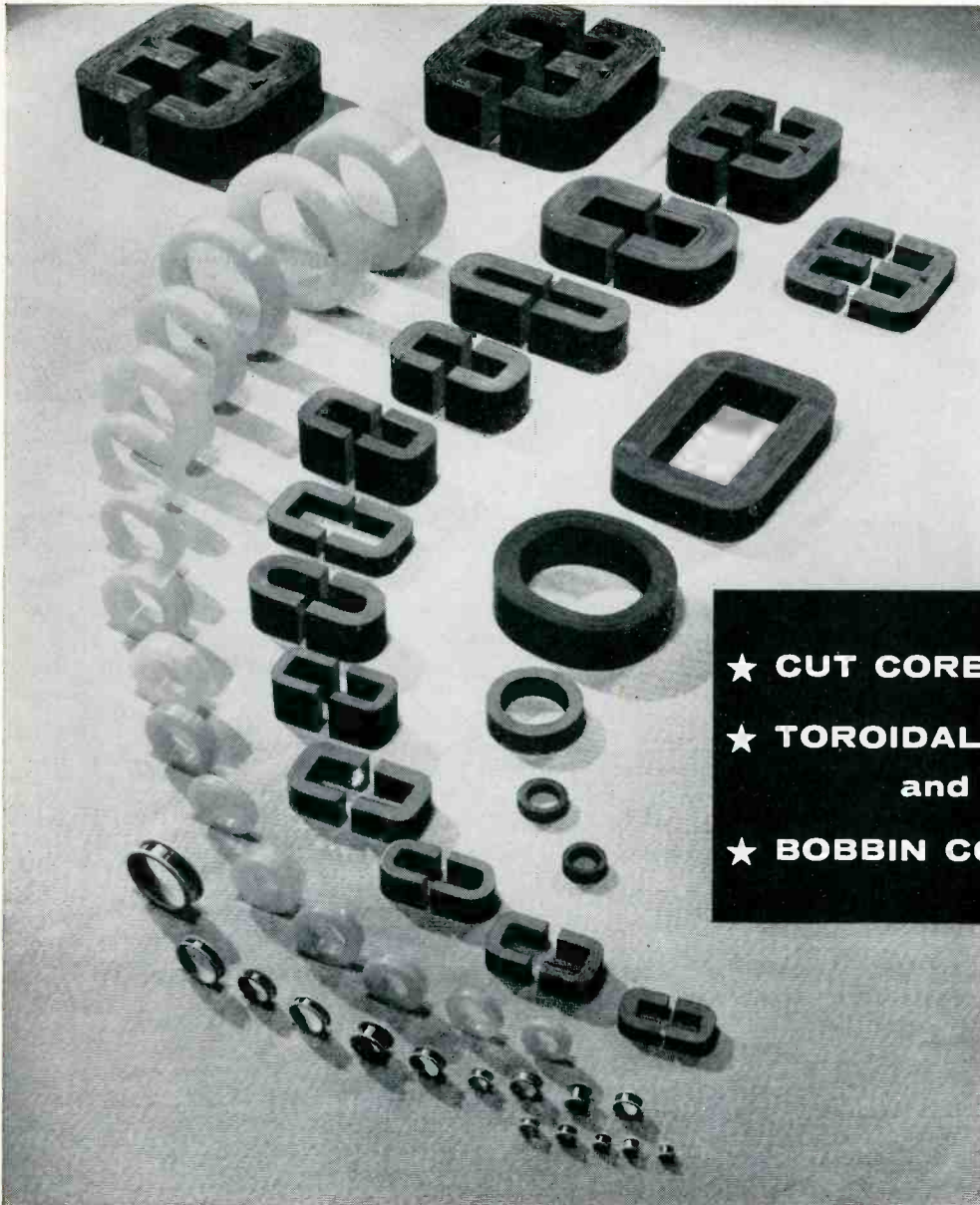
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SIZES: Cores weighing from a fraction

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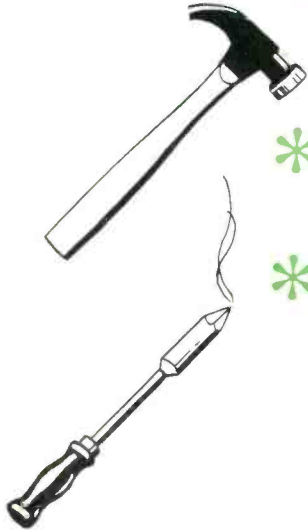
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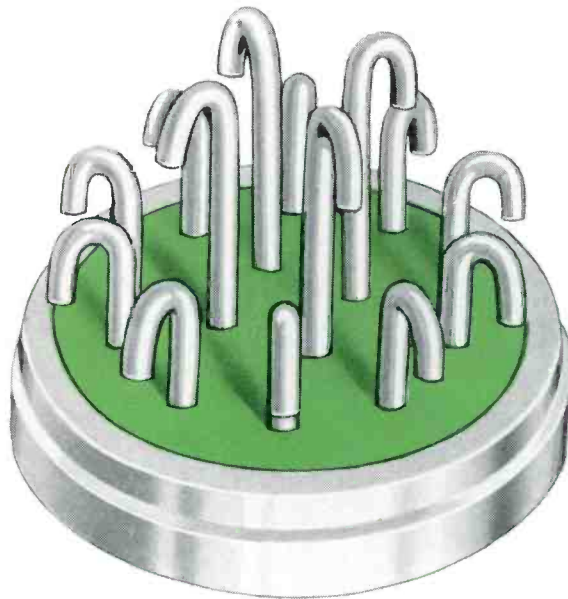
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Video Recorder

(Continued from page 73)

is passed through the necessary electronics to provide a video monitor circuit. The picture appearing on the monitor is thus derived from the same FM signals which feed the heads. Actual current in the record heads is indicated by a meter on the control panel. Positive assurance that normal recording is in process is thus always visible.

Sound Track

The sound track is recorded directly along the upper edge of the two-inch tape in a conventional manner. The circuitry and performance of the sound system are comparable in every way to those of a professional audio recorder. Frequency response and signal-to-noise ratio make the fullest possible use of the FM television sound transmission medium. Preservation of high fidelity sound, long unavailable in delayed television broadcasts, is an inherent advantage of this magnetic recording method.

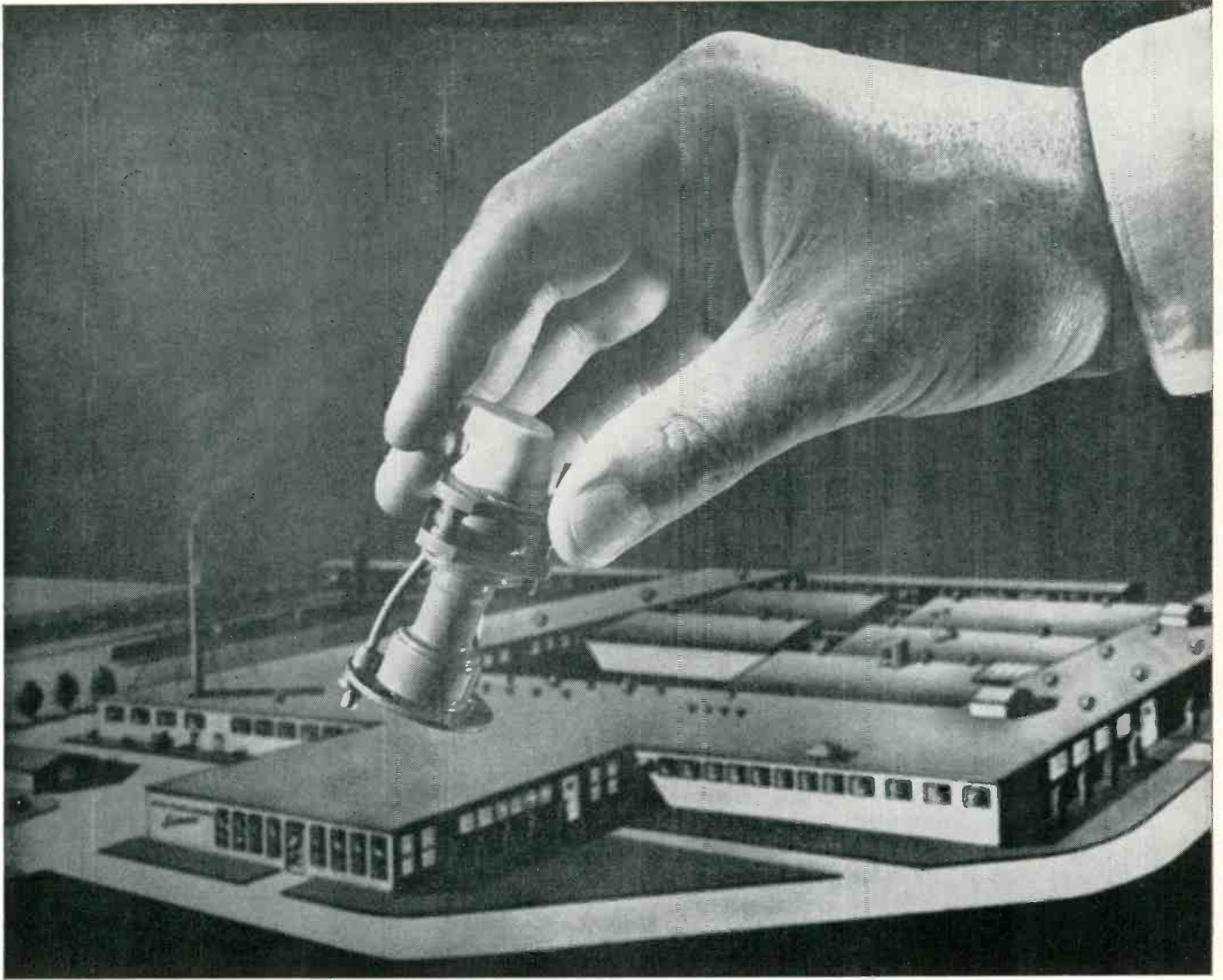
Cue Channel

Multiplexed on the control track is a narrow-band audio channel, on which may be recorded instructions for later playback, information concerning the "take," or any other spoken cues which the user may desire. Its presence in no way influences the function of the control, video, or sound tracks.

Performance

The "live" quality of the video tape playback is due mainly to two inherent advantages over fast photographic delay systems. The electrical transfer-characteristic of the special FM recording process is inherently very nearly linear, giving faithful reproduction of the full gray scale. The resolution capability of the video tape recorder considerably exceeds that of the average TV receiver.

Thus, when a tape recorded program is telecast, the limitation of picture quality will be in the home receiver rather than in the transmission. Horizontal resolution, de-



Hand holds Eimac 1K015CA local oscillator C Band Klystron, 5300-6000mc

New EIMAC Microwave Center Opens at Salt Lake City, Utah for Research and Production of Local Oscillator Klystrons

A new microwave facility for Eimac local oscillator reflex klystron research and production opened last month at our Salt Lake City, Utah plant. For 13 of the 22 year history of Eitel-McCullough, Inc., the production excellence of the Salt Lake City installation has been instrumental in establishing Eimac as the world's largest manufacturer of transmitting tubes.

And now this production skill and decentralized location 600 miles from the Pacific Coast combines with research specialization to offer ready made advantages to users of reflex klystrons. Investigate these Eimac advantages to fulfill your requirements for development or production of rugged local oscillator microwave klystrons.



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terminated by the bandpass and by the constants of American TV broadcast standards, is 320 lines.

Operation

In function, the video tape recorder is a logical extension of present day audio recording practices. In common with audio tape recorders, it has push-button control, re-usability of tape, immediate playback, and excellent relation of original versus reproduced quality. It can, therefore, perform for the TV industry something like the same revolution which the audio magnetic recorder has already performed for the radio and recording industries.

Other Applications

Since the video tape recorder is basically a long-playing, wide-band recording device which presents at

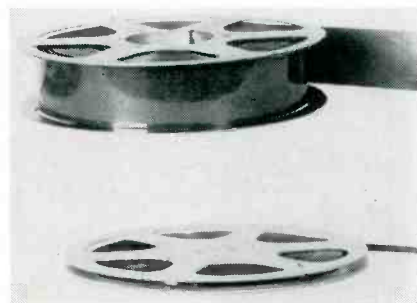


Fig. 5: Two-in. video tape compared to conventional 1/4-in. audio tape

its output all of the information in a signal 4 mc wide with a signal-to-noise ratio in excess of 30 db, it is clear that the unit is adaptable for color TV, radar signals, computer information, and other high-speed data. Engineers are already approaching the solution to the problem of color TV recording, with the eventual aim of producing a machine handling either monochrome or color.

10% Price Cut on Germanium Rectifiers

A price reduction averaging 10 per cent on 5 to 10 amp germanium rectifiers has been announced by GE. The new prices of the rectifiers bring them within the price range of other equivalent dry rectifiers.

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Miniaturized 3/4" diameter composition



15/16" diameter composition



15/16" diameter composition with SPST switch



1-1/8" diameter concentric tandem tone switch and composition variable resistor with SPST on-off switch



1-1/8" diameter composition with SPST switch



1-17/64" diameter 2 watt wirewound



1-17/32" diameter 4 watt wirewound

Typical Ear-Mounted Controls



Molded shaft twist ear mounted 15/16" diameter composition



Hollow shaft twist ear mounted 15/16" diameter composition for screwdriver adjustment



Twist ear mounted 15/16" diameter composition with flattened shaft for push-on knobs



Twist ear mounted 15/16" diameter composition with SPST switch



Twist ear mounted 1 1/16" diameter preset tandem



Miniaturized clinch ear mounted composition



Miniaturized clinch ear mounted composition with SPST switch

Typical Printed Circuit Controls



Solder or clinch ear mounted 15/16" diameter composition with flush shaft



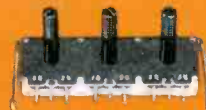
Bushing mounted 15/16" diameter concentric tandem composition with SPST switch



Self-supporting snap-in mounted 15/16" diameter composition



Self-supporting snap-in bracket mounted 15/16" diameter composition with SPST switch



Self-supporting snap-in mounted compact 3-section multiple composition



Miniaturized bushing mounted 3/4" diameter composition

Terminals For Wire Wrapping



Bushing mounted 15/16" diameter composition with SPST switch

Typical Military Controls



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Relay Tests

(Continued from page 70)

selected duration will indicate failure. The range of contact separation time should be between 5 to 1000 μ sec. For convenience, it should be possible to select any value as the reject level within this range. In addition, the instrumentation should measure contact resistance, insulation resistance, pull-in and drop-out voltage (or current), and other characteristics which may be critical under vibratory conditions representative of the actual operating life of the relay. Even though the measurements are not a requirement of any current military specifications, relays must be appraised in environments closely simulating the expected service conditions to attain the magnitude of reliability required in airborne equipment.

New Designs

Relay engineers are recognizing shortcomings of the clapper type armatures. This recognition is evidenced by the increasing number of relay designs with plunger or balanced rotating-type armatures. The results are that recent designs, such as balanced rotating-armature relays, have been vibrated as high as 35 g acceleration through a frequency spectrum from 3 to 2000 cps without evidence of chatter. Plunger type relays are also being successfully vibrated at 25 g. A limiting factor still seems to be contact springs. It is hoped that the information presented here demonstrates the simplicity of some measures which can be used successfully toward improving relay reliability under airborne operating conditions.

Factory Service For GE Mobile Equip.

A new sales policy, under which the factory will accept mobile radio service contracts, has been announced by G. A. Svitek, newly-appointed national service manager for General Electric Communication Equipment.

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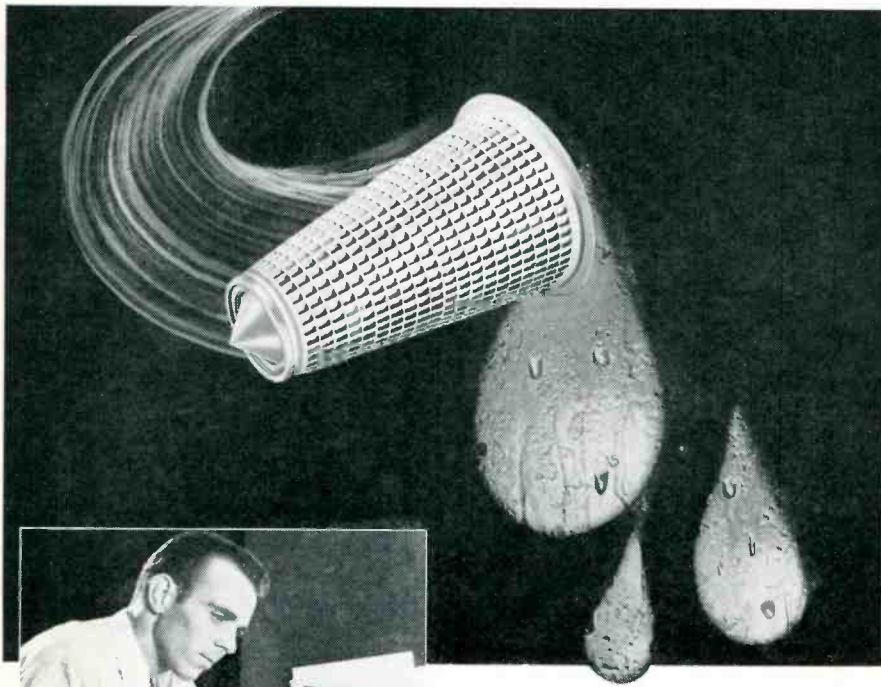
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Antenna Design

(Continued from page 85)

quires a length of about 5 ft.—much too great for top or bottom locations. Several possibilities are indicated and their relative merits are being investigated at the present time. One location which appears attractive from the pattern standpoint is a vertical dipole in front of the helicopter, but this type of installation will cause some inconvenience for engine maintenance crews. Possibly a better alternative is two elements, one on each side of the aircraft fed in phase. The spacing between each element and the side of the aircraft must be sufficiently large so that a satisfactory radiation resistance can be obtained and yet not too large so that lobing in the horizontal plane occurs.

Vertical Whip

Another possibility appears attractive with some aircraft which have hollow rotor shafts. Acceptable patterns have been obtained with a vertical whip projecting through the top of the rotor drive mechanism. With this arrangement, the clearance problem is eliminated except when storing the helicopter in space with limited vertical clearance. Possibly a simple disconnect device would suffice, however. If all of these approaches are found to be impractical, automatic matching may be the only remaining alternative. The weight penalties attached to this solution have not yet been assessed.

The location of ADF loops follows accepted practice. Fig. 5 shows the results of electrolytic tank measurements on a H-21 helicopter. As can be seen, there is considerable freedom in location of a loop antenna assuming a possible compensation in the ADF set of 20°.

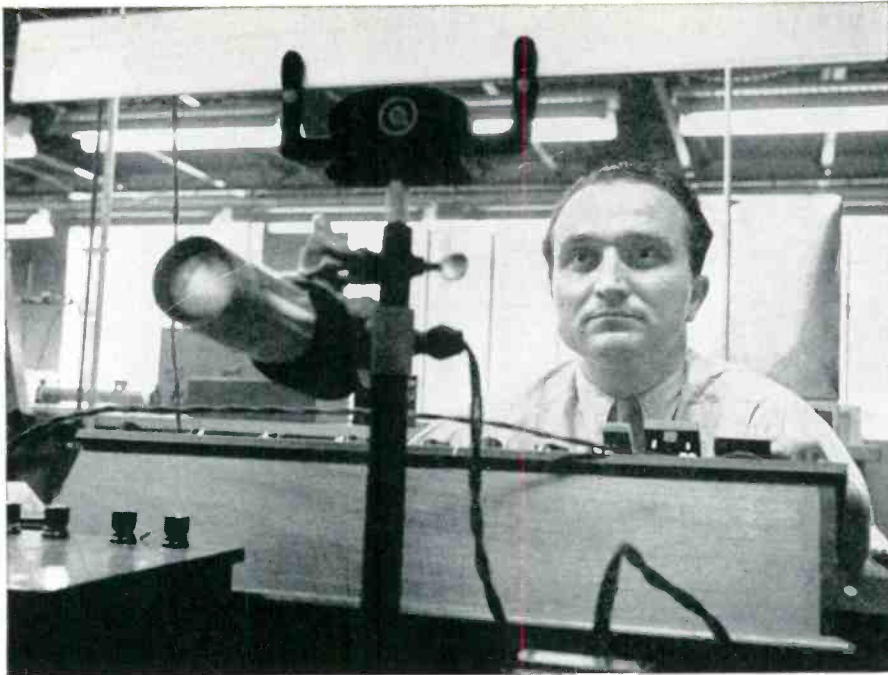
For sense antennas, a zero tilt angle (null directly downward) is very desirable. With single rotor helicopters the best location is usually near the axis of the rotor which may necessitate a bottom mounting. With restricted clearances, the standard "T" antenna may be undesirable. One possible solution is a faired-in top loading plate for a vertical antenna. A 17 in. square plate spaced about



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Scientist at control box of a Sanford-Bennett High-H-Permeameter measures hysteresis loop of Indox ceramic magnet.

How temperature affects magnets

An interview with Dr. Rudolf K. Tenzer, scientist, The Indiana Steel Products Company

BECAUSE PERMANENT MAGNET remanence changes, resulting from varying temperatures, often necessitate corrections, compensations, or allowances, Dr. Tenzer undertook a series of studies on the subject. Some of the data used by him in answering the questions posed below resulted from work sponsored by the Wright Air Development Center of the U. S. Air Force. Reprints of an article by Dr. Tenzer on the subject are available by writing The Indiana Steel Products Co., Dept. N-8, Valparaiso, Ind.

Question: How does the remanence of permanent magnets vary with temperature?

Answer: Normally, remanence decreases with an increase in temperature . . . becoming zero at the Curie point, where all ferromagnetic properties vanish.

Question: Does a change in temperature result in a permanent change in remanence?

Answer: Not necessarily. Investigations which we have conducted show that temperature effects on ferromagnetic materials reveal both non-reversible and reversible variations.

Question: Can the result of these influences be evaluated?

Answer: Proper measuring techniques will evaluate the non-reversible variations as well as the reversible variations.

Question: Are non-reversible variations permanent changes in the remanence of a magnet?

Answer: Non-reversible variations are permanent until the initial remanence is restored by remagnetizing. This effect is not the same as irreversible metallurgical changes which prevent restoration of initial remanence by remagnetizing.

Question: What are reversible variations in remanence?

Answer: When a magnet has been stabilized for a certain temperature range, remanence variations within this temperature range are reversible.

Question: How are magnets stabilized for a given temperature range?

Answer: The magnet is exposed to repeated temperature cycling over a given range until the non-reversible variation becomes zero and remanence at room temperature remains the same for each additional cycle.

Question: Can the amount of remanence variation with temperature be predicted?

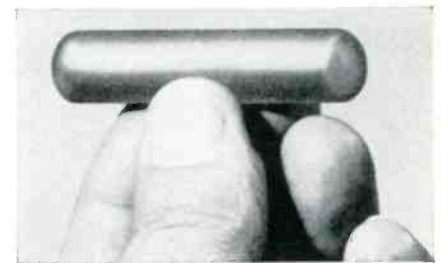
Answer: Our experiments in this field have produced quantitative results which can be used in predicting both the reversible and the non-reversible variations in remanence resulting from temperature change.

Question: Over what temperature range can these measurements be applied?

Answer: Our initial work in this field has been carried out in the temperature range from -60°C to 350°C .

Indiana expands research and production facilities

Currently under construction at Valparaiso, Ind., is a half-million dollar addition to the main plant of The Indiana Steel Products Co. The new structure will provide facilities for expanded research of magnetic materials, and increased production of Indox ceramic permanent magnets.



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3 in. from the skin appears adequate.

For marker beacon reception on small helicopters, a factor is encountered which with larger aircraft need not be considered. The antenna on the aircraft is polarized with the electric vector along the line of flight. In other words, it is parallel to the fore and aft axis of the helicopter. At 75 MC. a wavelength is about 13 ft. With the smaller helicopters this means an over-all length of 2 or 3 wavelengths. Pattern measurements show that the signal downward will, in general, not be single lobed but will have several lobes with depressions between in the order of three to six db deep. The resulting effect on the marker beacon operation has not yet been determined.

Rotor Modulation

An even greater departure from conventional fixed-wing antenna design techniques is caused by the movement of the rotor blades. Rotor modulation adds another factor to the basic variables of pattern and impedance characteristics which must be considered by the antenna development engineer.

Fig. 1 shows the amplitude modulation produced with a short vertical stub top loaded with a horizontal bar with two different orientations. Fortunately, laboratory measurements indicate that the effect of rotor modulation of this magnitude on present day FM receivers and transmitters is negligible. Operational experience confirms these measurements. Even amplitude modulated VHF and UHF communication does not seem to be greatly affected by the rotor movements.

Modulation Plotting

Although in most instances, rotor modulation does not seriously degrade communication system performance, some navigational systems are adversely affected. Stanford Research Institute has developed equipment for automatically plotting both the modulation envelope and the harmonic components.

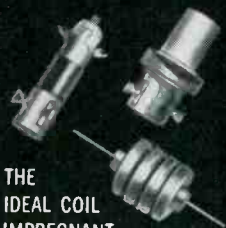
The modulation envelope is plotted by rotating the rotor blades while recording a pattern in the normal fashion. The model itself

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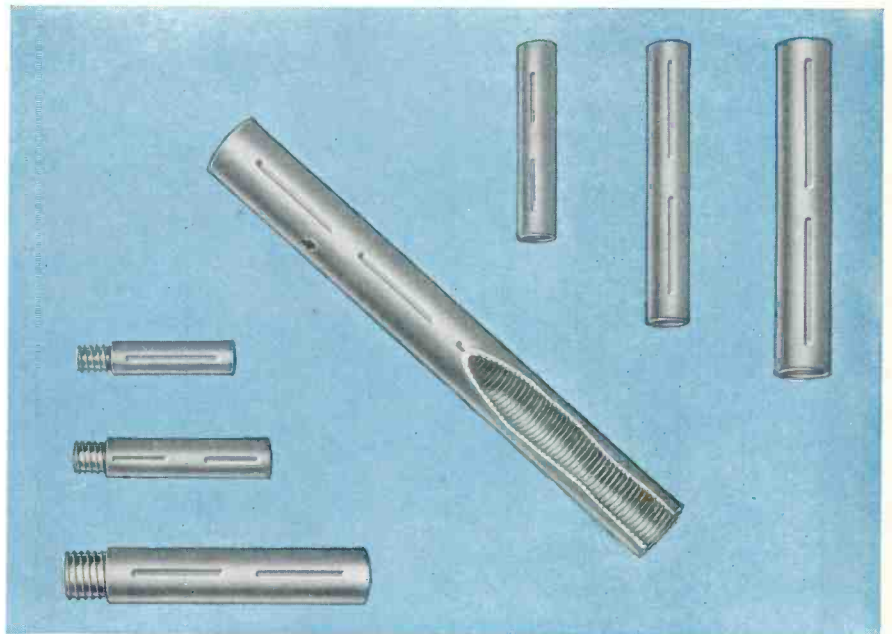
is rotated slowly and the rotor is rotated, by a small motor within the model, at a speed sufficiently slow so that the recorder pen will follow the maximum excursions caused by the modulation. The maximum usable model rotor speed will, of course, depend upon the modulation amplitude encountered with a given antenna installation.

Harmonic Modulation

The percentage of modulation contributed by the fundamental frequency and each of its harmonics can be measured by the use of special equipment in conjunction with the polar recorder. This additional equipment consists basically of: (1) a synchronous motor which drives the rotor at a constant speed; (2) a high gain amplifier which contains an automatic gain control circuit and (3) a series of narrow-band filters by which the fundamental modulation frequency of any of its various harmonics can be selected. The automatic gain control circuit removes the effect of the pattern. In other words, it becomes a circle; hence, by selecting the desired filter the relative level of the fundamental harmonics can be plotted automatically as the model is rotated.

A noteworthy example of a system which is degraded by rotor modulation is the VOR, where the standard receiver compares the relative phase of 30-cps FM and 30-cps AM components to obtain directional information. Any 30-cps modulation introduced by the rotor blades will cause an error in the indicated bearing. The H-19 helicopter is particularly susceptible to VOR rotor modulation interference (See Fig 6), because its three-bladed rotor is driven at speeds near 200 rpm when cruising, thereby leading to a third-harmonic component of rotor modulation near 30 cps. A standard VOR antenna installation for this aircraft utilizes a "ram's horn" antenna mounted on top of the tail boom. Radiation pattern measurements for this installation indicated that good omnidirectional coverage was provided, since the gain on the horizon was, on the average, only slightly less than an isotrope and never dropped to less than 6 db below isotropic gain. However, the critical third-

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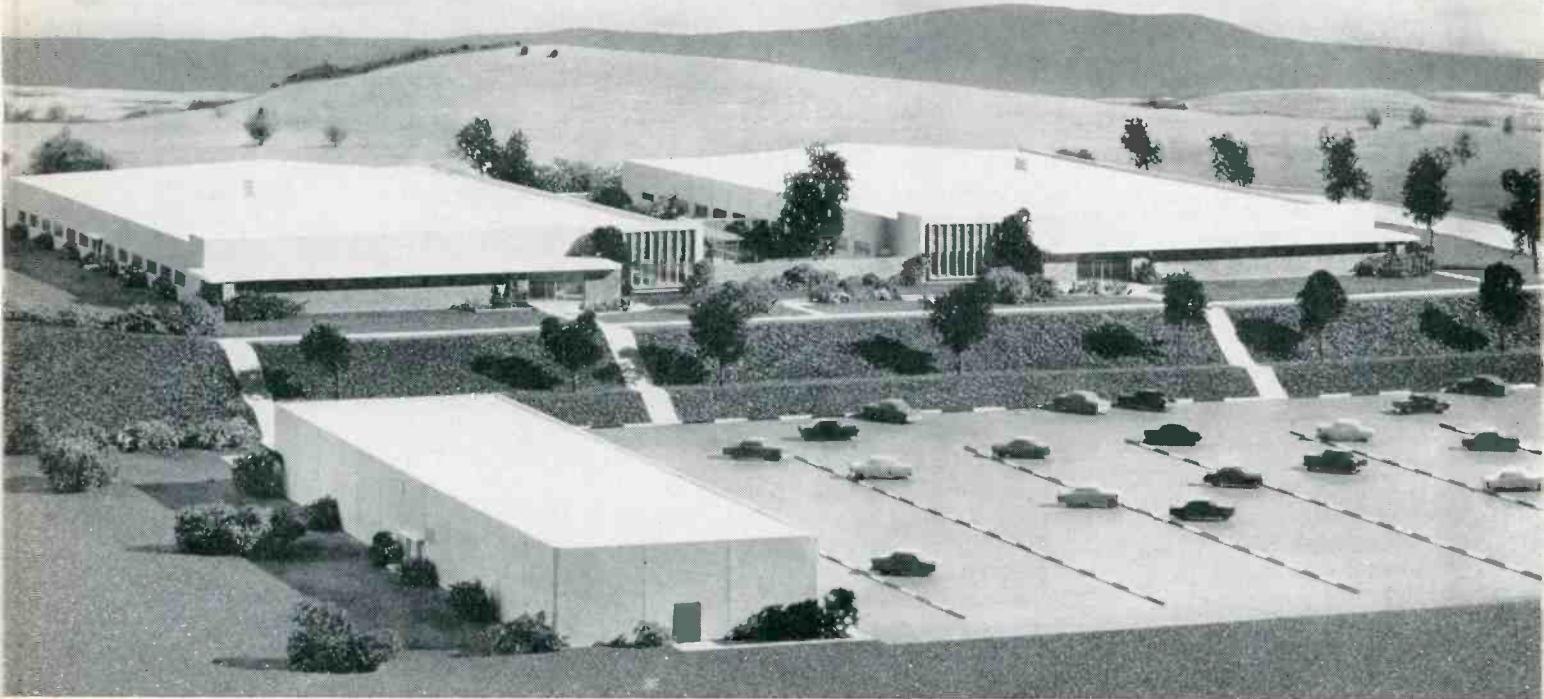
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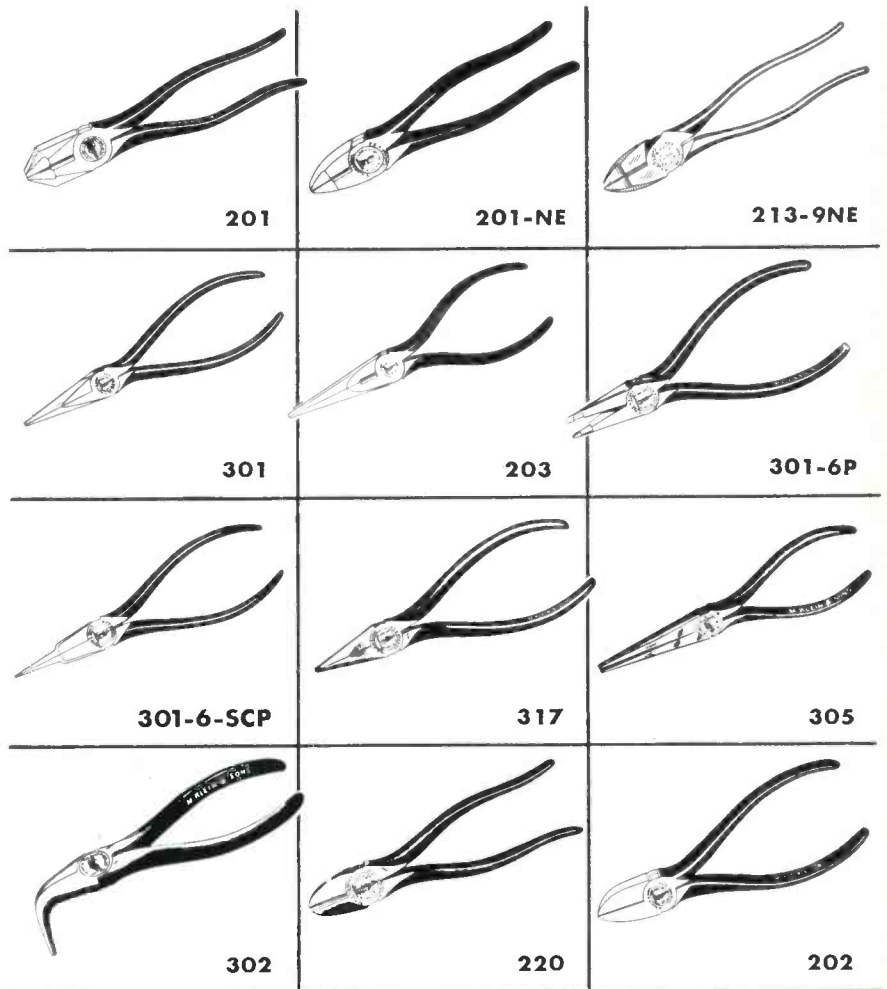
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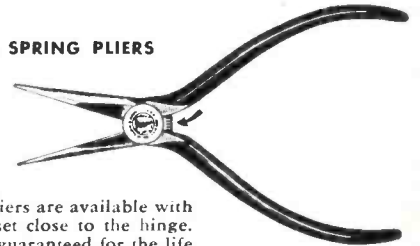
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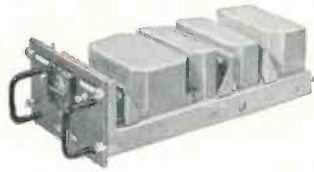
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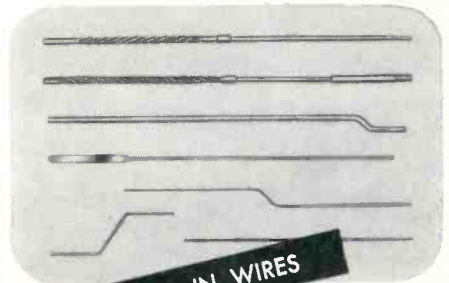
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Antenna Design

(Continued from page 117)

harmonic component contributed over 10 per cent modulation at some azimuth angles. This modulation percentage will produce a $\pm 8^\circ$ to 12° swing of the OBS and OBI indicators with engine speeds from 193 to 207 rpm. With balanced half loops mounted on each side of the fin behind the cockpit and below the tail boom, this modulation can be reduced to less than 5%. This reduction, together with simple circuit modifications to the OBS and OBI indicator circuits, results in a maximum swing of $\pm 8^\circ$ over the more limited range of engine speeds of 198 to 202 rpm.

