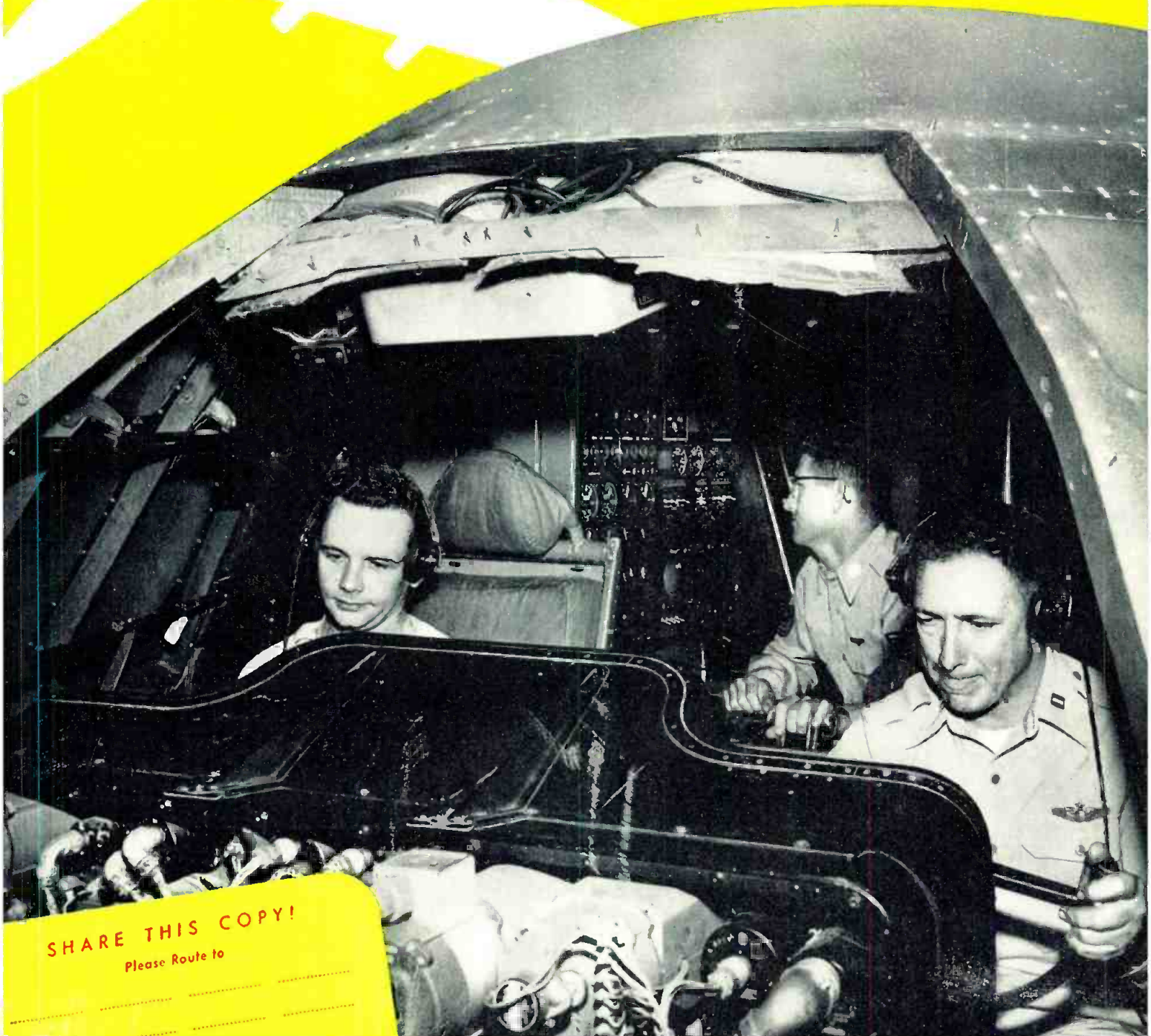
May • 195

TELE-TECH
& Electronic Industries

Electronic Simulators
Bolster Air Force Operations



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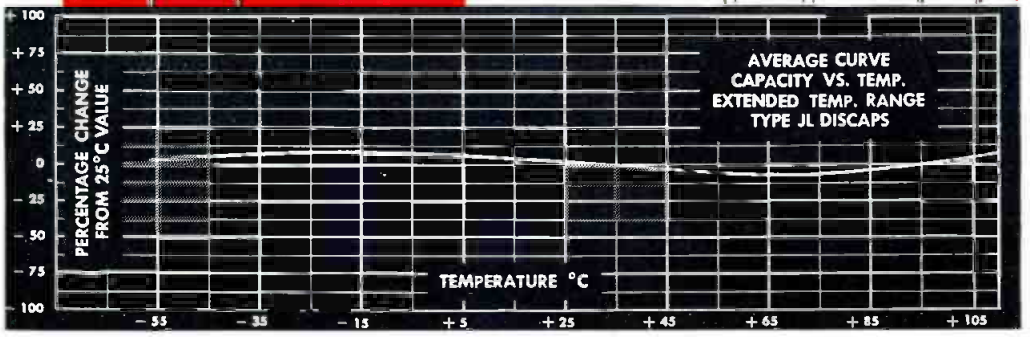
MAXIMUM EFFECTIVENESS AT LOWEST COST...

RMC Type JL DISCAPS

RMC Type JL DISCAPS provide ideal performance over an extended temperature range. The maximum capacity change between —60° and +110° C is only ±7.5% of capacity at 25° C. Lower initial cost, smaller size, and greater mechanical strength combine to effect worthwhile economies in production line operations.

In addition to standard leads, Type JL DISCAPS, as well as temperature compensating and by-pass types, are available with RMC's exclusive "Wedg-Loc" leads or plug in leads for printed circuit applications.

If you have a capacitor problem RMC engineers are prepared to work with you. Your inquiry is invited.



POWER FACTOR: 1% max. @ 1 K C (initial)
POWER FACTOR: 2.5% max. @ 1 K C, after humidity
WORKING VOLTAGE: 1000 V.D.C.
TEST VOLTAGE (FLASH): 2000 V.D.C.
LEADS: No. 22 tinned copper (.026 dia.)

INSULATION: Durez phenolic—vacuum waxed
INITIAL LEAKAGE RESISTANCE: Guaranteed higher than 7500 megohms
AFTER HUMIDITY LEAKAGE RESISTANCE: Guaranteed higher than 1000 megahms
CAPACITY TOLERANCE: ± 10% ± 20% at 25° C

DISCAP CERAMIC CAPACITORS

RMC

RADIO MATERIALS CORPORATION

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

FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.

Two RMC Plants Devoted Exclusively to Ceramic Capacitors

TELE-TECH
& Electronic Industries

MAY, 1955

FRONT COVER: ELECTRONIC FLIGHT SIMULATORS are playing an increasingly vital role in streamlining military and commercial aircraft operations. These training units, costing about $800,000 to $1,000,000, utilize a system of analog computers connected to the controls and instruments of a duplicated cockpit to simulate exactly an aircraft's performance. Simulators offer cost savings, greater safety and better pilot training. Photo shows advanced training crew working out simulated flight trauble in Curtiss-Wright simulator located at Palm Beach Air Force Base, Fla. For details, see article starting on page 68.

DEPARTMENTS

TELE-TECH & ELECTRONIC INDUSTRIES, May 1955, Vol. 14, No. 5. Published monthly by Caldwell-Clements, Inc. Publishers also of MART and TECHNICIAN. Publication Office, Emmett St., Bristol, Conn. Editorial, advertising and executive offices, 480 Lexington Avenue, New York 17. Telephone PLaza 9-7880. M. Clements, President; M. H. Newton, Assistant to President; John J. Borghi, Vice President and Treasurer; M. B. Clements, Secretary. Acceptonce under section 34.64 Postal Laws and Regulations authorized ot Bristol, Conn., June 9, 1954. Additional acceptance at New York, N. Y. 75¢ a copy. Subscription Rotes: United Stotes and U. S. Possessions: 1 year $5.00; 2 years $8.00; 3 years $10.00. Canada: 1 year $7.00; 2 years $11.00; 3 years $14.00. All other countries: 1 year $10.00; 2 years $16.00. Please give title, position and company connections when subscribing.

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SUBMINIATURE and MINIATUR

and **STANDARD** Toroids. Available in wide frequency range with inductance accuracy of 1%. Finishes: tape, resin dipped, encapsulated, hermetically sealed, form-fitting metal cases, molded silicon rubber. Special toroids engineered to your application. Write for Catalog 102A.

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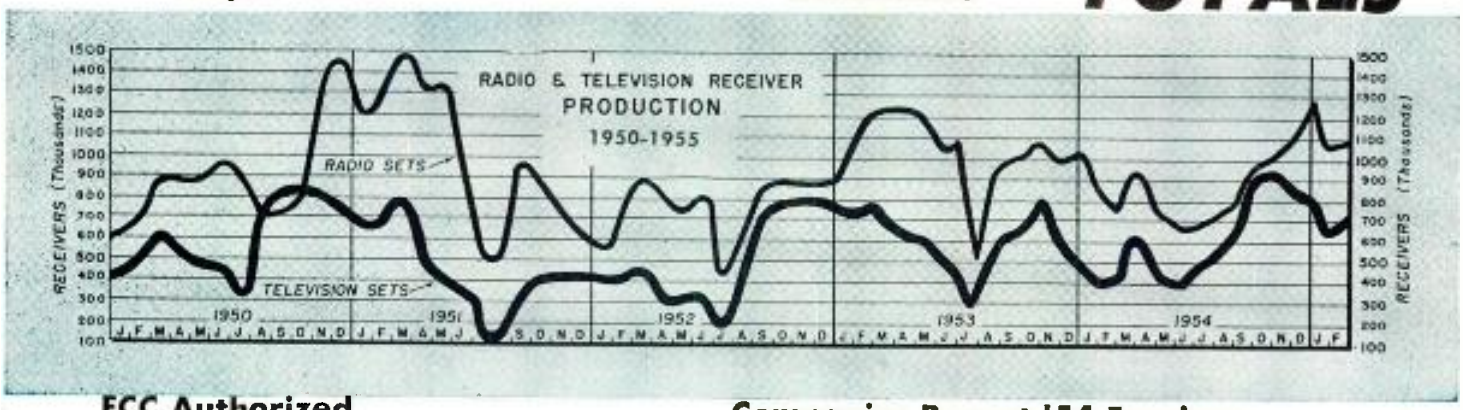
Pacific Division: 720 Mission St., S. Pasadena, Calif

FIRST IN TOROIDS AND RELATED NETWORKS

ELECTRONIC INDUSTRIES TOTALS



FCC Authorized Stations—1955

Service	No. Auth.
Safety and Special Services	42,048
Public Safety	17,289
Industrial Services	23,405
Marine Services	48,977
Land Transportation	17,234
Disaster	312
Amateur	130,642
R.A.C.E.S.	1,514
Common Carrier Service	1,822
Experimental Services	597
Broadcast Services	
Broadcast Services	
Std. AM	2,793
FM	553
Educational FM	123
TV	578
Educational TV	33
Experimental TV	17
TV Auxiliary	478
International	39
Developmental	3
Remote Pickup	1,479
Studio Transmitter	44
Broadcast Total	6,140

Companies Report '54 Earnings

Spring is annual report time for a great many electronic producers. Here summarized are figures from the reports of various organizations received to date.

Company	Sales—000's		Income—000's		Earnings/Share		Dividends/Common	
	1954	1953	1954	1953	1954	1953	1954	1953
Burroughs Corp.	169,099	160,455	7,796	7,206	1.56	1.44	1.00	0.90
Dumont Labs. Inc., A.B.	92,843	91,829	7,597*	1,544	3.17*	0.60	0.00	0.00
General Precision Equipment Corp.	123,333	87,764	5,488	3,436	6.49	5.09	1.90	1.00
Hoffman Electronics Corp.	42,647	50,415	1,485	1,200	2.08	1.68	1.00	1.00
International Telephone and Telephone Company	372,639	362,193	20,069**	22,378	2.80	3.12	1.00	1.00
Minnesota Mining and Mfg. Corp.	230,890	219,916	24,624	17,592	2.95	2.14	1.30	1.00
Radio Corp. of America	940,950	853,054	40,525	35,022	2.66	2.27	1.35	1.20
Sprague Electric Co.	42,355	46,779	3,333	2,888	2.68	2.32	0.50†	
Stewart Warner Corp.	92,882	128,798	2,757	4,081			1.60	1.80
Sylvania Electric Prods. Inc.	281,642	293,267	9,480	9,536	2.92	3.10	2.00	2.00†
Texas Instruments Inc.	24,387	27,008	1,200	1,270	0.40	0.42	—	—
Trov-Ler Radio Corp.	16,347	14,470	241				0.30	0.10
Zenith Radio Corp.	138,608	166,733	5,676	5,632	11.53	11.44	3.00	3.00

* Includes profit on sale of WDTV

** Net loss $2,400,000 on disposition of assets of Coolerator Division

† plus stock dividend

GOVERNMENT ELECTRONIC CONTRACT AWARDS

This list classifies and gives the value of electronic equipment selected from contracts awarded by government procurement agencies in March 1955.

Actuators	465,226	Fuses	206,531	Receivers, radar set	28,064
Actuators and Misc. Units	98,403	Fuse Boxes	51,300	Receivers, radio	1,957,976
Alternators	91,323	Generators, ac	756,626	Receivers, telephone	34,991
Amplifiers	494,521	Generators and Panels	278,761	Recorders	57,850
Amplifiers and Controls	79,974	Generators and Regulators, etc	993,490	Recorder Group	1,518,743
Antennas	110,700	Generators, signal	106,638	Recorder-Reproducers	175,439
Anodes	27,801	Generators, starter	375,206	Rectifier Assys	29,970
Anodes, cobalt	52,503	Headsets, microphone	1,220,675	Relays	35,644
Bases, antenna	49,707	Heating Units, induction	35,053	Relays, keying	34,913
Batteries	250,470	Indicators	3,611,558	Resistors, potentiometer	32,360
Batteries, dry	1,303,390	Indicators, airspeed	2,117,995	Resistors, variable	115,263
Batteries, storage	737,854	Indicators, directional	194,889	Replacement Kits	29,873
Bodies, gunsight camera	620,885	Indicators, tachometer	76,140	Replacement Kits, amplifier	40,182
Cable Assys	347,822	Intercom Units	35,281	Replacement Kits, computer	98,491
Cable, electric	70,600	Kits	92,376	Rocket Sounding Beacon Extension	426,691
Cable, telephone	25,407	Kits, drone control	48,176	Switch-Floats	29,162
Cable, watertight	2,491,796	Kits, indicator control	40,604	Switches, pressure	65,244
Cabinets, electrical	53,669	Kits, "Retrofit"	252,503	Switches, slide	80,880
Coders	34,900	Klystrons	29,600	Switches, thermostatic	93,760
Coil Assys	67,196	Loudspeakers	201,659	Simulators, modification	400,000
Components, radio altimeter	137,013	Modulator, radio	121,094	Spare Parts, actuator	37,373
Computers	9,313,486	Motor Assys	170,569	Spare Parts, amplifier	437,184
Computer Assys	416,517	Motors, dc	70,332	Spare Parts, autopilot	1,216,372
Connector Assys	74,355	Motor Generators	783,830	Telephone Circuits	32,268
Controls	436,861	Microphones, dynamic	208,782	Telephone Sets	55,883
Controls, air conditioning	39,268	Modification Kits	464,661	Terminal Equipment, multiplex	45,522
Controls, indicator	3,999,056	Modification Kits, amplifier	348,133	Test Equipment, printer projector	103,052
Controls, master	294,078	Modification Kits, antenna	41,060	Test Sets, radar	88,050
Control Systems, gunfire	2,304,225	Modification Kits, azimuth computer	30,377	Test Stands	58,670
Control Units	95,564	Modification Kits, pedestal	99,988	Tranceivers	20,087
Converters	74,393	Modification Kits, power unit	83,640	Transformers	62,224
Crystal Units	76,557	Modification Kits, rectifier tube	26,928	Transformers, power and plate	33,410
Data Recorders	1,200,000	Modification Kits, safe switch	61,610	Transformers, pulse	70,571
Detectors	180,763	Modification Kits, signal generator	41,790	Transformers, step-up	48,950
Domes, sonar	257,040	Modification Kits, transformer	99,330	Transformer Rectifiers	55,242
Dummy Loads	126,081	Multimeters	49,202	Transmitters	511,639
Dynamotors	349,307	Ordalt Kits, radar	506,713	Transmitters, multipurpose pressure	704,831
Electrodes, welding	233,285	Oscillator Sub Assys	29,482	Tubes, electron	5,696,296
Electronic Componets	5,590,990	Parts, bomb sight	2,595,271	TV Camera Chains	36,000
Exciters, vibration	26,719	Pickups, etc	67,620	TV Cameras	26,451
Field Changes, radar repeater	102,100	Power Supplies	1,203,591	Voltage Regulators	190,253
Filters	13,565	Radar Sets	7,801,040	Wire, electric magnetic	38,376
Flight Simulators	450,000	Radio Sets	3,468,273	X-Ray Equipment	30,872

Standard Electronics . . .

PROOF OF ECONOMY

SAVE with S-E TV Transmitting Equipment!

1 **A RECENT COMPARISON** of transmitter equipment manufactured by Standard Electronics and by Manufacturer "B" showed that if you bought S-E high power VHF transmitting equipment your savings in initial cost and operating expenses over 10 years would amount to:

total savings approx. $293,000.00

SAVINGS with S-E 50 KW Transmitter compared to competitive 50 KW Transmitter "B" (10 YEARS)

	OPERATING TUBE COSTS	POWER COSTS	INITIAL INVESTMENT	TOTAL COSTS
Transmitter "B"	$312,000	$144,360	$224,000	$680,360
S-E	$ 57,600	$108,360	$221,000	$386,960
Savings with S-E	$254,400	$ 36,000	$ 3,000	$293,400

NOW . . . Operating information is available to compare S-E equipment with manufacturer "C's". Examine the detailed "proof of economy" presented here.

2 **AGAIN,** S-E can show substantial savings! The chart at right illustrates the overall savings you can realize in 10 years when you buy S-E, as compared to operating costs of equipment by Manufacturer "C".

total savings approx. $169,000.00

SAVINGS with S-E 25 KW Transmitter compared to Transmitter "C" with only 20 KW (10 YEARS)

	OPERATING TUBE COSTS	POWER COSTS	TOTAL COSTS
Transmitter "C"	$167,400	$83,520	$250,920
S-E	$ 22,200	$59,520	$ 81,720
Savings with S-E	$145,200	$24,000	$169,200

3 **AND** to further accentuate this saving, note that Manufacturer "C" rates his high band transmitter at 20 KW compared to S-E's rating of 25 KW.

you get 25% additional transmitter power output . . . AND FOR LESS MONEY, TOO!