With ADF systems, a corresponding critical frequency is the modulation employed in the receiver that is used to drive the loop servo motor. If sufficient modulation is introduced on the sense antenna at this frequency by the rotor blade rotation a serious bearing error can result. However, the modulation frequencies used in presently available equipment are sufficiently high so that the rotor modulation does not degrade the performance appreciably. If the number of blades or the rotor speeds are increased, or if new equipment is designed using lower modulation frequencies, this factor may be of importance.

Freq. Meter

(Continued from page 87)

lation waveform of Fig. 4. The microwave output from the klystron was applied to the transfer oscillator. That instrument was then tuned so that the microwave signal was heterodyned down to 70 kc. This frequency contained the same frequency excursions present in the original microwave signal.

The 70 kc frequency was then applied to the new frequency meter, which measured the average frequency. In addition, for each cycle of the 70 kc frequency, the meter produced a standard voltage pulse. Since the 70 kc frequency contained a frequency

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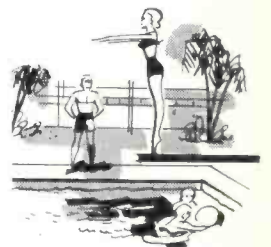
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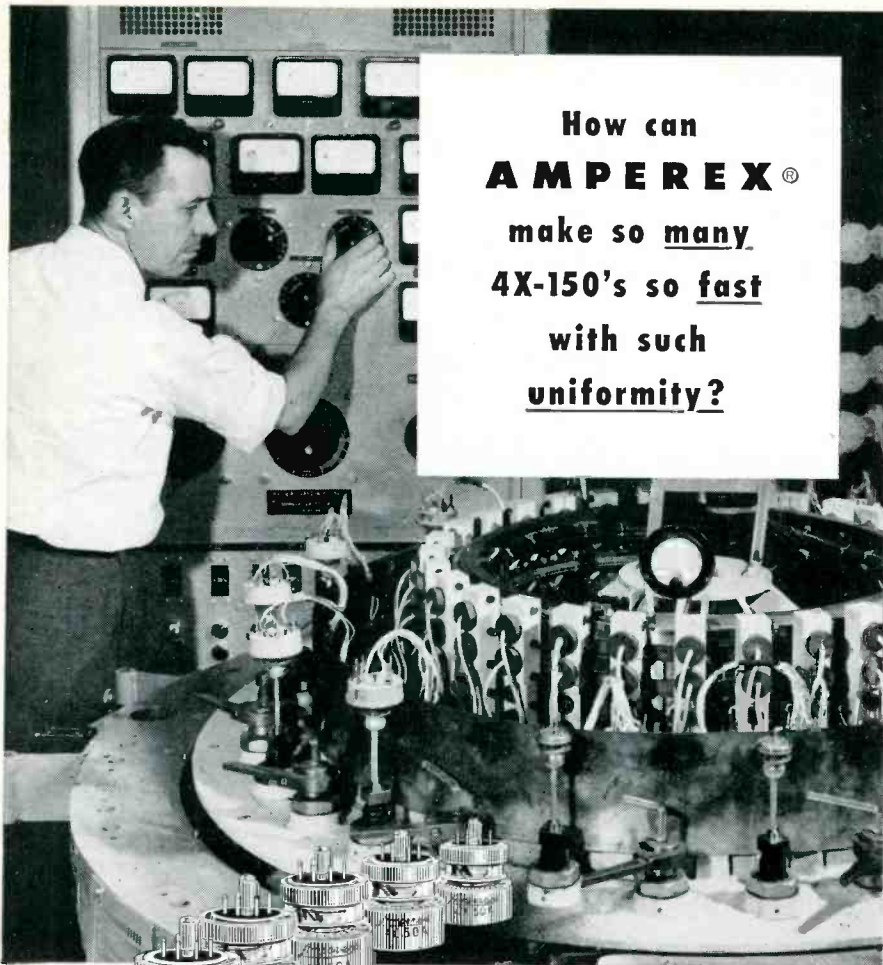
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excursion, these pulses appeared in time as shown in Fig 6 (b). The original deviation waveform can thus be recovered by averaging the pulses with a suitable low-pass filter, as indicated in Fig. 6 (c).

The amount of deviation can be determined readily, since the peak-to-peak amplitude of the variations in the short-time average level will be exactly proportional to the deviation. The amplitude and width of the pulses is such as to give a d-c output level of -10 volts at the filter output for a full-scale reading on the meter. The applied frequency of 70 kc results

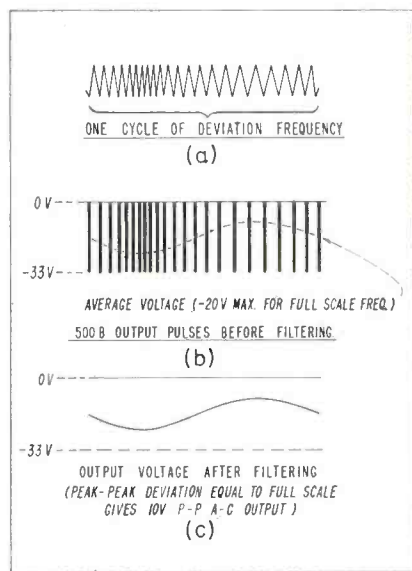


Fig. 6: Waveforms at (a) input, (b) pulse conversion stage, and (c) output of frequency meter

in a 7/10 full-scale reading on the 100 kc range or an output voltage of 0.1 volt d-c/kc. By measuring the peak-to-peak amplitude of the varying component of the d-c output with an oscilloscope, the deviation of 15 kc was obtained.

While the above approach to f-m measurements is not new, the versatility of the setup and the ease with which measurements are made are considerable. The lowest carrier on which f-m could be detected is fixed in the vicinity of 10 cps by the lowest range of the frequency meter. The highest carrier frequency can be above 12 kmc when a transfer oscillator is used. Readout is also simple since an oscilloscope or voltmeter can be made to read directly in kc per

division. Non-technical personnel can thus make rapid measurements in production work, since the only judgment required is to determine whether the deviation exceeds a pre-determined level. If an oscilloscope is used, any unusual patterns will be seen and can be investigated.

For laboratory work simplicity may not be the most valued feature of an f-m measurement setup, but flexibility is very important. The ability to measure small f-m deviations directly on almost any carrier frequency with ease and accuracy is valuable indeed. Further, the arrangement has the advantage over a peak-reading modulation meter that waveform and frequency components can be determined.

Spark Gap

(Continued from page 81)

impedance matching transformers can also develop high secondary or primary voltages if the load fails or is removed for any reason. Protection against this type of damage is shown in Fig. 3.

Capacitors, pulse forming networks, and by-pass units may be protected against surges as shown in Fig. 4.

Instrument failure in high voltage circuits can cause dangerously high voltages to appear at unexpected points. In the circuit of Fig. 5, should the ammeter or the voltmeter develop an open, the total circuit voltage will appear across the meter terminals. This hazard can be controlled by safety gaps placed as shown.

In all cases of protection of components by safety gaps, the effect of the gap discharge on the circuit and the resultant fault current on the gap must be considered. In the case where the normal circuit operating voltage is below the extinguishing voltage of the gap, the circuit will probably recover after the surge has passed. This would be the condition normally encountered in Fig. 2, choke or inductance protection. The safety gap in this case need carry only the surge energy. In the case where a heavy

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follow through current will continue after the surge has passed, as might occur in Fig. 4, or a continuous fault current as in Figs. 3 and 4, the continuous dissipation rating of the gap must sustain this current long enough to permit a circuit breaker or a fuse to operate.

As a switch in an operation circuit, a spark gap can provide repeated operations with relatively little change in characteristics if it is run within its ratings. The circuit of Fig. 6 shows a method of

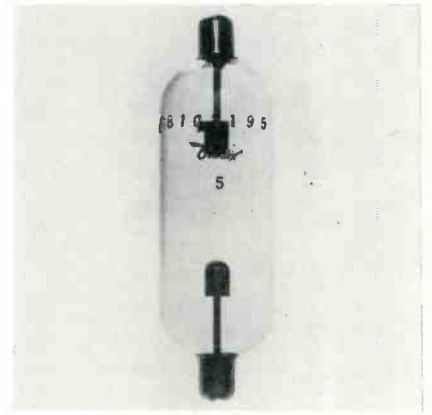


Fig. 7: Commercial spark gap unit

producing high voltage pulses. The capacitor charges through the resistance and periodically discharges through the spark gap. The pulse thus formed is stepped up through the transformer.

The addition of a third electrode to the spark gap produces a unit which can be triggered and becomes more like the conventional thyratron although capable of carrying much higher peak currents.

Sealed spark gaps are presently capable of withstanding operation between +600° F and -100° F temperature range. Static breakdown voltage tolerances can be held as close as those commonly associated with panel type instruments although a 10% tolerance is generally suitable for most applications.

New RETMA President

Dr. W. R. G. Baker, vice president of GE, was elected RETMA president at the annual RETMA Convention in Chicago. Dr. Baker has headed the Association's engineering activities since 1934.

Remote Amplifier

(Continued from page 74)

a 22 v. battery to get sufficient output with T2. A load line drawn for a 15,000 ohm load, for a CK722 transistor, shows a wide excursion of collector voltage with a relatively small base current and collector current change, indicating a small driving voltage is required and a very low collector current needed at the operating point. Also, operating voltage is not critical. Thus battery aging should not have much of an effect on distortion. The operating point for the collector of



Completed hand-size transistor amplifier

each transistor in the last stage is 2 ma at 22 v. Total amplifier drain, all stages, is about 5 ma. A program output of +4 v.u. is easily obtained under these conditions.

Frequency response of the amplifier is shown in Fig. 2. Measurement was made with 250 ohms input and the output loaded at 600 ohms. Distortion is shown in Fig. 3. Measurements were made at normal program output. Noise is very close to 50 db below normal program output.

Temperature changes in the transistors during operation under the above conditions are very small and the collector current remains sufficiently stable. Collector dissipation is well within limits. Also, the feedback resistors R9 and R10 have a stabilizing effect.

The amplifier described is a high quality, rugged and dependable piece of equipment. It is hoped it will contribute to better, more dependable, and less complicated remote broadcasts.

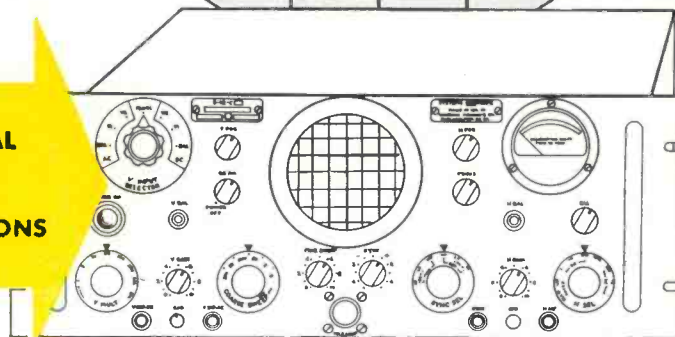
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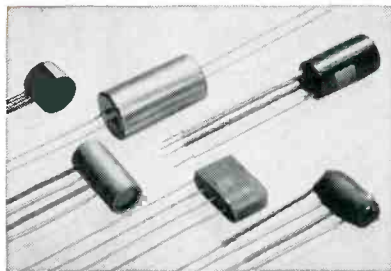
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Microwave

(Continued from page 90)

microwave equipment with respect to intermodulation distortion must be provided by the microwave manufacturer. This data is needed by the transmission engineer before he can design a system consistent with the established transmission standards. A typical microwave system loaded with 120 telephone channels, operating in accordance with accepted loading statistics, will contribute intermodulation noise of about +16 dba to each carrier channel during 1% of the busy hour.

Thermal Noise

Thermal noise in the head-end of the receiver is caused by random motion of electrons in the input resistance and in components of the receiver located before the first amplifier stage. For an adequately designed microwave system, thermal noise will have no significance during normal propagation conditions. Thermal noise has to be taken into account only during the time that fading occurs. The thermal noise data for a receiver should be provided by the manufacturer. A set of curves such as that illustrated in Fig. 4 will give complete information.

When the noise characteristics of the channelizing equipment, the modulator noise, the intermodulation distortion, and the thermal noise characteristics of the microwave equipment are known, the noise performance of the overall system can be calculated for both normal and faded propagation conditions.

With noise factors of the magnitudes described, microwave toll systems employing single-sideband suppressed-carrier channelizing can be extended to 10 or 15 repeater sections without resorting to the use of companders or heterodyne repeaters. Section lengths up to at least 55 mi. are possible, depending upon the type of terrain to be traversed and the clearance which can be obtained.

Heterodyne repeaters, while capable of reducing noise in long systems, lack flexibility for dropping and inserting channels at

repeater and branching points. Such flexibility has proved advantageous in many medium-route installations. Furthermore, maintenance is standardized when back-to-back microwave terminals are used as repeaters.

Reliability

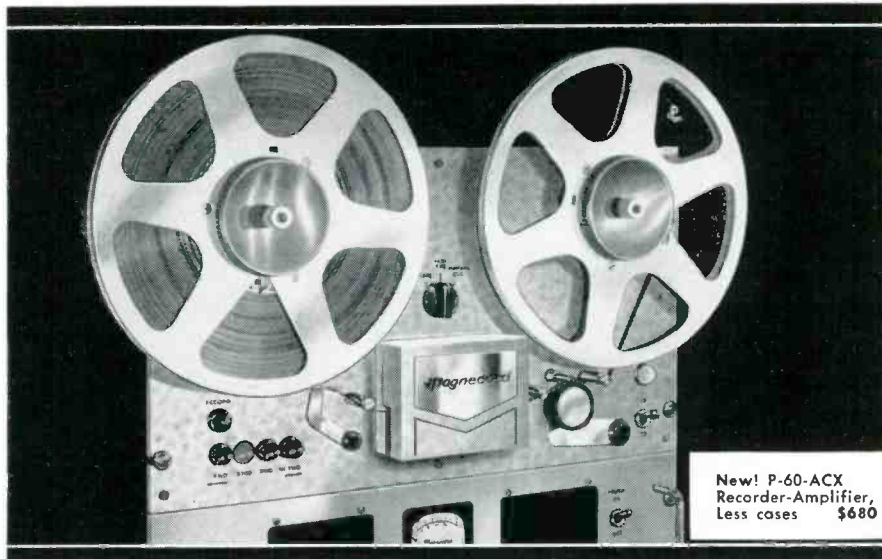
To provide the high degree of reliability required by the telephone industry, the microwave equipment must utilize the highest quality components. Adequate metering must be provided, power supplies should be conservatively rated and adequately fused, and the entire system provided with monitoring and alarm circuits so that troubles can be localized immediately. Equipment arrangements should be such that all components and panels are easily replaceable.

Where equipment is installed at unattended locations, and particularly where the need for exceptional reliability is important, a suitable remote control and supervision system should be installed. The remote control and supervision system should operate over a facility independent of the system it supervises. In the Bell system, the supervisory and control signals of many TD-2 routes are carried over paralleling open-wire, cable, or radio systems.

Frequently, medium-route systems do not have adequate paralleling facilities, and may be required to carry their own remote control and alarm tones. Since a working system is needed to convey supervisory information and, since the most important information concerns unserviceable equipment, standby microwave becomes essential. In fact, for maximum reliability of service, standby microwave equipment and an adequate remote control and supervision system go hand-in-hand. Fig. 5 shows an array of microwave equipment and its associated remote control and supervisory equipment for use in the telephone network of the Hawaiian Islands.

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The requirement for long life of microwave equipment is related to the requirement of reliability. A telephone company should expect its microwave equipment to serve in the toll plant for at least as long as its associated carrier telephone and telegraph equipment. This imposes an obligation upon the microwave manufacturer to design and supply quality equipment, and then be ready and willing to stock spare parts and to provide spare panels for an indefinite number of years even if manufacture of the equipment has been discontinued.

Compatibility

Microwave equipment specifically designed for use in the telephone industry must include features not normally found in radio equipment used for other types of service. These features include:

1. Same general mechanical characteristics as other telephone equipment.
2. Circuit design and layout in accordance with conventional telephone practices.
3. Electrical characteristics coordinated with other telephone equipment.

The physical arrangement of microwave equipment should be such that it can be used anywhere in the toll plant. The advantages of housing microwave equipment without restrictions in any convenient location are immediately apparent. One of the hurdles which radio has had to overcome in the highly standardized telephone industry is its "special" nature. Special equipment, installed on a roof or in a hut, does not take advantage of the constant routine checking and maintenance procedures long established as standard telephone practice.

(Continued on page 146)

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PUBLICATIONS REVIEWED IN THIS ISSUE

Abbreviation	Publication Name	Abbreviation	Publication Name	Abbreviation	Publication Name
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Arc. El. Uber.	Archiv der elektrischen Übertragung	Freq.	Hochfrequenz	Radiotek.	Radiotekhnika
Auto. Con.	Automatic Control	Hochfreq.	Hochfrequenz-technik und Elektroakustik	Rev. Sci.	Review of Scientific Instruments
BC News	Broadcast News	ISA J	ISA Journal	Rev. Tech.	Revue Technique
Bell Rec.	Bell Laboratories Record	Inst. & Auto.	Instruments & Automation	T-T & El. Ind.	Tele-Tech & ELECTRONIC INDUSTRIES
Con. Eng.	Control Engineering	Insul.	Insulation	Wirel. Eng.	Wireless Engineer
El.	Electronics	Int. Proj.	International Projectionist		
El. Des.	Electronic Design	J BIRE	Journal of the British Institution of Radio Engineers		
El. Eng.	Electronic Engineering				

Also see government reports and patents under "U. S. Government."



ANTENNAS, PROPAGATION

Interference Due to Reflections in Multi-Channel FM Radio Systems, by G. Bosse and M. Wagner. "Freq." May 1956. 6 pp. The effect of different maximum frequency deviation on different FM channels to compensate for expected variations in interference due to reflections is studied by the method suggested by W. R. Bennett et al in Bell Tech. J. (1955). The results are graphically represented.

Problems of Aerophysics in the Hypersonic Region, by J. Bond, Jr. "Aero D." June 1956. 5 pp. At high hypersonic speeds, the dissociation and ionization of air in the immediate vicinity of a vehicle may influence its design. The transmission of radio signals through the shock layer becomes increasingly difficult as the velocity of the object increases. The determination of the power required to transmit a radio signal through the shock layer depends upon the signal frequency and on the distribution of electrons in the shock layer.

An Antenna System With a Reflecting Mirror, by V. D. Kuznetsov. "Radiotek." March 1956. 12 pp. The paper analyzes the operation of an antenna system with a reflecting mirror. It discusses the problems of the optimum shape for the surfaces of the antenna and mirror, the efficiency of the energy transfer from the antenna to the reflecting mirror, the utilization of the surface of the upper mirror, the gain coefficient, the shape of the directivity pattern and the shielding action of the reflector. Formulas are derived which permit design of the system.

Helicopter Antenna Design, by A. Ellis. "T-T & El. Ind." Aug. 1956. 4 pp. Unique problems arising from the configuration and function of helicopters are discussed. New methods and equipment have been designed to study radiation shielding, rotor modulation, harmonic ratios, and airframe resonance.

Systematic Investigation of the Effect of the Geomagnetic Activity on the Nocturnal Critical Frequencies of the F₂-Layer, by G. Lange-Hesse. "Arc. El. Uber." April 1956. 6 pp. A statistical examination of the deviation of the nocturnal critical frequencies of the F₂-layer establish its dependence on geomagnetic activity, sunspot cycle and season. Figures indicating the reliability of predictions of nocturnal disturbances in HF radio transmission are derived.



AUDIO

Ampex's New Video Tape Recorder, by R. Snyder. "T-T & El. Ind." Aug. 1956. 3 pp. Describes a new tv recorder using a multi-headed disc, spinning at 14,000 rpm to record 4 mc video signals on a 2-in. magnetic tape traveling 15 ips. Immediate application is program delay service for East-West tv; future applications include color tv and high-speed data recording.

Tape Doubles Response of Disk Recorders, by W. Gilson. "El." July 1956. 1 pp. A method is described for circumventing limited high frequency response of ordinary cutting heads of

disk recorders. Essentially, a tape recording is fed into the cutting head, both tape and disk units being run at half speed.

Wide Range Meter Measures Flutter and Wow, by H. Wirth. "El." July 1956. 2 pp. A test instrument is described which measures speed variations in tape recorder transport mechanisms. A simple system using an fm discriminator detects changes in the recorded signal.

Coupled Oscillations in Cavity Resonators having a Grid, by E. Kohlsdorf. "Hochfreq." April 1956. 3 pp. Sound absorbing structures comprising a grid, acting as a mass, and an air cushion between the grid and a wall, acting as a spring, are considered. The effect of mechanical oscillations of the grid structure which couples to the oscillations of the grid-air cushion combination is investigated.

On the Sound Level at Corners, at Edges and on the Walls of Closed Rooms in the Presence of Noise, by W. Woehle. "Hochfreq." April 1956. 3 pp. It is shown that, for specified assumptions, elementary calculations yield the differences in the sound levels at the corners, at the edges and along the walls of closed rectangular walls. Measurements show good agreement for a noise spectrum between 37.5 and 75 cycles in a room of approximately 60 m³.

The Acoustics of the Berlin Opera, by W. Reichardt. "Hochfreq." April 1956. 11 pp. A model of the opera (1:20) to be rebuilt has been studied. The results of diffusion, clarity, and echo measurements are reported; the reasons for unsatisfactory results pointed out and measures taken to improve such results are described. Results of measurements taken in the rebuilt building are compared to the model measurements.

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interest, by writing to: "Electronic Sources" Editors, Tele-Tech & ELECTRONIC INDUSTRIES, Chestnut & 56th Sts., Philadelphia 39. The editors can recommend translation agencies.

To obtain copies of U.S. patents, and research reports on military and government projects reviewed here, send payment indicated directly to federal agency as instructed in section entitled "U.S. Government."



The Amount of Sound Absorption of Cavities and its Dependence on the Arrangement, by E. Kohlsdorf. "Hochfreq." April 1956. 3 pp. The behavior of sound-absorbing cavities, i.e., a grid structure arranged in front of an air cushion, is studied. Particular attention is given to the incidence of the sound, at right angles or diffuse, and of the arrangement of the cavities as it affects the sound absorption.

Intelligibility of Amplitude-Limited Speech, by H. Schneider. "Freq." May 1956. 10 pp. A comparison of the various methods of limiting the amplitude of a speech signal, such as tilting of the spectrum, peak clipping, multi-band transmission, and frequency shift, is presented. Extensive measurements have been carried out and are reported.



CIRCUITS

Minimizing Noise in Electronic Systems, by R. Wendt. "T-T & El. Ind." Aug. 1956. 4 pp. Internally generated noise is a constant problem to equipment designers. Discussed in this article are some causes of capacitive, leakage, conductive, and inductive noise pickup, and practical preventive measures.

Simplified Cascode Design, by F. Evans. "T-T & El. Ind." Aug. 1956. 1 pp. A method is presented for approximating the characteristics of a cascode unit, using the published E_b-I_b curves of the triode type employed.

Selective 1 CPS Bandwidth Amplifier, by W. Nonnenmacher. "El. Rund." May 1956. 4 pp. A high selectivity if-amplifier has been developed as part of a measuring amplifier for noise voltage spectroscopy. The high selectivity is produced by disattenuation of the resonance circuit by means of a feed-back cathode amplifier (Q multiplier). Bandwidth can be altered by adjustment of the feed-back factor. The required stability is achieved by the intense counter coupling of the cathode amplifier.

Remote Control of Electro-Acoustic Equipment, by H. Petzoldt. "El. Rund." May 1956. 3 pp. Remote control of switching operations in electro-acoustic main control centers is required owing to number and scope of simultaneous switching operations, to remoteness of operator, on account of mutual functional coupling or dependence of a plurality of switching operations. A new remote control equipment for the switching of 6 loudspeakers from a remote microphone speaker location under precedence order conditions is described with reference to a circuit diagram.

Amplitude Limitation in LC-Oscillators Using Two Biased Diodes, by Z. Akcasu. "Wirel. Eng." June 1956. 5 pp. An LC-oscillator which includes two biased diodes in the grid circuit to limit oscillation amplitude is analyzed. Amplitude of oscillation and harmonic distortion are calculated and represented by curves. From these curves it is observed that oscillations can be modulated linearly; no frequency modulation occurs during amplitude modulation and harmonic distortion is very low.

Mathematical Treatment of Nonlinear Keying Operations, by F. Weitzsch. "El. Rund." May 1956. 4 pp. Networks exert electronic keying functions if the passage of a rectangular pulse involves a time function of certain electric magnitudes. Their determination gives rise to some difficulty caused by the presence of such nonlinear elements as hysteresis-affected inductivities, etc., in the circuit. Normalized orthogonal systems are established and means of approximating their integrals are discussed.

Decade Counter Tube Circuitry, Part II, by J. Adams. "El. Des." June 1, 1956. Continuing a discussion of the basic operation of decade counter tubes (Part I, "El. Des." May 15, 1956), the author presents a complete counter circuit for applications involving high speed counting.

Analytical Method for Complex Transistor Circuits, by Ya. K. Trokhimenko. "Radiotek." March 1956. 7 pp. The paper briefly discusses the admittance matrix of a transistor and describes a method of analysis for complex circuits, which is based upon reducing the complex circuit to an equivalent fourpole and conducting the design according to the parameters of the fourpole.

Amplitude Stabilization of Self-Oscillations by an Inertial Nonlinearity, by E. O. Saakov. "Radiotek." March 1956. 11 pp. The paper analyzes the operation of the simplest circuits with nonlinear resistors having a thermal inertia, when such resistors are used to stabilize the amplitude of sinusoidal self-oscillations. Relationships are derived for the calculation of the steady-state amplitude of the oscillator output.

A Wide Range Photo-electric Automatic Gain Control, by C. Riddle. "El. Eng." July 1956. 5 pp. A photocell and tube are arranged in such a way that the output voltage is proportional to the light modulation, and independent of the value of the steady light flux. The circuit is extremely simple, and the range over which the light flux may vary is very large (100,000:1).

An Improved Type of Differential Amplifier, by J. Richards. "El. Eng." July 1956. 3 pp. A differential amplifier stage capable of giving a high rejection ratio with unselected tubes and components and without a balance control is analyzed, and a particular amplifier is described in some detail. The stage is particularly suitable for converting balanced to unbalanced signals.

A Variable Multiple Pulse-Stream Generator, by W. Woods-Hill. "El. Eng." July 1956. 2 pp. During the development of circuits intended for use in electronic computers there is a need for checking, with a minimum of apparatus, the logic of circuits which require numerous pulse streams for their operation. An apparatus for such checking is described.

A Less-Than-Minimum Phase Shift Network, R. Destebelle, C. Savant, and C. Savant. "T-T & El. Ind." Aug. 1956. 3 pp. A combination of a tuned amplifier and a phase sensitive demodulator is described which allows high Q without instability.

Synchronization of an Oscillator by Means of Radio-Frequency Pulses, by E. S. Voronin and G. N. Berestovsky. "Radiotek." March 1956. 7 pp. The paper theoretically and experimentally investigates the process of synchronizing a harmonic oscillator by means of rectangular radio-frequency pulses. Calculations are conducted for the process of establishing the phase and amplitude of the oscillations. The results are experimentally verified at 1 mc. It is shown that the time for establishing a steady state depends heavily upon the initial phase.

Interaction Between Signal and Noise in an Inertial Detector, by L. S. Gutkin. (Continuation of paper in Feb. Issue.) "Radiotek." March 1956. 12 pp. Detailed qualitative and quantitative analysis including thorough mathematical derivations. This second part of a two-part paper deals with the signal-to-noise ratio at the output of the detector. It includes: 1) evaluation of the internal resistance of the detector, 2) evaluation of the current from the equivalent low-frequency current generator, 3) evaluation of the noise voltage across the detector load.

The Frequency Dependence of Self-Excited Microwave Generators with Complex Load, by H. Paul. "El. Rund." June 1956. 4 pp. In this final section of a previous article, the changes in the Rieke diagram resulting from a load positioned several wavelengths from the plane containing the plate slot are treated. Mismatching is discussed, and a measuring method suggested.