VHF Output Power Rating

Transmitter "C"	20 KW
S-E	25 KW
Percent Extra Power with S-E	25%

4 **FOR INSTANCE, TUBE COSTS:** The chart at the right is a tabulation of all tubes having a list price of over $100.00 each, used in Transmitter "C" and in the S-E transmitter.

The total list price of these tubes is shown in the chart to the right. It is evident that the *replacement cost* of the high priced tubes is almost 200% greater for Transmitter "C" than for S-E . . . resultant

savings of approx. $5,000.00

Tube Tabulation

	DRIVER	AMPLIFIER
S-E	4—4X500 2—AX9904R	8—AX9904R
Transmitter "C"	2—3X2500A3 8—5513 4—5588	4—6166 6—869B

Tube List Prices

	DRIVER	AMPLIFIER	TOTAL
Transmitter "C"	$3076	$4448	$7524
S-E	$ 904	$1680	$2584
Savings with S-E	$2172	$2768	$4940

All the figures used in this presentation are based on the latest available information for High Band VHF Transmitting Equipment

THIS MEANS your operating cost for tubes alone, based on 6,000 hours per year with an S-E 25 KW transmitter will SAVE YOU (compared to Transmitter "C") a 10 year total

savings of approx. $145,000.00

IN ADDITION substantial savings in your power bill are yours when you purchase S-E transmitting equipment. A comparison of published data for an S-E 25 KW and for Manufacturer C's 20 KW transmitter operated at black level with a 90% power factor, indicates a 10 year

savings of approx. $24,000.00

SUMMARY: From this information, savings in operating costs over a period of 10 years would indicate that YOU can

SAVE APPROX. $169,000.00

with economical, dependable S-E Transmitters!

Operating Tube Cost

	HOURLY COST TRANSMITTER "C	HOURLY COST S-E	HOURLY SAVINGS WITH S-E	10 YEAR SAVINGS WITH S-E
Driver	$1.28	$0.15	$1.13	$67,800
Amplifier	$1.51	$0.22	$1.29	$77,400
Total Transmitter	$2.79	$0.37	$2.42	$145,200

Power Cost

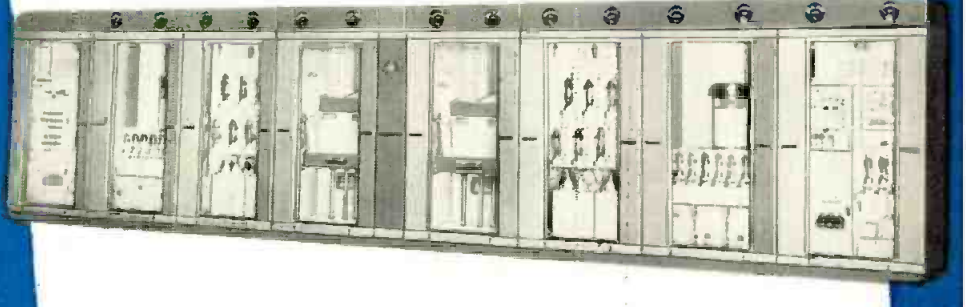
	DRIVER KW	AMPLIFIER KW	TOTAL TRANSMITTER KW	YEARLY DEMAND CHARGE @ $3 PER KW	YEARLY POWER COST @ 1¢ PER KWH	TOTAL
Transmitter "C"	22	65	87	$3,132.	$ 5,220	$8,352
S-E	15	47	62	$2,232	$ 3,720	$5,952
Savings with S-E	7	18	25	$ 900	$ 1,500	$ 2,400
10 Year Savings				$9,000	$15,000	$24,000

Savings in Operating Costs (10 Years)

TUBE SAVINGS	$145,200
POWER SAVINGS	$ 24,000
TOTAL	$169,200

PROOF once again that with S-E TV Transmitting equipment you SAVE IN EVERY WAY!

Standard Electronics high band 25 KW transmitter gives you these extra ECONOMY PLUS features . . . economical installation . . . less floor space . . . integral air cooling . . . no complex plumbing and water pumps . . . "Add-A-Unit" permits expansion to higher power with no obsolescence of present equipment . . . ability to handle color is engineered into every S-E transmitter.



Compare S-E with any other make of transmitter for ECONOMY...QUALITY...PERFORMANCE!

For specifications and a copy of the "PROOF OF ECONOMY REPORT" write, wire, or phone Standard Electronics.

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Operating costs are determined on the basis of 6000 hours of operation per year. Detailed comparison available on request.

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CIRCULATION NOW 27,000

An increase of 5,000, effective with the January 1955 issue, provides greater penetration of plants, stations and laboratories in the primary markets of the industry—Manufacturing, Broadcasting and Armed Forces procurement.

These are the markets with greatest buying power and greatest expansion, industrially and geographically.

The circulation of TELE-TECH is increasing in two ways:

1—Growth of TELE-TECH's Unit Coverage of top-ranking engineers—the magazine's basic readership, preselected for complimentary subscriptions.

2—Making paid subscriptions available to other engineers in research, design, production, operation and maintenance.

Although currently effective, the increased circulation cannot appear in audit statements until the first half of 1955 is audited.

THE ELECTRONIC INDUSTRIES DIRECTORY

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

Type 874-MD Sweep Drive . . . for G-R Slotted Line

This device represents an important advance in the field of automatic instrumentation. In conjunction with the Slotted Line, it makes possible accurate, truly *rapid* measurements of VSWR, complex reflection coefficient or impedance of antennas, termination filters, pads, cables and other network elements.

The Drive can be attached easily to one end of any of the new improved Type 874-LBA Slotted Lines. Sweep speed and length of line swept are completely adjustable, even while the carriage is traveling. Optimum settings for various measurements may thus be made.

For CRO horizontal deflection a sawtooth voltage is provided, the magnitude of which is accurately proportional to carriage position. This feature permits easy calibration of the horizontal scope axis. If the driving oscillator is square-wave modulated, a base line is made available for the scope and VSWR can be measured directly on the scope face. Positions of voltage minima can also be determined in this manner. Where preferable, a standing-wave meter can be used in place of the scope at slow speeds.

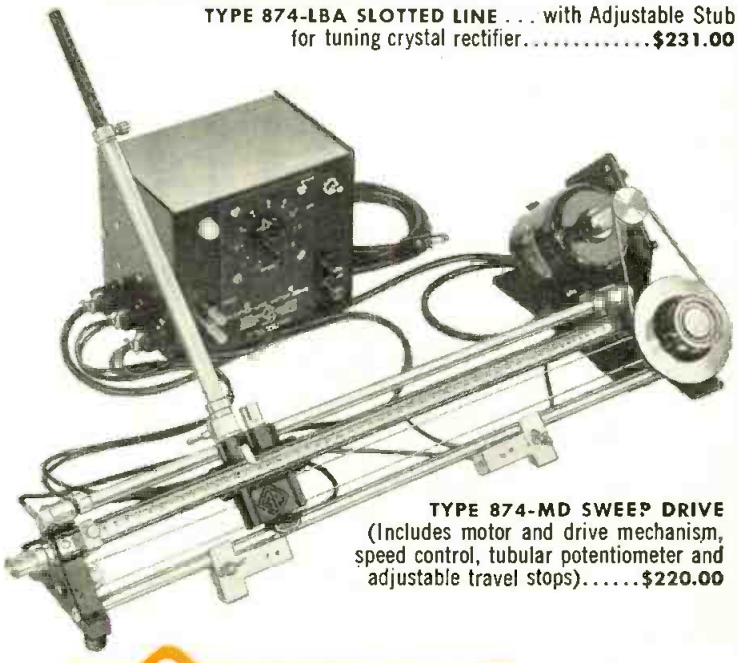
This Drive has no backlash problems whatever, because the Sweep is determined by the *position* of the carriage. Consequently, both forward and backward sweeps are used.

SWEEP SPEED — continuously adjustable from one full sweep (46 cm) in more than 10 seconds, to one full sweep in less than one second.

SWEEP RANGE — continuously adjustable from 1 cm to 46 cm.

SIGNAL FOR CRO HORIZONTAL PLATES — voltage divider with sliding contact on carriage provides d-c output.

TYPE 874-LBA SLOTTED LINE . . . with Adjustable Stub for tuning crystal rectifier.....**$231.00**



TYPE 874-MD SWEEP DRIVE
(Includes motor and drive mechanism, speed control, tubular potentiometer and adjustable travel stops).....**$220.00**

GENERAL RADIO Company

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in Electronics

NEW - RAYTHEON

Dependable, versatile, low cost, convenient

FEATURES OF THE KTR

1. Meets or exceeds all FCC and RETMA specifications
2. Highest quality color or monochrome transmission
3. Audio multiplex built-in
4. Quickly, easily tunable
5. Convenient packaging and serviceability
6. Highly resistant to extreme weather conditions
7. Simple, rugged, miniaturized design
8. Multiplex audio-video range to 25 miles for single hops; greater distance using repeaters
9. Excellent signal-to-noise ratio
10. Proven performance in leading TV stations

"HEART" OF THE KTR

Within the transmitter RF head are located a tunable reference cavity, wave guide, antenna feed and a klystron in a thermostatically controlled oven. The tunable reference cavity is accurate to ±½mc over an ambient temperature range of −30° to +50°C. The klystron is rugged, reliable and built for exceptionally long life.

This "heart" of the Raytheon KTR typifies the simplicity, dependability and versatility of these microwave links—designed to offer broadcasters outstanding service at lowest cost.

See Raytheon's exhibit at booth 31, NARTB show, May 22-27, Shoreham Hotel, Washington, D. C.

Produced by the world's leading maker

TV MICROWAVE LINKS

First link for the 13,000Mc Band, video and audio

KTR-100 F

Here is the long-awaited link for the uncrowded 13,000mc band. Ideal for transmitting high quality signals over relatively short distance, this equipment can be used for remotes or as a STL. Exclusive frequency assignments have been available in the 13,000mc band and all that has been lacking was the equipment. NOW—Raytheon supplies the missing link.

First and only link for field-sequential color

KTR-100 B

Available at 6,000, 7,000 and 13,000mc bands.

This important new unit provides the ultimate in versatility. It may be used for high quality transmission of G.E.—C.B.S. field sequential color signals, with the compatible color system, and with monochrome by merely turning a switch.

New link for common carrier band, video and audio

KTR-100 E
(6,000mc band)

Another new link in this famous series is the KTR-100E. Designed for use in the 6,000mc band it offers the quality of performance telecasters have come to expect from Raytheon... another instance of Excellence in Electronics.

Time proven for color and monochrome, video and audio

KTR-100 A
(7,000mc band)

In use by leading television stations (names on request) across the nation, the KTR-100A has proven itself in thousands of operating hours in a variety of intallations of all kinds. Famous for reliability and flexibility, this outstanding unit has an enviable reputation for low initial, maintenance and operating costs.

Cuelink model ACL-3

This 26mc narrow band FM radio communications system provides audio-cuing for lining up microwave installations and for permanent two-way voice communication between broadcast or microwave sites. Furnished with hand sets and antennas. Packaged for portable or rack mounting.

RAYTHEON MANUFACTURING COMPANY

Equipment Marketing Division

WALTHAM 54, MASSACHUSETTS

RAYTHEON

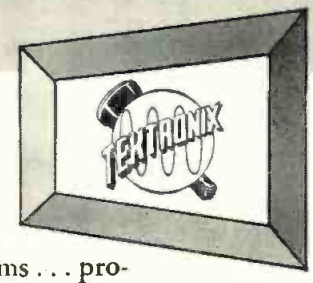
Excellence in Electronics

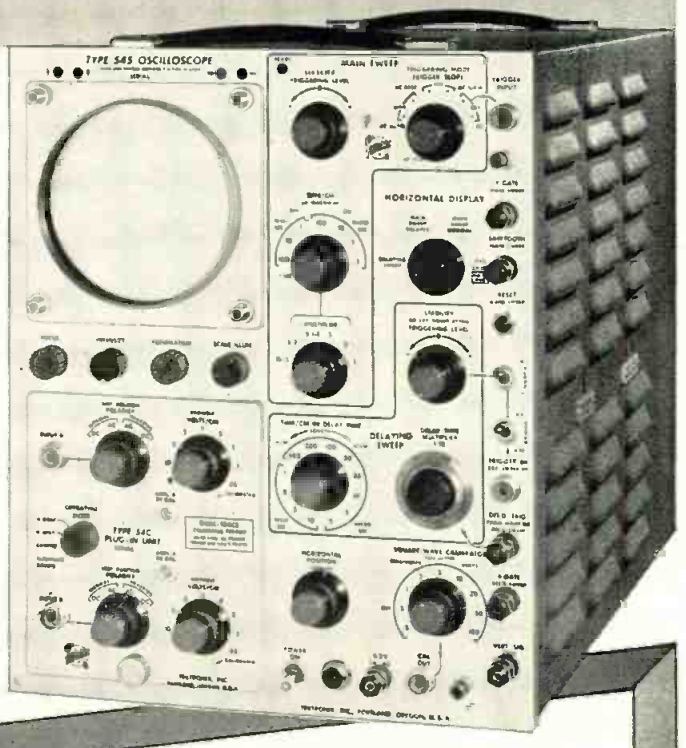
# of MICROWAVE EQUIPMENT

New *for fast-rise applications*

(12 MILLIMICROSECONDS)

Tektronix Type 545 and Type 541 CATHODE-RAY OSCILLOSCOPES





TYPE 545—This new high-speed laboratory oscilloscope, in combination with the new Type 53K/54K Fast-Rise Plug-In Unit . . . opens the way to quicker, easier analyses of fast-rising waveforms . . . providing faithful displays and accurate measurement facilities well beyond the range of previous oscilloscopes of its size and cost. The Type 545-Type 53K/54K combination offers a vertical-amplifier passband of dc to 30 mc (12-millimicrosecond risetime) at calibrated sensitivities to 0.05 v/cm, with a full 4-cm linear vertical deflection. A wide range of calibrated sweeps, with calibrated sweep delay from 1 μsec to 0.1 sec, and high accelerating potential, 10 kv, fully complement this greatly extended vertical-amplifier range.

The Type 545 is the most versatile oscilloscope ever made, for it can be quickly converted to many other applications. By merely plugging in the appropriate Type 53/54 Plug-In Preamplifier you are ready for wide-band, wide-band high gain, dual-trace, high-gain differential, microvolt-sensitivity, or wide-band differential applications. It's a rare oscilloscope application that isn't easily handled by this modern method.

Vertical-Amplifier Characteristics with Type 53K/54K Unit Plugged In

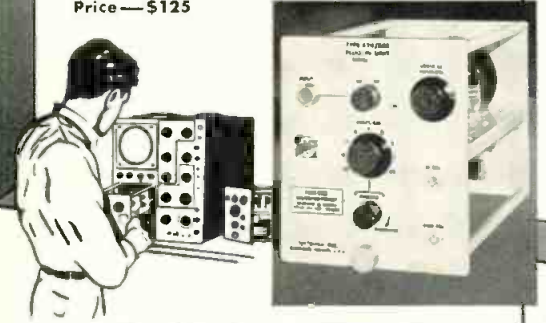
Transient Response—Risetime, 12 millimicroseconds.

Frequency Response—Passband, dc to 30 mc. (down 3 db ± ½ db at 30 mc, only 6 db at 45 mc).

Input impedance 20 μμf, 1 megohm.

Sensitivity—0.05 v/cm to 20 v/cm in 9 calibrated steps.

Price—$125



LOW INPUT CAPACITANCE

With Accessory Probes for Type 53K/54K

Probe	Input Impedance	Maximum Sensitivity
P405	11.5 μμf, 5 megohms	0.25 v/cm
P410	7.5 μμf, 10 megohms	0.5 v/cm
P420	4.5 μμf, 10 megohms	1 v/cm
P450	2.5 μμf, 10 megohms	2.5 v/cm
P4100	2.5 μμf, 10 megohms	5 v/cm

Type 545 Oscilloscope Characteristics

Wide Sweep Range
24 Calibrated sweeps from 0.1 μsec/cm to 5 sec/cm, accurate within 3%. Accurate 5-x magnifier extends calibrated range to 0.02 μsec/cm. Continuously variable from 0.02 μsec/cm to 12 sec/cm.

Wide Sweep-Delay Range
Additional delaying-sweep circuitry provides conventional, or triggered jitter-free delay, 1 μsec to 0.1 sec in 12 calibrated ranges. Range accuracy within 2%. Incremental accuracy within 0.2% of full scale.

Versatile Triggering
Internal or external, with amplitude-level selection or AUTOMATIC TRIGGERING. High-frequency synchronization up to 30 mc.

Square-Wave Amplitude Calibrator
0.2 mv to 100 v in 18 steps, accurate within 3%.

New Cathode-Ray Tube
Tektronix T54P 5" precision metallized crt provides 4-cm vertical and 10-cm horizontal linear deflection. 10-kv regulated accelerating potential.

Balanced Delay Network
0.15 μsec vertical signal delay.

DC-Coupled Unblanking
Uniform unblanking at all sweep speeds and repetition rates.

Electronic Voltage Regulation
All voltages affecting calibrations are fully regulated.

CRT Beam Position Indicators

Type 545—$1450 plus price of desired plug-in units.

Type 541—Same characteristics, less deloyed-sweep facility—$1145 plus price of desired plug-in units.

Prices f.o.b. Portland (Beaverton), Oregon

Please call your Tektronix Field Engineer or Representative for complete specifications.

Tektronix, Inc.

P. O. BOX 831L • PORTLAND 7, OREGON

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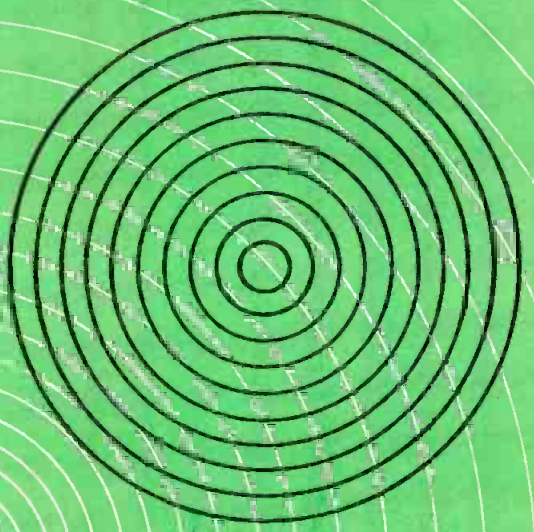


STANDARDIZE WITH CANNON

NEW XLR
...an important addition to the XL Series

P *series*

X *series*

for simplified **AUDIO** *circuitry!*

BRS *series*

UA *series*

D *series*

U *series*

K *series*

Standardize with Cannon Audio Connectors . . . designed to meet all audio equipment disconnect needs. Simplify circuitry and cabling. Get quiet, continuous operation with the standard connectors of the industry—*Cannon Plugs.*

You'll find exactly the type you need in 14 extensive series expressly designed for radio, sound, TV and related fields . . . in cord, rack or panel chassis, audio and low-level, portable, hermetic sealed, miniature and subminiature, and power-supply types. Standard equipment with leading manufacturers of electronic equipment. The old reliable "Latchlock" feature on Cannon microphone connectors . . . standard on top-ranking microphones.

Complete Audio Connector Bulletin is yours for the asking . . . D Series in separate bulletin coded D-4.

CANNON PLUGS

SINCE 1915 CANNON ELECTRIC

Please refer to Dept. 201

CANNON ELECTRIC COMPANY
3209 Humboldt St.
Los Angeles 31, California

Factories in Los Angeles; East Haven; Toronto, Canada; London, England. Licensees in Paris, Tokyo, Melbourne. Representatives in all principal cities. Distributors everywhere.

THIS IS IT!

NEW 3-WATT Blue Jacket®

miniaturized axial-lead wire wound resistor

This power-type wire wound axial-lead Blue Jacket is hardly larger than a match head *but it performs like a giant!* It's a rugged vitreous-enamel coated job—and like the entire Blue Jacket family, it is built to withstand severest humidity performance requirements.

Blue Jackets are ideal for dip-soldered sub-assemblies . . . for point-to-point wiring . . . for terminal board mounting and processed wiring boards. They're low in cost, eliminate extra hardware, save time and labor in mounting!

Axial-lead Blue Jackets in 3, 5 and 10 watt ratings are available without delay in any quantity you require. ★ ★ ★

SPRAGUE TYPE NO.	WATTAGE RATING	DIMENSIONS L (inches)	D	MAXIMUM RESISTANCE
151E	3	1 7/32	13/64	10,000 Ω
27E	5	1 1/8	5/16	30,000 Ω
28E	10	1 7/8	5/16	50,000 Ω

Standard Resistance Tolerance: ±5%

SPRAGUE

WRITE FOR ENGINEERING BULLETIN NO. 111B

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

As We Go To Press...

Field mobility of new control system for pilotless jet fighter-bombers is shown during U.S.A.F. acceptance trials. Guidance antennas are vehicle mounted; control box at right

Remote Control System for Jet Aircraft

A new, improved system for remote control of jet fighter aircraft, on special "drone" missions, pilotless intercept or nuclear tests, has been announced by the Air Research and Development Command of USAF and the Sperry Gyroscope Co. The system provides automatic takeoff and landings with control at all times by radio and radar during climbs and dives, cruise, orbiting or other aerial maneuvers.

New UHF radio guidance and command sub-systems supply "tighter" precision signals to the drone fighter craft, from USAF jet pilots at the "beeper" ground stations or in an accompanying jet "director" plane. But if all control signals should be cut off while the drone is airborne, from ground power failure or bomb damage, in 5 seconds an electronic "brain" takes over to maintain a constant level and position with a left-turn orbit at 265 mph, until signal is restored to guide the aircraft back for normal landing procedures.

In the new control layout, special care was given to accessibility of sub-systems and components for ease of maintenance, and to design simplicity for manufacturing in production quantities. Size and shape of numerous elements have been reduced, in order to retain the standard Lockheed F-80C cockpit arrangement, especially for all flight safety and emergency controls. A safety pilot is frequently carried during training or flight test check-outs of the airborne system.

Noteworthy improvements include new anti-skid control in the remote brake sub-system; center-line tanks with parachute recovery gear for certain recording instruments; and improved provisions in the nose section for a telemetry system of coded signals air-to-ground and air-to-air. "Metal stick" control is now added in the cockpit, to aid in system ground-checking, for pre-mission setup and practice, and to provide means of training safety pilots.

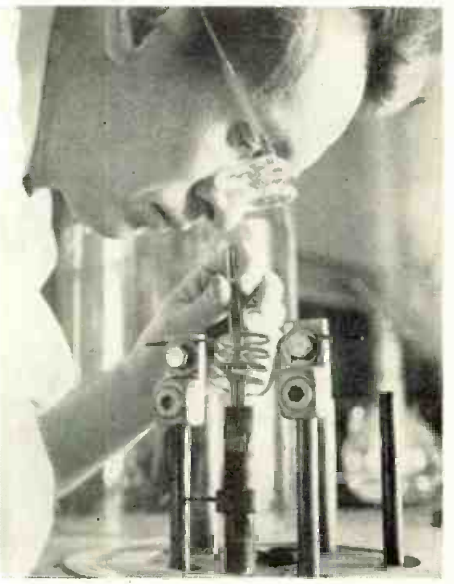
MORE NEWS on page 15

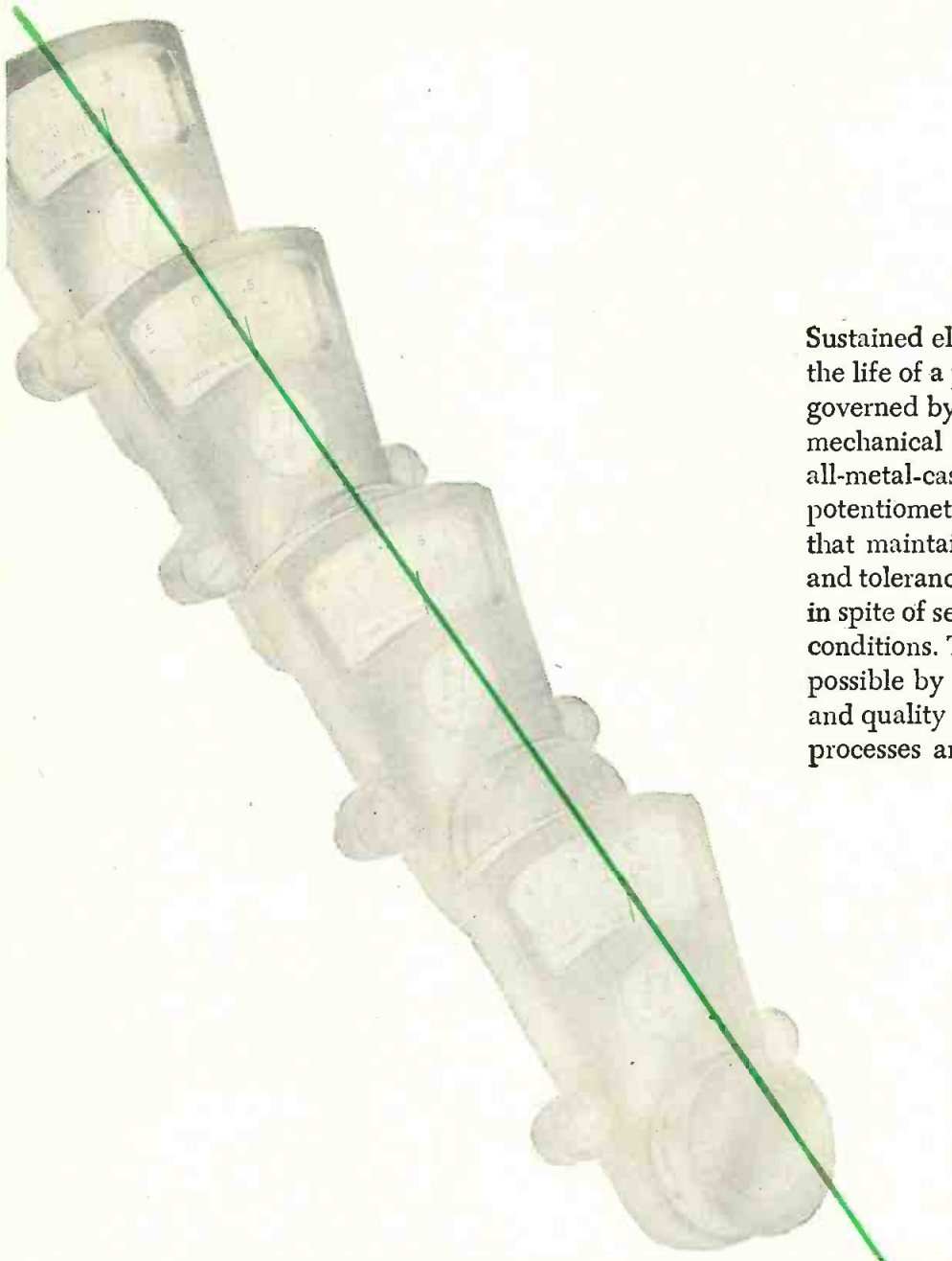
Max Beers, Sperry Gyroscope project chief, and Lt. Col. J. P. Grant check out remote beep control system for pilotless jet aircraft

Savings in Diamond Tools

Dr. H. Tracy Hall of the GE Research Laboratory has a novel method of mounting stones in diamond tools, which is estimated to save 90%. A much smaller stone is used that will rest in a shallow cavity. Conventional mounts necessitate larger diamonds and deeper cavities, with as much as 90% of the diamond buried in the tool. This is accomplished, in part, by the use of titian hydride as a "wetting agent," and a solder, such as silver-copper.

Dr. Hall preparing to vacuum-bond a diamond





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

SUSTAINED ACCURACY

through mechanical rigidity

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

This is another example of how Fairchild's complete line can give you the answers, no matter what factors govern your choice of precision potentiometers. Write Fairchild Camera and Instrument Corporation, 225 Park Avenue, Hicksville, L. I., N. Y., Dept. 140-62E1.

FAIRCHILD

PRECISION POTENTIOMETERS

As We Go To Press . . . (Continued)

Corning Enters Low Cost Component Market

Increasing participation in the low-cost radio and TV components field is being planned by Corning Glass Works, a major producer of glass bulbs for TV picture tubes, radio tubes, and incandescent lamps. This was revealed today by Thomas H. Truslow, General Manager of the company's New Products Div., who cited a recently concluded agreement for the marketing of a number of electronic components through the distributors of Erie Resistor Corp., sweeping price reductions in certain lines, and the introduction of a number of low-cost components especially designed for commercial radio and TV applications.

Closed Circuit TV For Shopping Centers

A closed circuit television system is being installed in a huge shopping center to give parents a constant clear view of their children at play in the center's supervised kiddie park. Reported as first of its kind, the system has recently been initiated at Modell's Shoppers' World, East Meadow, L.I., N.Y. Details of the plan were announced by Irvin Paul Sulds, president of Telecom Systems, Inc., 501 Madison Ave., New York City and William D. Modell, president of the shopping center. Telecom will install and maintain the system on a long-term lease. The installation consists of a Farnsworth 600-A camera and seven large-screen receivers suspended from the ceiling at convenient spots throughout the block-long building. The camera, focused on the play area, will feed the picture to monitors, linked in a closed-circuit camera.

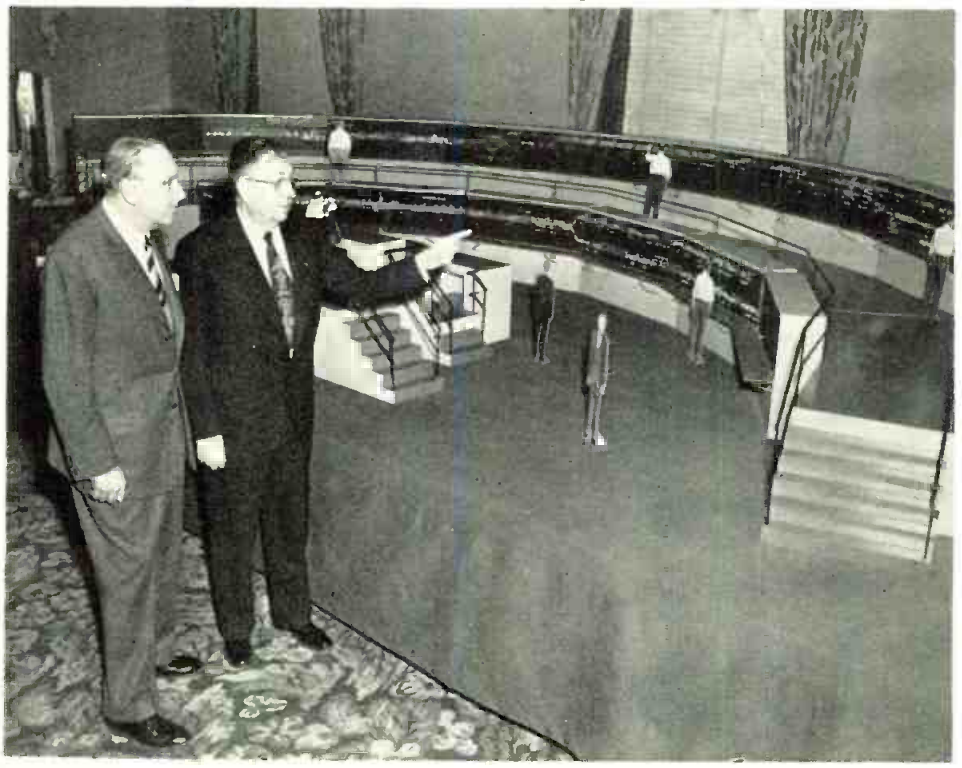
Centralized Traffic Control

Col. Sydney H. Bingham (right in photo below), Executive Director and General Manager of the New York Transit Authority explains a model of the new Centralized Traffic Control Machine System which the Union Switch & Signal Division of Westinghouse Air Brake Co. is installing to provide push-button control for the entire IRT subway system of train movements and signals.

Viewing the model of the master control unit is Edward O. Boshell, Chairman and President of Westinghouse Air Brake. Union Switch & Signal already has installed a control center with an ultra-modern signal section for the IRT Flushing Line from the Queens Level of the Times Square station and this will be in complete operation before year's end.

An annual operating saving of $3,000,000 combined with speedier and more efficient IRT train service is expected when the push-button Centralized Traffic Control System spans the entire IRT System.

S. H. Bingham points out new traffic control to Westinghouse Air Brake Pres. E. O. Boshell



AT&T "horn reflector" microwave antenna installation is capable of handling 15,000 phone conversations and 10 TV programs at same time

New Microwave Antennas

A new type microwave antenna, designated "horn-reflector," was recently installed by the Long Lines Dept. of American Telephone and Telegraph Co. at a station near Terrell, Texas. These super-capacity antennas will be used on a route now under construction between Dallas, Texas and Jackson, Miss., for telephone and television service.

Horn-reflector antennas, which are to replace the so-called "delay lens" antennas now used operate over a very broad frequency band. A single antenna will be able to handle simultaneous transmission in the common carrier band of 3,700-4,200 MC and also in bands in the 6,000 and 11,000 MC regions. Eventually, it will be possible for this antenna to handle 15,000 telephone conversations and 10 television programs at the same time.

Another advantage of the new antenna is that it is capable of transmitting simultaneously both horizontally and vertically polarized waves. This feature will be used to reduce crosstalk coupling between adjacent channels on the systems.

The horn-reflector antenna aperture has a cross-section of 65 square feet. A circular wave guide supplies energy to the feed horn which has a smooth transition from the 2.8-in. inside diameter of the wave guide to the 11.6-in. square aperture of the feed horn. The approximate gain of the horn-reflector antenna as compared with an isotropic radiator, ranges from about 39db at 4,000mc to 418db at 11,000mc.

MORE NEWS on page 16

As We Go To Press . . . (Continued)

Philco Announces Transistor Computer

The "TRANSAC," an entirely new concept of linking transistors in a miniature "electronic brain"—or computer—an abbreviated form for transistor automatic computer, has been developed in the Research and Engineering Laboratories of Philco Corp.

Known as the Philco Direct-Coupled Transistor Circuit, the invention presages mass production of transistorized computers capable of calculations at phenomenal speeds, and is a long step toward development of a "universal computer." For example, a digital computer using the direct-coupled transistor circuit could perform 600,000 additions or subtractions a second. Such a computer would operate approximately 10 times as fast, and its size, weight and cost would be about one-third that of any previously announced transistorized computer. The high rate of speed achieved is made possible by the use of the surface-barrier transistor which Philco now reports as being in mass production with completely automatized manufacturing techniques.

One of the principal advantages of the direct-coupled circuit is that it reduces many fold the number of required components in all of the computer circuits. For example, diodes and vacuum tubes are entirely eliminated in an ordinary 'flip-flop' circuit for a digital computer.

"TRANSAC" digital computer module contains all elements required for addition, subtraction, multiplication and division, as well as common control circuits using only transistors and resistors.

In packaging a computer using the Philco direct-coupled circuitry, all elements required for addition, subtraction, multiplication and division, as well as common control circuits, are combined on a single replaceable unit—a printed wiring card—having on it only transistors and resistors. No other electronic components are required.

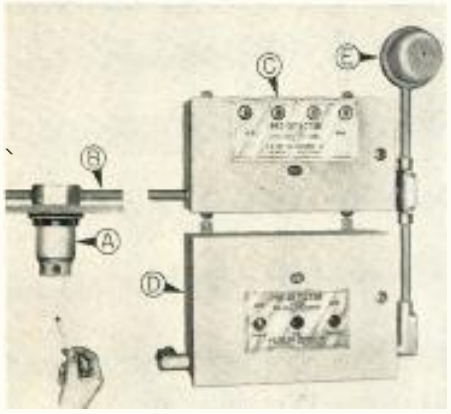
Automatic, Radio-Active Pre-Detector Fire System

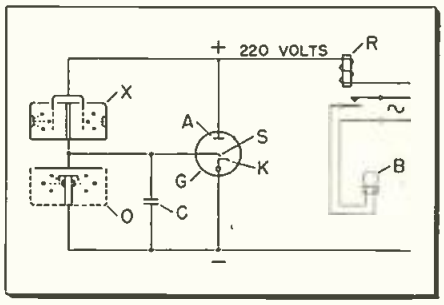
Operation of the new UL approved method of detecting fire at its earliest stage, announced by Pyrene-C-O-Two, Newark, N. J. is based on prior European research in the ionization principal of fire detection that enables reaction from invisible traces of combustion gases, as well as smoke, independently to the presence of flame or temperature rise.

Heart of the C-O-Two Pre-Detector System is an overhead device electrically connected to a fire indicating cabinet. On a single circuit, these pre-detector heads can be connected directly. Presence of invisible gases, or smoke, causes the head to activate relays in the fire indicating cabinet which sound alarms, close doors, release fire extinguishers, etc.

Each space indicating cabinet enables employment of up to four circuits and shows a gas or smoke affected area by number and contains relay contacts to perform predetermined duties. Four such cabinets can be connected to one fire indicating cabinet, making 16 circuits on one system.

Pre-detector head (A), space or location indicating cabinet (C) and fire indicating cabinet (D), conduit (B) and alarm bell (E) complete assembly





Circuit shows exposed chamber (O) adjusted to same voltage as sealed chamber (X). Radioactive source in each chamber makes chambers electrically conductive. Smoke affects exposed chamber, causes gas-discharge tube (G) to become conductive and operate alarm relay (R) sounding alarm bell (B). Tube includes anode (A), cathode (K), starter (S)

Automation Course At M.I.T. Summer Session

To assist in meeting the intense demand for technical information in the field of automatic control, a two-week Special Summer Program in "Numerical Control of Machine Tools," will be presented by the Massachusetts Institute of Technology from Aug. 22 through Sept. 2. A number of numerical-control programs are now under way in the aircraft, machine tool, electronic, and other industries. This program is planned to provide technical information to industry and government and so to facilitate transfer of numeral control techniques from laboratory development to industrial utilization. Prof. J. Francis Reintjes, Director of the Servomechanisms Laboratory of the M.I.T. Dept. of Electrical Engineering, will direct the program, in co-operation with Mr. James O. McDonough and other members of the Numerical Control Group in the Laboratory.