Trailing Edge (Decay) of a Pulse in a Cathode Follower with a Capacitive Load, by M. L. Volin. "Radiotek." March 1956. 7 pp. The paper discusses the causes of the extended decay of the trailing edge of a pulse when it

passes through a heavily loaded cathode follower. An experimentally verified method is given for calculating the decay time for the trailing edge. Circuits for increasing the slope of the trailing edge are analyzed.

The Origin of the Six-Terminal Network Curve, Its Graphical Evaluation and Its Application to Determine the Transformation Properties of Loss-Less Six-Terminal and Eight-Terminal Networks, by H. Lueg. "Arc. El. Uber." April 1956. 12 pp. The formulas for a six-terminal network are coordinated with a set of vectors rotating in the complex plane. It is shown how the curve for the six-terminal network permits the determination of the input impedance for any terminating impedance.

Bridge Stabilized Oscillators and Their Derivatives, by E. J. Post and J. van der Scheer. "J BIRE." June 1956. 6 pp. The bridge stabilized oscillator with unspecified amplifying section can be regarded as a source of a wide class of feedback oscillators. Simple operations such as crosswise interchange of bridge elements, as well as suitable unbalancing of the bridge, will lead to most of the available feedback oscillator circuits as the derivatives of the bridge device. Principles involved are studied.

The Impedance Concept, Part 2, by C. Mayo and J. Head. "Wirel. Eng." May 1956. 8 pp. In Part One it was shown how useful information on circuit behavior could be obtained within the 'p-world,' p being a variable closely associated with time differentiation which can be manipulated algebraically. A general condition for a polynomial P_n of degree n in p to be free from zeros with positive real parts was obtained, and applied to the case of a three-stage RC feedback amplifier. Part 2 determines the effect of adding extra "step-circuit" elements on the gain and maximum feedback obtainable.

Design Chart for Selective Cathode Traps, by K. Hillman. "El." July 1956. 2 pp. Equations are discussed for determining attenuation introduced at trap frequency and at other desired frequencies. A graph is presented for determination of values of R, L, and C for cathode traps.

Telemetry Demodulator for Wide-Band F-M Data, by T. Warzecha. "El." July 1956. 3 pp. The demodulator described converts fm to pm for pulse averaging recovery of the signal. Also described is a means of recording the fm signal.

Regulator Stabilizes Infrared Detector, by H. Weisbecker. "El." July 1956. 2 pp. Bolometer-type infrared detectors used on aircraft give ambiguous indication at intensity variation rates up to 25 cps unless the power supply is well regulated. A chopper-derived ac loop is described which can supplement more conventional dc regulation and cut variations to less than a millivolt.

Automatic Tuning for High-Power Transmitter, by V. DeLong. "El." July 1956. 4 pp. A system is described by which a frequency-selecting dial operates a servo system which tunes transmitter stages and adjusts the loading of the final stage. A combination of wide and narrow band discriminator circuits pulls the servos into critical tuning positions over a wide range.



COMMUNICATIONS

Designing Microwave Equipment for Telephone Companies, by W. Fisher. "T-T & El. Ind." Aug. 1956. 5 pp. The requirements of a medium-route microwave system—handling up to 300 telephone channels—are examined with respect to installation costs, transmission quality and performance, reliability, and compatibility. Data includes average installation costs and typical system statistics.



Transistor Remote Amplifier, by E. Smith. "T-T & El. Ind." Aug. 1956. 2 pp. A small, battery-operated 4-transistor channel amplifier using low-level mixing and having two independently controlled mikes is described. Complete circuitry and response-test results are presented.

Reducing Noise in Communications Systems, Part V, by W. Bennett. "El." July 1956. 4 pp. Transmitting information through noise can be accomplished by exchanging excess bandwidth for improved signal-to-noise ratio. Pulse-code modulation does this efficiently and permits regenerating pulses that have become distorted. Error detecting and correcting codes offer additional advantages.

Regulating Amplifier Corrects Slope and Level, by W. Chaskin and H. Kimball. "El." July 1956. 3 pp. A servo-control which automatically adjusts gain to accommodate changes in attenuation in long open-wire telephone lines is described. Pilot-tone pairs of 40 and 80 kc with 99 and 150 kc are employed to control gain.

Multipath Simulator Tests Communications, by A. Deuth, H. Ressler, J. Smith, and G. Stamps. "El." July 1956. 3 pp. The authors describe a system using an ultrasonic artificial ionosphere and crystal transducers operating at 150 kc in air to simulate radio fading.

Arcing at Telephone Relay Contacts, by P. Kisliuk. "Bell Rec." June 1956. 5 pp. Research now in progress is aimed at extending the useful lifetimes of relay contacts. Oscilloscopic studies are in agreement with earlier work, that arcs occur before there is any metallic contact. This article presents results of extensive investigation and experimentation with arcing.

Balanced Revertive-Pulsing Circuits, by E. Spack. "Bell Rec." July 1956. 4 pp. Revertive pulsing is the signaling method used to control motor-driven switches at a terminating office in the panel type of automatic switching system. When crossbar systems were designed, they included revertive pulsing for compatibility with existing offices, using relays to simulate the action of the mechanical switches. No. 5 crossbar has grown rapidly in suburban areas, and it has been found that arc interference in these areas can adversely affect the revertive-pulsing circuits. To prevent this, new balanced arrangements have been designed for both panel and crossbar incoming circuits.

Distortion of the Duration of Telegraph Pulses Due to the Effect of Fluctuating Interference in a Frequency-Modulated System, by A. M. Zingerenko. "Radiotek." March 1956. 11 pp. The paper derives a formula for the frequency variation which results when fm signals are transmitted in the presence of fluctuating interference. The mean-square distortion of the duration of the telegraph pulses is determined.

Application of Magnetic Null Devices to Telemetering and Registering Units, by A. M. Pschenichnikov. "Elek." Jan. 1956. 6 pp. A primarily qualitative analysis of the use of magnetic amplifiers as null devices. The paper describes their principle of operation, their chief properties and characteristics and the possibilities for their extensive use. Their use as inverters, in polyphase and bridge systems, and the use of second-harmonic induction are discussed. The lower sensitivity threshold is made a minimum.

Simultaneous Tuning of Tuned Circuits in Superheterodyne Receivers, by W. Rotkiewicz. "Hochfreq." April 1956. 11 pp. The difficulties encountered in simultaneously tuning two capacitively-tuned circuits in a receiver are studied. Equations for the tuned h.f. circuits and the associated oscillators are given. The errors are evaluated for tuning curves identical at two or at three points.

Visual Detectability of Signals in Noise, by J. Griffiths. "Wirel. Eng." May 1956. 3 pp. The effect of 'contrast' (in the form of a bias) on the detectability of signals displayed for visual observation in a noise background is very controversial, as many different considera-

tions arise in different applications. This article is concerned with the effect of such contrast on a particular derived signal-to-noise-ratio criterion, and it is shown that the results obtained agree, at least qualitatively, with experimental results on probability of detection in very simple systems.

Repeaters for Twelve-Channel Military Telephone, by J. Barstow, Jr. "Bell Rec." June 1956. 4 pp. A recently developed light-weight system permits transmitting twelve telephone conversations over a single four-conductor cable. Both attended and unattended repeaters have been developed which permit the terminals to be placed as much as 200 miles apart.

Effective Capacitance in Modulated Power Amplifiers, by R. Lee. "El. Des." June 1, 1956. 3 pp. Incidental capacitance has a marked influence on the electrical performance of high-level AM power amplifiers, particularly in the modulator. Several components of incidental capacitance are analyzed and their effects discussed.

Voice-Controlled Blocking Circuits in Telephone Signal Transmission by Radio, by K. Fischer. "El. Rund." June 1956. 5 pp. A voice-controlled blocking circuit is required at the junction of the radio transmission and the two-wire line, provided the radio link cannot be stabilized. Various such blocking circuits are compared and their fields of application indicated.

The Reciprocity of Time and Frequency in Communication Engineering, by H. Marko. "Nach Z." May 1956. 7 pp. The Fourier transformation is applied to stationary phenomena, statistically known phenomena, and to non-linear systems, such as modulators. Electrical phenomena and mathematical formulas are closely interrelated to facilitate understanding.

Radio Set AN/TRC-24: Exciter and Frequency Control, by G. Rodwin and N. Lund. "Bell Rec." July 1956. 4 pp. The radio portions of a compact and portable multi-channel telephone system are described. The exciter, with its associated frequency-control circuit, enables the radio transmitter to operate on any one of a large number of stabilized frequencies.



COMPONENTS

Nonlinear Ceramic Dielectrics, by N. Rudnick and G. Howatt. "Con. Eng." July 1956. 7 pp. The ceramic dielectrics have been put to many uses in the control field, chiefly as transducers that make use of their piezoelectric properties. They have still another, far less exploited characteristic. They are nonlinear in the same way as are ferromagnetic materials: they display a hysteresis loop. Because of this analogy they are called ferroelectrics. Nonlinear dielectrics can amplify electrical signals somewhat as magnetic amplifiers. Such dielectric amplifiers have several inherent potential advantages over magnetic amplifiers for voltage and moderate power amplifier applications.

Spark Gap—New Circuit Component, by J. Johnstone. "T-T & El. Ind." Aug. 1956. 2 pp. Use of spark gap units as voltage-sensitive switches handling extremely high currents with low voltage drop is described. Units can be small and can be made relatively insensitive to temperature, pressure, altitude, and humidity. A spark gap pulse generator circuit is illustrated.

Specifying Toroidal Reactors, by R. Edgar. "El. Des." June 15, 1956. 2 pp. Molybdenum permalloy powder toroidal cores have been used extensively in recent years because of high Q stability over a wide range of voltages and good stability with respect to dc magnetization. However, it is often desirable to know just how a toroidal reactor is affected by the core used in order to specify these reactors correctly. The article describes a typical toroid and points the way to improved design.

A Guide to Applying Resistance Pots, by H. Gray, Jr. "Con. Eng." July 1956. 14 pp. Since the potentiometer used often spells the difference between a workable and unworkable system, or between a complex and greatly simplified one, the selection procedure is important. The author presents information in the form of a guide to selection of pots for specific uses.

Ultrasonic Delay Lines, by J. May, Jr. "Bell Rec." June 1956. 5 pp. As modern electronic equipment is called upon to perform increasingly intricate operations, electrical signals must frequently be delayed within a circuit. Most methods of providing such delay require considerable space or equipment. This article describes ultrasonic delay lines which occupy a relatively small space, and can provide time intervals ranging from a fraction of a μ sec to several thousand μ sec.

Factors Affecting Resistor Tolerances, by F. Paul. "El. Des." June 1, 1956. 1 pp. Minimum circuit design tolerances for resistors must often be much greater than the rated resistor tolerances specified by manufacturers. Recommended minimum design tolerances are given.

Transit-Time Accelerometer, by L. Jones. "Rev. Sci." June 1956. 4 pp. An omnidirectional transit-time accelerometer, developed for measuring the drag acceleration of spheres dropped from rockets, is described.



COMPUTERS

Binary Conversion for A-D Converters, by I. Resnick. "El. Des." June 15, 1956. 2 pp. Serialization of parallel data may be desirable or necessary for minimization of the number of recording channels required, telemetering on a single channel, and preparation of data for further processing. This article describes a shift-register system used to convert data coming in parallel form into serial form, and a means of converting cyclical-binary code into conventional-binary code.

Factors in Selecting Data Handling Systems, by A. Hix. "ISA J" June 1956. 4 pp. This is a discussion of industrial data handling systems from the standpoint of operational control, cost-accounting and inventory control, preparation of operating and managerial reports, and engineering studies.

Mechanized Memory and Logic—What Electronics Can Do, by J. Felker. "Bell Rec." June 1956. 6 pp. Despite its seeming complexity, electronic switching promises a wholesale simplification of telephony and, it is believed, more economical telephone service. This article presents simplified definitions of the basic concepts of such systems.

Practical Analog-Digital Converters, by M. Klein, F. Williams, and H. Morgan. "Inst. & Auto." June 1956. 9 pp. The authors present a list and descriptions showing the state of the art and the types of commercially available converters designed for shaft position conversion with binary output, shaft position conversion with uncoded output, shaft position conversion for direct data printing, data loggers with all-electronic conversion, and all-electronic high-speed conversion.

Designing Analogy Circuits from Test Data, by G. D. McCann. "ISA J" June 1956. 5 pp. The author discusses direct synthesis of analog circuits from tests such as influence coefficient or normal mode shake tests.

What's Inside Transac—I, by A. Cavaleri, Jr. "El. Des." July 1, 1956. 3 pp. A transistorized automatic computer using surface barrier transistors is described. It is capable of performing about 416,000 additions per sec, and can multiply two six-digit numbers in about 48 μ sec. Typical circuit units are illustrated and described.



International ELECTRONIC SOURCES

Optimizing with a Computer, by J. Strong. "Auto. Con." June 1956. 3 pp. Combining advanced mathematical techniques with a careful analysis of the controlling factors and objectives in scientific, industrial, or business situations, Operations Research can sometimes produce new answers or viewpoints in what were previously considered unsolvable problem areas. Several mathematical tools, such as linear programming and queueing theory are discussed.

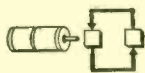
New Computer Method for Obtaining Optimum Area, by J. Tyroler and C. Smith. "Rev. Sci." June 1956. 2 pp. An automatic computer method for obtaining the optimum area for any fixed interval under a transient is described and discussed. This method automatically chooses the point on the transient where integration of the area is initiated and a pre-set timer stops the integrator after the selected time interval has elapsed.

Electronic Methods of Analogue Multiplication, by Z. Czajowski. "El. Eng." July 1956. 5 pp. The author presents a general survey of the principles used in analog multiplication. An attempt has been made to classify the different methods of approach to the problem and to compare all systems as to accuracy, speed, and complexity. This article deals with those devices which perform multiplication directly by application of some mathematical or physical formula.

The Simple Bridge Can Solve Equations, by W. Pease. "Com. Eng." July 1956. 1 p. By properly including the variables in the arms of a self-balancing bridge circuit, a single amplifier can serve to solve an entire equation. With precision components the overall accuracy can be as high as .01 per cent. The solution of a slant range equation is used for illustration.

Digital Storage Using Neon Tubes, by M. Raphael and A. Robinson. "El." July 1956. 4 pp. A means of providing inexpensive storage for digital data using a neon-tube matrix is described. The memory uses multiplier-photo-tube read out.

How to Design Reliable Computers, by F. A. Ordemann. "El. Eq." June 1956. 4 pp. Reliability, a major consideration in the design of all electronic equipment, assumes extreme importance in computer development. This article outlines the steps taken by one major computer manufacturer to enhance the dependability of his product.



CONTROLS

Electronic Step Actuated Integrative Control Equipment with Approximately Continuous Performance, by G. Weitner. "El. Rund." May 1956. 3 pp. Control equipment with approximately continuous integrative performance permits adjusting motor control via conventional mains contacts and control button adjustment of the adjusting velocity and the permanent deviation. Its temporal performance and basic design circuits are discussed with reference to an actual equipment example using a thyatron in combination with a relay.

Photoelectric Amplifier for Flame Guards, by E. Suchel. "El. Rund." June 1956. 2 pp. The flame guard photocell controls an alarm which sounds when the flame of an oilburner dies down. Circuit requirements are stated and a specially designed circuit is illustrated and discussed.

Control Techniques for Nuclear Reactors, by W. Whitehead and H. Lamonds. "Auto. Con." June 1956. 3 pp. The accelerated rate at which nuclear power reactors are being developed has led to the evolution of many new reactor types, but, as this article points out, the control systems for all these are based on a few fundamental principles and employ familiar hydraulic, pneumatic, and electronic control elements.

Relays for Control Applications, by W. Lockwood. "Auto. Con." June 1956. 2 pp. A general discussion of types and suitability of relays for a variety of applications.

Cascade Control Systems, by N. Gollin. "Con. Eng." July 1956. 5 pp. Proper choice of the control arrangement improves the performance of the control system. If this arrangement involves the adjustment of the set-point of the controller in a control loop by means of another measured variable, it is called Cascade Control. The type of cascade control system considered here is one where the two measured variables are related through the process. By block diagrams and transfer functions of the system's elements, cascade control systems can be analyzed to show how much they improve control of the process.

Capacitor Type Fuel Gages and Controls, by S. Solarez. "Aero D." June 1956. 4 pp. Modern aircraft fuel gage systems can allow for disposable fuel tanks, fuel programming to maintain aircraft stability, and indicators to show tank-full during in-flight refueling.

Structural Constant for Magnetic Amplifiers, by S. Ya. Dunayevsky. "Elek." Feb. 1956. 6 pp. The paper develops an approach to designing magnetic amplifiers, which is intended for those cases when the amplification factor is one of the main indices of the amplifier. The output power and the control power are included in the specified data. Complete design procedure is analyzed.



INDUSTRIAL ELECTRONICS

Application of Magnetic Amplifiers to Electric Drives, by A. G. Efanov, B. M. Gutkin, Yu. R. Reingold. "Elek." Feb. 1956. 6 pp. Paper discusses the use of magnetic amplifiers as intermediate amplifiers for the purpose of raising the gain of rotary amplifiers whose characteristics have been stabilized by negative feedback. Coupling circuits between the magnetic and rotary amplifiers are analyzed, static and dynamic characteristics are given, coil data is specified for the magnetic amplifiers and specific industrial examples are given.

Experimental Investigation of the Dynamic Properties of a Rotary Amplifier and the Design of Its Parameters, by E. L. Ettinger and Yu. R. Reingold. "Elek." March 1956. 9 pp. Experimental frequency responses of a rotary amplifier are used to analyze the effect of internal feedback, mutual inductance between the control coils, the degree of compensation and the load upon the dynamic properties of the amplifier. All of the basic parameters are then found for both no-load and load conditions. A simplified transfer function is derived, and the coefficients of the transfer function are calculated for various conditions. The method is generalized to include other typical elements of an automatic drive. It is shown that complex systems can be reduced to combinations of elementary members.

The Short-Interval Timer, by G. Hitchcox. "El. Eng." July 1956. 4 pp. Many industrial devices operate so rapidly that electronic time measurement is required, both in designing and in testing them. Examples are: fuses and contact-breakers, high speed relays, camera shutters, and explosive caps. This article describes the factors which govern the specification and design of a modern short interval timer intended for general purpose uses.

Gear Gage Controls Automatic Hobber, by R. Miles. "El." July 1956. 5 pp. An electronic inspector uses probes attached to the cores of linear variable-differential transformers to measure the pitch diameter and the root fillet of gears. Dimensional deviation signals are stored and compared electronically to determine corrective measures based on trends, ignoring individual variation. Corrective signals cause automatic readjustment of the gear-cutting machine.

Voltage Control of a Hydraulic Alternator of 36,000 KVA by Magnetic Amplifiers, by J. Fournier. "Hochfreq." April 1956. 16 pp. The circuit diagram is shown and explained; performance data are given in great detail. Good stability and rapid control have been obtained.

Application of Magnetic Amplifiers to an Automatic DC Motor Drive, by S. S. Royzen and K. Ya. Goasen. "Elek." March 1956. 8 pp. Theoretical discussion of the use of a magnetic amplifier in place of the rotary amplifier which is in the feedback loop of a dc motor speed regulator. The amplifier provides the necessary gain needed to maintain sufficiently accurate speed regulation with less bulk, less complexity and less loss. Systems with generator and rectifier supplies are analyzed, and experimental results are cited.

A New Circuit for Regulating the Load on an Electric Blooming-Mill Drive, by V. I. Arkhangelsky. "Elek." March 1956. 8 pp. The present device used for regulating the armature current of the drive motor is a rotary amplifier that suffers from the following disadvantages: a) there is no continuous control of the acceleration of the loaded motor during start, b) the regulator does not affect the field of the motor properly when the motor is slowed down from its maximum speed, c) the regulator has an unsatisfactory law of variation for the reference voltage as a function of exciting current. The new circuit overcomes these drawbacks. The loaded motor can be operated so that optimum characteristics are obtained with full utilization of overload capacity.

Vapor-Pressure Analyzer Computes Liquid Concentration, by L. Griffith. "Con. Eng." July 1956. 2 pp. A simple analyzer detects a liquid's vapor pressure and temperature and performs a computation on these two process variables to yield a continuous direct reading of concentration.



MATERIALS

Basic Insulating Materials, by G. Moses. "Insul." June 1956. 4 pp. A number of basic material components are used either separately or as combinations in composite insulation products. This article contains a general description of solid, non-resinous materials including asbestos, fiber glass, synthetic textiles, and mica; and reviews the peculiar characteristics of each which fit it to specific uses and limit its use in other applications.

Cathode Ray Tube Phosphors, by R. Millet. "El. Des." June 15, 1956. 2 pp. Specification of the correct CRT screen phosphor for a particular design application is often difficult. A design analysis of phosphors, including characteristics and suggested applications is presented.

A New Method of Electric Welding of Copper Cable Joints, by W. Ruecker and P. Raphael. "Nach. Z." May 1956. 3 pp. A 6-volt battery is applied to the carbon electrodes spaced 0.1 mm apart. A series of conical openings is provided in the circumference of the two circular electrodes, each electrode having half-conical recesses. The wire ends are placed into these openings and the weld is shaped like a small cone.



MEASURING & TESTING

Discriminator-Output Frequency Meter, by D. Marshall. "T-T & El. Ind." Aug. 1956. 3 pp. Circuitry and performance of a discriminator-output frequency meter for 3 cps to 100 kc are described. The meter analyzes fm information by use of a triggered-pulse, frequency-to-voltage conversion system.



The "Frequency-Microscope," a Registering Frequency Meter of High Sensitivity, by G. Ohl. "Arc. El. Uber." April 1956. 6 pp. A comparison of two frequencies is accomplished by heterodyning the two frequencies and recording the difference frequency. The recorder consists of a synchronous motor controlled by an adjustable frequency derived from a quartz crystal and a chronograph. Graphical and numerical methods to evaluate the frequency difference from the direction of the traced lines are given.

Vibrational Stability Tests for Magnetic Relays, by A. Maschmeyer. "T-T & El. Ind." Aug. 1956. 4 pp. Clapper type relays are evaluated under vibrational conditions of 3 to 2000 cps and accelerations to 35 g. Prime areas of relay improvement are found to be design of contact springs, contact supports, and relay mountings.

A Ruggedized Graphic Millimeter, by G. Walters. "T-T & El. Ind." Aug. 1956. 3 pp. Considerable difficulty has been experienced in using existing graphic recorders in airborne installations due to improper operation in the presence of shock or vibration forces. This article describes the techniques employed in designing a ruggedized instrument suitable for operation under the extreme environmental conditions specified by the military.

Method for Eliminating Omegatron Radial Field Errors or for Direct Measurement of Mass Ratios, by H. Woodford and J. Gardner. "Rev. Sci." June 1956. 4 pp. An omegatron having two pairs of ion-accelerating plates instead of one and using resonance absorption detection has been used successfully to obtain simultaneous cyclotron resonances of two different ion species in the same field. When used in conjunction with a nuclear resonance probe, the method effectively eliminates errors due to perturbing radial electric fields in the omegatron; alternatively, if radial electric fields are considered negligible, the method permits the direct measurement of mass ratios.

An AC Potentiometer for Measurement of Amplitude and Phase, by M. J. Somerville. "El. Eng." July 1956. 2 pp. A simple ac potentiometer circuit using ac coupled amplifiers is described. The design utilized enables the generation of in-phase and quadrature components which remain accurately in quadrature with one another, even though substantial phase shifts will occur in the ac couplings involved.

Fast Timing of Scintillation Pulses, by H. Ticho and J. Gauger. "Rev. Sci." June 1956. 6 pp. Some modifications of the conventional chronotron circuit are discussed. Using such a modified chronotron, time interval distributions due to two liquid scintillation counters have been studied under various experimental conditions. These studies suggest that even when counters with sensitive areas of approximately 300 cm² are used, a precision of ± 0.25 μ sec in an individual time interval measurement can be achieved if the distance between the particle trajectory and the photosensitive surface is known.

An Electronic Timing Unit, by N. B. Acred and G. Bishop. "El. Eng." July 1956. 7 pp. This article describes in some detail the design and construction of equipment for measuring the time intervals encountered in determining the speed of an aircraft flying over a straight course of known length. The primary requirement was that the timing unit should measure and display time intervals between 1 and 99.999 sec with an accuracy of 1 part in 10⁴. This, and other factors which influenced the design are discussed.

Photoelectric-Optical and Thermoelectric-Optical Amplifiers, by B. P. Kozyrev. "Elek." Feb. 1956. 8 pp. The paper analyzes the design and construction of photoelectric-optical and thermoelectric-optical amplifiers used with galvanometers for high-sensitivity measurements. Detailed design parameters and dimensions are given for existing standard amplifiers, and design equations are derived. The transformation of a photoelectric-optical amplifier into a thermoelectric-optical one is discussed.

Aural Electrocardiograms, by A. Gemant and D. Burch. "Rev. Sci." June 1956. 2 pp. In heart surgery the need arises for electrocardiograms that do not require visual attention. This has been achieved by converting the voltage wave pattern into a sound pattern of varying pitch; the latter is an exact reproduction of the voltage wave. The apparatus used for the conversion is described.

Extending the Limits of Resistance Measurement Using Electronic Techniques, by G. Hitchcox. "J BIRE" June 1956. 11 pp. In general, the article is confined to a discussion of devices and techniques which are suitable for inclusion in commercial instruments, rather than of those which, by their complication, delicacy, or specialization, are restricted to the laboratory. It opens with a description of the basic ohmmeter in its two dual forms, refers to three low resistance systems, two using direct and one alternating test currents, and then goes on to describe what is thought to be a novel instrument which can measure very low resistance using pulsed test currents to reduce thermal dissipation in the test sample.

Diamond, a Practical Radiation Counter, by W. Cotty. "J BIRE" June 1956. 15 pp. The properties which make diamond an attractive material for a practical conduction counter are discussed and the general theory of conduction counting is outlined. The counting property is thought to be a structural property and this also is responsible for the ill effects of polarization; diamonds, however, have been found which have the natural ability to maintain a steady counting rate for long periods and a method for selecting them is given. The principles of amplification are described in detail.

A Phase Meter for 50 Cycles to 30 MC, by O. Macek. "Freq." May 1956. 6 pp. The phase meter consists of two identical amplifiers and a CR tube displaying an ellipse. Alternatively the signal to be compared may be mixed with an oscillation between 1 mc and 30 mc to result in a suitable beat frequency. A phase difference of 1° can still be read. Various methods are discussed.

Determination of the Amplitude Distribution on Plane Surfaces from the Directional Distribution of Their Radiation Fields, by K. Feher. "Arc. El. Uber." April 1956. 10 pp. This continuation of a previous article describes the experimental set-up and the evaluation methods. The results for an aluminum plate vibrated by a piezoelectric crystal and for a plate vibrated by waves incident at a specified angle are reported.

Four-Place Timer Codes Oscillograph Recordings, by S. Dorsey. "El." July 1956. 3 pp. A timing generator is described which creates a pattern indicating time in increments of .001 seconds.

Group-Delay Measurements, by C. Heuvelman and A. van Weel. "Wirel. Eng." May 1956. 7 pp. A description is given of a simple group-delay meter which, in combination with any conventional wobulator generator, gives the group-delay characteristic directly on an oscilloscope.

A Five-Band Recording Spectroradiometer, by C. McCamy. "NBS J" May 1956. 7 pp. An accidental fire in an aircraft engine compartment can be dealt with successfully only if the fire is detected within a few seconds after it starts. Devices that respond to the radiant energy from flames have received considerable attention because a single unit can detect fires anywhere within a large space. Such detectors must be able to discriminate between flame and sun or hot engine parts. To accomplish this discrimination, the use of two characteristics of flame radiation has been proposed: the spectral distribution of energy and the fluctuations in the radiant intensity known as "flicker." In order to explore some of the possibilities, the instrument described in this article was built to record the radiant intensity of flames in several broad regions of the spectrum and to determine the frequency distribution of flicker.

A Mechanical-Electronic Transducer for Low Range Pressure and Force, by B. McKay. "ISA J" June 1956. 3 pp. Article gives circuitry, construction, application, and performance details of the RCA type 5734 transducer tube for measurement of pressures and force or weight, with particular mention of specific applications in the biological field. Past work is cited and new applications suggested.

Advances in the Design and Application of the Radio-Frequency Permeameter, by A. Rasmussen, A. Enfield, and A. Hess. "NBS J." May 1956. 8 pp. Improvements are described for increasing the frequency coverage, accuracy, and ease of application of the r-f permeameter developed at NBS to measure initial complex permeability of toroidally shaped ferromagnetic materials of low conductivity.

Slideback Electrometer, by N. Doctor and P. Franklin. "Inst. & Auto." June 1956. 3 pp. Low-leakage resistance paths in terminal boards, in laminates which bear etched wiring circuits, and in potted assemblies can seriously alter operation of electronic systems. An instrument is described for measuring resistances between 10¹⁰ and 10¹⁵ ohms. The instrument is in part a slideback voltmeter employing an electrometer tetrode.

Low Distortion and Low Noise in Small-Amplitude Motions, by B. McFadden. "Con. Eng." July 1956. 2 pp. Distortionless, noise-free mechanical motion at sinusoidal double amplitude of .01 deg is produced by a table designed to simulate aircraft motions for instrument testing. The table has a noise threshold below one second of arc.

Balloon-Borne System for Tracking the Sun, by H. Edwards, A. Goddard, Jr., M. Juza, T. Maher, and F. Speck. "Rev. Sci." June 1956. 5 pp. A balloon-borne system for tracking the sun both in elevation and azimuth is described.

Phase-Angle Measurement, by C. Vincent. "Wirel. Eng." May 1956. 5 pp. This article discusses the method of phase-angle measurement due to Fleming, in which X and Y deflections are adjusted for equality, and the phase difference is deduced from the proportions of the resulting ellipse. A thorough analysis is made of the geometrical factors which might lead to error in this method.

CAMA—Automatic Trunk-Test Circuit, by R. Dusenberry. "Bell Rec." June 1956. 4 pp. In a Centralized Automatic Message Accounting installation, trunks from local telephone offices are periodically tested by a circuit which can automatically test 2,000 incoming trunk circuits, without interrupting busy circuits. The author discusses necessary test functions and describes the operation of the tester.

Electrostatic Particle Size Analyzer, by H. Yoshikawa, G. Swartz, J. MacWaters, and W. Fite. "Rev. Sci." June 1956. 4 pp. This article comprises the theoretical analysis and physical description of an Electrostatic Particle Size Analyzer (EPSA) for determining the particle size distribution of aerosols in the 1- to 20-micron size range.

Wide Amplitude String Galvanometer for Direct Recording, by L. Browder. "Rev. Sci." June 1956. 5 pp. By employing an Einthoven or string galvanometer rather than the usual D'Arsonval galvanometer in a direct-writing oscillograph a considerable reduction in inertia of the moving element is obtained. The use of compliant end supports makes possible very large deflections so that a 10-cm long string having a resonant frequency of 230 cps can be made to move through an amplitude of 2.5 cm.

Automatic Scanning Device, by L. Holm. "Rev. Sci." June 1956. 5 pp. The driving mechanism and the control and recording circuits of an automatic device for repeated, continuous, unidimensional scanning of radioactive objects are described. The scanner can run at several different speeds from 4.10X10⁻³ up to 1.32 mm/sec. It is shown theoretically and illustrated with actual examples that it is possible to construct "equilibrium curves", i.e., curves corresponding to an infinitely low scanning speed, from those recorded with finite scanning speeds.



RADAR, NAVIGATION

Radar Doppler-Frequency Nomograph, by G. Baker. "El. Des." May 15, 1956. A design tool relating doppler frequency, radial velocity, and transmitted wavelength.

Three-Dimensional Radar Video Simulator, by P. Pielich. "El." July 1956. 3 pp. Terrain-clearance radar data is presented as three-dimensional oscilloscope display by using simulated-video generator and conventional flying-spot scanner. The mechanization of such a display was found to be a relatively simple matter.

Electrical Altimeters for Airplanes, by E. Roessler. "El. Rund." May 1956. 3 pp. Diverse kinds of electrical altimeters, especially capacitive, pulse echo, and frequency modulation types, are described in detail with reference to the historical development. The combination of weather radar, a collision warning radar, and a pulse altimeter finally is regarded as a possible technical solution of the pertinent problems of aeronautical engineering.