General Back Named For IRE Fellow Award

Major General George I Back, who will be succeeded by Major General James D. O'Connell, receives the certificate naming him for the Institute of Radio Engineers Fellow Award. Thomas B. Jacocks presenting the certificate is Chairman of the Washington section of IRE.

MORE NEWS on page 19

HE STANDARD OF COMPARISON FOR OVER 20 YEARS

HIGH FIDELITY TRANSFORMERS

ROM STOCK... ITEMS BELOW AND 650 OTHERS IN OUR CATALOGUE B.

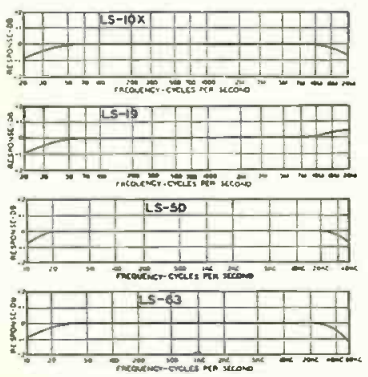
TYPICAL UNITS

INEAR STANDARD series

ear Standard units represent the acme m the standpoint of uniform frequency sponse, low wave form distortion, rough shielding and dependability. LS its have a guaranteed response within b. from 20 to 20,000 cycles.

m balanced coil structures and multi- alloy shielding, where required, pro- e extremely low inductive pickup.

se are the finest high fidelity trans- mers in the world. 85 stock types m milliwatts to kilowatts.



LS-10X Shielded Input
Multiple line (50, 200, 250, 500/600, etc.) to 50,000 ohms . . . multiple shielded.

LS-19 Plate to Two Grids
Primary 15,000 ohms.
Secondary 95,000 ohms C.T.

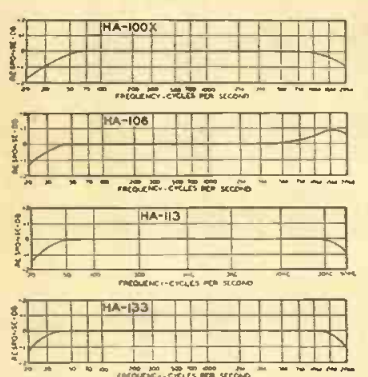
LS-50 Plate to Line
15,000 ohms to multiple line . . . +15 db. level.

LS-63 P.P. Plates to Voice Coil
Primary 10,000 C.T. and 6,000 C.T. suited to Williamson, MLF, ul.-linear circuits. Secondary 1.2, 2.5, 5, 7.5, 10, 15, 20, 30 ohms. 20 watts.

CASE	LS-1	LS-2	LS-3
Length	3⅛"	4-7/16"	5-13/16"
Width	2⅝"	3½"	5"
Height	3¼"	4-3/16"	4-11/16"
Unit Wt	3 lbs.	7 5 lbs	15 lbs

IPERMALLOY series

is series provides virtually all the aracteristics of the Linear Standard up in a more compact and lighter ucture. The frequency response is thin 1 db. from 30 to 20,000 cycles. permalloy nickel iron cores and hum lanced core structures provide mini- m distortion and low hum pickup. In- t transformers, maximum level +10db. cular terminal layout and top and ttom mounting.



HA-100X Shielded Input
Multiple line to 60,000 ohm grid . . . tri-alloy shielding for low hum pickup.

HA-106 Plate to Two Grids
15,000 ohms to 135,000 ohms in two sections . . +12 db. level.

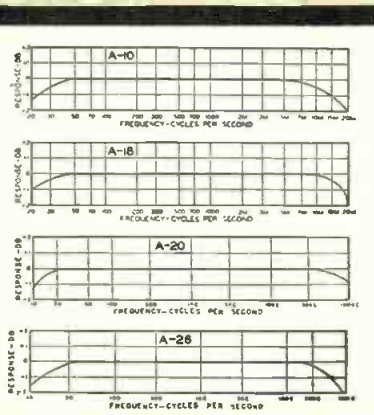
HA-113 Plate to Line
15,000 ohms to multiple line . . . +12 db. level . . . 0 DC in primary.

HA-133 Plate (DC) to Line
15,000 ohms to multiple line . . . +15 db. level . . 8 Ma. DC in primary.

Case	H-1	H-2
Length	2⅜"	3-9/16"
Width	1-15/16"	2-13/16"
Height	3⅛"	3½"
Unit Weight	2 lbs.	5 lbs.

LTRA COMPACT series

C Ultra Compact audio units are small d light in weight, ideally suited to re- ite amplifier and similar compact uipment. The frequency response is thin 2 db. from 30 to 20,000 cycles. m balanced coil structure plus high nductivity die cast case provides good luctive shielding. Maximum operating el is +7db. Top and bottom mounting well as circular terminal layout are ed in this series as well as the ones scribed above.

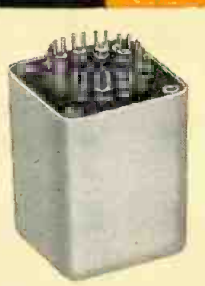


A-10 Line to Grid
Multiple line to 50,000 ohm grid.

A-18 Plate to Two Grids
15,000 ohms to 80,000 ohms, primary and secondary both split.

A-20 Mixing Transformer
Multiple line to multiple line for mixing mikes, lines, etc.

A-26 P.P. Plates to Line
30,000 ohms plate to plate, to multiple line.

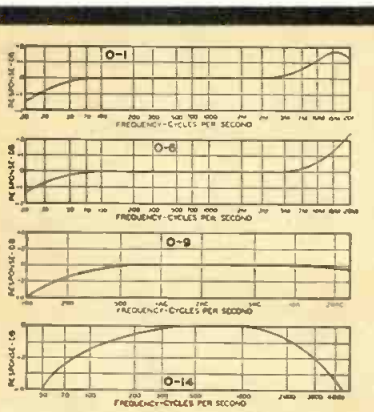


A CASE

Length	1½"
Width	1½"
Height	2"
Unit Weight	½ lb.

UNCER series

C Ouncer units are ideal for portable, ncealed service, and similar applica- ns. These units are extremely compact fully impregnated and sealed in a wn housing. Most items provide fre- ency response within 1 db. from 30 to ,000 cycles. Maximum operating level b. These units are also available in stock P series which provide plug-in e. The 0-16 is a new line to grid trans- mer using two heavy gauge hiper- lloy shields for high hum shielding.



0-1 Line to Grid
Primary 50, 200/250, 500/600 ohms to 50,000 ohm grid.

0-6 Plate to Two Grids
15,000 ohms to 95,000 ohms C.T.

0-9 Plate (DC) to Line
Primary 15,000 ohms, Secondary 50, 200/250, 500/600.

0-14 50: 1 Line to Grid
Primary 200 ohms, Secondary :5 megohm for mike or line to grid.

OUNCER CASE

Diameter	⅞"
Height	1-3/16"
Unit Weight	1 oz.

PECIAL UNITS O YOUR NEEDS

f you manufacture high fidelity gear, send your specifications for prices.

UNITED TRANSFORMER CO.

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

Coming Events

A listing of meetings, conferences, shows, etc., occurring during the period April 1955 through January 1956 that are of special interest to electronic engineers

May 2-5—3rd Annual Semiconductor Symposium of Electrochemical Soc., Cincinnati, Ohio.

May 2-13—British Industries Fair, London and Birmingham, England.

May 3-5—URSI Spring Meeting, sponsored by the IRE Professional Group on Antennas and Propagation, Microwave Theory and Techniques and Circuit Theory, National Bureau of Standards, Washington, D. C.

May 4-6—4th Int'l Aviation Trade Show, 69th Regiment Armory, N.Y.

May 4-6—AIEE District #2 Meeting, Deshler-Hilton Hotel, Columbus, Ohio

May 6—American Assoc. of Spectrographers 6th Annual Conference, Chicago, Ill.

May 9-11—1955 National Conference of Aeronautical Electronics, sponsored by IRE Dayton Section on Airborne Electronics, Biltmore Hotel, Dayton, Ohio.

May 10-12—Metal Powder Show sponsored by Metal Powder Assn., Bellevue-Stratford Hotel, Philadelphia, Pa.

May 16-19—Electronic Parts Distributors Show, Conrad Hilton Hotel, Chicago, Ill.

May 16-20—National Materials Handling Exposition, International Amphitheatre, Chicago, Ill.

May 18-20—Nat'l Telemetering Conference and Exhibit, sponsored by IRE, AIEE, IAS, ISA, Hotel Morrison, Chicago, Ill.

May 19-21—Global Communications Conference, sponsored by Armed Forces Communications Assn., Hotel Commodore, New York, N. Y.

May 23-25—9th Annual Convention of the American Society for Quality Control, Hotel Statler and Hotel New Yorker, New York City, N. Y.

May 23-25—American Society for Quality Control, Hotel Statler, New York, N.Y.

May 24-26—9th Annual Broadcast Engineering Conference, sponsored by NARTB, Shoreham and Sheraton Park Hotels, Washington, D.C.

May 26-27—Electronic Components Conference, Los Angeles, Calif.

June 1-11—British Plastics Exhibition, Olympia, London, England.

June 2-5—ARRL Hudson Div. Convention and Amateur Radio Equipment Show, Hotel Adelon, Long Beach, N.Y.

June 2-3—IRE Materials Symposium, sponsored by the Philadelphia section of the Professional Group on Components, Convention Hall, Philadelphia, Pa.

June 6-8—National Community Television Assn. Convention—Park Sheraton Hotel, New York, N. Y.

June 7-10—National Spring Meeting of the American Welding Society, Hotel Muehlebach, Kansas City, Mo.

June 14-16—Conference and Exhibit on Magnetics, sponsored by the AIEE, in cooperation with the APS and the AIMME, William Penn Hotel, Pittsburgh, Pa.

June 20-23—2nd International Powder Metallurgy Congress, Reutte, Tyrol, Austria.

June 20-25—Professional Group on Antennas and Propagation, University of Michigan, Ann Arbor, Mich.

June 20-25—Symposium on Electromagnetic Wave Theory, sponsored by Commission VI of URSI and Univ. of Mich., University of Mich., Ann Arbor, Mich.

June 25-July 1—58th Annual Meeting ASTM, Atlantic City, N. J.

June 26-July 1—58th Annual Meeting of the American Society for Testing Materials, Chalfonte-Haddon Hall, Atlantic City, N.J.

June 27-July 1—AIEE Summer Meeting, New Ocean House, Swampscott, Mass.

July 12-14—2nd Western Plant Maintenance Show, Pan Pacific Auditorium, Los Angeles, Calif.

Aug. 15-19—AIEE Pacific General Meeting, Butte, Montana.

Aug. 23-Sept. 3—British National Radio Show, Earls Court, London, England.

Aug. 24-26—Western Electronic Show & Convention, San Francisco Civic Auditorium, San Francisco, Calif.

Aug. 26-Sept. 4—German Radio, Television, Gramophone and Radiogram Exhibition, Dusseldorf, Germany.

Sept. 6-17—Production Engineering Show and Machine Tool Show, Navy Pier and International Amphitheatre, Chicago, Ill.

Sept. 12-16—10th Annual Conference and Exhibit, sponsored by ISA, Shrine Exposition Hall and Auditorium, Los Angeles, Calif.

Sept. 14-16—ACM General Meeting, Moore School of Electrical Eng., Univ. of Pa., Philadelphia, Pa.

Sept. 20-22—10th Anniversary Industrial Packaging and Materials Handling Show, Kingsbridge Armory, New York, N. Y.

Sept. 27-Oct. 1—Int'l. Analog Computation Meeting, Brussels, Belgium.

Sept. 28-29—Industrial Electronics Conference, sponsored by the AIEE and IRE, Detroit Rackam Memorial Auditorium, Detroit, Michigan.

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

Oct. 3-7—AIEE Fall General Meeting, Morrison Hotel, Chicago, Illinois.

Oct. 3-7—78th Semi-annual Convention of the SMPTE, Lake Placid, New York, N.Y.

Oct. 11-13—AIEE Aircraft Electronic Equipment Conference, Los Angeles, California.

Oct. 21-23—New England Hi-Fi Show, Hotel Touraine, Boston, Mass.

Nov. 2-5—World Symposium on Applied Solar Energy, conducted under leadership of Stanford Research Institute, Phoenix, Arizona.

Nov. 9-10-11—19th Annual National Time and Motion Society and Management Clinic, Hotel Sherman, Chicago, Ill.

Nov. 14-17—Second International Automation Exposition, Chicago Navy Pier, Chicago, Illinois.

Dec. 12-17—Nuclear Congress and Atomic Exposition, sponsored by the Engineers Joint Council, Cleveland, Ohio.

Jan. 30-Feb. 3, 1956—AIEE Winter General Meeting, Statler Hotel, New York, N.Y.

Abbreviations:
ACM: Assoc. for Computing Machines.
AES: Audio Engineering Society.
AIEE: American Institute of Electrical Engineers.
AIMME—American Institute of Mining & Metallurgical Engineers
APS—American Physical Society
ASTM: American Society for Testing Materials.
IRE: Institute of Radio Engineers.
IAS: Institute of Aeronautical Sciences.
ISA: Instrument Society of America.
NACE: National Assoc. Corrosion Engineers.
NARTB: National Assoc. of Radio and TV Broadcasters.
RETMA: Radio-Electronics-TV Manufacturers Assoc.
RTCA: Radio Technical Commission for Aeronautics.
RTCM: Radio Technical Commission for Marine Services.
URSI: International Scientific Radio Union.

MORE NEWS on page 22

CZECH ACTORS, refugees from communism, listen to playback of weekly satirical program "Cafe de l'Europe" on tape recording machine in one of Radio Free Europe's Munich studios. Supported by contributions from American citizens, RFE now beams as many as 20 hours of home news and entertainment every day to the five key satellite countries of Czechoslovakia, Hungary, Poland, Romania and Bulgaria. Programs compete hour by hour with communist stations in such cities as Prague, Warsaw and Budapest.

BITING WIT and patriotic music featured in popular tape recorded programs like "Kohout's Cabaret" incite bitter attacks on RFE by Red officials in satellite countries. With tape, exile entertainers, clergymen, statesmen from behind Iron Curtain can address listeners in their native languages at all hours of the day.

ARMORED CAR ESCAPEES from Czechoslovakia tape record the story of their flight to freedom for Radio Free Europe listeners. Besides world news, RFE tells captive peoples the *real* news in their own countries. Coded messages to families and friends are daily part of network's schedule.

THE RADIO NETWORK THAT BRINGS HOPE TO 50 MILLION EUROPEANS

Leaders of Iron Curtain countries are anxious to drown out Radio Free Europe because RFE is stimulating opposition to communism in key satellite countries. By exposing communist collaborators . . . answering Red propaganda . . . revealing news suppressed by Moscow, RFE gives the will to resist oppression to the captive populations of Romania, Hungary, Poland, Czechoslovakia and Bulgaria.

But the job of broadcasting the truth grows harder. The Communists are stepping up their efforts to block Radio Free Europe. So far, superior engineering know-how has kept RFE ahead of Red "jammers". But now, more and *stronger* transmitters are urgently needed. Keep the truth turned on—by contributing to Radio Free Europe. Send your "Truth Dollars" to CRUSADE FOR FREEDOM, c/o your Postmaster.

Radio Free Europe uses "SCOTCH" Brand Magnetic Recording Tapes exclusively to assure uniform, highest quality broadcast results.

OKLAHOMA CITY radio producer David Sureck fights daily battle with communism. Directing inspirational and service programs, adult and children's broadcasts, he exposes Red propaganda. Most RFE programs are tape recorded for round-the-clock broadcasting from transmitters in West Germany and Portugal.

29 TRANSMITTERS like this one near Mannheim, Germany help Radio Free Europe break through the Iron Curtain. By beaming all transmitters on one target for certain periods of the day, RFE makes Soviet jamming ineffective.

"SCOTCH" BRAND Magnetic Recording Tapes are used exclusively by Radio Free Europe in the U.S. and abroad. "Scotch" Brand's easy erasability and superior fidelity make it a favorite with RFE engineers.

Electronic Industries News Briefs

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

ATOMIC ENERGY COMMISSION has revealed that one of the most complete weather-support organizations ever assembled for atomic test work is in operation during the present series of nuclear weapons tests at the Nevada proving ground.

AT&T LONG LINES DEPARTMENT announces radiotelephone service between the United States and the Ascension Islands, a British possession in the central Atlantic. The rate, excluding tax, for a three-minute call is $12.

AUTOMATIC ELECTRIC CO. has 17 Signal Corps technicians attending a special eleven-week training course in Chicago to learn the fundamentals of the automatic teletypewriter switching center operations using the AN/FGC-30.

CBS-COLUMBIA TV receivers, made by **CBS COLUMBIA**, 3400 Forty-Seventh Ave., Long Island City 1, N.Y., Div. of **COLUMBIA BROADCASTING SYSTEM**, have been installed in the 100-room Colony Hotel, Palm Beach, Fla. by the **IRA HIRSCHMANN** Co., Inc.

CBS-HYTRON, DIV. OF COLUMBIA BROADCASTING System, Inc., has announced that the brand name for the division's radio and TV tubes and semiconductor products has been changed from "CBS-HYTRON" to the letters, "CBS."

CHAMPLAIN CO. of Bloomfield, N. J. announces the Registron, a new electronic system that automatically controls cutoff and color register on rotary printing presses.

COLLINS RADIO reports that the first very-high frequency VOR omni-range radio aid for air navigation in South America has been installed by Braniff International Airways at La Paz, Bolivia, highest commercial airport in the world.

COOK ELECTRIC CO., Chicago 14, Ill. has opened a new district office at 3862 N. Carrollton, Indianapolis, Indiana with H. Weir Cook, Jr., as District Manager.

CORNING GLASS WORKS is making limited shipments of 22-in. rectangular glass bulbs for color television tubes.

Merger of **DAYSTROM, INC.** and **WESTON ELECTRICAL INSTRUMENT CORP.** is in process.

ELECTRODATA CORP., digital computer manufacturer of Pasadena, Calif., has stepped up its nationwide expansion program with the opening of new regional sales and service headquarters in the Midwest and Southeast. The branch offices, located in Evanston, Ill. and Washington, D.C., will offer technical, consulting and training services.

ELECTRONIC SPECIALTY CO., 3456 Glendale Blvd., Los Angeles, Calif., has acquired controlling interest in Electromec, Inc., of Burbank, Calif. William E. Howe and Chas. M. Brown will continue as president and chief engineer, respectively, of the affiliate. William H. Burgess, president of the parent company, recently announced that the construction of a new plant at 5121 San Fernando Rd., Los Angeles, is under way that will house all divisions of Electronic Specialty Co.