Transmission of Radar PPI Pictures with Reduced Bandwidth, by H. Meinke and H. Groll. "Nach. Z." May 1956. 8 pp. The received Radar signals are fed to a linear electronic memory by a modulated electron beam. The electronic memory is based on the charging principle and will be additive. A slower moving scanning beam transfers the added signal to an output resistor via a collector and transmitted. This system is discussed and radar pictures are shown.

Designing a Simulated Rate of Climb Indicator, by R. Neunes and P. Stein. "ISA J." June 1956. 4 pp. Instrumentation of an altitude test facility led to the development of an equivalent rate of climb indicator comprising a completely self-contained, portable unit containing a transistorized dc amplifier, built-in calibration device, and zero-suppression for extended range use. The design employs commercially available transducers and measuring instruments.

The Distant Field of a Paraboloid Having Rotational Symmetry in Combination with a Dipole at Right Angles to the Plane of the Opening, by F. Mueller. "Hochfreq." April 1956. 4 pp. The surface currents in the reflectors are computed from the distant field of the dipole; this leads to a computation of the distant field of the assembly. The result indicates a split direction for the main beam; the field is similar to the distant field of the E_0 -wave of a circular wave guide.

The Night-Effect on Direction Finders, by P. Miram. "El. Rund." June 1956. 4 pp. Fluctuations of this effect and possibilities for its remedies are considered. The various pictures received are discussed and a table is included in an effort to systematically correlate the disturbances and their cause.



SEMICONDUCTORS

Intermetallic Semiconductors, by H. Hrostowski. "Bell Rec." July 1956. 5 pp. There is a class of semiconductors other than silicon and germanium about which our knowledge is as yet incomplete. Recent investigations show that we can make intermetallic compounds with a wider range of electrical properties than is obtainable with silicon and germanium, and thus it may be possible to produce more versatile transistors and other semiconductor devices.

What Type of Degenerative Feedback for Transistors? by R. Hurley. "El. Des." June 15, 1956. 3 pp. The greater the number of stages per feedback loop, the greater is the predictability of the transistor amplifier gain at mid-frequencies for given overall gain. However, for more than two transistor stages per loop, instability results, the suppression of which reduces bandwidth. Experimental data is presented: results show that a two-stage transistor amplifier using current feedback is "some sort of optimum," as to midband gain predictability and bandwidth.

Superregenerative Transistor Oscillator, by R. Kircher and I. Kaminow. "El." July 1956. 2 pp. Equal on-off intervals of 500 cps audio frequency are obtained at a rate of 7 cps using a junction transistor in a basic self-quenching oscillator circuit. Effects of circuit parameter variation on the performance of the oscillator are given.

Transistor Circuitry in Japan. "El." July 1956. 5 pp. Japanese transistorized products including four different types of broadcast receivers, a portable tape recorder, and a hearing aid are reviewed.

Transistor Telemeter Small Missiles, by C. Kortman. "El." July 1956. 3 pp. Spin information is placed on a subcarrier channel of an fm/fm system, using a germanium photocell and transistors.

Automatic Curve Tracing Aids Transistor Circuit Design, by N. Goldich. "El. Des." July 1, 1956. 2 pp. Curve tracers can be effectively used to evaluate transistors in circuit design. They are particularly useful in analyzing changes in transistor characteristics with load, operating time, and environmental conditions. This article is a delineation of a typical curve tracer and explains how it can be used as a design tool.

Transistor Circuit Design with Intermediate Connections Terminal, by A. Jorysz. "El. Des." July 1, 1956. 3 pp. Recently, a new class of transistor circuits has been developed, which exhibits interesting and quite useful properties. The new circuits are more general and allow better control of impedances and amplification properties of the transistor. The most general form of the new circuit may be considered as a parallel-series or series-parallel combination of a transistor and an impedance bridge. The author discusses a group of three simple circuits: the "intermediate emitter-base," the "intermediate emitter-collector," and the "intermediate base-collector."

Designing "Free-Power" Transistor Apparatus, by H. Hoffmann. "T-T & El. Ind." Aug. 1956. 3 pp. A discussion of equipment deriving its power from natural or artificial energy fields is given. Transistor equipment using light, sound, and rf energy for power is described.

Designing Transistorized Test Equipment, by T. Lommasson and K. Hardin. "El. Des." July 1, 1956. 2 pp. Replacing vacuum tubes with transistors requires particular consideration of temperature effects, drive and impedance matching requirements, and frequency response. Some of the design problems encountered in the design of a small transistorized test set are discussed in this article.



TELEVISION

Designing Storage-Tube Equipment, by J. Buckbee and A. Luftman. "El." July 1956. 5 pp. Special cathode-ray tubes for storing information are useful in frequency-bandwidth conversion, mt radar, and data storage and analysis. High-voltage power supply, video amplifiers, sweep and blanking generator, focus-current regulator and staircase raster generator used with storage tube are described. Typical use is tv transmission over telephone lines.

Color Television on the L1 Coaxial Carrier System, by H. Hey. "Bell Rec." July 1956. 4 pp. The advent of color tv with its more stringent transmission requirements, made it necessary to modify existing L1 tv channels. To fill this need, existing B2 and C2 tv terminals have been integrated into B3 and C3 color tv terminals by the addition of new equipment.

Eidophor May Revive Lagging Theatre-TV Operations, by N. Wasserman. "Int. Proj." June 1956. 3 pp. A new closed-circuit TV system, capable of producing a wide-screen color picture with a high degree of clarity was originally developed by the Swiss and is now undergoing final development. An arc lamp projects a beam through a condenser to a schlieren lens. The light which is deflected strikes a reflector which is coated with an oily Eidophor liquid. When agitated by the scanning beam of an electron gun, this oily liquid forms tiny ridges or prisms which alter the reflective pattern of the light in such a way as to form an image. Only that light which is diverted by electron-agitated portions of the Eidophor liquid is reflected so as to pass through the schlieren lens and through the projection system to the screen.

Raising the Selectivity of Television Receivers, by Ya. I. Efrussi. "Radiotek." March 1956. 10 pp. The paper analyzes circuits for the intermediate amplifier stages in television receivers. These circuits permit an increase in selectivity and a simultaneous decrease in the number of tuned circuits. It is shown that in order to retain high video quality the selectivity must not exceed a specified value.

The Selenium Diode in TV Design, by J. Cataldo. "T-T & El. Ind." Aug. 1956. 2 pp. Applications for semi-conductor components, particularly selenium diodes, in tv receiver design are described. The horizontal phase detector circuit is analyzed, with both selenium diode and conventional vacuum tubes and comparative performance figures are given.

On the Theory of Mertz and Gray, by H. Schoenfelder. "Freq." May 1956. 6 pp. An analysis of the pulses in the frequency spectrum of a television signal is presented to illustrate the results of the theory of Mertz and Gray (Bell Tech. J. 1934).

Color Television Transmission Systems, by K. Teer. "Nach. Z." May 1956. 3 pp. The Philips system is compared with the N.T.S.C. system. The Philips two AM-sub-carrier system (T.S.C.-system) transmits a 3.6 mc carrier (2 mc wide) for the red color component and a 4.6 mc carrier (1 mc wide) for the blue color component. A control signal to adjust the amplitude relationship between the signals, corresponding to the burst signal, is also transmitted.

Design Project for a Television and Radio City in Bogota, Colombia, by W. Duschinsky. "BC News" June 1956. 14 pp. How to build proper centralized radio and television facilities in a growing city like Bogota is a problem which is all too familiar to broadcasting and television enterprises in many parts of the world. The Government of Colombia has formally approved the project described in this article, and is proceeding with extensive streamlining of its communications facilities, including radiotelephone and radiotelegraph, as well as broadcast and television.

Chrominance Circuits for Colour Television Receivers (Part 2), by B. Osborne. "El. Eng." July 1956. 5 pp. This article is a brief review of circuit techniques applicable to the chrominance section of a color tv receiver designed to receive an N.T.S.C. type signal.

Design of Industrial Television Equipment, by W. Mayer. "El. Rund." May 1956. 4 pp. Resistor and Vidicon-tubes, owing to their simple design, have been adopted generally as camera tubes for industrial tv equipment. Circuit design depends on due consideration of special qualities of the camera tube resistance screen. Conditions are discussed determining the production of inertia-free images (small signal plate voltage and adequate electron jet current values), also problems of resolution power, noise, focusing, and aperture loss.

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TRANSMISSION LINES

Ferrites in Waveguides, by G. Thompson. "J BIRE" June 1956. 18 pp. The gyromagnetic mechanism which controls the permeability of a ferrite at microwave frequencies is investigated theoretically in several simple cases, and the tensor form of the permeability in the general case is indicated. The theory is first applied to circular waveguides containing a ferrite magnetized along the axis. Applications of the effects in the construction of isolators and circulators are described. These include resonance and reflection isolators for circularly polarized modes, and also devices which make use of Faraday rotation. The effects of transverse magnetization of the ferrite is then discussed. Applications in rectangular guide in the form of resonance isolators, non-reciprocal phase circulators, and field displacement devices are described.

The Frequency Dependence of Self-Excited Micro-Wave Generators Under Complex Load, by H. Paul. "El. Rund." May 1956. 4 pp. The influence of frequency alterations due to a complex load on the operation of a transmitter, especially a magnetron transmitter, is examined with reference to the Rieke-frequency diagram. In the present paper, instability regions for certain kinds of load and their origin are discussed. Maximum admissible misadaptation for certain cable lengths is calculated, also the frequency operation of the transmitter near stability limits.



TUBES

Klystron Control System, by R. Reeves. "Wirel. Eng." June 1956. 9 pp. The concept of a "control plane" is introduced to illustrate klystron properties, and the automatic tuning problem is recast as one in two dimensions. Provision of a/c for primary radar is described in detail. The article describes test equipment which presents the control plane on the face of a crt and maps either klystron mode areas and frequency contours or servo-trajectories onto the plane. The a/c system described takes cognizance of oscillation strength while searching for, or tracking the required frequency. A sampling technique for mode centering is introduced which affords minimum disturbance to the controls and provides a slightly better error criterion.

Modern Reflex Klystrons, by R. Hechtel. "Arc. El. Uber." April 1956. 6 pp. An introduction on the design considerations for reflex klystrons is followed by a description of the Raytheon RK 5976, (6250 to 7425 mc), the Western Electric 431 (3700 to 4200 mc) and the experimental Telefunken reflex klystron (3600 to 4200 mc). Tables and charts facilitate the presentation of tube characteristics.

Ceramics in Electronic Tubes, by G. Gallet. "Rev. Tech." April 1956. 13 pp. This article gives an account of the development possibilities of electronic tubes through the use of ceramics. Different cases are listed where the use of ceramic products brings about an improvement either in the manufacture or in the characteristics of the tube. A review of the mechanical, electrical, and thermal qualities which govern the choice of ceramic is included.

Hydrogen Thyratrons, by J. Chantreau and P. Leduc. "Rev. Tech." April 1956. 20 pp. A detailed description of the manufacture and testing of thyratrons is given, together with a review of the advantages of hydrogen thyratrons and the characteristics of TH-6345, 6435, 6522, and 6907 tubes.

Reliability as a Design and Maintenance Problem, by R. Matthews. "El. Eng." July 1956. 3 pp. Attention is drawn to the critical importance of reliability in complex electronic equipment. Tube performance is suggested as being largely responsible, and an estimate is made of this factor in equipment failure. A design philosophy is proposed which could improve operational reliability, provided it was backed by the appropriate maintenance system. Tube by tube negative feedback and marginal checking techniques are then examined as related solutions to the problem.

Experimental Verification of the Theory of Reflex Klystrons, by R. Musson-Genon. "Rev. Tech." April 1956. 92 pp. The theoretical determination of the characteristics of the circuit with localized constants equivalent to a resonant cavity is reviewed. A description is given of different experimental methods with or without electronic beam. A review is presented of the theoretical determination of the different parameters arising in the expression of the second order of the admittance of the electronic beam: finite transit times in the H.F. space, non-uniform retarding field, multiple paths, phase aberration. Description is given of the various experimental methods defining these parameters.

High-Powered C-Band Klystron Amplifiers, by R. Haeghele. "T-T & El. Ind." Aug. 1956. 3 pp. Need for increased power in microwave is met by a line of linear four-cavity klystron amplifiers for 5300 to 8000 mc. Described here are the designing highlights: ceramic-to-metal techniques, novel tuning methods, and unique input and output fittings.

Very High Frequency Triode TH 021, by F. Hulster. "Rev. Tech." April 1956. 18 pp. Beginning with the phenomenon of power drop in triodes with an increase in frequency, the physical principles to be observed in the construction of vhf triodes are then more generally set forth, and in particular the principles which result from the phenomena of transit time and of interaction of the tube with the resonant circuit.



U. S. GOVERNMENT

Total Cross Sections for 14-MEV Neutrons—Comparison of Measured Values with Values Calculated From the Complex Square-Well Model (PB 111853), by W. McGarry, J. Elliot, and W. Faust, NRL. Dec. 1955. 5 pp. 50¢. (OTS) A comparison was made between measured 14-Mev neutron total cross sections and theoretical values calculated from the complex square-well model of the nuclear interaction. The theoretical parameters used in the calculations were obtained from previous work on 14-Mev neutron differential elastic cross sections. The comparison shows that the calculated cross sections are low, indicating either that a greater nuclear radius parameter is required (in contradiction to the differential elastic scattering data) or that the theoretical model utilizing a square well is an oversimplification.

Systems Engineering (PB 111801), by J. Warfield, Pennsylvania State U. Aug. 1955. 30 pp. 75¢. (OTS) To provide useful material for the systems engineer in any industry, technical considerations are eliminated and only material common to most systems problems is included in the book. An introduction to systems engineering is given, the factors surrounding a typical systems-engineering problem are enumerated, and the systems design process is outlined.

Units and Systems of Weights and Measures (NBS Circular 570), by L. Judson, NBS. April 1956. 29 pp. 25¢. (Govt. Printing Office, Washington 25, D. C.) This circular brings together much of the information previously available in separate mimeographed leaflets.

Monte Carlo Reactor Calculation (PB 111865), by S. Podgor and L. Beach, NRL. Dec. 1955. 10 pp. 50¢. (OTS) The Monte Carlo method was used to estimate the slowing down of fast neutrons in a spherical homogeneous mixture of U^{235} and H_2O . The estimated probability distribution of thermalization was compared favorably with those of other calculational methods and with experimental measurements. These probability distributions were used to calculate the critical ratio of U^{235} to H_2O for both bare and reflected core reactors.

Debunching in UHF Velocity-Modulated High Density Electron Beams (PB 111799), by M. Weinstein, U. of Illinois. April 1955. 112 pp. \$3. (OTS) The role of space charge of large beam current densities in field free drift regions of a velocity modulated electron beam is investigated, with particular attention to space charge "debunching." A beam analyzing system, enabling the observer to see the velocity distribution of electrons during the complete cycle at a point of interest along the beam, was employed to obtain experimental knowledge about the velocities in each phase increment of a complete modulation cycle.

Behavior of Brittle-State Materials, Part 1 (PB 111987), Part 2 (PB 121002), by O. Salmassy and others, Battelle Memorial Institute. June 1955. Part 1, 153 pp. \$4; Part 2, 161 pp. \$4.25. (OTS) Part 1 investigates the factors influencing the fracture of brittle ceramic materials with emphasis primarily on the effects of size and stress state, as well as the effects of strain rate and temperature. Part 2 sets forth principles for the selection, evaluation, and design of brittle materials from a statistical and probability viewpoint. The entire distribution curve of fracture stresses was indicated to be a function of size and stress state of a brittle body. All materials investigated showed the same qualitative effect of size and stress state.

Industrial Preparedness Study: Transistors and Transistor Manufacturing Equipment, RCA May 1955. Vol. 1 (PB 111822), 200 pp. \$5. Vol. 2 (PB 111820), 42 pp. \$1.25. (OTS) Necessary manufacturing equipment and facilities for a point-contact switching transistor and a general purpose junction transistor were designed, built, and operated in a pilot run. Vol. 1 reviews engineering development and summarizes design features. Pilot production problems are discussed, and complete manufacturing instructions are included. Vol. 2 contains descriptions and photographs of the mechanized equipment developed for point-contact production.

Energy Distribution in Luminescence Spectra of Organic Compounds (PB 111872), by F. Germann, Colorado U. Nov. 1954. 163 pp. \$4.25. (OTS) As a result of the frequent use of solutions of fluorescent materials in scintillation counters, interest in the phenomenon of energy transfer in phosphor systems has been greatly stimulated. A new system for the detection of infrared radiation (7,000 A-20,000 A) is described. It uses a lead sulfide photoconductive cell and a high gain AC amplifier. With this new detector, infrared phosphorescence of a number of different substances was studied. Phosphorescent emission was found for a series of cadmium sulfide-zinc sulfide phosphors up to a wavelength of 9,000 A.

Evaluation of Antistatic Agents on Nylon Parachute Cloth (PB 121141), by J. Sweeney, Lowell Technological Institute Research Foundation. Sept. 1955. 71 pp. \$2. (OTS) Justification was found for the utilization of fabric surface resistance as the measurable parameter. Special instrumentation was developed to provide the desired test conditions of -30° F and 10 percent RH and permit the required range of resistance measurements. No permanent antistatic agent was found to be effective at low temperatures, but specific non-permanent agents gave the treated material a surface resistance at test conditions which was comparable to the resistance of untreated nylon fabric at standard test conditions of 70° F and 65 percent RH.

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PATENTS

Phase Shift Oscillator, No. 2,749,441. Inv. D. A. Kelly. Iss. June 5, 1956. A voltage feedback is applied to a multistage phase inverting amplifier. Series-connected L-sections are used as a phase-shift tuner in the feedback path reversing the phase at the operating frequency. Degenerative feedback is also supplied.

Direct-Reading Frequency Meter, No. 2,749,515. Inv. P. G. Hansel. Assigned Servo Corp. of America. Iss. June 5, 1956. The output frequency of a wide-range continuously-tuned oscillator is compared to the harmonics of a crystal-controlled oscillator, each frequency coincidence being counted for each tuning sweep. The unknown frequency is similarly compared to the output of the continuously-tuned oscillator and applied to the same counter. The counter being stopped at simultaneous counts, giving an indication of the particular harmonic frequency swept just before attainment of the unknown frequency.

Electromagnetic Horn, No. 2,749,545. Inv. J. A. Kostriza. Assigned International Telephone and Telegraph Corp. Iss. June 5, 1956. Dielectric material is positioned between two parallel conductors of a transmission line. The conductors having a first section of uniform width leading to a terminating section flaring outwardly to provide an impedance transition between the uniform-width transmission line section and free space.

Transistor Oscillator with Current Transformer Feedback Network, No. 2,748,274. Inv. A. R. Pearlman. Assigned Clevite Corp. Iss. May 29, 1956. Two transistors are coupled in push-pull and their output fed to a transformer coupling to a load. The primary of a feedback transformer is supplied by the load, and the secondary of the feedback transformer serves as input to the transistors.

Intercarrier Wave Translation Circuits, No. 2,745,954. Inv. G. F. Devine and R. F. Foster. Assigned General Electric Co. Iss. May 15, 1956. The different carrier frequency AM and FM waves received in a TV receiver are intermodulated in a two-control grid tube. The AM wave is derived and detected from the first-electrode cathode circuit. A filter circuit between the plate and the cathode derives the intermodulated wave for limiting and demodulation.

Semi-Conductor Signal Generator, No. 2,745,960. Inv. B. D. Griffith. Assigned RCA. Iss. May 15, 1956. A resistor and capacitor in series are connected between the collector and emitter electrodes of a point-contact type semiconductor. Another capacitor and variable resistor are connected in parallel between the emitter and the base electrode. The variable resistor controls the current of the emitter and thus the oscillation frequency. Suitable bias voltages are provided.

Vacuum Tube Shield and Heat Radiator, No. 2,745,295. Inv. E. J. Lideen. Iss. May 15, 1956. The shield and heat radiator is a grounded corrugated metal cylinder closely surrounding the tube. At the bottom, where it rests on the socket, small openings are provided for the entrance of cooling air which then progresses along the vertical corrugations. The shield can be mounted by sliding it over the tube.

Television Receiver Circuit, No. 2,745,899. Inv. R. A. Maher and Ch. C. Pfitzer. Assigned Avco Manufacturing Corp. Iss. May 15, 1956. In a color television receiver the phase of the color subcarrier oscillator output is compared with a received color burst signal for synchronization of the oscillator. This oscillator controls the elements of a color grid aligned with the horizontal strips of phosphors of different color. At least one low harmonic of this oscillator output is applied to a beam intensity modulating electrode.

T-Connected Stub Filters for Use on Very High Frequencies, No. 2,751,557. Inv. B. M. Sosin. Assigned Marconi's Wireless Telegraph Co., Ltd. Iss. June 19, 1956. The connecting arm of a T-connected stub is not a multiple of a quarter wavelength at any operating frequency. This connecting arm is connected in parallel to the two other arms; one arm is open-circuited at its other end and an odd multiple of a quarter wavelength, while the other arm is short-circuited at its other end and shorter than a quarter wavelength.

High Frequency Capacitor, No. 2,751,560. Inv. E. F. Brinker. Assigned Lavoie Labs, Inc. Iss. June 19, 1956. Two sets of stator blades are mounted respectively at the end of two spaced rectangular conductors of a transmission line and extend in the direction of the line. Two electrically connected groups of rotor blades, interleaving respectively with the two sets of stator blades, are rotatably mounted.

Color Television Synchronizing Apparatus, No. 2,748,188. Inv. R. J. Stahl and N. L. Heikes. Assigned Color Television Inc. Iss. May 29, 1956. A tunable synchronizing frequency oscillator is controlled by a voltage derived from a phase comparison of a sub-harmonic of its output with another voltage. This comparison voltage is derived from a frequency stabilized oscillator tuned to a harmonic of the half-line frequency.

Television Color Synchronization, No. 2,751,430. Inv. G. E. Kelly. Assigned RCA. Iss. June 19, 1956. The color synchronizer comprises a color sampler driven by a crystal-controlled oscillator. The phase of the received burst signal is compared with the phase of the oscillator output to derive a control signal which is applied to the piezoelectric crystal controlling the oscillator.

Signal Translation System, No. 2,751,437. Inv. C. H. Hoepfner. Assigned Raytheon Manufacturing Co. Iss. June 19, 1956. The receiving antenna of a communication system supplies a plurality of frequency signals, the frequencies representing the intelligence. These frequencies are converted into pulses, divided and recorded. A reproducer feeds a magnetic string oscillograph.

Automatic Gain Control Circuit for Transistor Amplifiers, No. 2,751,446. Inv. C. C. Bopp. Assigned Avco Manufacturing Corp. Iss. June 19, 1956. The gain control circuit for a main transistor amplifier is a direct current transistor amplifier. The bias voltage source of the collector electrode of the main transistor amplifier is connected in series with the collector electrode to transmitter electrode path of the direct current transistor amplifier. The collector electrode to transistor electrode impedance of the direct current transistor amplifier is variable.

Superregenerative Transistor Broadcast Receiver, No. 2,751,497. Inv. R. S. Duncan. Assigned Bell Tel. Labs., Inc. Iss. June 19, 1956. A transistor oscillator with a regenerative feedback is used. This feedback is controlled to compensate for the current gain factor of the transistor which decreases with frequency over the operating band so that the oscillator will alternately start and stop oscillating.

Cathode-Ray Tube, No. 2,750,525. Inv. R. C. Palmer. Assigned Allen B. Du Mont Labs. Iss. June 12, 1956. The face plate of a cathode-ray tube is made of light-sensitive glass which may assume different colors. This plate is photographically fixed to provide a series of strips effective as color filters for different color. These filter strips can be arranged to provide, for instance, alternating blue and red filters.

Intercarrier Sound System, No. 2,750,441. Inv. K. Schlesinger. Assigned Motorola, Inc. Iss. June 12, 1956. An intercarrier 4.5 MC wave is frequency-modulated by the audio signal and amplitude-modulated by low-frequency pulses of the video signal. This wave is limited and mixed to produce a 300 kc to 600 kc FM wave which is fed to a blocking oscillator. The blocking oscillator output is demodulated by a filter supplying the audio output.

Superregenerative Superheterodyne Wave-Signal Receiver, No. 2,748,267. Inv. D. Richman. Assigned Hazeltine Research, Inc. Iss. May 29, 1956. The heterodyned wave is supplied to a regenerative oscillator having a quench circuit. Further, the regenerative circuit supplies another heterodyne signal in response to the heterodyne signal and the signal supplied by the regenerative oscillator. This signal is fed to a frequency-selective circuit.

Direct Current Amplifier, No. 2,750,453. Inv. R. L. Pritchard. Assigned General Electric Co. Iss. June 12, 1956. A varying resistance which is to be measured is connected to the base electrode of a transistor having a current amplification factor less than unity. A dc voltage source and an output resistor, having a resistance which is small compared to the one to be measured, are connected between the collector and the emitter, the free end of the varying resistance being connected to the common terminal of the voltage source and the collector electrode.

Device for the Amplification of Both Voice and Signalling Voltages, No. 2,749,394. Inv. L. B. Person et al. Assigned Telefonaktiebolaget L. M. Ericsson. Iss. June 5, 1956. In a device for the amplification of voltages above a given frequency, a feedback low-pass filter, passing frequencies lower than voice frequency, is connected to the cathode of a tube. A high negative voltage is applied over a large resistor to the other terminal of the network. A grounded voice by-pass capacitor is also connected to this terminal, while a biasing voltage is applied thereto over a diode.

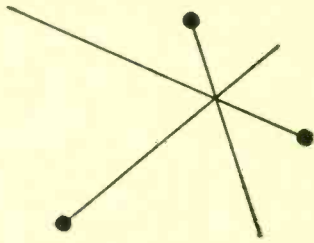
Trigger Circuit, No. 2,749,437. Inv. W. G. Parr. Assigned Pye Ltd. Iss. June 5, 1956. A plurality of flip-flop connected double tubes is arranged in series. A resistor is interposed between the grids of one of the tubes and ground. The control grid of another tube is connected to a resistor and grounded rectifier in series, resetting pulses being applied to the junction of the resistor and rectifier. The input is applied to a cathode and the output taken from a plate.

Multivibrator Trigger Circuit, No. 2,745,955. Inv. B. L. Havens. Assigned International Business Machines Corp. Iss. May 15, 1956. Each grid of the two multivibrator trigger tubes is connected to a rectifier and a resistor having their other terminals at a constant potential. This limits the negative voltage excursion on the grids, whereby the recovery time is reduced. A rectifier is connected to the grids in such a manner that the control pulse will trigger only the more positive grid.

Trigger Circuits, No. 2,745,959. Inv. A. R. Kilbey and G. E. Tucker. Assigned Raytheon Manufacturing Co. Iss. May 15, 1956. A reactive impedance is inserted into the cathode lead of an electron tube and another reactive impedance is placed in the plate circuit. During conduction of the tube, the two impedances will resonate. The control signal is applied to the grid of the tube.

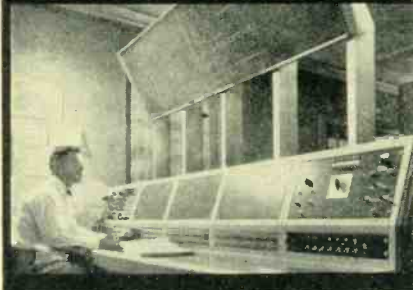
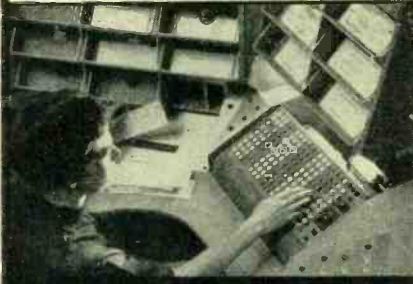
Radio-Frequency Controlled Plasmatron, No. 2,750,455. Inv. H. J. Geisler. Assigned International Business Machines Corp. Iss. June 12, 1956. Two pairs of opposing electrodes enclosing a common space are mounted in a gaseous discharge tube. An ionizing dc potential is applied to one pair of electrodes through a choke coil filter grounded over an output resistor. An amplitude-modulated high-frequency oscillation is fed to the other pair of electrodes which are balanced with respect to ground.

Color Television Transmitter, No. 2,750,439. Inv. R. D. Kell. Assigned RCA. Iss. June 12, 1956. A full band-width panchromatic signal and two color component signal trains are developed. The low-frequency component of each of the color signals is combined with the low-frequency panchromatic signal. This combination signal and the low-frequency components of the two color signals are consecutively and cyclically sampled at a comparatively high frequency and the resulting signal is mixed with the panchromatic signal to produce a composite signal for transmission.



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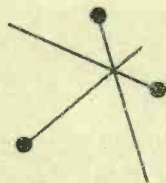
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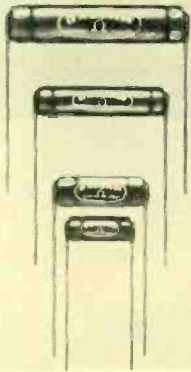
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New Printed Circuit Components

MINIATURE RESISTORS

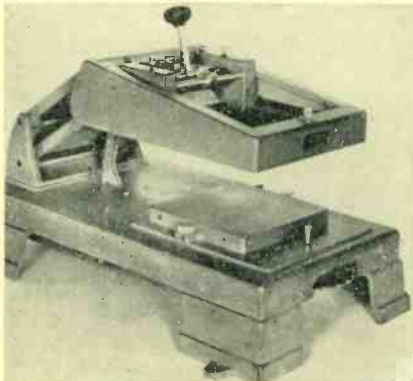
The new Dalohm Type RLS miniature power resistors, designed for printed circuit applications, are basically the same as the Type RS resistors, except that



they have radial instead of axial leads. They come in 6 sizes and 4 wattages, 2, 5, 7, and 10 w. Max. resistance values are 4.4K, 15.5K, 22K, and 55K, respectively. Temperature coefficient: 0.00002/Deg. C; di-electric strength of 1000 VAC. V block test; tolerances: 0.05% to 3%. Dale Products, Inc., Columbus, Neb. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-1)

SCREEN PRINTER

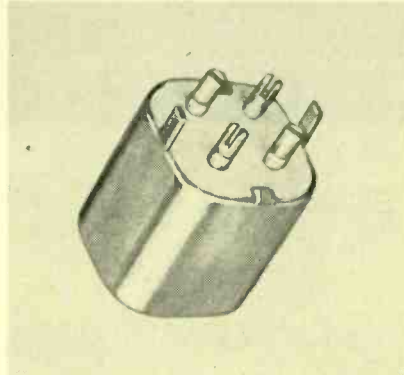
Screen Process Printer for printed circuits will print an actual area of up to 6 x 6 in. on copper clad laminates of any thickness. The screen is closed to the work by an air cylinder, while the squeegee is operated by a simple hand motion. Pressure, angle of squeegee, and registration locks



are provided leaving nothing to operator judgment. 200 impressions per hr. are readily achieved. Mech-Tronic Equipment Co., P.O. Box 510, Silver Spring, Md. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-143)

COIL FORM

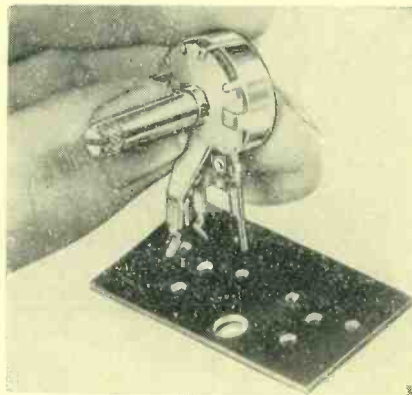
Shielded coil form for printed circuits, designed as LS-12, has a square shaped plated brass housing, whose dimensions are $\frac{1}{2}$ x $\frac{1}{2}$ x $\frac{1}{2}$ in. Inside the housing is



a coil form with an internally adjustable powdered iron core, tunable from top or bottom. The LS-12 mounts by two tabs that can be inserted through a printed circuit board and can be dip-soldered from one side of the board to complete installation. Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-20)

SNAP-IN CONTROL

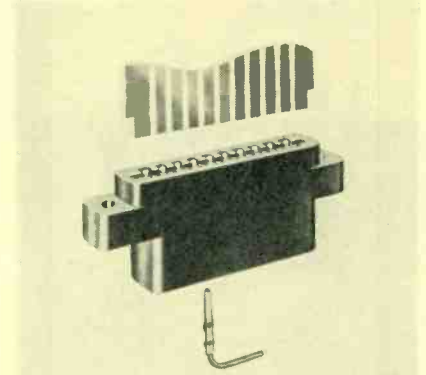
Self-supporting, snap-in variable resistor for printed wiring known as the Stackpole Type LR-70, measures $\frac{57}{64}$ in. dia. and stands $\frac{7}{8}$ in. off the mounting board. It is supported by four legs—the three regular voltage taps, and a larger, case ground leg. Sin-



gle or double-pole snap switches are available with ratings from 15 a., 15 v. dc; to 6 a. at 125 v. ac-dc. Electric Component Div. of Stackpole Carbon Co., St. Marys, Pa. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-90)

CARD RECEPTACLE

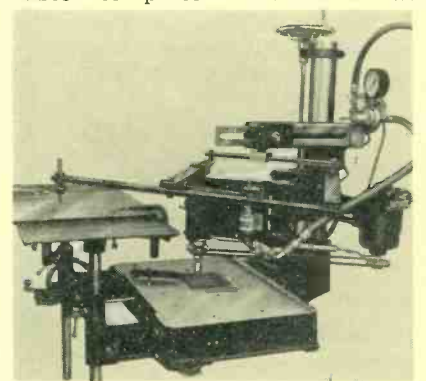
Line of double-row, printed card receptacles, designated as Series UPCR-DTP, feature beryllium copper contacts with taper-pin terminals embodied within a



high-compression solid molding. Available in 6, 10, 15, 18 and 22 contacts per row, for $\frac{1}{16}$ in. and $\frac{3}{32}$ in. printed cards, receptacles have an insulation resistance of over 100,000 megohms and voltage capacity of 2200 v ac (RMS) at sea level, and 600 v ac (RMS) at 60,000 ft. Components, Inc., 454 E. 148th St., N. Y. 55, N. Y. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-31)

CIRCUIT DRILLING

Speed-up in the drilling of printed circuit plates is now possible with a newly-developed pneumatic attachment to the New Hermes pantograph. Machine enables an unskilled operator to increase the drilling operation to more than 100 holes per min. A master template from which the

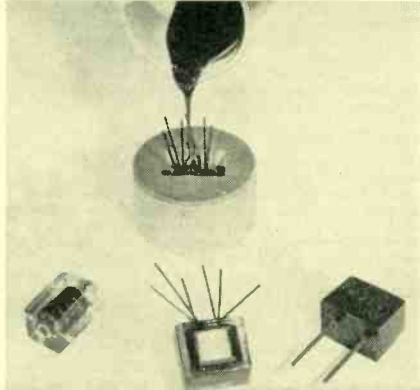


drill pattern is reproduced, shows a number of dots representing the amount of holes to be drilled. New Hermes Engraving Machine Corp., 13-19 University Place, N. Y. 3, N. Y. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-26)

New Microwave Products

EPOXY RESINS

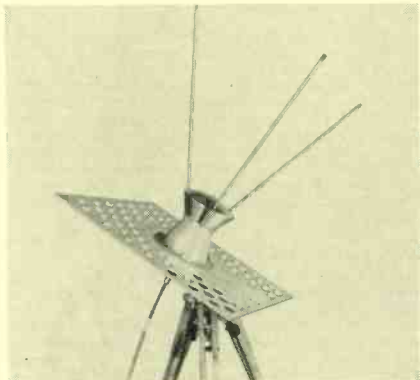
"Family" of epoxy resin systems are marketed under the trade name "Randac." Randac R-4060 exhibits nearly constant values for volume resistivity, loss or dissipa-



tion factor, and dielectric constant from room temperature to 130° C. R-4059 is a 100% reactive, mineral-filled, thermosetting liquid designed for room-temp. application which, in the cured state, is semi-flexible. R-4053 a 100% solid resin is thermoplastic until cured. **Mitchell-Rand Insulation Company, Inc.**, 55-A Murray St., New York 7, N. Y. Tele-Tech & ELECTRONIC INDUSTRIES (7-72)

ANTENNA

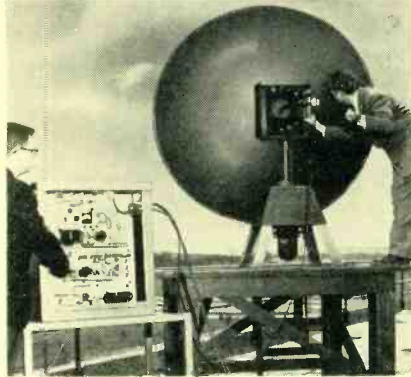
Patterned after a Signal Corps design, the new 91280-1 Discone Antenna fully meets the requirements of specifications MIL-I-11683A and MIL-S-10379A. Used in conjunction with the Stoddart NM-30A Radio Interference-Field Intensity measuring equipment, it is suitable for making broad-band



interference measurements within the frequency range of 40 to 400 MC. **Stoddart Aircraft Radio Co., Inc.**, 6644 Santa Monica Blvd., Hollywood 28, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-98)

MICROWAVE SYSTEM

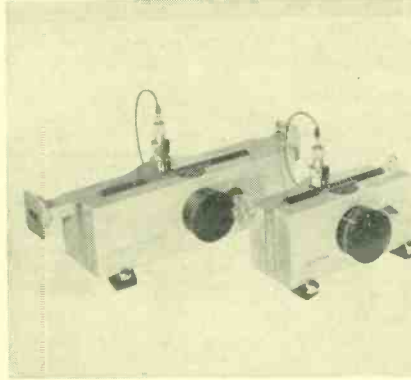
This new and compact 2,000 MC microwave relay system for TV combines for the first time outputs of separate aural and visual transmitters into a common antenna.



The complete system weighs less than 200 lbs. and comprises 2 transmitting and 2 receiving units, and 2 parabolic antennas or "dishes." The system will be available in 2 models; the TL-3-A, including both aural and visual equipment; and model TL-3-D, visual equipment only. **General Electric Co., Electronics Park, Syracuse, N. Y. Tele-Tech & ELECTRONIC INDUSTRIES** (Ask for 7-12)

STANDING WAVE DETECTOR

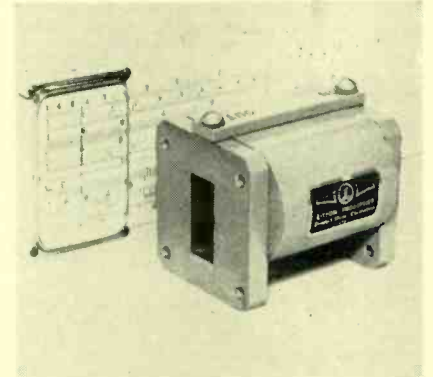
Consisting of only three basic units—the carriage and drive section, the block, and the probe, Type DB-825 can measure all standard microwave and ultramicro-wave frequencies, from 5.8 KMC to 90 KMC. The slot is built



perfectly parallel to the waveguide axis, and probe travel is held parallel to the waveguide axis. **DeMornay-Bonardi**, 780 S. Arroyo Pkway., Pasadena, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-159)

FERRITE ISOLATOR

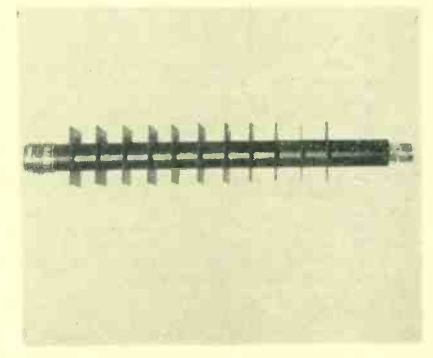
The new Model X110 Ferrite Load Isolator is designed for use in X-Band systems where space and weight are at a premium. Unit weighs 1 lb. and is 2 in. long



and 2 in. wide. Nine db isolation is provided at 100 kw peak power over a bandwidth of 8600 to 9600 mc. It provides a compact solution to "long-line" effects and other loading problems caused by lengthy transmission lines or excessive VSWR's. **Litton Industries, Components Div.**, 336 North Foothill Road, Beverly Hills, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 7-18)

COAXIAL TERMINATION

New high power coaxial termination for the 900 to 10,000 mc range, Model 369, has a power rating of 200 w. average and 50,000 w. peak. Capable of withstanding temperatures in excess of 500° F., it is useful for terminating directional couplers and other devices in high power sys-



tems in actual operation or for test purposes. The unit is 11 in. long and is available with a type N female connector. **Narda Corp., Mineola, L. I., N. Y. Tele-Tech & ELECTRONIC INDUSTRIES** (Ask for 7-8)

Western Manufacturers Offer Technical Data . . .

(Ask for WC-1)

Diodes, transistors and deposited carbon resistors are shown on catalog sheets. Engineering data sheets, and catalogs showing wire-wound resistors, precision carbon-coated resistors and copper oxide rectifiers, also available. (Nucleonic Products)

(Ask for WC-2)

Motor brochure on rotating electrical equipment, including data sheets and photos, and a performance specification on a new instrumentation camera (35mm type—MPSC35-100) are offered. Engineering drawings included in both brochures. (Bill Jack Scientific Instrument)

(Ask for WC-3)

Etched circuitry and related electronic components and assemblies are described in a four-page brochure. Material includes photos and brief descriptions of components; back cover has graphs relating to current carrying capacity and voltage drops expected for various weights of copper used in printed circuitry. Charts have been incorporated in the Standards Manual at North American Aviation. (Graphik-Circuits Div., Cinch Mfg.)

(Ask for WC-4)

Data sheets offered are: special cathode ray tubes, vacuum gage tubes, vacuum measuring equipment, spot and seam welders, and fractional cycle timers. Engineering bulletins available include: phosphor characteristics, and welders. (Vacuum Tube Products)

(Ask for WC-5)

Pulse handling instruments line is described in eight catalog sheets and specification sheets. Items include: two time delay generators, a digital time delay generator, pulse generators, a marker generator, and a pulse forming unit. (Rutherford Electronics)

(Ask for WC-6)

Fluoroplastics Kelon-T (Teflon) and Kelon-F (Kel-F, Fluorothene) are described in engineering bulletins. Kelon-T and Kelon-F are used to make back-up rings, standard O-rings, piston-rings, scraper rings, valve packings and stand-off and feed-through insulators. Wide variety of applications for these fluoroplastics is listed, and bulletins include specs and drawings. (W. S. Shamban)

(Ask for WC-7)

Cinema encapsulated resistors, wire-wound fixed, are described in a bulletin which includes scaled drawings and specifications for each type. Military types and series for printed circuits are included among the available resistors. (Cinema Engineering)

(Ask for WC-8)

Plug-in catalog includes a special section on plug-in units and an application chart for quick reference in applying plug-in units. Special section of plug-in units involves: counting and frequency division (digital counting and analog counting); pulse and sweep generators; time selection; squaring circuits; pulse amplifiers; and linear amplifiers. For systems designers, the catalog is concerned with standard plug-in units for military and commercial users, as well as special plug-in units fabricated to customer drawings. Catalog has photos, engineering drawings, specs and price list. (Ecco Production)

(Ask for WC-9)

Application case history No. 113, describing use of rubberized abrasive for deburring and polishing component metal electronic tube parts, and industrial catalog and price list are offered. Case history gives details of problem and its solution. Catalog, illustrated, gives specs, uses and operating suggestions on wheels, points, blocks, sticks and cones, for burring, smoothing and polishing. (Cratex Mfg.)

(Ask for WC-10)

Engineering-drawing aids are available for three specifications: free space attenuation

nomograph, thermal noise nomograph, and noise figure vs. frequency for high frequency triodes. (Interstate Electronics)

(Ask for WC-11)

Digitizer data are included in Data File 661, which contains technical bulletins with application data, specs, photos, and schematic diagrams used in building up digital readout systems. (Coleman Engineering)

(Ask for WC-12)

Dictionary of carrier and microwave terms, and monthly company magazine, The Demodulator, are available upon request. Dictionary contains charts and nomographs especially for communications engineers. Magazine features factual information on carrier telephone, carrier telegraph and microwave communications; material is slanted for both non-technical management and the experienced communications engineer. (Lenkurt Electric)

(Ask for WC-13)

Monthly technical publication discussing major technical developments and new catalog is offered upon request. Called The Tracerlog, magazine recently announced a new catalog of technical services and radioactive chemicals, which is available upon request without charge. (Tracerlab)

(Ask for WC-14)

Fluorescent paints, inks and dyes are among the products described in a brochure which lists daylight materials and black light materials. Wide variety of luminous materials and products such as phosphorescent paints for signs are offered. Price list is offered for paints and crayons; black light lamps and fixtures and filters; Hi-Brite oil base color and Ultra-Brite signal color; inks and textile colors; and miscellaneous non-packaged items, such as luminous paper, penetrant fluids, magnetic powder and luminous pigments. (Shannon Luminous Materials)

(Ask for WC-15)

Major television chassis components are listed in a chart which includes all chassis made by the company. Correct replacement part stock numbers are provided, for quick reference, under component headings and chassis numbers are given in both right and left margins. A model-chassis index is also provided to help locate chassis number if only model number of receiver is known. (Radio Div., Hoffman Electronics)

(Ask for WC-16)

A circuit designer (Model C-38) and stack-up connecting leads are described in two flyers. Material on the circuit designer is illustrated, gives specs and lists accessories. Leads are illustrated and features and model details are given. (Pomona Electronics)

(Ask for WC-17)

Micaply Epoxy-Glass, a laminate, is described in detail in a booklet. Product applications include etched circuits, commutators, binary code discs and lighted panels, for clad material; for unclad material, applications include electrical insulation, mock-up boards, gaskets and high R-F grounding insulation (copper or aluminum sandwiched in laminate). Micaply Epoxy-Glass is made in three grades—military, industrial and punching. Price lists are given in booklet. (Mica Corp.)

(Ask for WC-18)

Sub-miniature and other switches are described in data sheets. Products covered in detail include: sub-miniature, snap-action basic switch; auxiliary actuators for sub-miniature switches; push button and toggle switches; and a sub-miniature high amperage switch. A description sheet, price list and definitions of technical terms are also available. (Milli-Switch Corp.)

(Ask for WC-19)

Technical bulletins are offered as engineering aids and include engineering drawings in some instances. Subjects include: triax and double shielded coax; index of engineering data draw-

ings; cellular polyethylene cables; hermetic seal connectors; pressurized connectors; color coding connectors; pricing of cable assemblies; "terminals" for cable center conductors; "locking terminals" for Microdot receptacles; cable specifications; cross index of Microdot coaxial connectors; and printed circuit receptacles and connectors. (Microdot, Inc.)

(Ask for WC-20)

Infrared spectroscopy reprints may be obtained in a handy package which serves as an introduction to the field. Thirteen articles, including a basic introductory article, are in the package, plus a bulletin on the Beckman IR-4 Infrared Spectrophotometer, a copy of Infrared Notes, and an index of all infrared reprints now available. (Scientific Instruments Div., Beckman Instruments)

(Ask for WC-21)

Precision instrument hardware, connectors, connector application notes, micro-miniature terminal lugs and rivets, and a miniature indicator lamp are among the subjects described, with illustrations and detailed specs, in a series of flyers. Features, ratings and specs are included. (Circon Component)

(Ask for WC-22)

Catalog of index books for accumulation of reports, technical information, specs, background data and clippings is available. These visible index books provide quick reference and portability, and may also be used for personal lists, sales contracts, cataloging references, sales control or follow-up, and inventory. (Recordplate Co.)

(Ask for WC-23)

Magnetic servo amplifiers and miniature power type DC voltage references are two items of descriptive literature for standard products. Amplifier 400 cycle MS series literature features a selection chart in selecting a standard magnetic amplifier to drive a standard 400-cycle servo motor. Both products are described in detail; charts and photos are included. (Timely Instruments & Controls)

(Ask for WC-24)

Antennas, antenna systems and transmission line are described in a 100-page catalog which contains the product description and engineering data of over 500 products. Twenty pages are concerned with system engineering data, and related information, especially for engineers working in this field of electronics. Catalog, available upon request, is fully illustrated with charts, photos and engineering drawings, plus specs. (Andrew California Corp.)

(Ask for WC-25)

Data files, catalogs and spec sheets, describing methods of using various instruments, are offered. Data files include: electronic timing, frequency measurement, electronic control, pressure measurement, programming operational equations for analog computers, and an introduction for operation of analog computers. A short form catalog describes the full line available, and another booklet discusses industrial systems engineering. New data files are in preparation. (Berkeley Div., Beckman Instruments)

(Ask for WC-26)

A summary data sheet, reprints of nine technical papers read or published, and an external house organ are available upon request. Data sheet lists and compares the entire line of precision potentiometers, and the house organ carries certain technical information and miscellaneous information. Reprints include these from Tele-Tech & ELECTRONIC INDUSTRIES: "Computing with Servo-Driven Potentiometers, Bradley & McCoy (Sept., 1952); and, "Accuracy of Potentiometer Linearity Measurements," McDonald & Hogan (Aug., 1953). (Helipot Corp., Div. of Beckman Instruments)

(Ask for WC-27)

"What's New with the Electron . . . 1956" is the title of an illustrated brochure, which discusses vacuum tubes, stacked ceramic tubes,

Selected publications, bulletins and catalogs, that are both useful and that have a permanent reference value for engineers, scientists and technicians, may be obtained from West Coast manufacturers upon request

To obtain this literature use the postage-paid Inquiry Card in the back of this issue—opposite page 176. List the number of each item of literature you want and mail the card. We shall refer your request to the manufacturers concerned. Unless otherwise noted, publications are available to interested persons without charge.

and new ceramic receiving tubes. New ceramic power transmitting tubes are also described. (Eitel-McCullough)

(Ask for WC-28)

"Ultra-Violet Lamp in Scientific Research," by Jack DeMent, research chemist of Portland, Ore., is offered as one of a series of bulletins. Catalog sheets on various ultra-violet lamps and equipment, illustrated and giving specs, also available upon request. (Ultra-Violet Products)

(Ask for WC-29)

Data sheets on scopes and meters, plus a small photographic reference handbook, will be sent upon request. Data sheets include: Digital vacuum tube volt-ohmmeter, oscilloscope (several types), digital printout systems, digital radiometer and an oscilloscope instruction sheet. (Hycan Mfg.)

(Ask for WC-30)

A technical bulletin and an external information bulletin are available. Tech. bulletin 3010A, 8 pages, describes an electronic data processing system; the No. 5 information bulletin tells about computer applications, company facilities and personnel. (ElectroData Corp.)

(Ask for WC-31)

Electric power drives and electric motors are described in product catalogs. Multi-mount reducers, slow-speed geared electric power drives, and explosion-proof motors are among the products described in available catalogs. Photos, drawings and specs are included. (Sterling Electric Motors)

(Ask for WC-32)

Long life L. M. Ericsson miniature electronic tubes are described in an illustrated brochure that includes graphs, charts and engineering drawings of various tube types. Features and tube quality tests are described, as are more than a score of different tubes. (State Labs)

(Ask for WC-33)

A report entitled "Project Datum, an Integrated Data Collecting and Processing System for Air Force Flight Test Center, Edwards AF Base, Calif." has been issued containing illustrations and drawings. The 58-page brochure includes these sections: central data processing system, airborne data acquisition system, rocket engine test station data acquisition system, high-speed track data acquisition system, and ground data acquisition system for radar photodolite. Report is based on a completed Air Force contract. (Electronic Engineering Co.)

(Ask for WC-34)

Four engineering bulletins discuss various electronic developments and products. Theoretical Analysis of Accuracy of Ratio Transformers points out that theoretical analysis of a perfect autotransformer used for stepdown purposes shows that if leakage inductance and winding resistance are uniformly distributed and the turns can be accurately tapped, the accuracy as a voltage divider for no load is perfect. Bulletin No. 2, Use of Gertsch Standard Ratio Transformers for Low Impedance Voltmeter Calibration, discusses the PT Series Standard Ratio Transformers that are useful for AC voltmeter calibrations. The system, basically, consists of a standard voltage source driving

the RatioTran which in turn drives the meter to be calibrated. Accuracy Calculations for Gertsch Standard Ratio Transformers (Bulletin No. 3) states that these Standard Ratio Transformers have accuracy specified by a formula which gives the maximum error which could be expected in the indicated ratio; this would give the error as a percentage of the output if the input is perfectly known. This accuracy is applicable to a bridge circuit, since the source voltage is common to both branches of the bridge circuit and variations of source voltage cause no error. The accuracy specification is given as a formula. Bulletin No. 4 shows the Use of Standard Ratio Transformers in Bridge Circuits, and discusses the use of a shielded bridge transformer. All bulletins are illustrated with engineering drawings or charts. (Kerisch Products, Inc.)

(Ask for WC-35)

Free subscriptions are available for the Audio-Record, a house organ published quarterly and containing news and information about sound recording materials. New products and uses of products are described in feature articles which are illustrated with photos. Each issue carries a technical discussion, illustrated, on recording problems and solutions. (Audio Devices, Inc.)

(Ask for WC-36)

Major developments, new products and other pertinent information, are included in Ampex Playback, a house organ published monthly. Material is illustrated with photographs. (Ampex Corp.)

(Ask for WC-37)

Electric generating plants are described in an 8-page, 3-color catalog which has been designed to simplify the selection of the proper type of generating plant and appropriate accessories. Full details are given with each illustration of various electric plants. Individual spec sheets for all models are listed as being available. (D. W. Onan)

(Ask for WC-38)

The Experimenter, published monthly, gives information on new products, technical information, and development news. Illustrated with photos and engineering drawings, the publication is sent to interested individuals upon request. (General Radio)

(Ask for WC-39)

An illustrated bulletin (No. 1000) in color describes and lists industrial shock and vibration mountings for all types of electronic controls and machine tool protection. Detailed specs are included. (Robinson Aviation)

(Ask for WC-40)

"Tubes That Can Take It" is the title of a brochure, based on a new motion picture describing a stacked ceramic receiving tube—a small electronic tube that can withstand environments found in airborne and missile applications. A flyer in color is also available, giving illustrations, drawings and specs on four different ceramic receiving tubes. (Eitel-McCullough)

(Ask for WC-41)

Bulletins, illustrated, describing various products and equipment are available. Materials include specs and illustration of an antenna kit, a standard frequency comparator, and an article discussing standard time and frequency broadcasts. (Specific Products)

(Ask for WC-42)

Synchros available for electronic applications are described in a 16-page illustrated brochure which includes drawings and specs. Specific applications and detailed descriptions are included. (Clifton Precision Products)

(Ask for WC-43)

Bulletin M562 describes the M562 Strain Gauge Power Supply, 5 v at 1 amp continuous. Unit is illustrated in bulletin and specs and applications are included. (Perkin)

(Ask for WC-44)

"It Pays to Specify 'Mylar'" is the title of an 8-page booklet (MB-8) available upon re-

quest. Material details experiences of manufacturers in using Mylar. (duPont)

(Ask for WC-45)

Technical descriptions in brief of the portable Series 3000 DC overpotential testers are included in the reprint of "Resume of DC Overpotential Testing," available upon request. (Beta Electric)

(Ask for WC-46)

Catalog sheets of four products are offered. Products are: Transconductance Analyzer and Circuit Designer, Transistorized Volt ohmmeter, Frequency Modulation Monitor, and FM Signal Generator. (New London Instrument)

(Ask for WC-47)

Printed Circuit Connectors are described in a new bulletin (No. 101). (Elco Corp.)

(Ask for WC-48)

Printed circuit tube-sockets are described and mounting dimensions given in Bulletin 102. (Elco Corp.)

(Ask for WC-49)

A new 6-page bulletin, "Microwave Noise Sources," describes noise tubes, waveguide mounts and attenuators. (Waveline Inc.)

(Ask for WC-50)

Bulletin No. T-505 gives specifications and operating characteristics of thermal time delay relays. (Curtiss-Wright)

(Ask for WC-51)

A 4-page bulletin (No. B-5) lists comprehensive data, tolerances, dimensions and temperature coefficients of insulated wire wound resistors. (International Resistance Co.)

(Ask for WC-52)

A new 12-page booklet describes materials handling methods and equipment, including descriptions of 28 different containers. (National Vulcanized Fibre Co.)

(Ask for WC-53)

"Multi-Track Magnetic Recording/Reproducing Heads" is the title of a new bulletin (No. 55-B) describing magnetic tape data recording and reproducing heads. Specifications and operating characteristics are included. (Davies Laboratories)

(Ask for WC-54)

TV transmitting antennas for low power TV stations are described in bulletin 432. (Prodelin Inc.)

(Ask for WC-55)

Tubeless high voltage airborne radar power supplies are discussed in a recent bulletin. (Perkins Engineering Corp.)

(Ask for WC-56)

An 8-page catalog (No. 257) describes a wide variety of antenna accessories for TV antenna intercom, etc. (Javex)

(Ask for WC-57)

Commutation switches for telemetering and similar applications are described in an 8-page illustrated booklet. (Mycalex Electronics)

(Ask for WC-58)

A general discussion of the properties of Nickel and Nickel Alloys is included in a new 20-page catalog of Nickel and Nickel Alloy tubing. (Superior Tube)

(Ask for WC-59)

Infrared radiometry is the general topic of a booklet now available. In addition to technical discussions, a line of infrared systems and components is described. (Barnes Engineering Co.)

(Ask for WC-60)

Solid tantalum capacitors are described in a new bulletin (No. 6.110). The bulletin lists 24 standard ratings from 1 mfd at 35 working volts dc to 350 mfd at 2 working volts. (Fansteel Metallurgical Corp.)



WASHINGTON

News Letter

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

EXCELLENT SUCCESSOR—The succession of Commissioner T. A. M. Craven, who had been on the FCC from 1937 to 1944 and had previously been its chief engineer, to veteran Commissioner E. M. Webster, also a leading Government radio engineer and "father" of Coast Guard communications, was heartening to the communications and radio industries under FCC jurisdiction. Commissioner Craven is recognized particularly as an authority in frequency allocations and has specialized knowledge of broadcasting and television engineering. Commissioner Webster, who holds the retired rank of Commodore in the Coast Guard, ended 47 years of service in the Government.

STRENGTHEN TV SERVICE—In its long-range plan ultimately to shift all or a major portion of TV operation to the UHF band in the next ten years, the FCC has presented a blueprint for television to promote more competitive operations to strengthen and expand TV service throughout the Nation. The television industry has been asked to submit comments on the plan by Oct. 1. It is estimated that the FCC will need possibly two years to reach a final decision. For the immediate implementation of UHF television service, the Commission increased maximum power of UHF stations from 1000 to 5000 kilowatts, effective Aug. 1, and plans interim considerations for eliminating in 13 different areas of the nation of VHF channel assignments to create improved opportunities for UHF TV broadcasting.

BIG ENGINEERING TASK—The FCC plan on UHF television presents a substantial task for radio engineers and research scientists. The Commission expressed the belief that a program of expedited research and development should be launched at once to achieve the maximum possible increase in the range, and the reduction of shadow areas, of UHF stations. The research and engineering development, the FCC advised, should be concentrated upon UHF transmitters with emphasis on increased transmitting power and feasibility of use of such techniques as UHF boosters and satellites, and upon receivers and receiving antennas with the aim of increasing the sensitivity of and reducing the noise factors of receivers as well as improving their selectivity to permit reassignment of UHF channels with a minimum number of restrictions on station separations.

TV ANNIVERSARIES—The first of July marked the 15th anniversary of the birth of regular television broadcast service and the fourth anniversary of the lifting of the TV "freeze." The Nation has 647 video stations currently authorized, of which 477 are on the air—457 commercial and 20 educational TV stations. More than 90% of the Nation's population is within range of at least one TV station, and over 75% are in service areas of two or more stations. Three out of every four American households have TV sets. So, the television industry can be proud of the tremendous progress made in serving the American people in this short span of time.

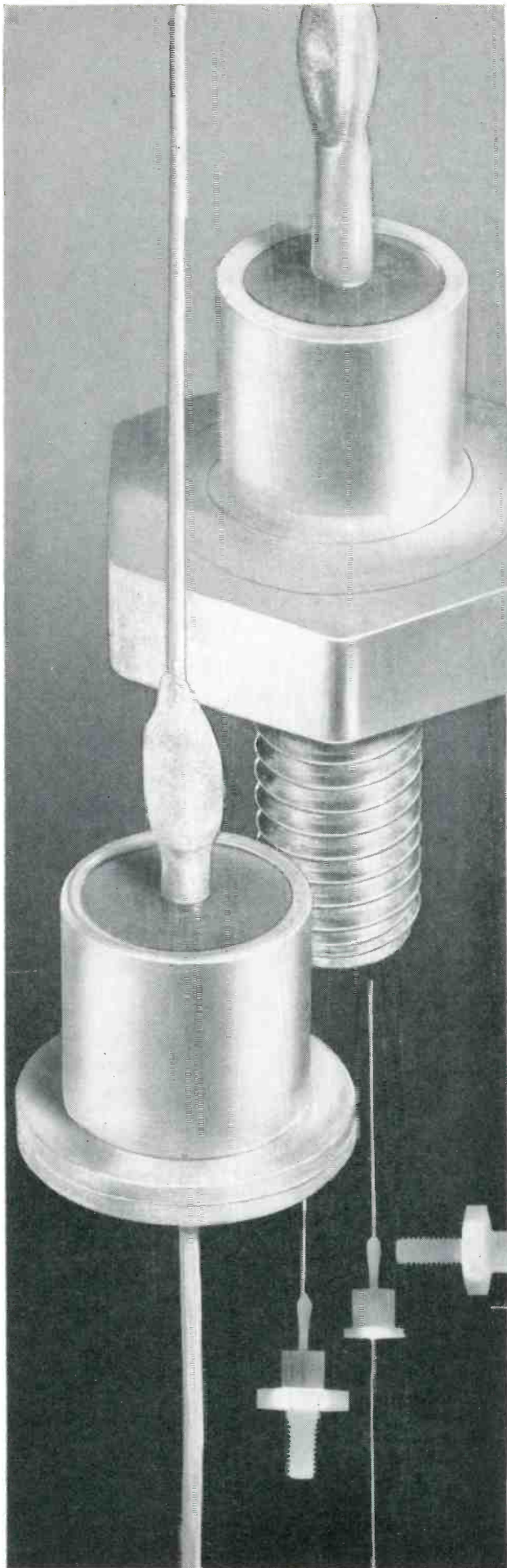
MOBILE RADIO PROSPECTS—The UHF television plan of the FCC holds out prospects for more frequency space for the important and continuously growing land mobile radio services. In fact, the Commission UHF report mentioned land mobile radio as a possible beneficiary of any VHF television frequency space to be abandoned in a switch to all-UHF. The FCC report also cited the possibility of the use of ionospheric scatter transmission in portions of the 30-60 MC frequency band, portions of which are being heavily used by present land mobile services. The Commission noted that the need and demand of land mobile radio for more space promises to increase further as the industrial uses of radio continue to develop.

HUGE VOLUME—The tremendous volume of operations in the safety and special radio services was depicted by FCC Chairman George C. McConaughy in a recent letter to a Congressman. The FCC during this fiscal year, which ended June 30, had a total receipt of applications of 172,000 for the year, compared to 88,000 in 1949. As of the beginning of July, there were 340,000 stations authorized—more than double the 153,000 in 1949.

COMMUNITY TV—The most pressing question in the community television antenna field—whether the CATV operators are violating property rights of telecasters when they circulate to their subscribers programs received from TV broadcast stations—may soon be the subject of a "friendly suit" filed by the National Association of Radio & Television Broadcasters against the National Community Television Association, which represents most of the community TV systems.

*National Press Building
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*ROLAND C. DAVIES
Washington Editor*



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The Westinghouse XP-5052 fused-junction silicon diode can handle 500 ma continuous d-c current at peak inverse voltages from 50 to 600 volts.