EMERSON RADIO AND PHONOGRAPH CORPORATION has been granted patent number 2,692,983 on the removable bezel ring and front glass feature for television receivers. The inventor is Arthur Eisenkramer.

FIELDEN INSTRUMENT DIVISION OF ROBERTSHAW-FULTON CONTROLS COMPANY and the **SUN OIL COMPANY** have entered into licensing arrangements to permit the manufacture and sale by Fielden of electronic devices to control the levels in processing of petroleum products. Such devices have been operating successfully in Sun Oil's Marcus Hook Refinery at Delaware, Pa. Fielden expects to begin production of the new line at once.

GE's Specialty Control Department located in Waynesboro, Va. has an order for 22 electronic tracer controls, valued at approximately $200,000. Tracer controls, sometimes called contour followers, are electronic devices that guide machine tool cutting heads by following metal patterns or templates.

GENERAL TRANSISTOR CORP., 95-18 Sutphin Blvd., Jamaica, N. Y. has offered a reduction of 50% on the cost of all transistors. Quantity prices to manufacturers now range from $1.40 to $2.65.

HELIPOT CORP. announces the acquisition of a 15-acre ocean-view site in Newport Beach, Calif. The firm anticipates early ground-breaking for a two-million dollar main plant to be ready in mid-1956, into which it will consolidate its facilities now scattered over South Pasadena, Pasadena, San Gabriel and Alhambra.

HELIPOT CORP., 916 Meridian Ave., S. Pasadena, Calif., has installed a new plating facility in which each plating tank is controlled by its own dc power supply. DC rectifiers at each tank control the amount of current used for each operation.

THE INDIANA STEEL PRODUCTS CO., Valparaiso, Ind., manufacturer of permanent magnets, has acquired the business of the **FERROXCUBE CORP.** of America, Saugerties, N.Y., formerly jointly owned by **PHILIPS INDUSTRIES, INC.**, and **SPRAGUE ELECTRIC CO.**, North Adams, Mass.

INDUSTRIAL TELEVISION, INC. announces the development and delivery to the Navy Bureau of Ships, a special TV camera device designed to extend the military applications of TV. The camera contains two pickup tubes instead of the usual one, as well as circuits for combining the output of each tube on a viewing screen. This permits the simultaneous viewing of a scene thru two different lens systems. Other features include automatic adjustment of the lens aperture by means of a photo transistor which allows use of the camera with a wide range of illumination levels without adjustment.

INTERNATIONAL NEWS SERVICE announces its Telenews daily news film service is now available to the NWDR (Nordwestdeutscher Rundfunk) television network in West Germany.

W. L. MAXSON CORP. has announced the establishment of a West Coast office at 8840 Olympic Blvd., Beverly Hills, Calif. Charles H. Vickery, Jr. has been named as manager and will direct sales and administrative activities on the West Coast.

NATIONAL BUREAU OF STANDARDS has developed a new device for investigating smog conditions in Los Angeles. It is an automatic photoelectric instrument for continuous measurement of ozone in the earth's atmosphere at low altitudes.

ORRADIO INDUSTRIES, INC., 120 Marvyn Rd., Opelika, Ala., have announced an 82% sales increase over the year preceding, for the current fiscal year ending March 1.

PACE ELECTRICAL INSTRUMENT CO., INC., meter manufacturing division of Precision Apparatus Co., Inc., of Glendale, L. I. announces removal to their new plant.

RADIO CORP. OF AMERICA, TUBE DIVISION, Harrison, N.J., has announced that the suggested resale price of the "Vidicon" TV camera tube (RCA-6198) has been reduced from $345 to $315.

RADIO RECEPTOR COMPANY reports that it is now making the smallest and lowest priced germanium transistors available and expects to produce over 2,000,000 units by the end of the year. The company is now making transistors which are only 0.2 in. square and ⅛-in. thick.

RCA has a new electron-image tube that can translate coded signals from tape, keyboard or radio into clearly defined letters and figures at speeds up to 100,000 words per minute for high-speed photographic recording.

REMINGTON RAND, INC., 315 Fourth Ave., New York 10, N.Y., announces that applications for registration in the company's computer courses, No. 001, "Introduction to Computers," No. 002, "Programming I," No. 003, "Programming II," and No. 020, "Logical Operation," are available at any Remington Rand office.

REON RESISTOR CORP., N.Y.C., manufacturers of precision resistors, has purchased the total assets of **COLUMBIA RESISTORS, INC.**, Pearl River, N. Y., makers of power resistors.

REYNOLDS METALS CO. Extrusion Plant of Phoenix is conducting tests to determine the feasibility of using aluminum flight decks on aircraft carriers. Good results were obtained during wear and tear trials.

SILICONE SEALS INC., of Illinois has been organized to engage in the design and production of silicone rubber hermetic terminals.

SMPTE 77th semiannual convention will feature a comprehensive presentation of the problems and techniques involved in planning, producing and distributing 16 MM nontheatrical motion pictures for educational and industrial use.

STEVENS INSTITUTE OF TECHNOLOGY announces four new degree programs for graduate students. Of the four new programs, to be offered starting next fall, three will lead to the degree of Doctor of Philosophy. These will be awarded for study in the Dept. of Chemistry, Mathematics and Physics which already grant the master's degree. The new doctoral programs will be in addition to that in applied mechanics now offered by the Dept. of Mechanical Engineering, for which the degree of Doctor of Science is awarded. The fourth of the new programs is one leading to the degree of Master of Science in Civil Engineering.

STEVENS MANUFACTURING CO., INC. has transferred all operations to a new plant at 45 N. Plymouth St., Lexington, Ohio. The new and larger plant is a single-story, modern brick structure of 31,000 square feet.

STUPAKOFF CERAMIC & MANUFACTURING CO., Latrobe, Pa. has announced that its glass-to-metal seals for hermetic sealing applications will soon be manufactured in Canada by Canada Sand Papers Ltd. at Preston, Ontario.

SYLVANIA ELECTRIC PRODUCTS INC. announced today it has seected a location in the town of Camillus, N. Y. near Syracuse, as the site of the company's new data processing center. The area is 30 acres on which the construction is expected to occupy 50,000 sq. ft.

TALK-A-RADIO, 25 Vanderbilt Ave., N. Y. has introduced to the home appliance field a combination radio receiver and home intercom system for room to room conversation.

TENSOLITE INSULATED WIRE CO., of 196 Main St., Tarrytown, N. Y. announces completion of new plant additions that have doubled production capacity for its line of miniature wire and cables for all electronic applications.

TEXAS INSTRUMENTS, Dallas, Texas, has purchased the assets of the **RADELL CORP.** of Indianapolis, manufacturer of a line of deposited carbon precision resistors. Mr. J. P. Rodgers, Jr., is general manager of the TI Components division, which will manufacture and market the Radell resistors. Mr. John R. Pies, former Radell manager, will join Texas Instruments as chief engineer of the Components division.

THOMPSON PRODUCTS, INC. announces plans to acquire two large manufacturing plants for $9,000,000. One plant is in Cleveland and one in Detroit.

UNIVERSAL ELECTRONICS CO., of Los Angeles, manufacturers of regulated dc power supplies, has purchased property and is building a new factory in Santa Monica. The move is scheduled for the middle of May, and there will be no cessation of manufacturing during the transfer from present leased quarters.

WANG LABORATORIES, 37 Hurley St., Cambridge, Mass., announces design and production of the "WEDILOG," a new electronic digital-analog differential computer, with applications in aeronautical design, trajectory problems, process control, dynamic systems analysis, etc.

WESTINGHOUSE ELECTRIC CORP. soon will place in operation at the Analytical Section of its E. Pittsburgh Works a new type, high-speed data processing machine. The machine is a Type 650 Magnetic Drum Data Processing Machine manufactured by IBM.

NEW MALLORY Multiple Controls

New strip-type Mallory controls are available in single, dual and triple sections.

Can Cut Your Production Costs . . .

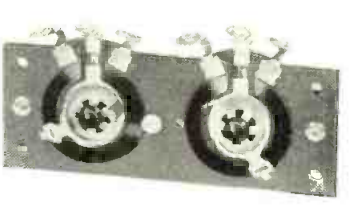
JUST added to the Mallory line of carbon controls is a new, completely different series that make possible real economies in your production. By means of a unique strip-type design, side-by-side dual and triple units are now available in a form that takes only as much labor to mount as a conventional single unit.

In addition, because of the radically simplified design, Mallory is able to offer multiple units at materially lower cost than that of corresponding numbers of conventional single controls.

WIDE VARIETY OF MODELS

The unusual flexibility of the new design makes it possible to offer many adaptations . . . at low cost. Mounting arrangement can be twist tabs or holes punched for riveting. Terminals can be solder lugs or wire wrap solderless types. Phenolic hex shafts are available in lengths up to 7/8" FMS, in 1/8" increments, with screwdriver slot for ease in adjustment. Resistances from 250 ohms to 10 megohms are available. Rotational stops, ground ring or provision for a flexible lead can be provided.

A Mallory control engineer will be glad to consult with you on how these new controls can be applied to your present or future equipment. For technical data, write or call Mallory today.



Rear view shows simple, rugged design, with resistance wafer attached directly to phenolic panel.

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

Serving Industry with These Products:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

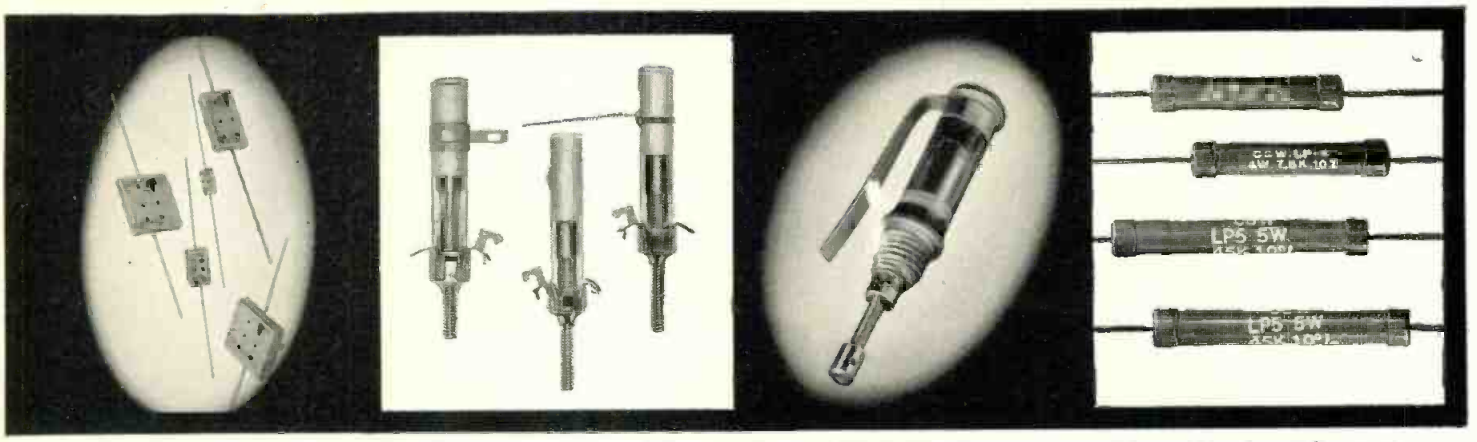
Expect more . . . Get more from

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

CORNING GLASS WORKS *is pleased to announce the appointment of the* **ERIE RESISTOR CORPORATION** as a stocking distributor of the electronic components listed below. These components are available for immediate delivery through authorized ERIE distributors in the United States and Canada

TRADE ERIE MARK
electronics

For information and prices, write, wire, or phone Erie Resistor Corporation, 644 West 12th St., Erie, Pa., or your Erie Distributor.



Corning Fixed-Glass Capacitors
CY10, CY15, CY20 and CY30
300 and 500 VDCW
Corning Fixed-Glass Capacitors for extreme miniaturization, strength, stability.

Corning Midget-Rotary Trimmer Capacitors. Wide mounting variety in range from 1-12.0, 1-8.0, 0.3-3.0 mmfds. Accurate. Economical.

Corning Direct-Traverse Trimmer Capacitors. For critical applications where you need an absolutely smooth capacitance curve even under extremely variable ambient temperatures.

Corning Low-Power Resistors
LP4—4 Watt, 200-40,000 Ω
LP5—5 Watt, 200-45,000 Ω
Corning Low-Power Resistors give you the highest resistance range of any low-power resistors available.

CORNING GLASS WORKS, Corning, New York
New Products Division
Corning means research in Glass

MICROWAVE SIGNAL GENERATORS

Complete coverage of the range 950-11,500 mcs /sec.

with Polarad single dial operation

Four new Microwave Signal Generators covering the range 950-11,500 mcs/sec. All with famous Polarad single dial operation. Each provides the maximum working range possible in one compact signal generator. And, additional Polarad Signal Generators are available to cover 12.4 to 39.7 kmc.

These features on all MSG units assure fast and simple operation: direct reading, single dial frequency control that tracks reflector voltages automatically . . . direct reading attenuator dial . . . conveniently placed controls, in logical sequence . . . high visibility on the face of each instrument.

Polarad Signal Generators are built to the same high standards required for military equipment. They are practical for the factory assembly line—engineered ventilation assures continuous and stable operation of all instrument functions. Components are readily accessible for easy maintenance. And laboratory accuracy is guaranteed under the most rigorous operating conditions.

Write directly to Polarad or your nearest Polarad representative for details.

	 MSG-1	 MSG-2	 MSG-3	 MSG-4
Frequency Range	950-2400 MCS/sec.	2150-4600 MCS/sec.	4450-8000 MCS/sec.	MSG 4 6950-10,800 MCS sec. | MSG 4A 6950-11,500 MCS/sec.
	(Frequency set by means of a single directly calibrated control).			
Frequency Accuracy	±1%	±1%	±1%	±1%
Power Output	1 MW	1 MW	.2 MW	.2 MW
Attenuator Range	120 db	120 db	120 db	120 db
Attenuator Accuracy	±2 db	±2 db	±2 db	±2 db
Output Impedance	50 ohms	50 ohms	50 ohms	50 ohms
Input Power	115V±10% 50-60 cps	115V±10% 50-60 cps	115V±10% 50-1000 cps	115V±10% 50-1000 cps
Internal Pulse Modulation:				
Pulse Width	0.5 to 10 microseconds		INTERNAL SQUARE WAVE (all models)	
Delay	3 to 300 microseconds			
Rate	40 to 4000 pulses per second		Rate: 40-4000 cps	
Synchronization	Internal or external, sine wave or pulse		Synchronization: Internal	
Internal FM:				
Type	Linear sawtooth			
Rate	40 to 4000 cps			
Synchronization	Internal or external, sine wave or pulse			
Frequency Deviation	±2.5 MCS	±2.5 MCS	±6 MCS	±6 MCS
External Pulse Modulation:				
Polarity	Positive or Negative			
Rate	40 to 4000 pulses per second			
Pulse width	0.5 to 2500 microseconds			
Pulse separation	(For multiple pulses) 1 to 2500 microseconds			
Output Synchronizing Pulses:				
Polarity	Positive, delayed & undelayed			
Rate	40 to 4000 pps			
Voltage	Greater than 25 volts			
Rise time	Less than 1 microsecond			
Size | Approx. weight	17" long x 13¼" high x 15½" deep | 60 lbs.		17" long x 15" high x 19½" deep | 100 lbs.	

"THE FINEST SIGNAL GENERATORS OF THEIR KIND"

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

REPRESENTATIVES: • Albuquerque • Atlanta • Baltimore • Bayonne • Bridgeport • Buffalo • Chicago • Dayton • Fort Worth • Los Angeles • New York Newton • Philadelphia • San Francisco • Syracuse • Washington, D. C. • Westbury • Winston-Salem • Canada, Arnprior, Toronto—Export: Rocke International Corporation

BOOKS

Military Control Specifications For Electron Tubes

Published by the Office of Technical Services, U.S. Department of Commerce, Washington 25, D.C. Publication No. PB 111561. 38 pages. Price $1.00.

Longer life and better performance of electron tubes can be assured by the use of carefully prepared specifications for their construction, performance and procurement. A military specifications control system which embodies many practical advances in specification writing is desscribed in this report. Manufacturers, particularly those interested in fulfilling government contracts, will find this system useful in establishing material and process controls and standards. The performance tests will enable them to determine whether the finished product, or supplies already in stock, will satisfactorily meet requirements.

The military specifications control system, described in a report from Wright Air Development Center, is designed to make the specification a practical and workable instrument for determining construction and procurement requirements and measuring standards of acceptable quality. The specifications provide a ready means of estimating compliance with a standard of quality on a lot basis, by sampling procedures, regardless of the location of the tubes.

Section 2 of the report describes improved tests and test methods for determining electrical and mechanical performance, detrimental properties, degradation rate, and electrical life. Charts illustrate and correlate results of tests, estimate their reliability, and analyze sampling methods.

Basic Vacuum Tubes and Their Uses

By John F. Rider and Henry Jacobowitz. Published 1955 by John F. Rider, Publisher, Inc., 480 Canal St., New York 13, N.Y. 208 pages. Price $3.00 paper bound, $4.50 cloth bound.

The experienced engineer will find this book an excellent elementary refresher on the construction and operation of vacuum tubes. It is simply and clearly written, covering practically all basic details in an easily understood manner.

Recurrent Electrical Transients

By L. W. Von Tersch and A. W. Svago. Published 1955 by Prentice-Hall, Inc., 70 Fifth Ave., New York 11, N.Y. 399 pages. Price $7.75.

This latest addition to the publisher's Electrical Engineering Series contains a thorough analysis of circuits in which the steady-state waveform may be considered as a series of recurrent electrical transients. The authors have stressed the time-constant concept in preference to frequency consideration, and laid

(*Continued on page* 140)

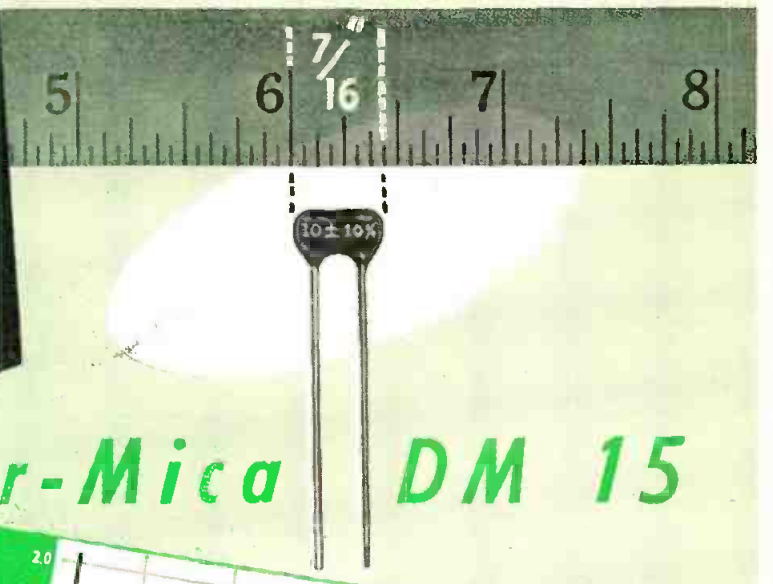
El-Menco

provides

Positive Proof

of Performance

of the powerful new . . .



Dur-Mica DM 15

world's smallest mica capacitor

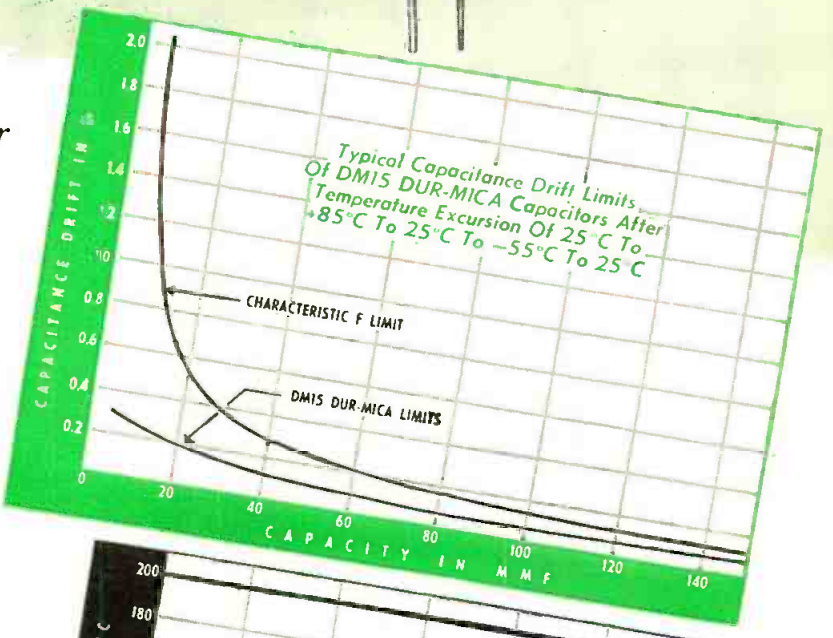
. . . First Miniature Dipped Mica Capacitors with Parallel Leads.

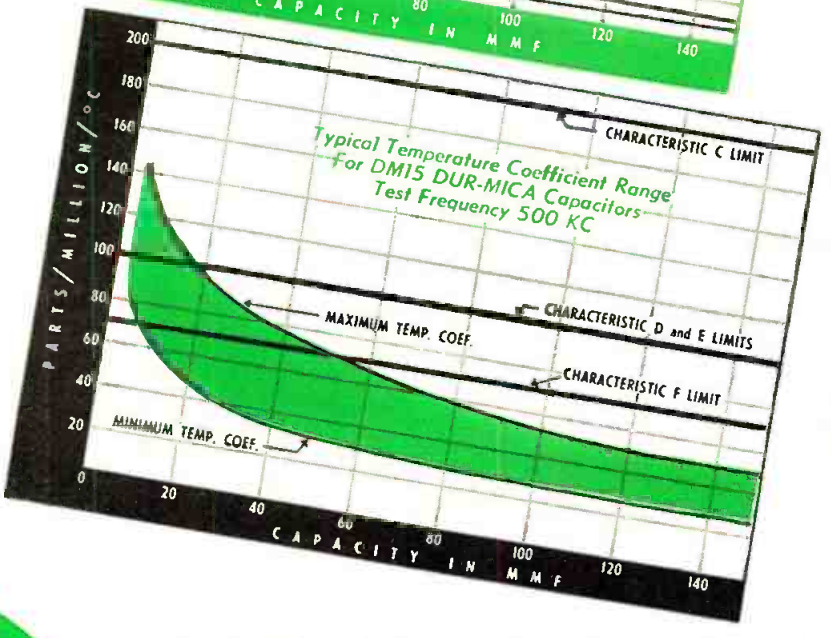
El Menco's Dur-Mica DM15 provides assurance of peak performance in a variety of transistor circuits and other miniature electronic equipment in military and civilian applications.
A new, tougher phenolic casing provides assurance of long-life and stability through wide ranges in temperature.
Parallel Leads provide greater versatility—allow efficient, safe use of the El Menco Dur-Mica DM15 in applications heretofore impractical.
Saves Money—El Menco's Dur-Mica DM15 costs even less than the famous El Menco CM15.
Provides economy of size.

CAPACITIES AVAILABLE:
DM15—Up to 510 mmf at 300vDCw
Up to 400 mmf at 500vDCw
DM20—Up to 5100 mmf at 300vDCw
Up to 3900 mmf at 500vDCw
Available in 125°C operating temperature. Minimum capacity tolerance available—± ½% or 0.5 mmf (whichever is greater).

Test El Menco "Dur-Micas" For Yourself!

For your special requirements—we are pleased to offer information and assistance. Write for free samples and catalog on your firm's letterhead.





El-Menco Capacitors

THE ELECTRO MOTIVE MFG. CO., INC.

WILLIMANTIC CONNECTICUT

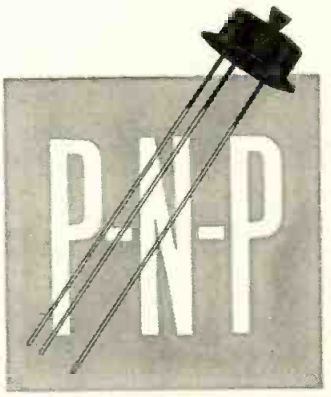
• molded mica • mica trimmer
• tubular paper • ceramic

Jobbers and distributors write to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y.

G.E. MECHANIZED PRODUCTION AT LOWER COST...ASSURES

Both types offer high reliability at temperatures

Take a close look at the transistor values G.E. now offers. Because production lines are now mechanized, these transistors are made in *less time* at *reduced cost.* Machine methods today assure strictest adherence to the top quality standards demanded of all General Electric Germanium Products.



TYPE 2N43A

Mechanization results in CONTROLLED CHARACTERISTICS, removing any inaccuracy on the part of the operator. Narrow limits are built into production transistors giving a more uniform product.

In military and commercial applications these G-E transistors offer precision quality, topmost reliability at mass-volume prices!

General Electric's P-N-P junction transistor, 2N43A, is the first to be written into Air Force specifications! MIL-T-25096 (USAF) was actually written around this G-E product which was developed for the military. Now it serves an ever-increasing number of commercial as well as military applications.

APPLICATIONS AND SPECIFICATIONS

TYPICAL USES: Audio and Intercom Amplifiers, Servo Amplifiers, Carrier Current Amplifiers, Test Equipment, Fuel Gauges.

SPECIFICATIONS OF THE 2N43A and USAF 2N43A

Absolute Maximum Ratings:

Collector Voltage (Referred to base)	−45 volts
Collector Current	−50 ma
Collector Dissipation	150 mw
Storage Temperature	100° C
Collector Cutoff Current (−45 volts)	−10 microamps

DESIGN FEATURES:

STURDY CONSTRUCTION... meets critical military tests for shock, vibration, humidity, life.

SEALED JUNCTION... contamination gases permanently eliminated!

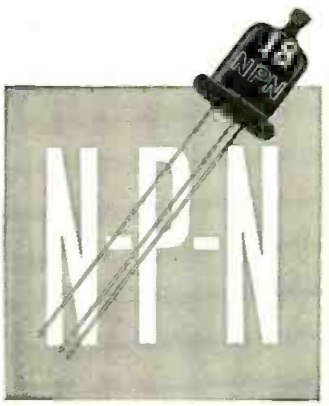
HIGH POWER OUTPUT... case design makes possible a collector dissipation of 150 mw.

HERMETIC SEAL... unaffected by moisture.

LONG LIFE... no change in characteristics during life of equipment.

MAKES TRANSISTORS AVAILABLE CONTROLLED CHARACTERISTICS

up to 100°C... are now available in production lots!



TYPE 2N78

HIGH FREQUENCY TRANSISTOR

A new, revolutionary manufacturing technique, the exclusive G-E rate-growing process, coupled with the all-welded hermetic seal, now makes possible extra long life, and noticeably-reduced manufacturing costs by—

- Making 2000 or more transistors from one rate-grown crystal.
- Achieving uniform characteristics in all 2000 transistors—*eliminating wasteful rejects.*

APPLICATIONS

For pulse and switching circuits, RF and IF amplifiers; high-frequency test equipment; telephone repeaters.

SPECIFICATIONS

Collector Voltage (Referred to Base)	15 V
Collector Current	20 ma
Emitter Current	−20 ma
Storage Temperature	100° C.
High Frequency Gain at 2 mc	13 db

- For further details on specifications and prices, write *General Electric Co., Section X-4855, Germanium Products, Electronics Park, Syracuse, N. Y.*

Billet of germanium is removed from furnace, prior to cutting into enough tiny pellets for 2000 transistors.

Progress Is Our Most Important Product

GENERAL ELECTRIC

PYRAMID SOLID DIELECTRIC GLASSEAL® CAPACITORS FOR

6 POINT PREFERENCE

1 Especially sturdy capacitors capable of withstanding vibrational stresses of high acceleration and frequency, and severe shock conditions as encountered in guided missiles and airborne equipment.

2 Utilize new, rugged compression-seal type, glass-to-metal solder-seal terminals. Terminals will *not* work loose or rotate under any operating condition.

3 Functional operating range from —55°C to +125°C.

4 Operates normally under severe humidity conditions.

5 Production tests for voltage breakdown, capacitance, power factor, insulation resistance and seal are performed on a 100% basis.

6 Capacitance range: .001 mfd. to 1.0 mfd.; voltage range: 100 to 600 V.D.C. operating; can be provided to standard tolerance of ±20% or to closer tolerances, if desired.

1. Hermetically sealed in metallic cases.

2. Power factor less than ±1%.

3. Subminiature in size.

4. Available in both inserted tab and extended foil constructions.

+ FACTORS

For complete engineering information contact your local Pyramid representative or write to—

CAPACITOR DIVISION

PYRAMID ELECTRIC COMPANY

1445 Hudson Blvd. • North Bergen, N. J.

New Tech Data for Engineers

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

Germanium Diodes

The Semi-Conductor Div., International Rectifier Corp., 1521 East Grand Ave., El Segundo, Calif., makes available Bulletin GD-2 that lists ratings and specifications on germanium diodes to those who make their requests on company letterhead. Ask for B-5-15)

Relays

The 41-page catalog, "Leach Precision Relays," released by Leach Relay Co., Div. of Leach Corp., 5915 Avalon Blvd., Los Angeles 3, Calif., presents the company's midget, circuit control, special purpose, radio and high frequency, and aircraft relays with dimensional drawings and engineering data. Also ordering information. (Ask for B-5-2)

Tubes

Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I. N. Y., has released an attractive, 6-page, full-color folder that presents the company's line of quality tubes and complete performance characteristics and operating conditions. (Ask for B-5-3)

Mounts

Barry Controls Inc., 1000 Pleasant St., Watertown, Mass., has released Barry Bulletin 546 that illustrates and describes how mounting machinery increases production and lowers costs. (Ask for B-5-47)

Electronic Products

A 4-page folder, released by Roller-Smith Corp., Instrument Div., 1825 W. Market St., Bethlehem, Pa., designated General Data No. 100, illustrates and describes the company's panel meters, switches, circuit breakers, etc. (Ask for B-5-5)

Impedance Bridges, Etc.

The first complete catalog published by Electro-Measurements, Inc., 4312 S. E. Stark St., Portland 15, Ore., presents the company's impedance bridges and accessory null bridge amplifiers; laboratory instruments; and a trade-name list of the company's manufactured electronic products. Gives circuit diagrams and pertinent engineering data. (Ask for B-5-6)

Distribution Amplifier

Bulletin TR-825, released by Television Transmitter Dept., Allen B. Du Mont Laboratories, Inc., Clifton, N. J. presents illustrations and engineering data covering the distribution amplifier, Type 5437-A., for use with video distribution, pulse distribution, and sync mixing. (Ask for B-5-7)

Electronic Components

Wells Sales Inc., 833 W. Chicago Ave., Chicago 22, Ill., have issued its 49-page electronic components Catalog No. C55 covering the corporation's 1955 line of capacitors, crystals, resistors, rheostats, switches coaxial connectors, transformers, and motors and their prices. (Ask for B-5-8)

Capacitors

The 6-page, 2-color, Bulletin No. 337-8 released by The Gudeman Co., 340 West Huron St., Chicago 10. Ill., describes and gives engineering specifications covering the 337 and 338 series miniature flat "Mylar" dielectric capacitors. (Ask for B-5-9)

Interval Timers

The R. W. Cramer Co., Centerbrook, Conn. has issued Bulletin PB-210 in 2 colors. The 8-page booklet features exploded views and descriptions and technical data covering interval timers. Gives wiring, dimensions and housing information. (Ask for B-5-10)

Taper Pins, Etc.

"AMP Taper Technique," a 13-page booklet issued by Air-craft-Marine Products, Inc., 2100 Paxton St., Harrisburg, Pa., illustrates and describes the advantages of taper pins, tab receptacles, "bloks," and tips, and gives pertinent data and characteristics. (Ask for 3-5-27)

Digital Instruments

A 4-page folder issued by Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, O. details a series of five related digital instruments for automatic counting, recording, and control. The basic components for the instruments are also described. (Ask for B-5-49)

Eyelets

A new standardized eyelet folder, issued by United Shoe Machinery Corp., 140 Federal St., Boston, Mass., illustrates more than 60 standard types and pictures the use of eyelets in electronic products. (Ask for B-5-46)

Switches

Micro Switch, Div. of Minneapolis-Honeywell Regulator Co., Freeport, Ill., has released an 8-page folder covering the company line of small precision switches. Describes the units graphically and gives dimensions. (Ask for B-5-45)

Tubes

Radio Corp. of America, Tube Div., Harrison, N. J. has released technical information covering RCA-6BQ6-GTB/6CU6, RCA-12BQ6-GTB/12CU6, RCA-25BQ6-GT/25CU6, and RCA-6CB5 beam power tubes, the RCA-6BK4 sharp-cut off beam triode, the RCA-6BL4 half-wave vacuum rectifier, and the RCA-21AXP22 color kinescope. (Ask for B-5-44)

Germanium Transistor

A 2-page technical release by CBS-Hytron, Div. of Columbia Broadcasting System, Inc., Danvers, Mass., describes and presents a detailed dimensional drawing covering the Type 2N38A P-N-P germanium transistor for 1-f amplifier applications. (Ask for B-5-43)

Varistors

International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa., has released Catalog Data Bulletin SR-3 that gives 6 pages of detailed charts and graphs and data on applications, characteristics, enclosures, etc., covering varistors—asymmetric non-linear resistors. (Ask for B-5-26)

Radar Systems

Designated GEA-6279, the 8-page bulletin shows GE radar antennas, mounts, components, and accessories for use with land and ship based radar systems announced by the company's Naval Ordnance Dept. Available at the General Electric Apparatus Sales Div., General Electric Co., Schenectady 5, N. Y. (Ask for B-5-25)

Power Supplies

"Power Supplies for Laboratory and Industry," Catalog 55, prepared by Lambda Electronics Corp., 103-02 Northern Blvd., Corona 68, N. Y. illustrates and gives the special features and specifications covering the different power supplies made by the company. (Ask for B-5-50)

Servo Systems

"Standard Servo Systems and Components," released by Feedback Controls, Inc., 1332 N. Henry St., Alexandria, Va., illustrates and presents dimensional drawings and performance data covering their line of booster, magnetic servo, universal operational, dc instrument amplifiers, and a standard electronic servo system 400 CPS package. (Ask for B-5-39)

OBTAIN THESE BULLETINS

described here by writing on company letterhead to Bulletins Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.

"AlSiMag"

American Lava Corp., Chattanooga 5, Tenn., subsidiary of Minnesota Mining and Manufacturing Co., has released Chart No. 551 covering the mechanical and electrical properties of "AlSiMag" ceramics. Supersedes Charts No. 531 and 544. (Ask for B-5-1)

Grid Wire

Baker & Co., Inc., 113 Astor St., Newark, N. J. have issued a 4-page folder describing a new non-sag platinum clad tungsten grid wire developed for higher frequency, higher power, vacuum tube grids. Gives comparison data between molybdenum and tungsten. (Ask for B-5-16)

Rotor Balancer

M. Ten Bosch, Inc., Pleasantville, N. Y., has issued a file folder that presents the advantages of the company's rotor balancer comprising a pickup unit and computer unit that provides complete information for correcting unbalance. (Ask for B-5-17)

Clamps

The 1955 revision of the "Top Hat" retainer catalog has been issued by Times Facsimile Corp., 540 West 58th St., New York 19, N. Y. Illustrates and gives dimensional drawings of the various hat types. (Ask for B-5-18)

Special Purpose Tubes

Chatham Electronics, Livingston, N. J., Div. of Gera Corp., has released a 4-page catalog covering the company's "Radiac" equipment, and its lines of rectifiers, thyratrons, twin power triodes, voltage regulators, reference tubes, and special products. (Ask for B-5-19)

Jack and Plug

The advantages and applications of the "Telex" miniature jack and plug combination are given in a new catalog sheet issued by Dept. KP, Telex, Inc., Telex Park, St. Paul 1, Minn. (Ask for B-5-14)

Electrical Standard Resistors

A 4-page data sheet, EB2(1), released by Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa., describes the firm's dc and ac electrical standard resistors. Presents specifications, tabular characteristics, construction features, and ordering instructions. (Ask for B-5-22)