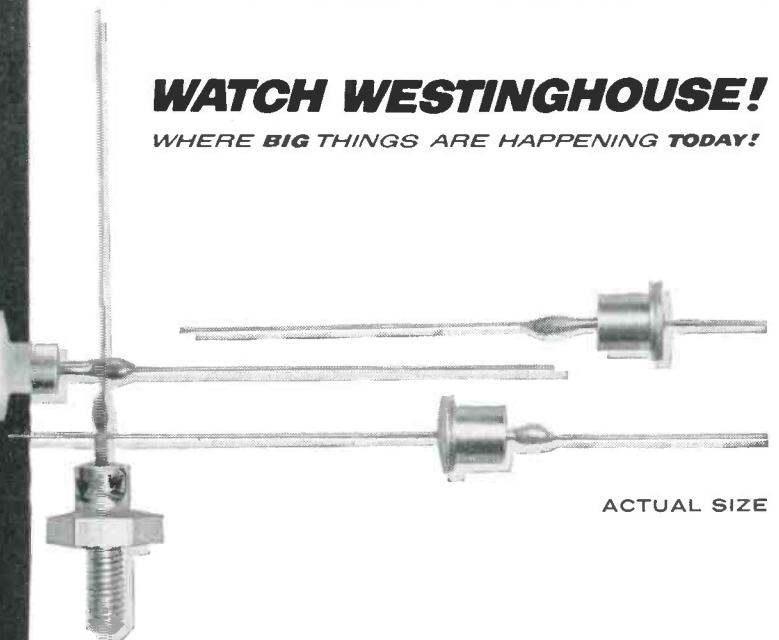
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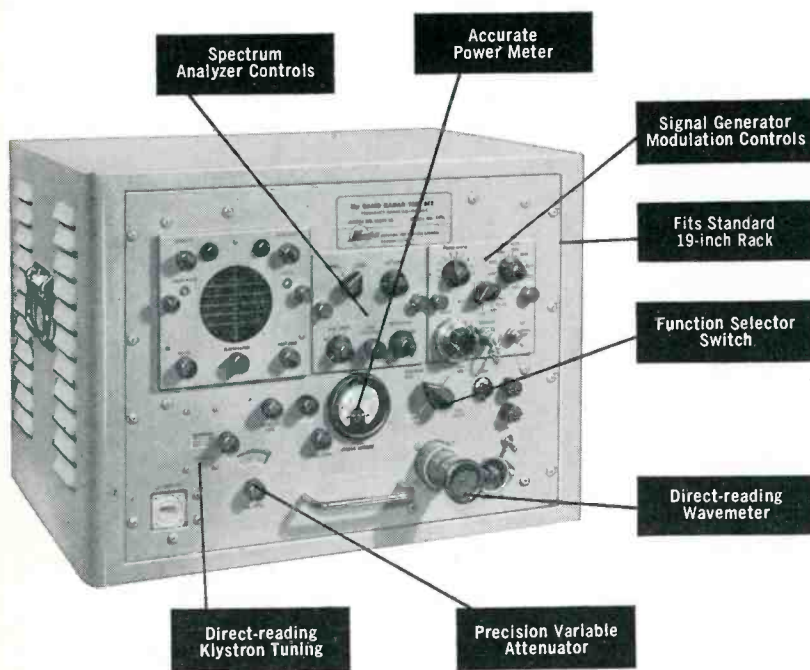
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Microwave

(Continued from page 128)

Experience is proving that microwave equipment, easily accessible in the central office and simply tested, is maintained as easily and performs as reliably as its associated carrier equipment. To make such routine maintenance possible drawings, engineering information, and maintenance practices along lines standardized by the telephone industry must be made available by the microwave manufacturer.

Conventional telephone engineering practices should be followed in the design and construction of the radio equipment to facilitate installation, troubleshooting, and maintenance. Also, the equipment should incorporate all necessary safety practices to protect personnel from the risk of shock.

Electrical coordination requires the impedances and levels, particularly on the drop side of the microwave equipment, to be identical to those encountered in the connecting carrier equipment. The microwave supplier should provide, on a coordinated basis, the necessary junction filters, amplifiers, equalizers, pads, impedance-matching transformers, and other accessory items that permit the telephone company to achieve the utmost flexibility in the use of the microwave equipment. Also, some means should be provided to monitor the microwave circuits, to switch automatically to standby microwave equipment, and to provide alarms to indicate that the equipment has failed.

Apart from reliability, the actual cost of maintaining the microwave system must be kept as small as possible. This requires equipment that can be checked and adjusted by telephone craftsmen as part of their routine duties. Maintenance practices should be provided which enable nonspecialist craftsmen to localize troubles and make repairs. Here again, it is extremely important that any changes in design be coordinated with changes in instruction material so that the equipment and the drawings agree in every detail.

Engineering and Installation Services

In the telephone industry, the engineering load on operating companies is often relieved by placing orders with the supplier for entire communication links. The supplier then takes on the responsibility for engineering the system into the telephone company's plant, ordering all items of equipment, and installing and lining-up the system. After completion of line-up, the working system together with suitable technical data is turned over to the telephone company. At least two suppliers are currently involved in providing such service to the telephone industry.

Typical Microwave Systems

It is possible here to provide statistics only on Lenkurt microwave systems. These statistics should be of some interest however, because they account for more than 40% of the medium-route microwaves systems in use by the telephone industry.

Table 1 gives statistics for the Lenkurt microwave systems installed or under construction at this time. Of 31 Lenkurt systems, 18 have been for Independent companies and 13 have been installed by the Bell System operating companies. The average section length is 23 mi. with the maximum length at 56 mi. and the minimum at 5.5 mi. The average system consists of two sections and requires one repeater. Almost 40% of the repeaters have branching or drop-off arrangements—a provision not conveniently obtained with heterodyne repeaters. The cost of the microwave equipment may range from about 10% to over 80% of the total cost of the installation. Most systems thus far installed use separate antennas for transmitting and receiving, but several have been equipped with r-f directional filters to permit transmission and reception on a common antenna.

References

1. "Load Rating Theory for Multichannel Amplifiers," Holbrook and Dixon; *Bell System Tech. Jour.*, Oct. 1939.
2. "A Speech Volume Survey on Telephone Message Circuits," V. Subrizi; *Bell Lab. Record*, Aug. 1953.



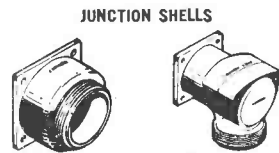
CABLE CLAMPS

TELESCOPING BUSHINGS

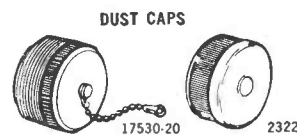
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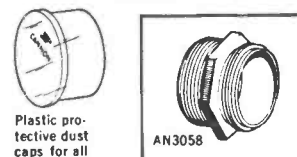
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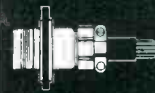


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Dr. Rudolfo M. Soria was named Vice President of Engineering by Amphenol Electronics Corp., Chicago (formerly American Phenolic Corp.).

Dr. Carlo L. Calosi has been elected a Vice President of Raytheon Mfg. Co., Waltham, Mass., and will participate in the management of the company's microwave and power tube operations.

G. Lupton Broomell, Jr., is now Assistant Director of Engineering at Leeds & Northrup Co., Philadelphia. He is also Acting Head of Engineering and Inspection.

John E. Meade is the new Director of Engineering, Electronics Div., American Machine & Foundry Co., Boston.



Henry F. McKenney



John E. Meade

Henry F. McKenney has been appointed Vice President for Engineering at Electronics Corp. of America, Cambridge, Mass.

Albert A. Chesnes has been named Technical Director of Chromatic Television Laboratories, Inc., New York, responsible for color development and military electronics activities. Other appointments: Sy Krinsky, to Chief Engineer; Paul Neuwirth, to Department Chief, Color TV Dept.; and Albert Jacobs, Department Chief of Government Research and Development.

Charles D. Branson is now Asst. Director of Research at the Research Center, Robertshaw-Fulton Controls Co., Irwin, Pa.

James Van Horne Lawrence is in the newly-created post of Director of Engineering Orientation, and George A. Crowther is Chief Engineer, at Ford Instrument Co., Div. of Sperry Rand Corp., Long Island City, N. Y.

(Continued on page 162)

Diode Design

(Continued from page 81)

free cathode and a sawtooth waveform from the horizontal output with the polarity shown (Fig. 1) is applied to the anode-cathode junction. The control voltage for the horizontal oscillator is obtained from the center tap of a high resistance load between the free anode and free cathode. In this circuit a 6AL5 duo-diode is normally used as the detector.

The circuit of Fig. 1 offers an ideal application for selenium diodes. For example, a pair of International Type 1U1 selenium diodes, series connected, can be readily used as replacements for the 6AL5 tube, as shown in Fig. 2. A dual

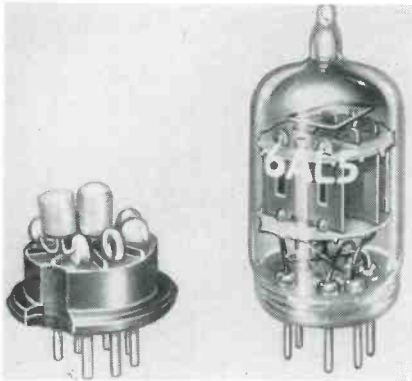


Fig. 3: Selenium diode circuit replaces 6AL5

unit Int'l. Type D-3086, which is essentially a doubler, can also be used as a replacement.

Due to the relatively high short capacity of a selenium diode compared to a thermionic diode, low-impedance sources must be used for the sync pulses and referenced sawtooth. Such a source for the sawtooth waveform is best obtained across a low value resistor in the low potential side of the horizontal deflection coil.

Shunt Capacitance

The Type 1U1 diode has an inherent shunt capacitance of approximately 170 mmf. Therefore, during the non-conducting half cycle, a capacity voltage division takes place through the 0.001 μ f capacitor and the diode shunt capacitance in series. Approximately 83% of the initial voltage will appear across the 100 K resistors. To re-

cover this voltage loss, the 0.001 μ f capacitor may be increased to 0.002 μ f as shown. The recovered voltage is greater than 90% as compared to 83% prior to the change in capacitor value.

Although the Type 1U1 selenium diode can be used as direct replacement in some TV receivers, there are several voltage values which should be considered to obtain the best operation of the horizontal AFC circuit. The sawtooth voltage from the horizontal output system


should have a value of approximately 15 v peak-to-peak. The positive and negative pulse voltages from the phase inverter are equal and should have a peak value of about 18 v. Obviously, these voltage values will change with input signal and any B-plus variation. However, these changes are not large in most TV receivers which have reasonable AGC operation.

References


* Selenium Diode Applications, *Radio-TV News*, Sept., 1953.

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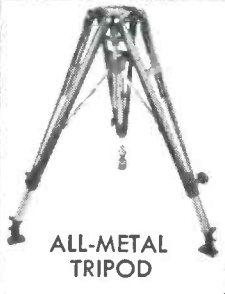
Famous BALANCED TV Head supporting a TV camera. Both are mounted on one of our all-metal tripods, which in turn is mounted on a Ceco Spider Dolly. Here is a "team" outstanding for versatility and maneuverability in studio or on location.



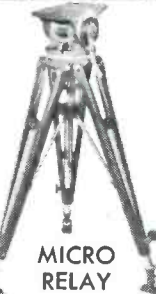
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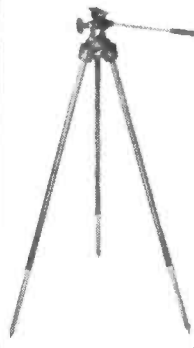
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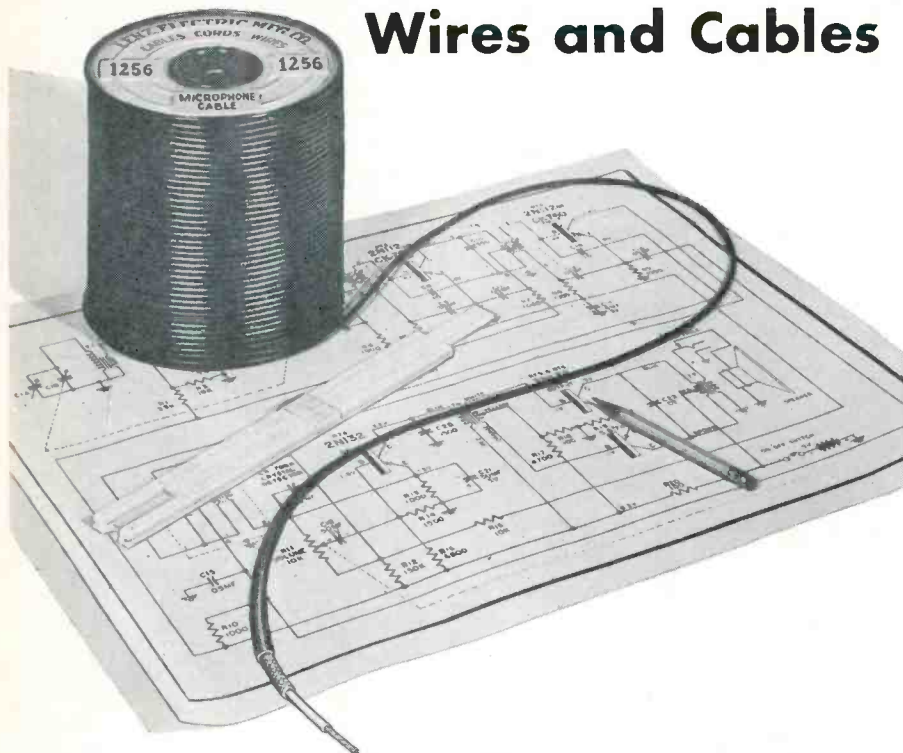
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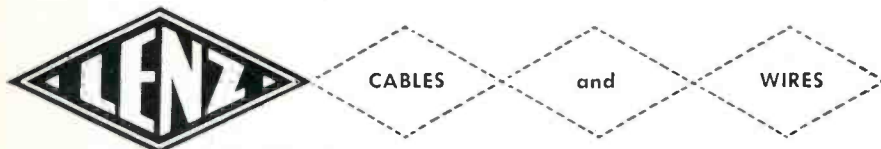
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"Free-Power"

(Continued from page 67)

Light-Powered Oscillators

The overall performance of an active element under operating conditions is tested by means of its self-excitation because the production of oscillations in a feedback circuit is based on a power gain somewhat greater than unity. The simplest oscillator circuit is the Hartley type whose transistor is inserted into a tank circuit with a center-tapped coil.

In the a-f range, such an oscillator starts oscillations at a supply energy of $\frac{1}{2} \mu\text{w}$ and, therefore, can easily be fed by a small photocell. This, by no means, has to be exposed to full sunlight. Assuming the brightness of diffused daylight or artificial illumination as 500 lux, this then equals an energy of $75 \mu\text{w}/\text{cm}^2$. A selenium photocell with an efficiency

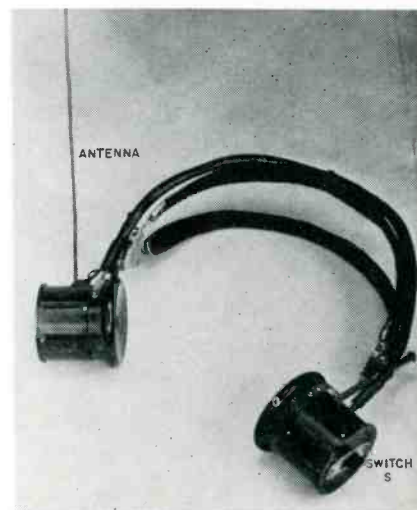


Fig. 6b: Compact CW monitor

of only 1% requires, for example, a surface of only 1.5 cm^2 to cause a transistorized a-f oscillator to burst into oscillations.

However, the available potentials in the vicinity of a few tenths of a volt limit the self-excitation of today's junction transistors to relatively-low frequencies. As a rule of thumb, we may say that the maximum oscillation frequency increases with the driving voltage so that higher frequencies can only be obtained with higher collector voltage and thus more driving power, until the breakdown or avalanche voltage and thermal dissipation sets a limit. The following examples will disclose what frequencies can be produced under the various operating condi-

tions and with the aid of different forms of free energy.

Light-Powered Receiver

Having found that modern junction transistors operate satisfactorily at a power level of a fraction of a mw, the thought occurs to build a multistage regenerative receiver sensitive enough so as to be fed by a few selenium cells or solar batteries. Fig. 1 is the circuitry of the first laboratory model whose photograph is shown in Fig. 2. The receiver contains a detector transistor with feedback from collector to emitter via a tickler coil, and control is performed by means of a variable condenser which provides a varying by-pass for the r-f choke in the collector circuit. In the broadcast band from 500 to 1600 kc, the receiver begins to operate with only 40 μ w driving energy which can easily be produced by the 6 selenium photocells arranged on top of the housing and subjected to diffused daylight or artificial illumination. Under these operating conditions, the audio amplifier produces only earphone volume but greater photocells or solar batteries may drive a little "power amplifier" and loudspeaker. The device illustrated at the left of the dotted lines in Figs. 1 and 2 will be discussed later.

Although a regenerative receiver is the simplest form requiring a minimum of transistor stages and driving power, a heterodyne receiver was built with a single i-f stage and a single a-f amplifier. Such an active receiver, of course, begins to operate satisfactorily with a minimum of 1 or 2 mw, and therefore needs a multiplicity of selenium cells or a powerful solar battery.

Hand-Powered Transmitters

A small flashlight generator or hand-dynamo easily produces between $\frac{1}{4}$ and $\frac{1}{2}$ w., which is sufficient to generate useful r-f energy. Fig. 3 is the photograph of a miniaturized transmitter for 250 kc. The ac from the hand-dynamo is rectified and converted into dc, but a relatively small filter capacitor provides a hum modulation by the fluctuating driving frequency. A satisfactory antenna efficiency is obtained by a ferrite core loop antenna. If the radiation of the small oscillator is picked up with a sensitive receiver, the a-f signals can be utilized to actuate a relay for the remote control of house and garage doors, radio and TV receivers, and the like. Moreover, the hand dynamo can be

miniaturized further and brought into the form of a flip generator which is actuated by merely pushing a button. Such a miniaturized transmitter having the size of a cigarette lighter then is a "Radio Key" in the true meaning of the word.

By the use of a hand-dynamo, one is not limited in frequency as before. Fig. 4 shows the outside and structure of a hand-powered telephone transmitter with built-in generator, crystal stabilization at approximately 4 mc, and AM with the aid of a sound-power mike driving a diode modulator. In open terrain,

the small transmitter covers a range of a few miles. Its advantage as compared with other and more powerful transmitters is that it requires no maintenance and has no shelf life problems, but is ready for use at all times, provided the user is physically able to push the generator lever and to address the microphone.

Voice-Powered Telephone Transmitter

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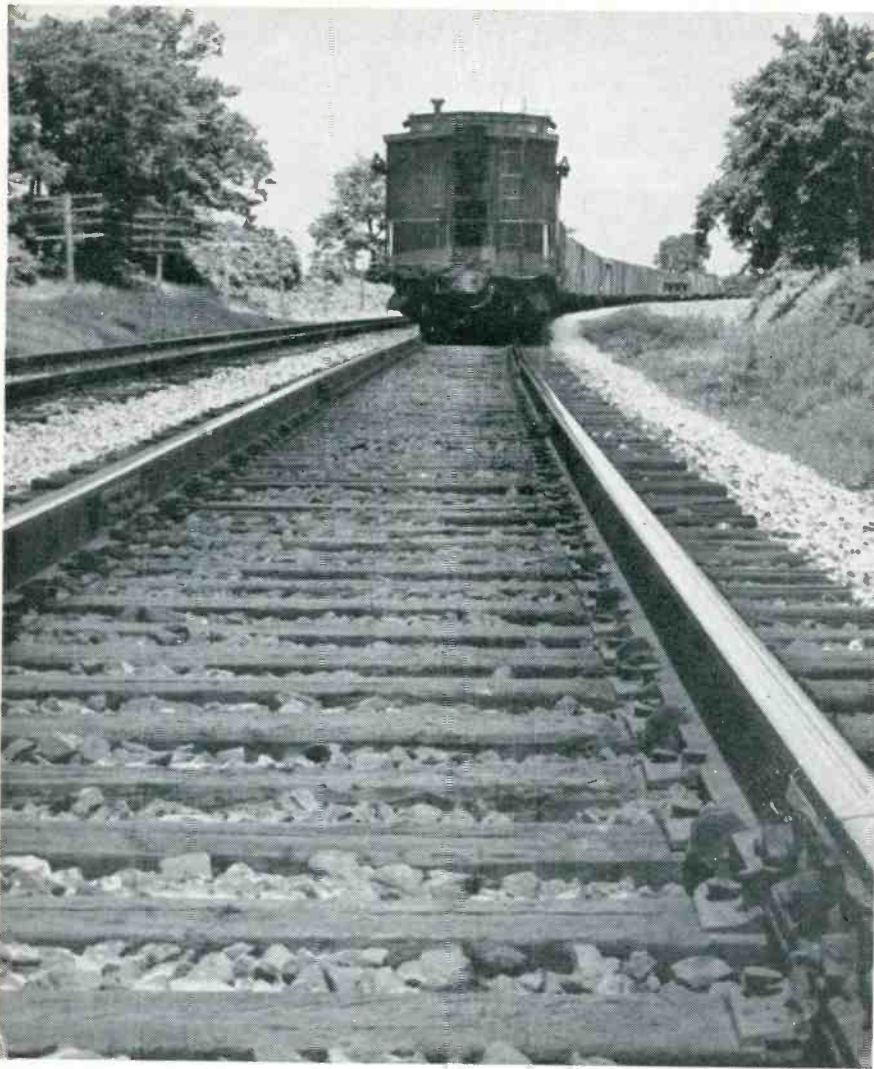
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a battery nor photo-element nor an extra generator nor any other power source. Its supply energy is directly generated by the sound-power microphone or an equivalent PM speaker whose original duty is nothing but amplitude modulation. In the present case, the sound-power mike not only provides the AM but, at the same time, feeds a minute "power pack" in the form of a step-up transformer which, via a crystal diode, charges a large filter condenser. A modulating signal is taken from a fraction of the transformer's secondary windings and is superimposed upon the dc across the condenser. In this way, satisfactory collector modulation is performed equivalent to the plate-modulation of a tube-type oscillator. The illustrated model generates a frequency of 250 kc and is provided with a ferrite rod antenna. The output energy, even under the full impact of loud speech, never exceeds a few μw , so that the range is limited to a few

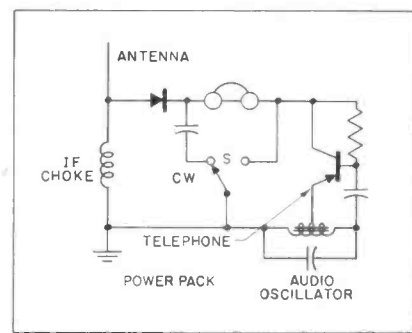


Fig. 6a: CW monitor circuit

hundred yds. High-sensitive transistors, having an avalanche voltage in the vicinity of 1 v., permit the generation of several mc, which extends the range up to a mile.

Earphone Monitor

Of all types of free energy, the driving of transistor apparatus with r-f energy has yet to be discussed. An illustrative example is the CW Monitor described by means of its circuit diagram in Fig. 6A, and its photograph in Fig. 6B. In the vicinity of a telegraph transmitter, there is such a strong radiation field as to permit a short antenna wire to recover sufficient energy to drive an a-f oscillator. As long as the station is on the air, the oscillator is energized and its a-f can be heard in the earphones. Morse telegraph signals or automatic keying signals produce associated tone signals without the necessity of any tuning, as in the case of beat frequencies. Furthermore, practical application is

facilitated in that the minute r-f power pack as well as the a-f oscillator are built into the enlarged capsules of the double-earphone. The operator or amateur has his station under continuous control without being handicapped by a cord.

In addition, there is a little switch "S" which allows the conversion of the CW monitor into a conventional crystal set for the detection of telephone signals.

Semi-Passive Receivers

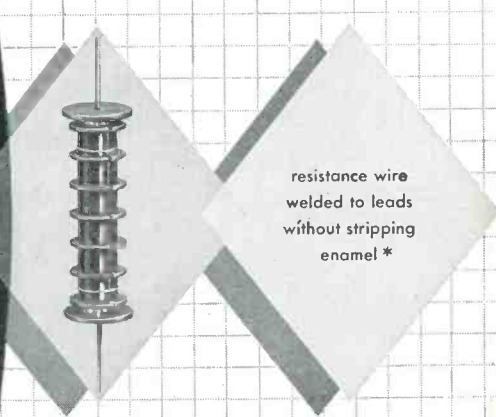
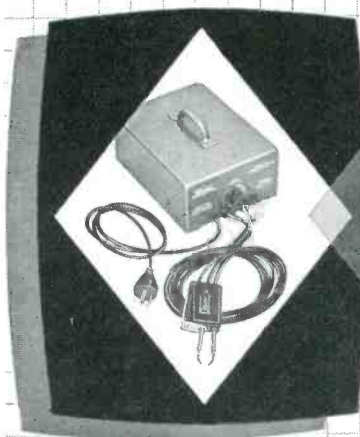
The novel principle of converting incoming r-f energy into dc power and then reconvertng this energy into "new" r-f energy opens an entirely new field. In most cases, the primary carrier will be deprived of its modulation signals so that the new carrier may be said to be generated by "secondary" energy.

The principle of secondary energy is demonstrated most convincingly by means of the aforementioned transistor receiver. For this purpose, the receiver illustrated in Figs. 1 and 2 contains, at the left of the broken line, an r-f power pack which replaces the previous photoelements. It can easily be seen that the power pack is an efficient crystal set having such a large filter condenser that a pure dc voltage develops across the terminals. As pointed out before, the dc voltage may be stabilized by means of little wet cells.

A receiver driven by secondary power represents a new category which combines the advantages of passive receivers such as crystal sets, and those of active types characterized by the relay action of their active network elements, vacuum tubes or transistors. Since the new receiver has its place between passive and active types, it may be called a "Semi-Passive" device. Semi-passive receivers offer no maintenance or shelf-like problems but their sensitivity, selectivity, and power handling capacity are great enough to permit the detection and amplification of weak radio signals of distant stations far below the level of the powering transmitter. In other words, a semi-passive receiver utilizes the energy of a powerful radio station, for example, the local broadcast station, for the detection and amplification of weak signals from remote transmitters. In the vicinity of the local station, with the aid of an efficient antenna, sufficient energy can be recovered to feed a small loudspeaker.

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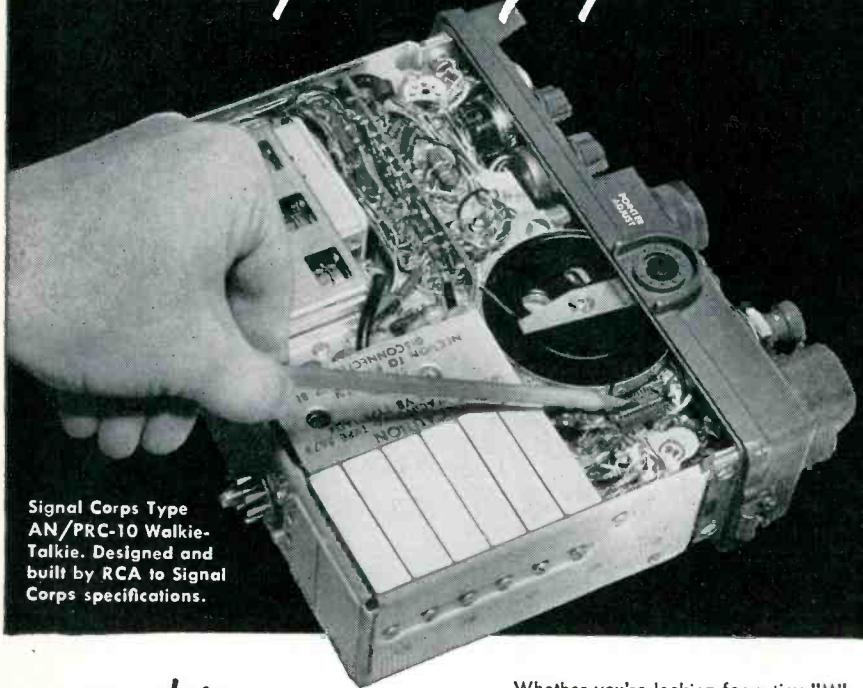
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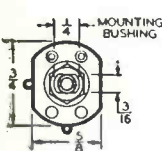
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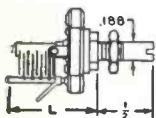
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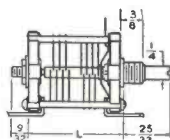
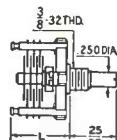
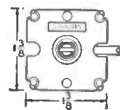
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with the aid of secondary power seems to offer no advantage as compared with the passive reception with a crystal set, because the output energy, in both cases, is given by the recovering ability of the antenna. A closer inspection, however, discloses that a semi-passive receiver is capable of greater output volume than a passive type. This becomes obvious if we keep in mind that the output level of a crystal set is equivalent to the carrier level multiplied by the degree of AM whereas the level of a semi-passive receiver is given exclusively by the carrier energy whether there are modulation signals superimposed or not. Hence, the available output energy of a semi-passive receiver can be adjusted equivalent to the powering carrier with a modulation of 100% or greater, provided the associated distortions are tolerable.

Conclusions

The principle of secondary power is by no means confined to semi-passive receivers. Another application is a secondary-powered transistor oscillator driven by the rectified r-f amplitudes of a supply transmitter. In this way, the incoming r-f is converted into another frequency band. At the same time, the new carrier can be subjected either to AM or FM by the incoming signals so that these are reradiated at another carrier frequency and with the same or another type of modulation as the primary signals. In addition, secondary-powered transmitters and semi-passive receivers may be combined so as to form transceivers or walkie-talkies the range of which is confined, of course, to the vicinity of a powerful supply transmitter. In this way, many problems offer themselves to the transistor expert whose consequences can hardly be predicted.

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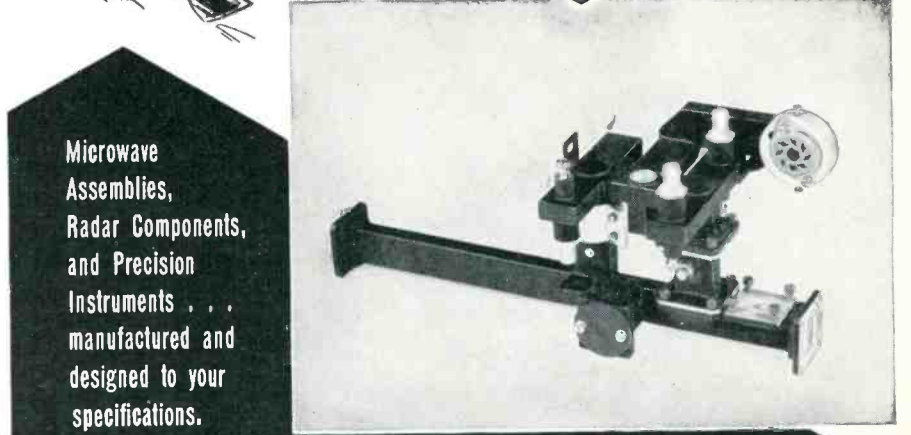
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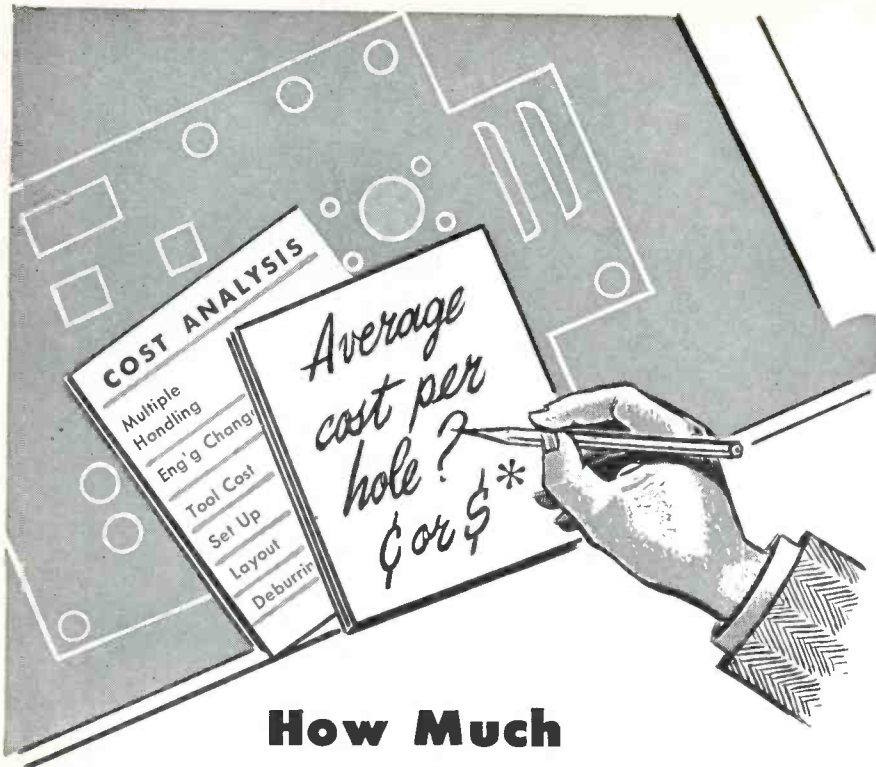


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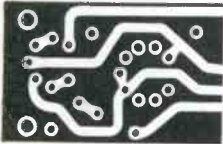
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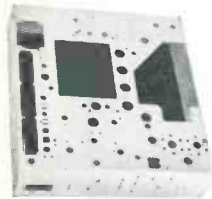
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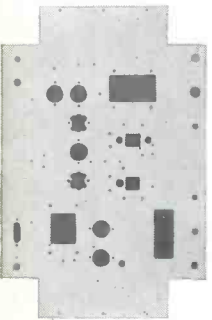


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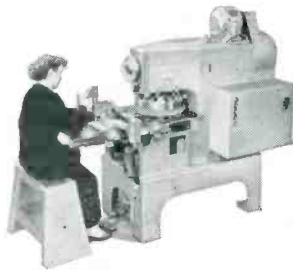


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CONTROL MECHANISMS AND AUTOMATION

Chairman: E. M. Grabbe, Ramo-Woolridge Corp.