Electronic Equipment

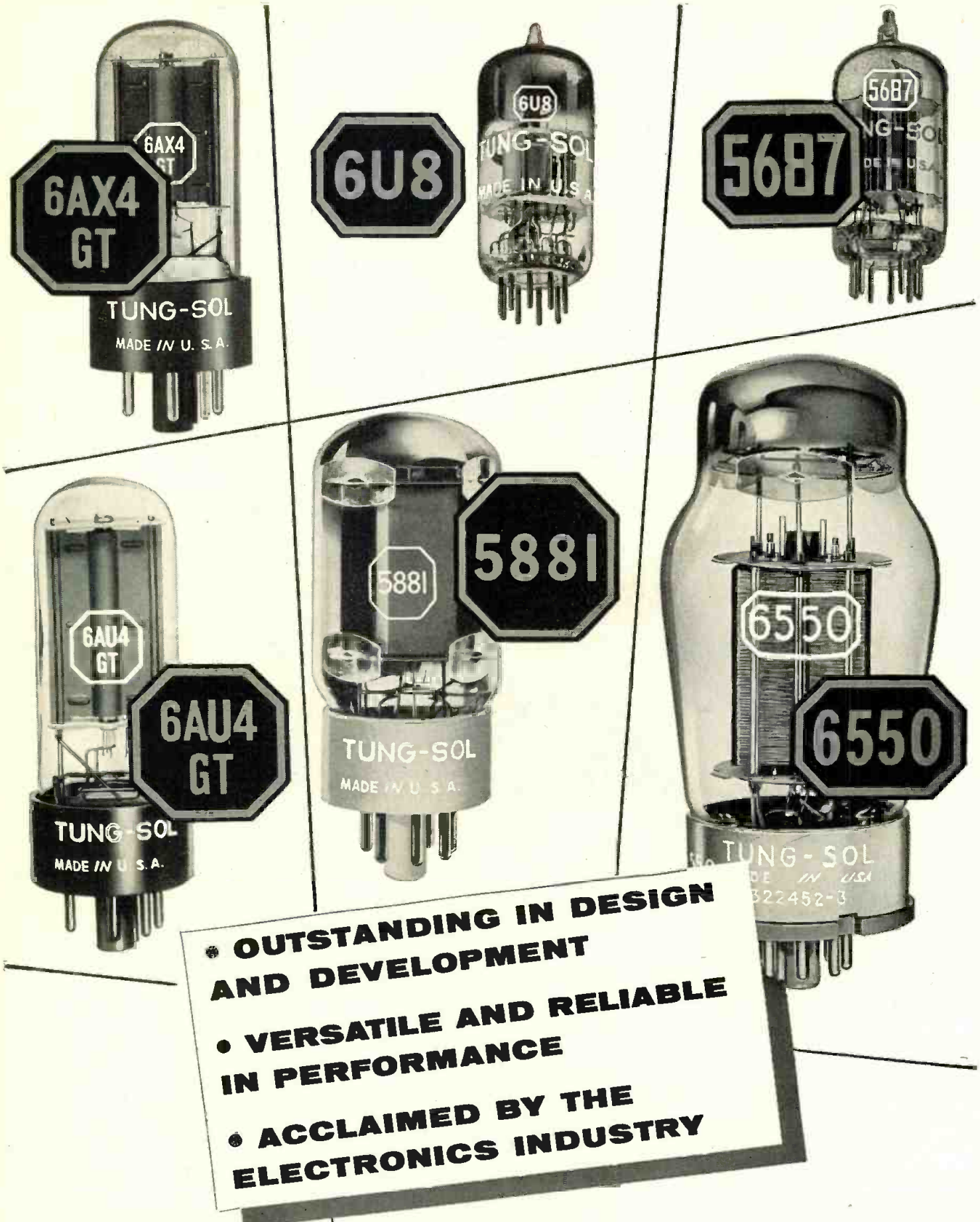
A 15-page booklet, presented by Varian Associates, 611 Hansen Way, Palo Alto, Calif., illustrates and describes the company's electronic products, gives a brief history of the organization, and summarizes its current engineering, manufacturing, and research and development activities. (Ask for B-5-23)

Ceramic Coating

Bulletin 155 contains complete data on "Nicote," a firmly-bonded, metal-to-ceramic coating which presents a surface on which a metal part or other metallized ceramic part can be soldered without special specification. Issued by Frenchtown Porcelain Co., 100 Muirhead Ave., Trenton 9, N. J. (Ask for B-5-24)

Lock Nuts and Fasteners

The Palnut Co., 61 Cordier St., Irvington 11, N. J., has published a 16-page catalog covering the company line of lock nuts and fasteners for radio, TV, and electronic assembly. Gives details, advantages, dimensions and applications. Includes information on wing lock nuts, and power and manual wrenches. (Ask for B-5-12)



- **OUTSTANDING IN DESIGN AND DEVELOPMENT**
- **VERSATILE AND RELIABLE IN PERFORMANCE**
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ELECTRON TUBES

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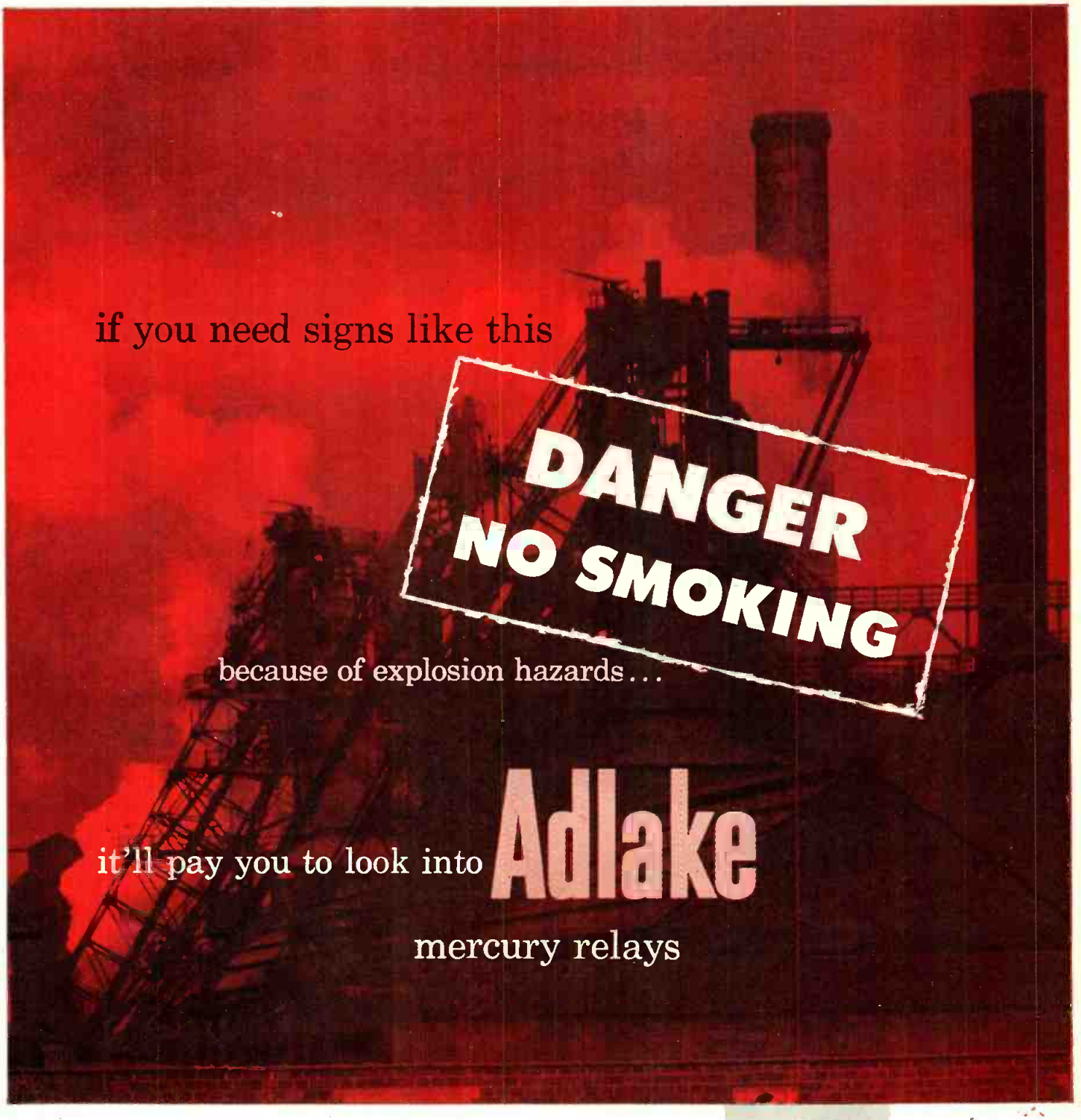
TUNG-SOL MAKES All-Glass Sealed Beam Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes, and Semiconductor Products.



Adlake relays require no maintenance whatever ...are quiet and chatterless...free from explosion hazard. Dust, dirt, moisture and temperature changes can't affect their operation. Mercury-to-mercury contact gives ideal snap action, with no burning, pitting or sticking. Time delay characteristics are fixed and non-adjustable.

Adlake 98th year of serving the transportation and building industries

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Established 1857 • ELKHART, INDIANA • New York • Chicago

the *original* and largest manufacturers of mercury plunger-type relays

TELE-TIPS

LOW BIDDERS for government contracts are now quickly and accurately determined via electronic computers by Defense Department agencies.

TV FOR MENTAL PATIENTS has proven therapeutic value. GE's Radio and TV Dept. reports that Dr. Rupert A. Chittick, Vermont State Hospital, tried a TV receiver in the recreation room during the last World's Series games. Patient reaction was remarkable, showing more than normal interest. Goal now is to have TV as well as a radio receiver in every ward.

ATOMIC FLAME shown recently at the National Bureau of Standard's open house is of considerable interest. The flame, bluish green in color, was produced by direct combination of oxygen atoms with acetylene gas at very low pressure—less than 1/1000 the normal atmospheric pressure. This pressure is equivalent to an altitude of about 200,000 feet. No one knows the actual temperature of the flame which varies between 1200° to 20,000° F. depending on thermometer. Bureau hopes to use phenomena eventually to make possible new jet engines and rockets for high altitude operation.

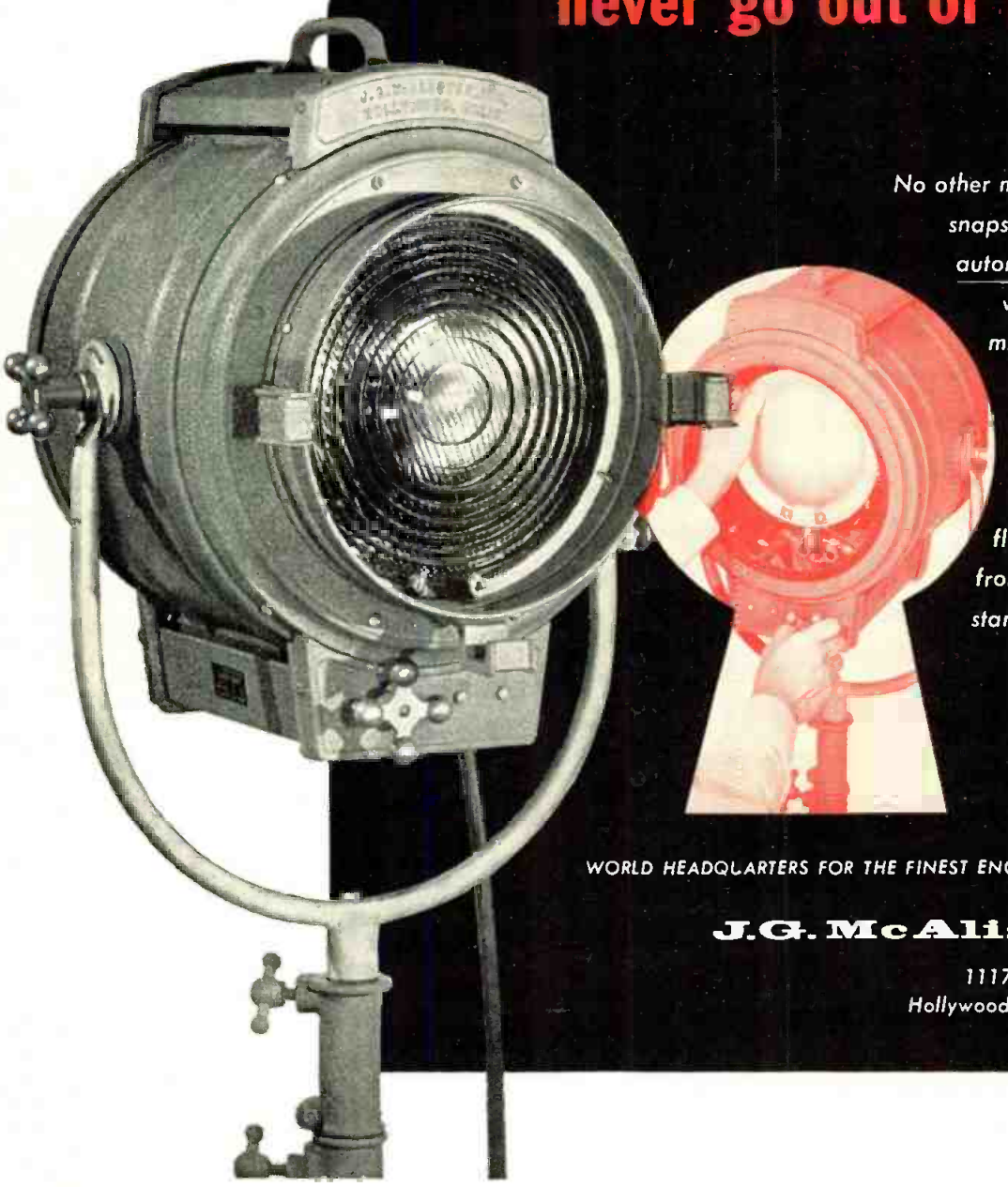
ELECTRONIC TUBES power locomotives. GE is delivering ten new locomotives to the New York, New Haven and Hartford Railroad which employ tube rectifiers in conjunction with a power transformer to change the 11,000 v 25 cycle ac feed to low voltage dc needed for traction motors.

APPLICATION OF RADIATION DEVICES to industry is becoming more and more common. According to item in the Ohmite News, a new instrument based on small angle radiation detection and presentation (SARDAP) will detect holes in metal having only 0.000001 cu. in. volume!

CLOSED CIRCUIT TV now being installed by Telecom Systems Inc., N.Y.C. in a new huge Nassau County, L. I. shopping center is designed to give parents a constant

(*Continued on page 40*)

exclusive perma-lock mirror is why J.G. McAlister spots never go out of focus



No other mirror, only a Perma-Lock snaps into position easily, locks automatically, and stays locked . . . which guarantees positive mirror alignment, perfect focus after every globe removal. Even a severe jolt can't disalign mirror. Other McAlister features: spot to flood focus, smooth and precise from front or rear, Fresnel lens standard on all spot equipment. Today, call or write:

WORLD HEADQUARTERS FOR THE FINEST ENGINEERED LIGHTING EQUIPMENT

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"Dragnet"

Philco 16MM CineScanner

PHILCO

FEATURES

- Provides preview—exclusive with Philco.
- Available in 16MM and 35MM models.
- Quiet, continuous film motion—no intermittent mechanism to cause film wear and damage.
- Cold light source—no burning or discoloring of film.
- Instantaneous run-up with provision for quick starts, stop and reversal.
- Highest quality reproduction in monochrome and color.

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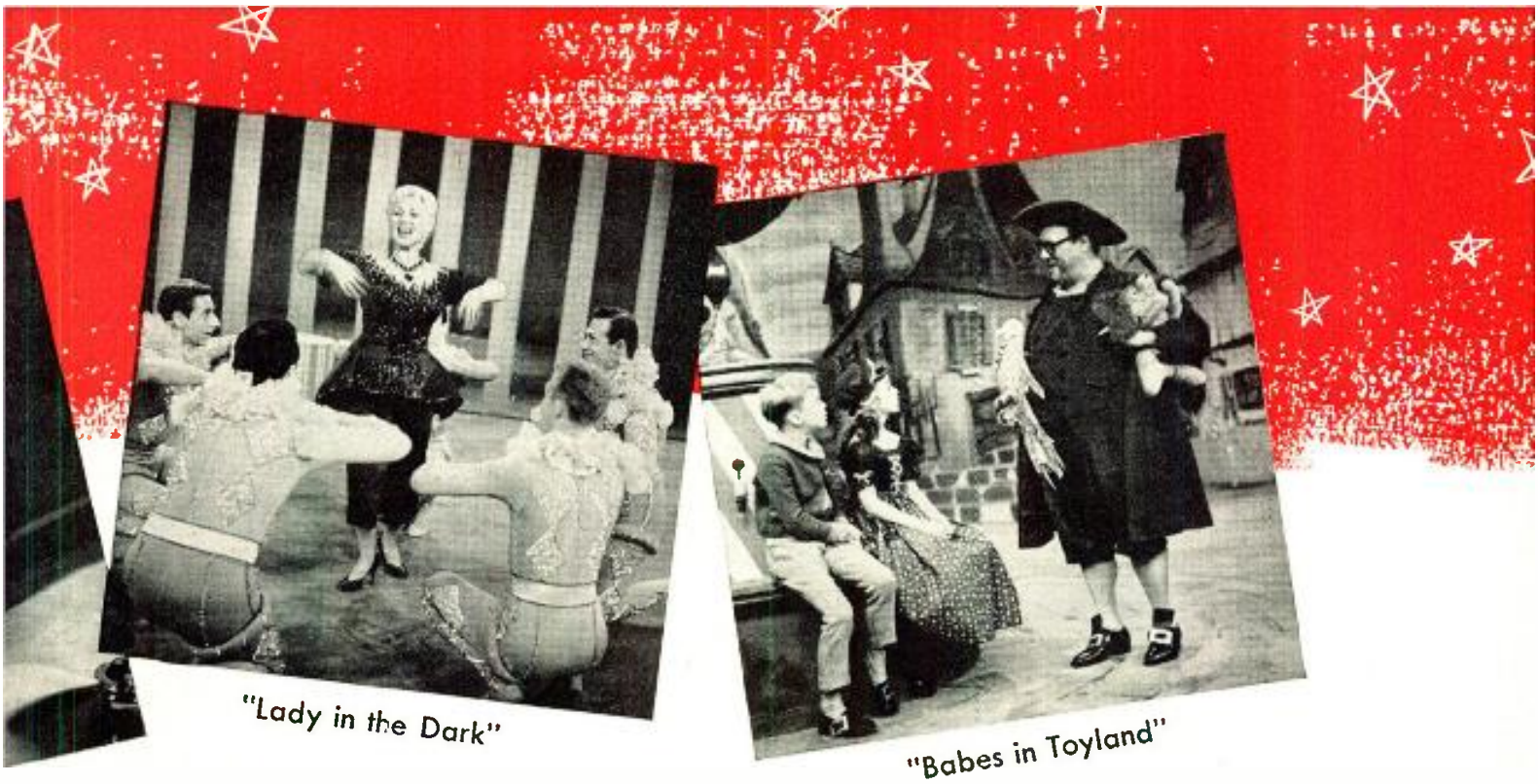

CineScanner

...film "star" of network color shows!

Over and over, the Philco CineScanner continues to prove itself the star performer on top-notch network shows: Transforming scenes-on-film to bright, crisp, steady pictures in rich full color . . . **with unequaled simplicity and dependability!**

CineScanner employs the simplest film telecasting technique known. There are no problems of shading or color registration. In fact, **color registration insurance is actually built in!**

Here's how CineScanner works:

A dependable cathode ray tube projects bright "cold" light through the film on to low cost, non-synchronous pickup tubes. Simultaneously, these tubes generate signals for the red, green and blue images—**all from a single scanning tube!** Operation is simple and direct. Costly camera tubes are eliminated. Perfect registration is assured.

CineScanner has other exclusive advantages. A continuous-motion film transport mechanism designed by Philco and built by the Mitchell Camera Company eliminates mechanical shutters and noisy film-damaging intermittents. The film can be started, stopped—run forward and backward—instantaneously!

Install the Philco CineScanner and enjoy this simple, practical way of film telecasting. You can start today in monochrome . . . convert tomorrow to color with a simple conversion kit.