"Mechanization and Application of Vertical Reference Systems," G. H. Singer, Kearfott Co.

"The Eye as a Control Mechanism," Robert B. Lockard, U. S. Naval Ordnance Test Station, China Lake.

"Automatic Determination of Missile Airfoil Characteristics in Mass Production," Ed. L. Watkins, Convair.

"A New Digital Path Control System for Machine Tools," Jack Rosenberg, Electronic Control Systems.

CIRCUIT THEORY—SWITCHING THEORY TOPOLOGY AND TIME DOMAIN SYNTHESIS

Chairman: L. A. Pipes, Univ. of California, Los Angeles.

"Switching Theory," D. A. Huffman, MIT.

"Some Aspects of the Network Analysis of Sequence Transducers," J. M. Simon, Sperry-Rand Corp.

"Some Topological Considerations in Network Theory," F. Reza, Syracuse Univ.

"Network Synthesis for Prescribed Impulse Response Using A Real Part Approximation," R. A. Pucel, Raytheon Manufacturing Co.

"Time Domain Synthesis by Delay Line Analogy," M. Strieby, Ramo-Woolridge Corp.

CYBERNETICS SYMPOSIUM

Chairman: Leonard Gardner, Rocketdyne.

"The Philosopher's Approach to Cybernetics," Abraham Kaplan, UCLA.

"Studies of Neural Physiology in the Learning Processes," Joseph A. Gingerelli, UCLA.

The third and fourth periods of this session will be devoted to an open panel discussion with audience participation.

Panel members: Robert Tschirgi, Stanley Frankel, Joseph Hirsch, Leonard Gardner, Abraham Kaplan, and Joseph A. Gingerelli.

MICROWAVE TUBES II

Chairman: H. R. Johnson, Hughes Aircraft Co.

"Characteristics of Modern External Tuning Cavity Reflex Klystrons," T. Moreno, Varian Associates.

"A Rugged 8 mm Reflex Klystron," W. G. Abraham and F. L. Salisbury, Varian Associates.

"An X-Band Folded Line Type Backward-Wave Oscillator," R. H. Winkler, Cascade Research Corp., Los Gatos.

"A Demountable Tube for Gas Discharge Microwave Detection Studies," H. Farber, Polytechnic Inst. of Brooklyn.

"Means for Electronically Controlling the Current from a Magnetron Cathode," J. S. Needle, Northwestern Univ.

"Design and Calculation procedures for Low-Noise TWT's," G. Wade, R. W. DeGrasse and L. D. Buchmiller, Stanford Univ.

"A Rugged 915 MCCW Magnetron for Electronic Cooking," P. C. Gardiner, G. E. Co., Schenectady.

COMPONENT RELIABILITY AND TEST METHODS

Chairman: G. H. DeWitz, Hoffman Laboratories.

"The Unreliable Universal Component," Marcus A. Acheson, Sylvania Electric Products, Inc."

"Improved Guided Missile Tube Reliability," Alfred Blattel, Raytheon Mfg. Co.

"Tube Failure Rate Variations," M. B. Feyernherm, RCA.

"Cine-Radiography, A New Testing Concept of Component Reliability," W. H. Grumet, Rototest Labs.

PANEL ON EDUCATION

Moderator: George Tenny, Vice President, McGraw-Hill.

Frederick Terman, Dean of Engineering of Stanford Univ.

Thomas L. Martin, Jr., Chairman, Electrical Engineering Dept., Univ. of Arizona.

Dan Noble, President, Motorola.

Burgess Dempster, President, Electronic Engineering Co.

COMPUTERS: ANALOG TECHNIQUES

Chairman: Milton E. Mohr, Ramo-Wooldridge Corp.

"Magnetic Amplifier Analog Computation Techniques," Henry W. Patton, Airpax Products Co., Baltimore.

"Wide-Dynamic Range Analog Integrator," George Myers, Rome Air Development Center, Air Research and Development Command, Rome.

"A New Computer for Complex Functions," Merle L. Morgan, Electro-Measurements, Inc., Portland.

"Automatic Computation of Fourier Expansion Coefficients by Analog Means," R. W. Hubbard and W. E. Johnson, National Bureau of Standards, Boulder.

TRANSISTOR CIRCUITS—SWITCHING AND COMPUTER APPLICATIONS

Chairman: M. S. Kesselman, Hughes Aircraft Co.

"Critical Survey of Fundamental of Junction Transistor Pulse and Switching Circuits," D. O. Pederson, Univ. of California, Berkeley.

"Maximum Efficiency Switching Circuits," R. H. Baker, Lincoln Lab., MIT.

"Transistor Circuitry for Analog to Digital Conversion," F. H. Blecher, Bell Telephone Labs.

INSTRUMENTATION TECHNIQUES

Chairman: F. Stanley Atchison, U. S. Naval Ordnance Lab., Corona.

"Distributed-Parameter Variable Delay Lines Using Skewed Turns for Delay Equalization," Frank D. Lewis and Robert M. Frazier, General Radio Co.

"Application of Scale Factors in Data Recording Systems," Thomas L. Greenwood, Redstone Arsenal.

"Adjustable Pulse Width High Voltage Power Supplies" by Victor Wouk, Beta Electric Corp.

"Transistorized Logarithmic Time-and-Amplitude Quantizer," Euyen Gott, Johns Hopkins Univ.

ANTENNAS II

Chairman: J. T. Bolljahn, Stanford Research Institute.

"Relation of Scattering Problems to Radiation from Simple Shapes," K. M. Siegel, Willow Run Laboratories, Univ. of Michigan.

"Launching Efficiency of Wires and Slots for a Dielectric Rod Waveguide," R. H. DuHamel and J. W. Duncan, Electrical Engineering Research Lab., Univ. of Illinois.

"Analysis of a Shunt Excited Airframe Antenna," T. G. Dalby, Boeing Airplane Co., Seattle.

"A New Method for Optimum Yagi Design," H. W. Ehrenspech and Poehler, Air Force Cambridge Research Center, Bedford, Mass.

HIGH TEMPERATURE COMPONENT PARTS

Chairman: Floyd Paul, Castell Corp.

"Miniature High Altitude and High Temperature Connectors," C. H. Stuart and R. F. Dorrell, Amphenol Corp.

"Impregnation of Toroids for High Temperature Service," E. O. Deimel, General Electric.

"Typical Expected Performance Characteristics of Extreme Temperature Range Tantalum Capacitors," J. W. Maxwell, P. R. Mallory.

"Some Basic Physical Properties of Silicon and How They Relate to Rectifier Design and Application," G. P. Finn, Sarkes-Tarzian.

RELIABILITY OF ELECTRONIC TUBES

Chairman: To be announced.

"White Noise Vibration Test for Electronic Tubes," John D. Robbins, Sylvania Electric.

"Environmental Effects of Vacuum Tube Life," H. D. Pleak, Sylvania Electric.

"Increased Reliability of Guided Missile Tubes Through Comprehensive Quality Control," H. H. Hoyle and N. J. Davis, Raytheon Mfg. Co.

"New Filamentary Tubes of High Reliability," Ross Wood, Raytheon Mfg. Co.

COMPUTERS: SOLID STATE SWITCHING DEVICES

Chairman: Lester L. Kilpatrick, Autonetics, North American.

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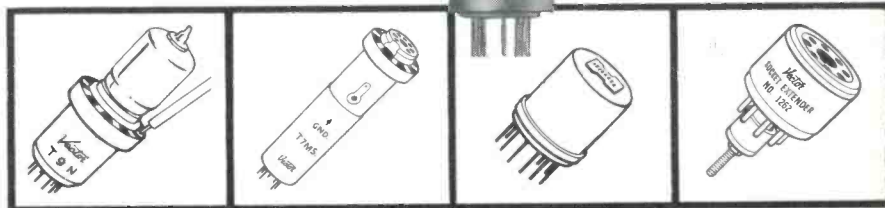
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"Magnetic Cores as Generalized Non-Linear Components," William H. Bridge, Airtronic Research, Inc., Washington.

"Pulse Response Properties of Magnetic Materials for Switching Applications," James D. Childress, General Ceramics Corp.

"High-Current Switching Applications of Low Power Transistors," Chaang Huang and William F. Palmer, Sylvania Electric Products, Inc., Woburn.

"High-Gain Transistor for Very High Switching Speeds," James B. Angell, Philco Corp., Philadelphia.

CIRCUIT THEORY—TRANSISTOR AND ACTIVE CIRCUITS

Chairman: R. D. Middlebrook, California Inst. of Technology.

"Power Transistor Specifications for Circuit Applications," H. T. Moore, Minneapolis-Honeywell.

"Transistor Bootstrap and Miller Sweep Circuit," J. S. Sherwin, Univ. of California, Berkeley.

"An All Transistorized Pulse Generator," E. J. Fuller, Sperry Gyroscope Co., Great Neck.

"Negative Impedance Converter Design and Its Use in Active Circuits," A. I. Larky, Stanford Univ.

"A D-C Negative Imittance Converter," M. A. Karp, Applied Physics Laboratory, Johns Hopkins Univ.

BROADCAST TRANSMISSION SYSTEMS

Chairman: John Knight, Engineer in Charge, KRCA (NBC).

"The Application of Modern Techniques to The Determination of Service Areas of Television Stations in Smooth and in Mountainous Terrain," A. Earl Cullum, Jr., Earl Cullum Jr. and Associates.

"Achievement of Practical Tape Speed for Recording Video Signals," C. P. Ginsburg, Ampex Corp., Redwood City.

"A Transistorized Television Camera Chain," W. Ussler, R. J. Decredico, G. W. Trebing, and J. W. Smiley, RCA, Camden.

"Design Considerations for a High Quality Transistorized Program Amplifier for Remote Broadcast Use," John K. Birch, Gates Radio Co.

MICROWAVE THEORY AND TECHNIQUES —FERRITES AND TEST EQUIPMENT

Chairman: Eric Strumwasser, Hughes Aircraft Co.

"Coupling Through an Aperture Containing Ferrites," Donald C. Stinson, Univ. of California.

"Microwave Frequency Doubling in Ferrites from 9 to 8 KMC," P. H. Vartanian, J. L. Melchor, W. P. Ayres, Electronic Defense Laboratory, Sylvania Electric.

"A Ferrite Image Rejection Filter for Use in S-Band Microwave Receivers," James H. Burgess, Electronic Defense Laboratory, Sylvania Electric

"Calorimeters for Centimeter and Millimeter Waves," Sam Hopfer, Polytechnic Research and Development Co.

ENVIRONMENTAL EFFECTS ON COMPONENT PARTS

Chairman: A. W. Rogers, Signal Corps Engineering Labs.

"Environmental Testing of Precision Potentiometers," Shultz-Green, Helipot Corp.

"Capabilities of Hot-Molded Composition Resistors," A. C. Pfister, Allen-Bradley Co.

"Hermetic Sealing of Precision Potentiometers," I. W. Braun, Circuit Instrument Inc.

"The Effects of Nuclear Radiation on Electronic Components," C. C. Robinson, W.A.D.C.

SEMICONDUCTORS I

Chairman: John W. Peterson, Pacific Semiconductor.

"Semiconductor Materials and Properties," Phyllis E. Stello, D. M. Van Winkel, and J. Dale Turner, Hughes Aircraft.

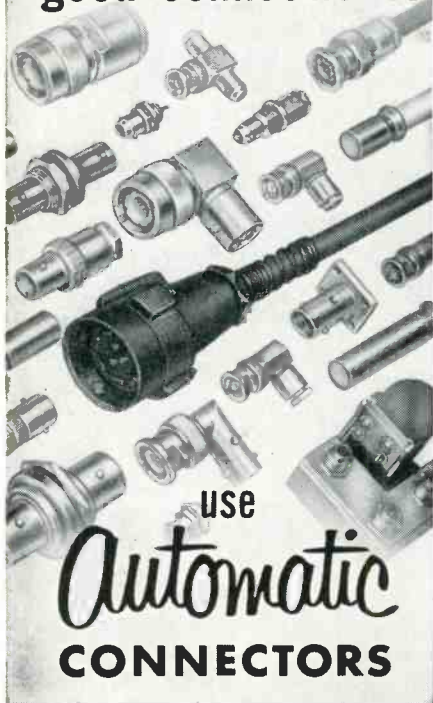
"Developments in Transistor Physics," Leopoldo B. Valdes, Shockley Semiconductor Labs.

"High Current Amplification—Forward and Reverse—At High Collector Current in PNP Transistors," A. P. Kordalewski, General Electric.

"Very High Power Transistors with Evaporated Aluminum Electrodes," Gene Strull and H. W. Henkels, Westinghouse Electric Corp.

"Silicon Alloy Power Transistors," R. E.

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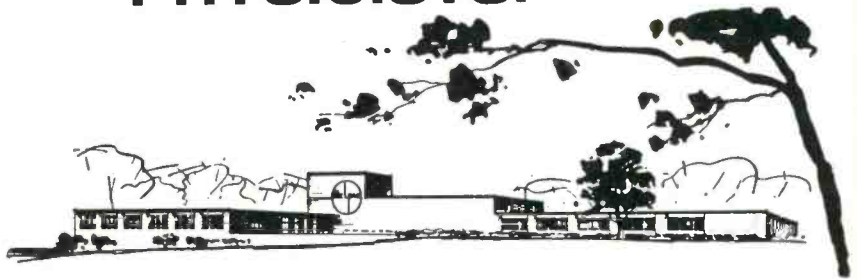
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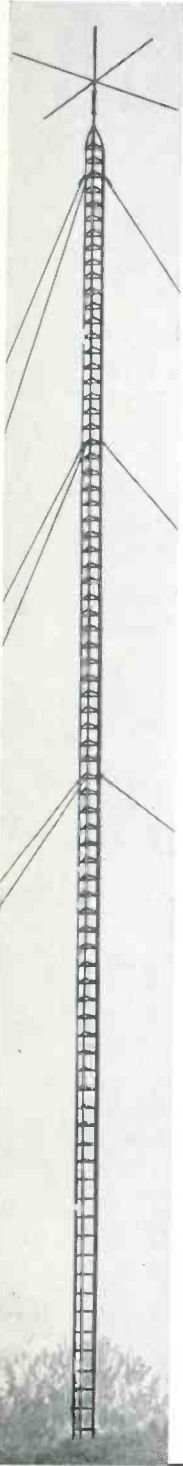
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COMPUTERS: ADVANCED DESIGN TECHNIQUES

Chairman: John L. Barnes, Systems Laboratories Corp.

"The Effect of a Transverse Field on Switching Rates of Magnetic Memory Cores," T. D. Rossing and S. M. Rubens, Remington Rand-Univac, St. Paul.

"High Speed Coincident-Flux Magnetic Storage Principles," E. W. Bauer and L. P. Hunter, IBM.

"Investigation of Problems Using Analog-Digital Computer Combinations," Herbert E. Salzer, Convair, San Diego.

"The Synthesis and Analysis of Digital Systems by Boolean Matrices," J. O. Campeau, Hughes Aircraft.

RADAR SYSTEMS

Chairman: Fred J. Nichols, Sprague.

"Taxi Radar—Eyes of the Tower," "The Radar Approach Control (RAPCON) Center," D. R. Kirschner, Rome Air Development Center, Rome.

"Extended Radar Range Timing Techniques," A. I. Mintzer, RCA, Moorestown.

"TACAN Bearing and Distance Measurement Techniques," J. B. Majerus and K. W. Porter, Collins Radio Co., Cedar Rapids.

VEHICULAR COMMUNICATIONS I

Chairman: Newton Monk, Bell Telephone Labs.

"A Communication System for the New York Throughway," D. S. DeWire, New York Telephone Co.

"Transistorized Communications Receivers," Seymour Schwartz, MIT.

"VHF Radio Coordinated Traffic Light Control System," Elmer W. Hammel, General Electric.

"VHF-UHF Communications System Interference Reduction through Use of Selective Filters," M. W. Caquelin, Collins Radio Co.

ANTENNAS III

Chairman: M. D. Adcock, Hughes Aircraft Co.

"Fundamental Problems in the Antenna Field," S. Silver, Univ. of California, Berkeley.

"Scanning Lens Design for Minimum Mean-Square Phase Error," E. K. Procter and M. Rees, General Electric Co., Palo Alto.

"A Duplexer for Sweep-Frequency Pulse Transmitters," R. Silberstein, National Bureau of Standards, Boulder.

"The Triport Conical Scan Antenna," E. Wantuch and L. A. Kaiser, Raytheon Manufacturing Co., Bedford.

NEW TRENDS IN COMPONENTS

Chairman: R. H. Baker, RCA.

"The Impact of New Electronics on Mercury Battery Designs," J. L. Dolfonso, P. R. Mallory.

"Criteria for Selection of Magnetron Beam Switching Tube as a Circuit Component," S. Kuchinsky, Haydu Brothers, Burroughs Corp.

"Application of Large Capacitors for Energy Storage," D. F. Warner, General Electric.

"Film Type Precision Resistors," B. Solow and C. Wellard, International Resistance Co., Philadelphia.

SEMICONDUCTORS II

Chairman: D. M. Van Winkle, Hughes Aircraft.

"Point Contact Diode Theory," Melvin Cutler, Hughes Aircraft.

"Component Improvement, Germanium and Silicon Low Power Rectifiers," G. N. Hall, General Electric.

"A Miniature Silicon Diode for Both Power and Circuit Applications," Arthur L. Rossoff, Radio Receptor Co., Inc.

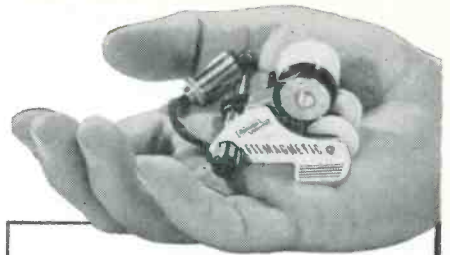
"A New UHF Transistor Structure," Wolfgang W. Gartner, Evans Signal Lab.

"Transistors with Vacuum Tube Properties," M. N. Ross and Hans E. Hollmann, National Aircraft Corp.

COMPUTERS: DATA GATHERING AND PRESENTATION SYSTEMS

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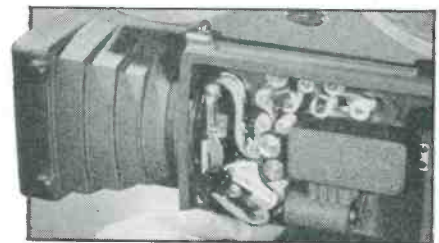
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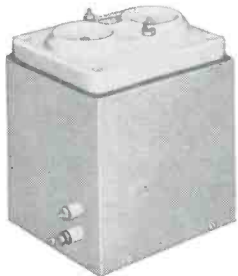
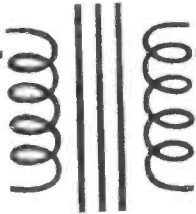
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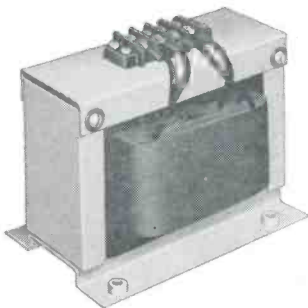
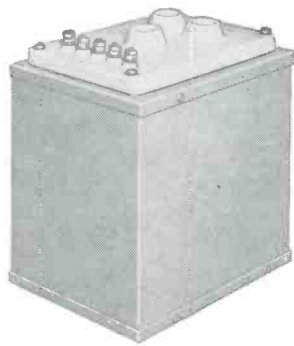
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By an ingenious engineering advance Sterling's new design and construction of D. C. Milliammeters makes possible a considerable slash in cost over conventional models. There is no sacrifice of quality—accuracy is held to $\pm 5\%$. Control of pointer damping and desired scale calibration can be provided. Available now, these meters are produced to special requirements and are offered even in 0-500 micro-ampere units. Use the coupon for full information.

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MANUFACTURING CO.
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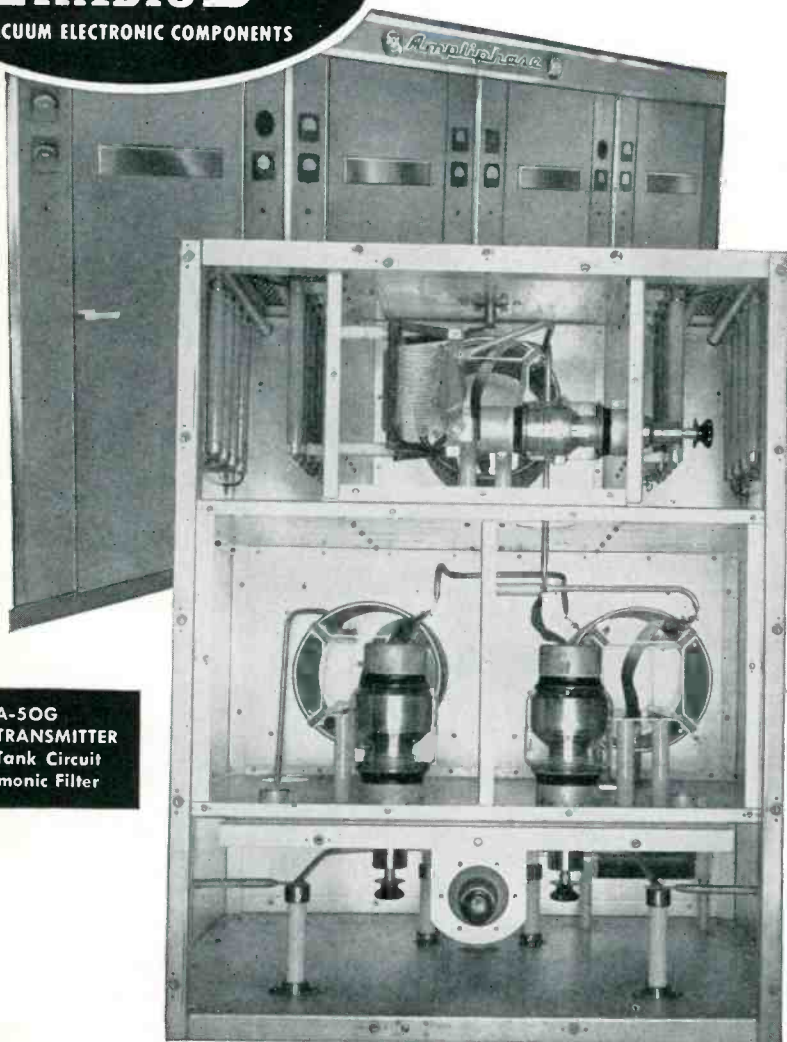
Please send me information on new low cost D. C. Milliammeters.

Name

Company

Address

City State



RCA BTA-SOG
50 KW TRANSMITTER
Output Tank Circuit
and Harmonic Filter

JENNINGS VACUUM CAPACITORS SIMPLIFY TRANSMITTER DESIGN

RCA like other transmitter manufacturers both in the United States and in Europe makes full use of Jennings Vacuum Capacitor in order to simplify transmitter design and increase circuit efficiency. Seventeen vacuum capacitors are used in the 50 kw broadcast transmitter shown above to help create a superior product for a competitive market.

The reason that vacuum capacitors are standard components in most modern high powered transmitters is be-

cause they are smaller, have wider capacity ranges, and are more efficient than other types of high voltage variable capacitors. The vacuum dielectric in these capacitors is such excellent insulation that for a given voltage rating a very small physical size is possible. Because they are small they have wider capacity ranges with much lower minimum capacities. This small size also reduces inductive losses while their all-copper construction reduces resistive losses making it possible to design more efficient circuits.

We would like to send you our catalog summary with its large selection of vacuum components to help simplify your transmitter designs.

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

Dry Process Enlarger for Digital Computing Systems," Henry G. Reuter, Jr., Radio Corp. of America, Camden.
 "Ultratype Camera, A High Speed Electron Optical Printer for Digital Computing Systems," A. M. Spielberg, S. R. Parker, and K. G. Kaufmann, Radio Corporation of America, Camden.
 "A High Speed, Precision, Large Quantity Data Processing System; IDIOT II," Martin L. Klein, Rocketdyne Division, North American Aviation, Canoga Park.
 "A Centralized Data Processing System for the Air Force Flight Test Center," O. F. Vogel, Electronic Engineering Company of Calif., Los Angeles.

AIRBORNE ELECTRONICS

Chairman: C. A. Ripinski, Electronic Industries, Burbank.
 "Thermal Design and Evaluation of an Airborne Electronic System," Richard E. Burton, Collins Radio Co., Cedar Rapids.
 "Flight Control Systems for Jet Transports," H. Miller and R. H. Wagner, Sperry Gyroscope, Great Neck.
 "Electronic Problems Encountered in High-Speed Commercial Jet Aircraft," Dick Hedges, Douglas Aircraft, Santa Monica.
 "Bearings and Their Properties as a Design Consideration in Electronic Systems," H. F. Stern, Industrial Tectonics, Inc., Los Angeles.

VEHICULAR COMMUNICATIONS II

Chairman: Maurice Kennedy, County of Los Angeles.
 "Communications with Moving Trains in Tunnels," Newton Monk, Bell Labs.
 "New Developments in Two-Way Communications," Angus MacDonald, Motorola.
 "Railroad Communications," D. L. Kesselhuth, Bendix.

INFORMATION THEORY

Chairman: Richard H. DeLano, Systems Laboratories Corp.
 "Synthesis of the Linear Time-Varying Predictor for Stationary Signals," Cheng Ling, Minneapolis-Honeywell.
 "The Relationship of Sequential Filter Theory to Information Theory and Its Application to the Detection of Signals in Noise by Bernoulli Trials," Herman Blasbalg, Johns Hopkins Univ.
 "Theory of Weighted Smoothing," Louis A. Ule, Gilfillan Bros., Inc.
 "The Response of a Phase-Locked Loop to a Sinusoid Plus Noise," Stephen G. Margolis, Jet Propulsion Lab.
 "Autocorrelator for Radioactive Sample Noise Generator," G. W. Anderson and James E. Murrin, J. B. Rea Co.

PRODUCTION CONSIDERATION OF ELECTRONIC EQUIPMENT

Chairman: Marvin Whitney, Hoffman Electronics Corp.
 "Problems of Semi-Automatic Assembly of Electronic Test Equipment," C. S. Selby, Hewlett-Packard.
 "Eyelet Failure in Etched Wiring," W. J. Hodges, Hughes Aircraft.
 "Mechanical Design Considerations in the Erma System," R. W. Melville, Stanford Research Inst., Palo Alto.
 "The Selection of Coatings for Printed Circuits," R. A. Martel and L. J. Martin, Hughes Aircraft.

Personal

(Continued from page 148)

William D. Bell has been retained as Consulting Engineer for Beckman Instruments' new Data and Control Systems Dept., Fullerton, Calif. He is head of Mellonics, sales and engineering consultants for electronic data processing.

PROBLEM #4

Design a miniature audio input transformer for airborne operation. Transformer to operate in an ambient temperature of plus 85°C, and to conform to the applicable parts of MIL E-5400 and MIL T-27. Duty cycle to be continuous with a minimum life of 1000 hours. Transformer to couple a 300 ohm source to a tube grid. Step-up turns ratio to be 1:17 minimum, with the maximum possible desired. Frequency response to be flat within 0.75 db from 20 cps to 7,000 cps, and flat within 1.2 db from 15 cps to 10,000 cps. Maximum signal level to be 500 mv @ 20 cps in 300 ohm primary. Electrostatic shield required between primary and secondary. Electromagnetic shielding to be 40 db minimum. Size to be kept minimum but must not exceed 1 1/8" x 7/8" x 1 3/8" high.

SOLUTION BY PEERLESS

Audio Transformer, low level input, miniaturized.
 Construction: Grade 1, Class A, MIL T-27
 Duty Cycle: Continuous
 Life: Greater than 1,000 hours.
 Ambient Temperature: +85 C max.
 Primary: Three terminal, center-tapped winding, 300 ohms nominal impedance.
 Secondary: Two terminal winding, 125,000 ohms nominal impedance.
 Turns ratio: 1:20 1/2
 Electrostatic Shield: Between primary and secondary.
 Electromagnetic Shield: 45 db
 Frequency response: 20 cps—7,500 cps, flat within 0.5 db and
 10 cps—10,000 cps, flat within 1.0 db with
 125,000 ohm load.
 Maximum Input Voltage: 500 mv at 20 cps
 Dimensions: 1" x 11/16" x 1" high + 1/8" terminal

The Peerless engineering staff has had a long and successful history of designing transformers to unusual and difficult specifications. Knowledge of this outstanding accomplishment is one of the reasons that Peerless transformers are the first choice of engineers throughout the country. Uniform dependability is assured by the most rigid quality control and advanced custom production techniques.

Consult Peerless for the best solution to your quality transformer requirements.



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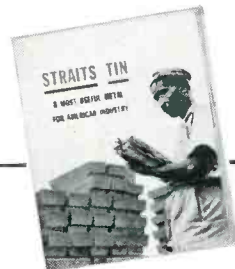
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News of Reps

Carl A. Stone Associates, Inc., 1102 South Western Ave., Los Angeles 6, has been named representative for the states of Calif. and Ariz., plus So. Nevada, by Shielding, Inc., Riverside, N. J., manufacturers of electromagnetic shielding enclosures. Mitchell Spears Co., Fort Worth, has been named sales engineering rep for Okla. and Texas, except for El Paso County, by Shielding, Inc.

W. L. Cunningham & Associates has been established at 435 Addison Ave., Elmhurst, Ill., to represent manufacturers of electronic equipment in the Chicago area. The new firm will represent Hammarlund Mfg. Co., New York, and Electrical Communications, Inc., San Francisco.

Syntronic Instruments, Inc., Addison, Ill., has named two new reps to handle its line of military and special-purpose deflection yokes and focus coils: Charles Segal Co., Boston, will handle the New England states, and Massey Associates, Washington, will cover the District of Columbia, Eastern Pa., Delaware, Md., Va. and Southern N. J.

McCarthy Associates, Los Angeles reps for Perkin Engineering Corp., El Segundo, Calif., now also cover No. Calif., Ariz., and Nevada, and have opened a San Francisco area office at 441 W. California Ave., Palo Alto.

Tel Instrument Electronics Corp., Carlstadt, N. J., has appointed two manufacturer sales reps for its TV studio and production test equipment: McCarthy Associates, Los Angeles area, will handle Calif., Ariz., and Nevada; Ken Meyers, Park Ridge, Ill., will represent TIC in Illinois, Wis., Ohio, Indiana, Michigan and Eastern Iowa.

Hugh Marsland & Co., Chicago, has been named sales rep for 12 Mid-Western states by Non-Linear Systems, Inc., Del Mar, Calif. Robert A. Waters, Inc., Wayland, Mass., has been named New England representative for Non-Linear Systems, Inc., of Del Mar, Calif.

Eugene Black has joined Land-C-Air Sales Co., Tuckahoe, N. Y., as a sales engineer.

Jack Berman has become sales representative for British Industries Corp., Port Washington, N. Y., in So. Calif., So. Nev. and Ariz. Harry A. Lasure has closed his sales office, which formerly represented B. I. C.

CO-AX

4 mmf/ft

★ **ULTRA LOW** capacitance & attenuation

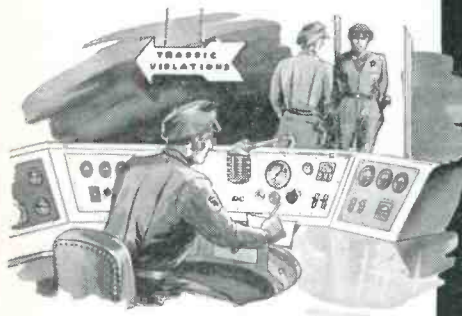
WE ARE SPECIALLY ORGANIZED TO HANDLE DIRECT ORDERS OR ENQUIRIES FROM OVERSEAS
SPOT DELIVERIES FOR U.S.
BILLED IN DOLLARS—
SETTLEMENT BY YOUR CHECK
CABLE OR AIRMAIL TODAY



TYPE	$\mu\mu\text{F}/\text{ft}$	IMPED. Ω	O.D.
C1	7.3	150	.36'
C11	6.3	173	.36'
C2	6.3	171	.44'
C22	5.5	184	.44'
C3	5.4	197	.64'
C33	4.8	220	.64'
C4	4.6	229	1.03'
C44	4.1	252	1.03'

NEW 'MX and SM' SUBMINIATURE CONNECTORS
Constant 50 Ω -63 Ω -70 Ω impedances

TRANSRADIO LTD. 138A Cromwell Rd. London SW7 ENGLAND CABLES: TRANSRAD, LONDON



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ELECTRICITY
MUST NOT
FAIL!

ONAN *Emergency* Electric Plants keep communications moving!

POLICE RADIO TRANSMITTERS, fire department signal systems, radio broadcast stations, microwave relay stations, TV, and other types of communications rely on Onan Electric Plants for emergency electricity. When regular power is interrupted, Onan plants start automatically, supply current for the duration of the outage, stop when power is restored.

Onan lightweight portable Electric Plants supply power for mobile radio transmitters and remote pickup trucks. Many sizes and models: *Write for folder!*



A SIZE FOR EVERY NEED

GASOLINE-DRIVEN—Air-cooled:
500 to 10,000 watts A.C. Water-
cooled: 10,000 to 50,000 watts A.C.



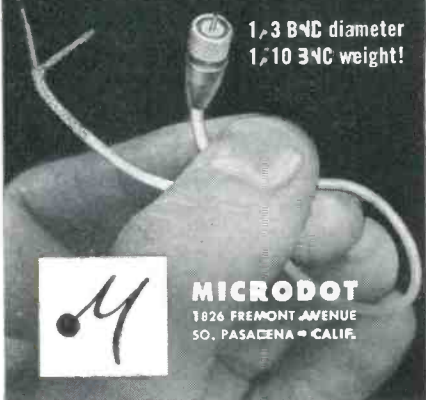
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Microdot cuts design time by multiplying possibilities... with the world's smallest, lightest microminiature coax connectors and cables available at 50, 70 or 93 ohms to meet your rigorous environmental requirements. Write today for applications data.

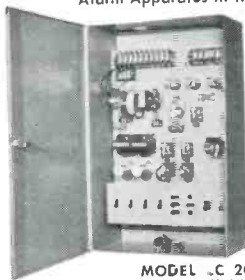


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**OBSTRUCTION LIGHTING CONTROL
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 for unattended TELEPHONE COMPANY
 MICROWAVE RADIO-RELAY stations.

- by HUGHEY & PHILLIPS, INC.
- your most dependable source of Obstruction Lighting Equipment
- the widest selection of Control & Alarm Apparatus in the Industry.



MODEL LC 2082
 For two light levels

- MODEL LC 2081** — for single light level
- MODEL LC 2083** — for three light levels.

These units provide a separate signal for failure of each top lamp and include maintenance-test switches. Also available with photo-electric control for tower obstruction lights.

Write today for information regarding your specific problems.

HUGHEY & PHILLIPS, INC.

Manufacturers of
 300MM Code Beacons, Obstruction Lights,
 Photo-Electric Controls, Beacon Flashers,
 Microwave Tower Control & Alarm Units,
 Remote Lamp Failure Indicator Systems,
 and Complete Tower Lighting Kits.

3300 NORTH SAN FERNANDO BLVD.
BURBANK, CALIF.

News of Reps

Computer-Measurements Corp., North Hollywood, Calif., has announced these new technical reps: L & M Associates, Fair Lawn, N. J., for New York, incl. Long Island, N. J., and Eastern Pa.; M. P. Odell Co., Westlake (Cleveland suburb), for Ohio, Eastern Michigan, Northern West Va., and Western Pa.; and Mitchell Spears Co., Fort Worth, to serve Okla. and Texas, except El Paso County.

James B. Lansing Sound, Inc., Los Angeles, has appointed two factory reps: Delzell-Maynard Sales Co., Dallas, for Texas, Okla., Alabama and Louisiana; and Dougherty Enterprises, Lanikai, T. H., will handle Hawaii.

Oak Mfg. Co., Chicago and Crystal Lake, Ill., is now using industrial distributors, instead of selling direct. Frank A. Emmet Co., Los Angeles, will cover Calif., Ariz. and So. Nevada. The Emmet firm has added 7000 sq. ft. to its Pico Blvd. office and warehouse, and plans to add display booths for products of manufacturers they represent.

Egbert & Fields Co., New York, has been reorganized. Samuel S. Egbert Co., 97 Reade St., New York 13, will specialize in industrial, radio, TV and Government markets for electronics sales, while Jack Fields Sales Co., 5 Howard St., Verona, N. J., will service high fidelity and radio parts jobbers in the New York Metropolitan and New Jersey areas.

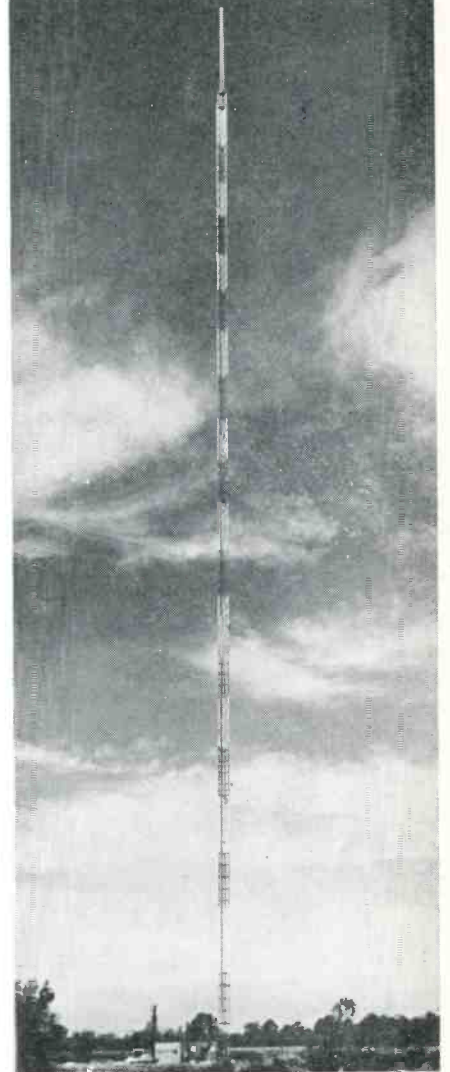
RMC Associates has moved from 170 East 80th St., New York, to 236 East 75th St., New York 21.

Frank O'Keefe and George H. Weiland have been named representatives of Central Transformer Co., Chicago. O'Keefe will cover Ohio and Indiana, and Weiland is assigned to Metropolitan New York and New Jersey.

William Richter Corp., Rochester, N. Y., has opened two new offices: in Syracuse, operated by Charles V. Hinzman; and in Hanson, Mass., for the New England states, with Robert L. Richter in charge.

The Jas. J. Backer Co., manufacturers' reps., recently moved into their new building at 221 West Galer St., Seattle 99, where there is an office building and 12,000 sq. ft. of warehouse space.

HIGH-GAIN
omnidirectional
VHF TV transmitting
ANTENNA



AMCI TYPE 1046
Channels 7 through 13

Shown above is the five-ray array recently installed for Station with Channel 7, in Washington, North Carolina. With a gain of 19.4, a single 6-1/8" coaxial transmission line feeder and in conjunction with a 20 kw transmitter, the antenna radiates an ERP of 316 kw AMCI Type 1 null fill-in assures proper coverage even in close to the tower. Write for Bulletin T-105.

ANTENNA SYSTEMS - COMPONENTS
 AIR NAVIGATION AIDS - INSTRUMENTS



ALFORD
 Manufacturing Co., Inc.
 299 ATLANTIC AVE., BOSTON, MASS.

STANDARD SIGNAL GENERATOR



**MODEL
65-B**
**RANGE
75 KC
to
30 MC**

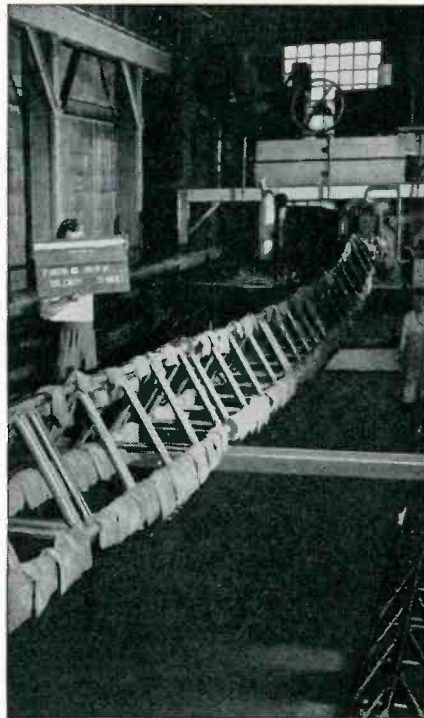
Individually Calibrated Scale

OUTPUT: Continuously variable, .1 microvolt to 2.2 volts.
OUTPUT IMPEDANCE: 5 ohms to .2 volt, rising to 15 ohms at 2.2 volts.
MODULATION: From zero to 100%. 400 cycles, 1000 cycles and provision for external modulation. Built-in, low distortion modulating amplifier.
POWER SUPPLY: 117 volts, 50-60 cycles, AC.
DIMENSIONS: 11" high, 20" long, 10 1/4" deep, overall.
WEIGHT: Approximately 50 lbs.

Catalog on request

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 Standard Signal Generators
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Each tower design is subjected to rigorous tests such as shown in the above photo. Progressive hydraulic pressures are applied simulating tower compression loading to determine the "buckling" point. Bags of lead shot are placed along vertical members to simulate maximum wind loadings. Every type of stress to which a tower might be subjected in actual service, is applied to Stainless tower designs with more severity than will ever be encountered in service.

Stainless literally "destroys" towers to make sure that the customer will be assured of absolute dependability!

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New
JONES 2400 SERIES PLUGS & SOCKETS

Improved Socket Contacts. Four individual flexing surfaces. Positive contact over practically their entire length.

Both Plug and Socket Contacts mounted in recessed pockets greatly increasing leakage distance, **INCREASING VOLTAGE RATING.**

Plug and Socket Contacts cadmium plated. Add to appearance of your equipment. Interchangeable with Jones 400 Series.

Ask for Catalog 21. Complete line Jones Plugs, Sockets, Terminal Strips.



P-2406-CCT Plug—with cable clamp in top,
 S-2406-SB Socket with shallow bracket for flush mounting.



See New Developments at the **WESCON SHOW** Booths 614-615

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Stainless, inc.
 NORTH WALES • PENNSYLVANIA

New Products

VOLTAGE REGULATOR

Type 6627/OB2WA is a miniature 2 electrode, inert gas-filled cold cathode tube for use as a voltage regulator. It maintains practically constant operating



voltage over a current range of 5 to 30 ma. and gives extremely small voltage drift throughout the life of the tube. Type 6627/OB2WA is specially designed to maintain stable operating voltages under conditions of bulb temperatures up to 150°C. Chatham Electronics, Livingston, N. J. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-23).

TRIMMER POT

New A10-W subminiature trimmer potentiometer is designed for critical avionic circuitry. Performance exceeds highest requirements of MIL-E-5272A and MIL-R-12934. Wire wound resistor element with 25 turns of wire; usable winding length is 98%. Temperature coeff. is 0.00002/°C. Dimen-



sions .220 x .312 x 1.250 in. Wgt. 2.25 grams. Operating temp.: -55°C. to 200°C. Powered at .8 watts, derated to 0 at 175°C. Dale Products, Inc., Columbus, Neb. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-38)

BIRD has the answers on COAXIAL LINE INSTRUMENTS

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WESCON SHOW - BOOTH 1137

Complete RF Power Measurement and Absorption Instruments for 50 Ohm Coaxial Lines.

"ThruLine" RF Wattmeters
(High, Medium or Low Power)

"Termaline" RF Wattmeters
(High, Medium or Low Power)

"Termaline" RF Resistors
(Air or Water Cooled)

Coaxial Switches, and
Coaxial RF Filters

We welcome your specific problems.
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TERMALINE Coaxial Line Instruments

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COMPANY
Sherman Oaks, Cal.



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the world's best
microphones

Ask about the
new CM-51
(only 4 1/2" high)
Write for complete
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ANCHOR RING*, CONE and MAGNET INSULATOR*

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Perfect insulation . . . easy to attach . . . economical. From stock and to your specifications. Also: safety glass mounting channels; dust seals; flexible bumper channels. *patented

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The unparalleled design flexibility of the Lackon® photo-marking process may offer you the best solution. With a minimum of gimmicks and gadgetry, Lackon® gives you a panel of unequalled marking accuracy, optimum legibility and lighting uniformity, with excellent resistance to severe environmental conditions. Designed, tested and quality controlled in our government approved laboratory, Lackon® edge lighted panels, knobs and knob skirts meet and exceed lighting, legibility and durability requirements of specification MIL-P-7788.



The Lackon® engineering staff of the United States Radium Corporation will readily assist your panel engineering department during the initial design stage. The cooperative application of their skill and experience in lighting techniques will speedily resolve design difficulties, result in decided production economies, and yield a remarkably superior finished product. For information write Dept. T-8
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**United States
Radium Corporation**

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Regional Offices: 5420 Vineland Ave., N. Hollywood, Calif.; 4624 W. Washington Blvd., Chicago, Ill. Affiliates: In Canada — Radelin-Kirk Ltd., 1168 Bay St., Toronto, Ont.; In Europe — United States Radium Corp.—Europe, 36 Avenue Krieg, Geneva, Switzerland.



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CHANNEL

New Products

POWER TRANSISTOR

The 2N155 power transistor is designed especially for the audio output stage of automobile radio receivers. Designed to operate from a 12-v. battery, this PNP



germanium-alloy junction transistor features high power gain, uniformity and exceptional reliability. It is plug-in for easy installation. Highly efficient heat dissipation. Heavy copper flange permits flow of heat to chassis. CBS-Hytron, Danvers, Mass. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-26).

COMPUTER TUBE

The 6829, a 9-pin miniature medium-mu twin triode, is designed for service in ruggedized military computing equipment. Features high-perveance design, low heater power, balanced sharp cut-off characteristics, on-off dependability and long life under

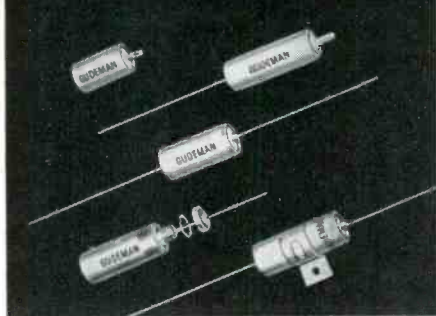


cut-off conditions. Altitude rating of 60,000 ft.; withstands impact acceleration of 450 G and vibrational acceleration of 2.5 G. General Electric, Schenectady 5, N. Y. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-2).

GUDEMAN

NEW "XC" PLASTIC FILM DIELECTRIC CAPACITORS

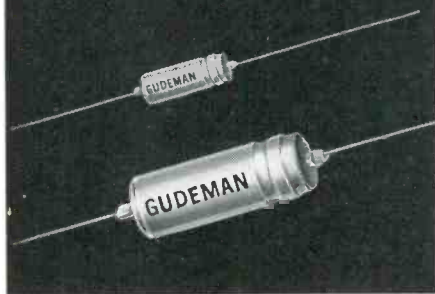
Hermetically Sealed (Glass to Metal)
Tubular Cased



The development of the Guddeman "XC" capacitors results in a new line of high temperature capacitors that has exceptionally high insulation resistance, low power factor and low dielectric absorption. The case sizes were selected whereby no voltage derating is required when the capacitors are used within a temperature range from -65°C . to $+165^{\circ}\text{C}$.

The Guddeman "XC" capacitors as shown are hermetically sealed, tubular, oil filled (Guddeman Impregnant #258), plastic film dielectric. Other case styles such as bathtub and rectangular types are available.

NEW MINIATURE DRY ELECTROLYTICS



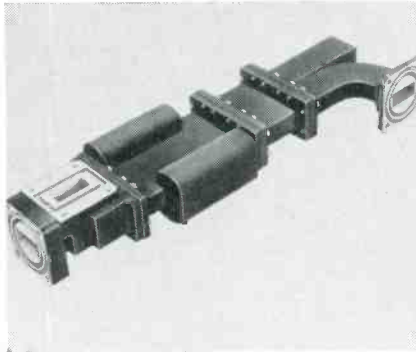
- Guddeman "EMM" Type
- Size Range $3/16"$ to $3/8"$
Diameter— $1/2"$ to $1"$ Long
- Capacity Range: 1 MFD to 100 MFD
- Voltage Range: 3 V.D.C. to 50 V.D.C.
- Operating Temperature: 65°C .
- Hermetically Sealed
- 99.99% Purity Foil
- Low Leakage Current
- Low Equivalent Series Resistance

THE **GUDEMAN** CO.
340 W. Huron, Chicago 10

New Products

DUPLEXER

X-band ferrite phase differential duplexer incorporates in a single device both duplexer and load isolation action. Functions as a switching device between



magnetron, receiver and antenna, and it also furnishes effective isolation between the magnetron and r-f energy reflected from line mismatches. Magnetron-to-load isolation is a minimum of 20 db. Airtion, Inc., Dept. B 1103 West Elizabeth Ave., Linden, N. J. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-34)

MICROWAVE DIODES

New point contact silicon mixer diodes for low noise mixer performance in L, S, C, and X band radar receiver circuitry. 1N23E fixed forward polarity and 1N415E reversible polarity diodes achieve minimum performance of 7.5 db overall systems NF at their X band design center frequency. In



S band equipments the 1N21E or 1N416E reversible mixer diode will result in a maximum overall system NF of 7.0 db. Microwave Assoc., 22 Cumminston St., Boston 15. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-15).

GUDEMAN

NEW MINIATURE FEED-THRU CAPACITORS

Paper Dielectric—Hermetically Sealed
Guddeman Impregnant #257
Types 271 and 272



The Guddeman Feed-Thru Capacitor, Types 271 and 272, is a three-terminal component designed to be used for R.F. Interference suppression in a manner similar to a low pass filter. The typical insertion loss characteristics for these Feed-Thru Capacitors when measured in a 50 ohm line are in accordance with MIL-Standard 220.

The internal construction of these Feed-Thru Capacitors is designed so as to minimize the inherent inductance; therefore, these units perform functionally as nearly as possible to an ideal capacitor.

NEW RADIO INTERFERENCE FILTERS



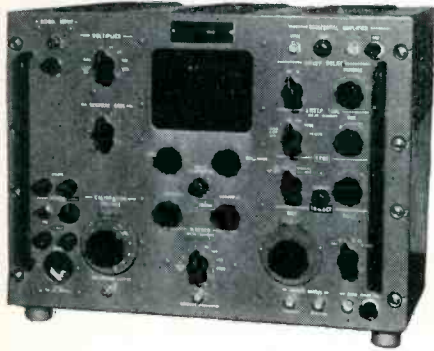
- Screw neck mounting
- Hermetically sealed tubular construction
- Glass compression or ceramic solder seal terminals
- High insertion loss from .15 to 1000 MC
- Ratings range from 1 to 20 amps at 125 V.A.C. (0-400 cycles) or 400 V.D.C.
- Operating temperature range: -55°C . to $+85^{\circ}\text{C}$.

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Lavoie

239CR
(AN/USM50A)

Oscilloscope



Now available as shelf item for exacting bench use . . . for design and production work.

ALSO FOR CONTRACTORS

to furnish as support equipment for military systems . . . for as AN/USM50A it is the official general purpose oscilloscope for the military services. Available with dust cover or for standard rack mount. Extremely rugged; easy and straightforward to use.

With the Exclusive LAVOIE Non-parallax Scale

For accurate voltage and time measurement. There can be no error of parallax... the unique Lavoie reflecting scale superimposes the reticule on the optical plane of the cathode-ray screen. The reflecting scale does not prevent the use of a camera with the Lavoie 239CR Oscilloscope. A camera adapter plate is available for use with the Fairchild F-284 camera. The same instrument is also available in the conventional flush-face version (model 239CF).

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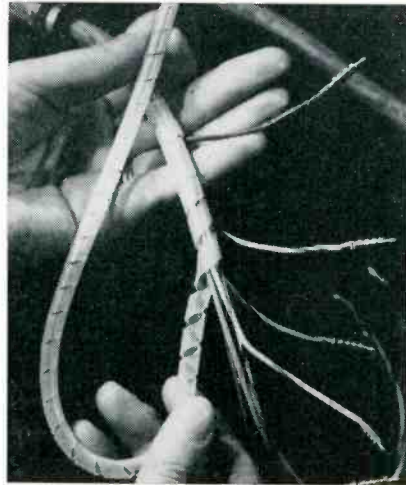
Lavoie Laboratories, Inc.

MORGANVILLE 11, NEW JERSEY

New Products

CABLE WRAPPING

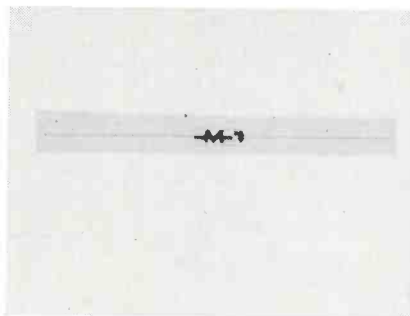
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YOKES

COSSOR (Canada) are now supplying precision deflection yokes to many of the largest laboratories and defence project industries in the U.S.A. Yokes are available to customer's specification, in Nickel Iron, Ferrite, Class A, Class H insulation.

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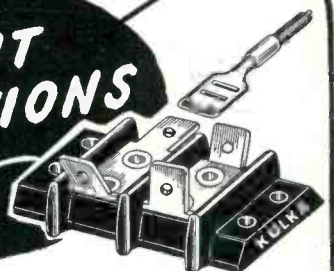
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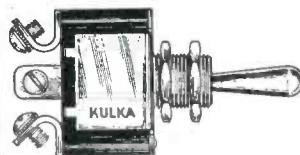
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ELECTRONIC SWITCHES



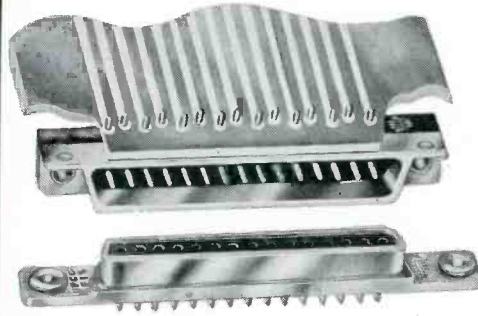
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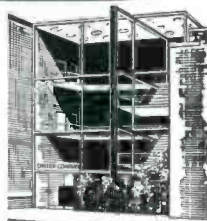
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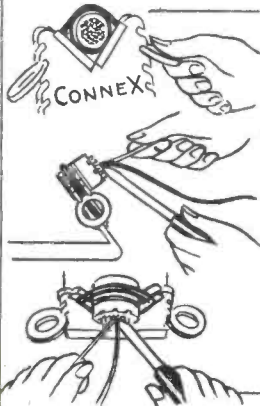
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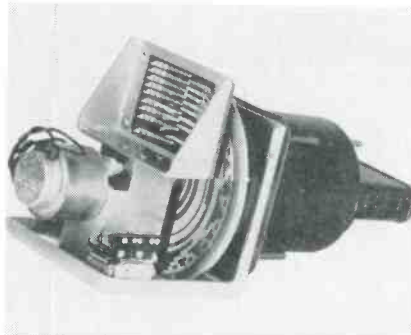
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New Products

A-D CONVERTER

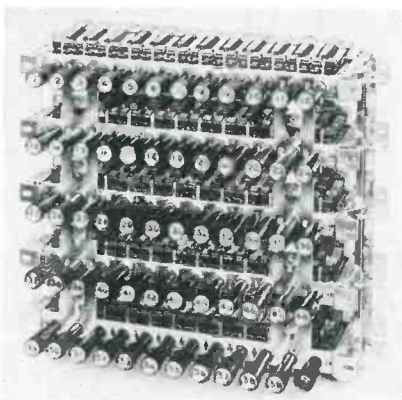
New analog-to-digital converter is a photo scanner which converts an analog meter indication into digital form. Basic elements are: (1) photocell and light source as-



sembly; (2) a pointer path length mirror; (3) small motor; (4) code disc; (5) relay; and (6) a group of digit storage relays. Digital readings may be taken at 3-sec. intervals and transmitted with an accuracy of 1% over long distances. Bendix-Pacific Div. 11600 Sherman Way, N. Hollywood, Calif. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-37)

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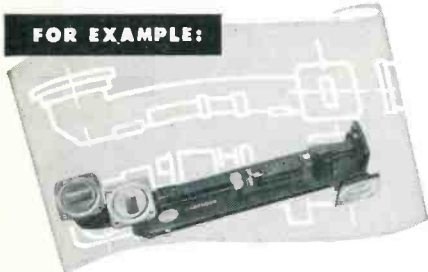
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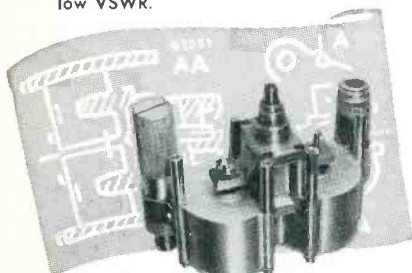
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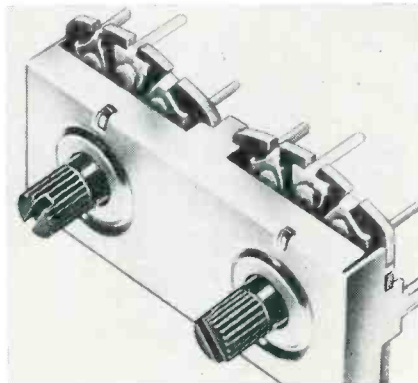
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New Products

TWIN CONTROL

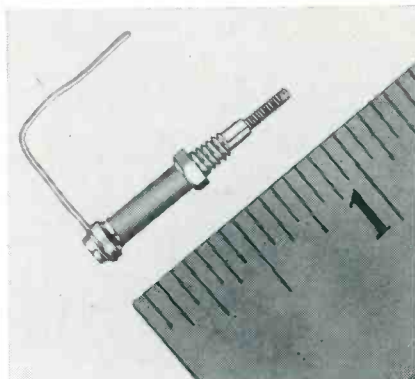
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in mounting and wiring time for equipment mfrs. Known as Type TU61, the new unit has two 1/4 in. diameter phenolic shafts adjustable from either side. Shafts on the panel side are screwdriver-slotted and cut flush with mounting plate. Stackpole Carbon Co., Electronic Components Div., St. Mary's, Pa. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-9).

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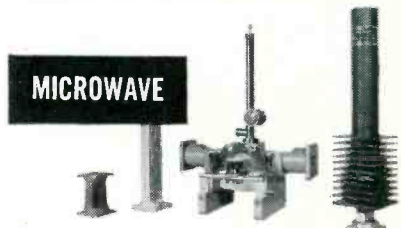


vibration, shock and humidity, the unit is ideal for varying types of service conditions. Cambridge Thermionic Corp., 445 Concord Ave., Cambridge 38, Mass. Tele-Tech & ELECTRONIC INDUSTRIES (Ask for 8-16).

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MAF-6	400	5	57.5	1.2	0.4
MAF-6	400	10	57.5	1.6	0.6
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MAP-1	60	5.	115	1.2	1.2
MAP-2	60	15.	115	1.6	2.4
MAP-3	60	50.	115	2.0	0.5
MAP-3-1	60	50.	115	7.0	2.9
MAP-4	60	175.	115	8.0	6.0
MAP-7	400	15.	115	0.6	2.8
MAP-8	400	50.	110	1.75	0.6

SATURABLE TRANSFORMER Phase reversible

Cat. No.	Supply Freq. in C.P.S.	Power Out. Watts	Volt. Out. V. AC	Sig. req'd for full outp. MA-DC	Total resis. contr. wdg. K Ω
MAS-1	60	15	115	6.0	27
MAS-2	400	6	115	4.0	10
MAS-5	400	2.7	26	4.0	3.2
MAS-6	400	30	115	4.0	8.0
MAS-7	400	40	115	5.5	8.0

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(Continued from page 8)

and George Glatz has been placed in charge of the firm's Syracuse, N. Y., office. Ray Over has become Amph-enol's district manager in Seattle.

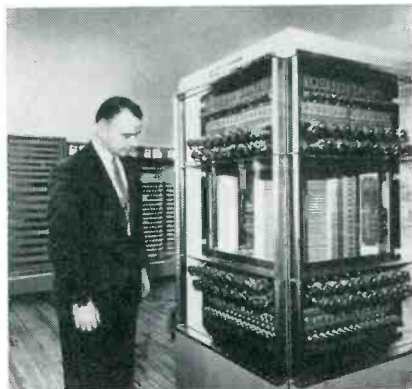
Rear Adm. Joseph I. Taylor, USN, Ret., has been appointed coordinator of plans and programs in the Government and Industrial Products Div., The Magnavox Co., Fort Wayne.

SAGE Computer

(Continued from page 20)

abilities of an electronic computer to receive information, to memorize, to calculate, and to record answers with the perspective and display talents of radar to present an instantaneous graphic picture of the location, speed, and direction of all planes within radar range. With a knowledge of flight plans of friendly planes available in the computer, hostile planes can be identified immediately and the most effective defense action taken—again on the basis of computer information and instruction.

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One of the Memory Array Frames which comprise the heart of the AN/FSQ-7 SAGE computer

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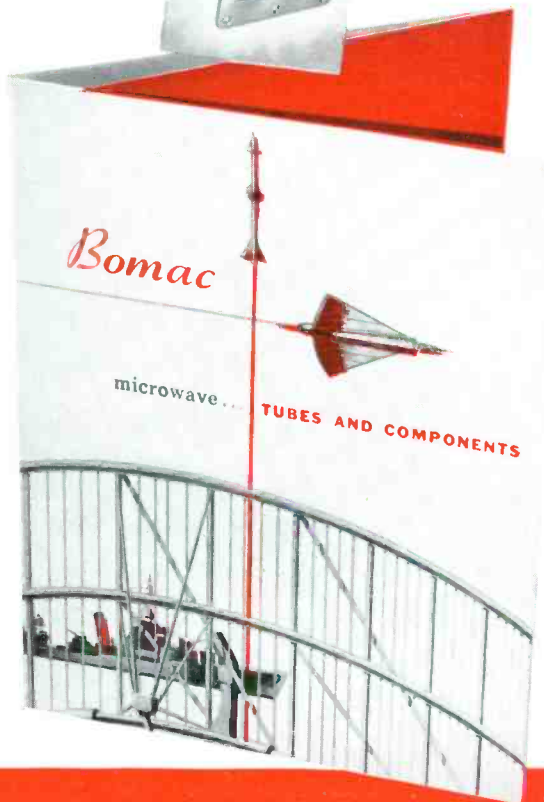
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