For complete information write Dept. TT

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GOVERNMENT AND INDUSTRIAL DIVISION

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Famous for
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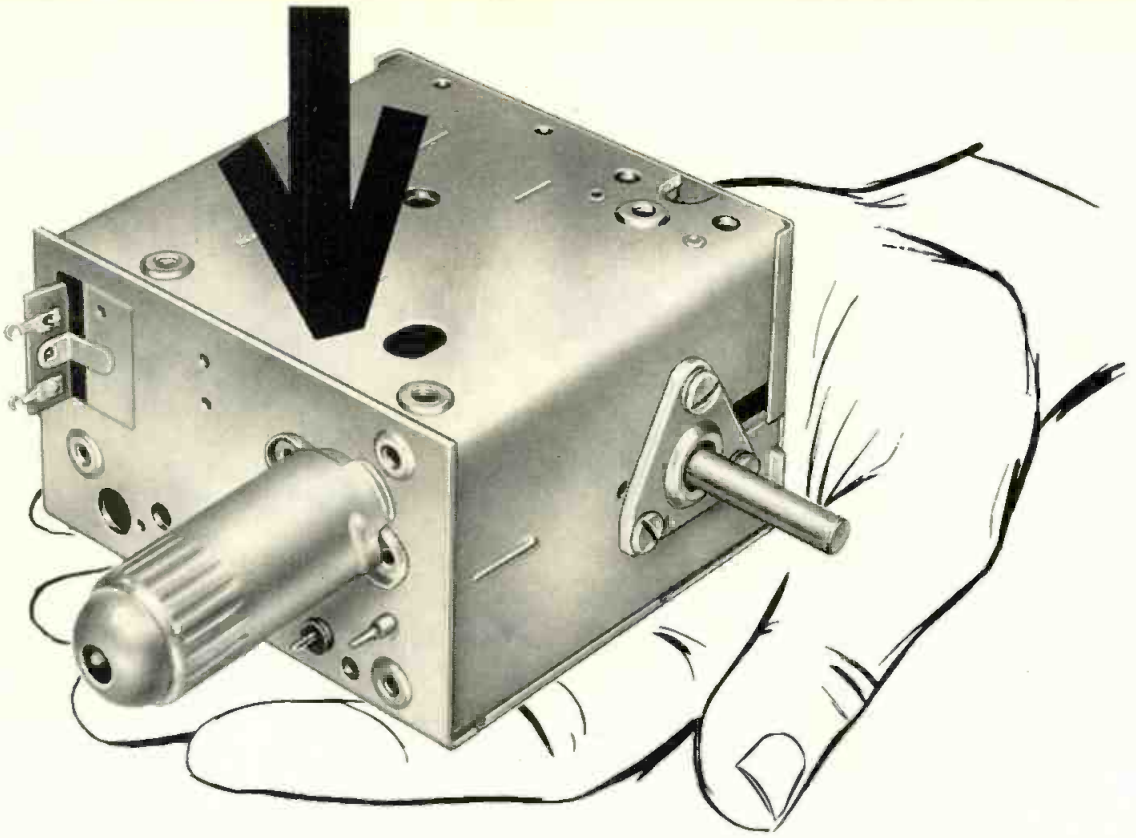


NEW

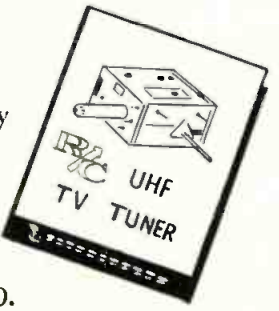
low cost UHF tuner

FEATURES OSCILLATOR RADIATION FIXES

Here's famous R/C quality at the lowest price ever! The new T-90 Series uhf t-v tuner meets all RETMA spurious radiation requirements. Yet it costs less than any previous Radio Condenser uhf tuner.

The double-circuit tuned T-90 Series has excellent i-f and image rejection, giving remarkably high selectivity. As indicated by R/C statistical quality control, the noise figure of the new tuner exceeds most requirements, and the drift characteristics are equally good. Field results to date have been uniformly excellent.

If you want information fast on the T-90 Series, we'll be happy to have one of our engineers call at your convenience.



Get Complete Engineering and Performance Data.
Write Radio Condenser for your free copy of Bulletin T-90.

RC

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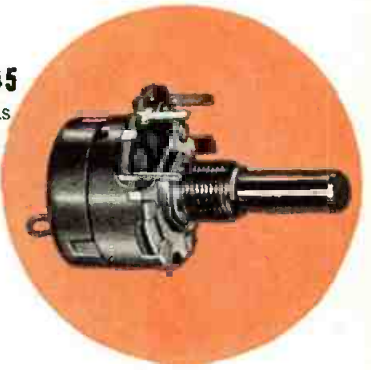
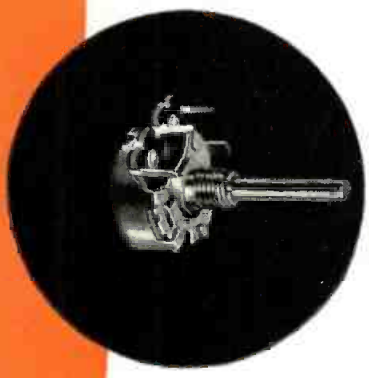
FOR YOUR AUTOMATION PROGRA

VARIABLE RESISTORS FOR PRINTED CIRCUITS

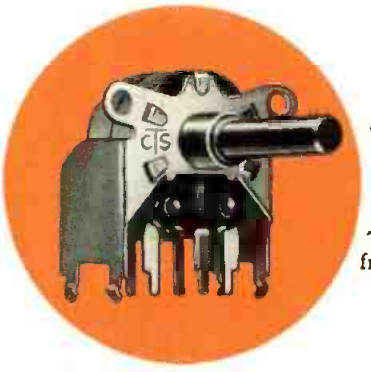
Type UPM-45
For TV preset control applications. Control mounts directly on printed circuit panel with no shaft extension through panel. Recessed screwdriver slot in front of control and 3/8" knurled shaft extension out back of control for finger adjustment. Terminals extend perpendicularly 7/32" from control's mounting surface.

Type GC-U45
Threaded bushing mounting. Terminals extend perpendicularly 7/32" from control's mounting surface. Available with or without associated switches.

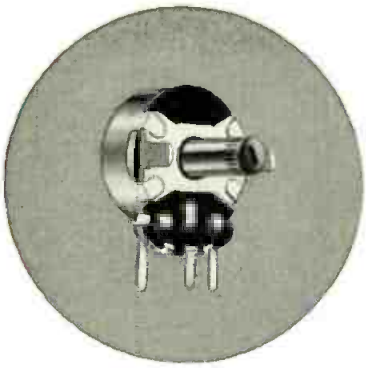




Type U70 (Miniaturized)
Threaded bushing mounting. Terminals extend perpendicularly 5/32" from control's mounting surface.

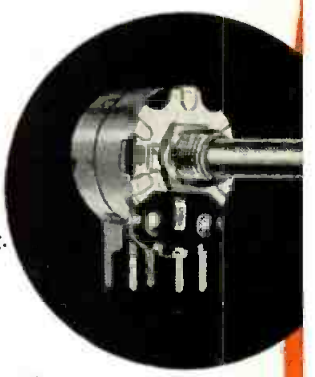


Type YGC-B45
Self-supporting snap-in bracket mounted control. Shaft center spaced 29/32" above printed circuit panel. Terminals extend 1-1/32" from control center.

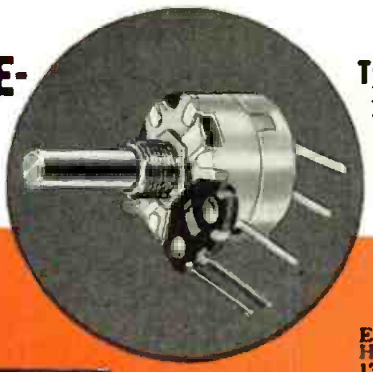


Type XP-45
For TV preset control applications. Control mounts on chassis or supporting bracket by twisting two ears. Available in numerous shaft lengths and types.

Type XGC-45
For applications using a mounting chassis to support printed circuit panel. Threaded bushing mounting.



VARIABLE RESISTORS FOR SOLDERLESS "WIRE-WRAP" CONNECTIONS



Type WGC-45
Designed for solderless wire-wrapped connections with the use of present wire-wrapping tools. Available with or without switch and in single or dual construction.

The controls illustrated are typical construction
CTS' years of engineering and technical experience makes availab
many other types for your automation nee

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The Exclusive Specialists in Precision Mass Production of Variable Resisto

TELE-TIPS

(*Continued from page* 34)

clear view of their children at play in the center's supervised kiddie park.

NOISELESS MERCURY SWITCHES, like good cheese, must age before they are at their best. Sluggishness caused by moisture in the mercury tube will show up if the switch rests 48 hours after manufacture. Minneapolis Honeywell inspectors, looking for an aging spot, decided on an old cheese aging room formerly used by a national dairy manufacturer.

NEW RETMA STANDARDS issued include: Midget i.f. Shields, REC-144, price 25 cents; Electron Tube Bases, Caps and Terminals, ET-103-D; Dimensional Characteristics of Electron Tubes, ET-105-C; 16 mm Motion Picture Projector for Use with Monochrome Film Chains Operating on Full-Storage Basis, TR-131, price 30 cents. All are now available from RETMA Engineering Office, 500 Fifth Ave., New York 17, N. Y.

SOCIAL SECURITY benefits for long term disability are now recognized for the first time. Previously it was possible for persons with long continued disability to lose all rights to benefits because average earnings included periods of low or no earnings. Under new law persons with long disability may apply to freeze their records—meaning that periods of low or no earnings need not be counted.

COMPUTER CHOPS TRANSFORMER DESIGN time to a matter of minutes where previously hours and weeks were required. Such is the report from Westinghouse Electric's Transformer Division. B. D. Henderson, vice president and acting manager announces successful production of power transformer designs using the IBM-701 computers.

AMATEUR RADIO ACTIVITIES SECTION OF RETMA is now plugging a new amateur radio course to all interested readers. The course is custom-designed for the beginner

(*Continued on page* 48)

hatched by HYDRO-AIRE

a low cost H-F TRANSISTOR you can count on!

THE BONDED BARRIER TRANSISTOR

First dependable H-F Transistor for quantity production

ABSOLUTE MAXIMUM SPECIFICATIONS	Collector Voltage	−12 volts
	Collector Current	−3 ma
	Collector Dissipation	30 mw
	Ambient Temperature	55°C.

AVERAGE CHARACTERISTICS AT TEMP. 20° C., FREQ. 1 kc, COMMON BASE

Collector Voltage	−4.5 volts
Emitter Current	0.5 ma
H 11, input impedance, output short circuit	350 ohms
H 12, voltage feedback ratio, input open circuit	3.5×10^{-4}
H 21, current amplification, output short circuit	−0.75
H 22, output admittance, input open circuit	10 mu ohms
Ico, Collector Cutoff Current	−5 mu a.
Max. Power Gain, Gnd. Emitter	25 db
Freq. Cutoff	5 mc

OTHER HYDRO-AIRE FIRSTS

- Hermetic Sealing
- Transistor Socket Strips
- Packaged line of Transistorized Audio Pre-amplifiers

NOW READY FOR QUANTITY PRODUCTION AT LOW COST

We held off counting this chicken until it was well and truly hatched! And now that time has come.

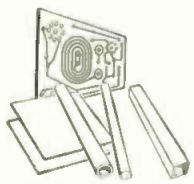
The Bonded Barrier Transistor has been exhaustively tested, and found dependable in service throughout the frequency range shown at left. Not only that: the Bonded Barrier process is ideally suited for large-scale production. Hydro-Aire's Electronics Division is now completing new mass production facilities to meet the widespread demand for a transistor that offers such great potential in electronic design.

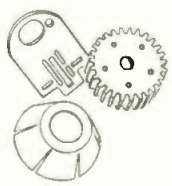
Sample quantities are already being shipped to certain users. You will appreciate that we shall have to hold to certain priorities on such a much-needed item; but we shall deal as fairly as possible with all legitimate inquiries. We can only advise you to contact us right away, so that you may be high on the list, both for test quantities now and production quantities later. Please write on your company letterhead.

ELECTRONICS *Division of* HYDRO-AIRE 3000 WINONA AVENUE, BURBANK *Inc.*

The Aviation Subsidiary of CRANE *Co.*

"Get prices down! Keep quality up! *BUT HOW?*"





With the many materials now available, and new ones coming on the scene, how can a designer be sure he's got the right answer?

Here's one way. Work with a company that has an exceptionally broad line of basic engineering materials, plus the research facilities and production experience you need to support your decision.

NVF materials—Vulcanized Fibre, Phenolite Laminated Plastic, Metal-Clad Phenolite and Fibre, Peerless Insulation—are surprisingly adaptable. Each is manufactured in many forms, grades, and combinations, with various degrees of hardness, resilience, flexibility, insulating ability, dielectric strength, moisture resistance, and ease of fabrication. What they can do—to reduce costs and preserve product quality—has raised many a manufacturer's eyebrows *and profits!*

NVF design assistance is complete. Our technical people can work with you while your project is in the head-scratching stage—make sure that you get exactly the right material or product for the specific job. But even more important, they stick with the project until it's completed to your satisfaction.

NVF maintains complete facilities for machining and forming ready-to-use parts. This saves you operating steps and gives you 100% usable parts. Working with a single integrated supplier often turns red figures into black ones.

If you have a design problem, call on National. It's the job of our engineering staff to discover ways and means of applying NVF materials to your difficult applications. Full details of our materials and services are yours without obligation.

Write for—

(1) 16 pg. Bulletin—full technical data—Vulcanized Fibre—Phenolite Laminated Plastic.

(2) 12 pg. Bulletin—Mechanize Your Wiring With Copper-Clad Phenolite.

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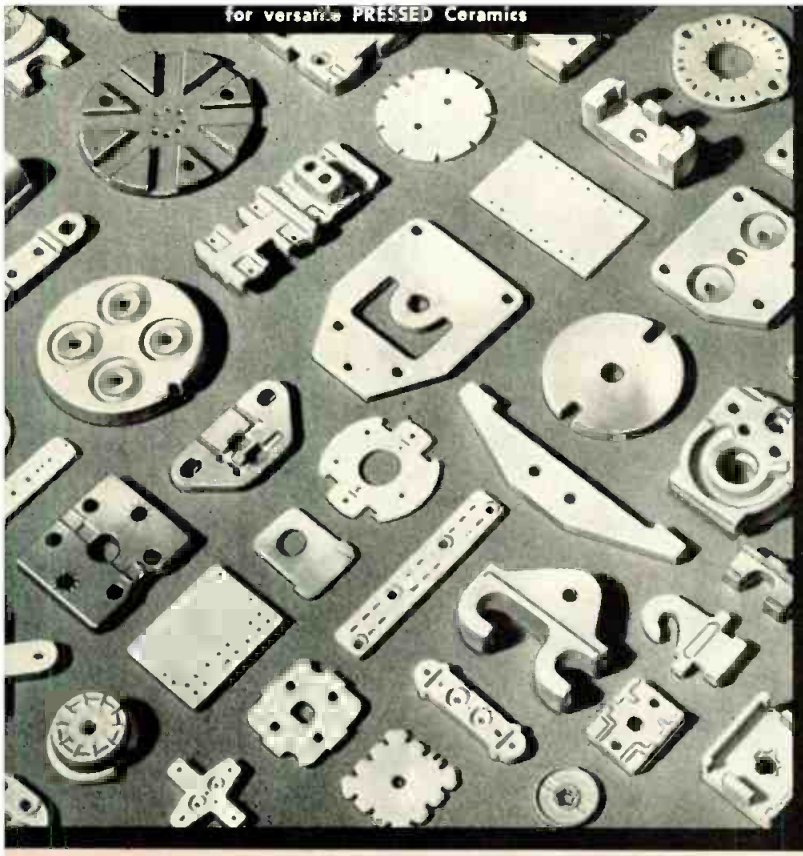
Also Manufacturers of Peerless Insulation, Materials Handling Receptacles, Vul-Cot Wastebaskets and Textile Bobbins.



for versatile PRESSED Ceramics

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Custom-made Technical Ceramics

FOR WIDEST CHOICE OF MATERIALS

FOR VOLUME PRODUCTION

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Send your blueprint with outline of operating conditions and let our engineers show you what AlSiMag can do for you!

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54TH YEAR OF CERAMIC LEADERSHIP

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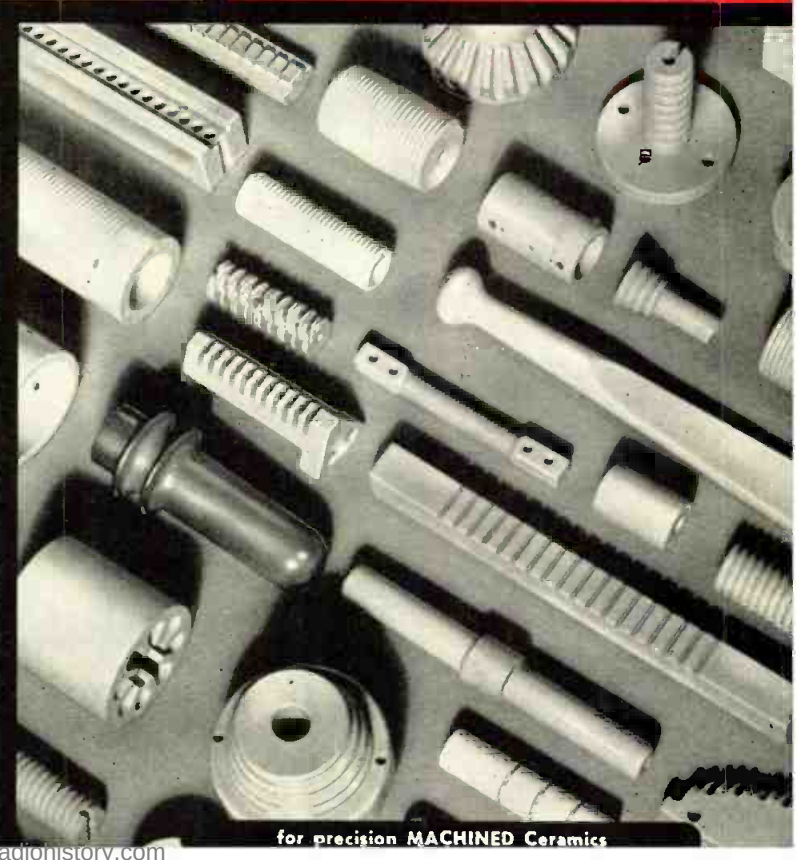
BRANCH OFFICES (see your local telephone directory): Cambridge, Mass. • Chicago, Ill. • Cleveland, Ohio • Dallas-Houston, Tex. • Indianapolis, Ind. • Los Angeles, Calif. • Newark, N. J. • Philadelphia-Pittsburgh, Pa. • St. Louis, Mo • South San Francisco, Calif. • Syracuse, N. Y. • Tulsa, Okla. Canada: Irvington Varnish & Insulator Division, Minnesota Mining & Manufacturing of Canada, Limited, 1390 Burlington Street, East, Hamilton, Ontario. Telephone Liberty 4-5735.

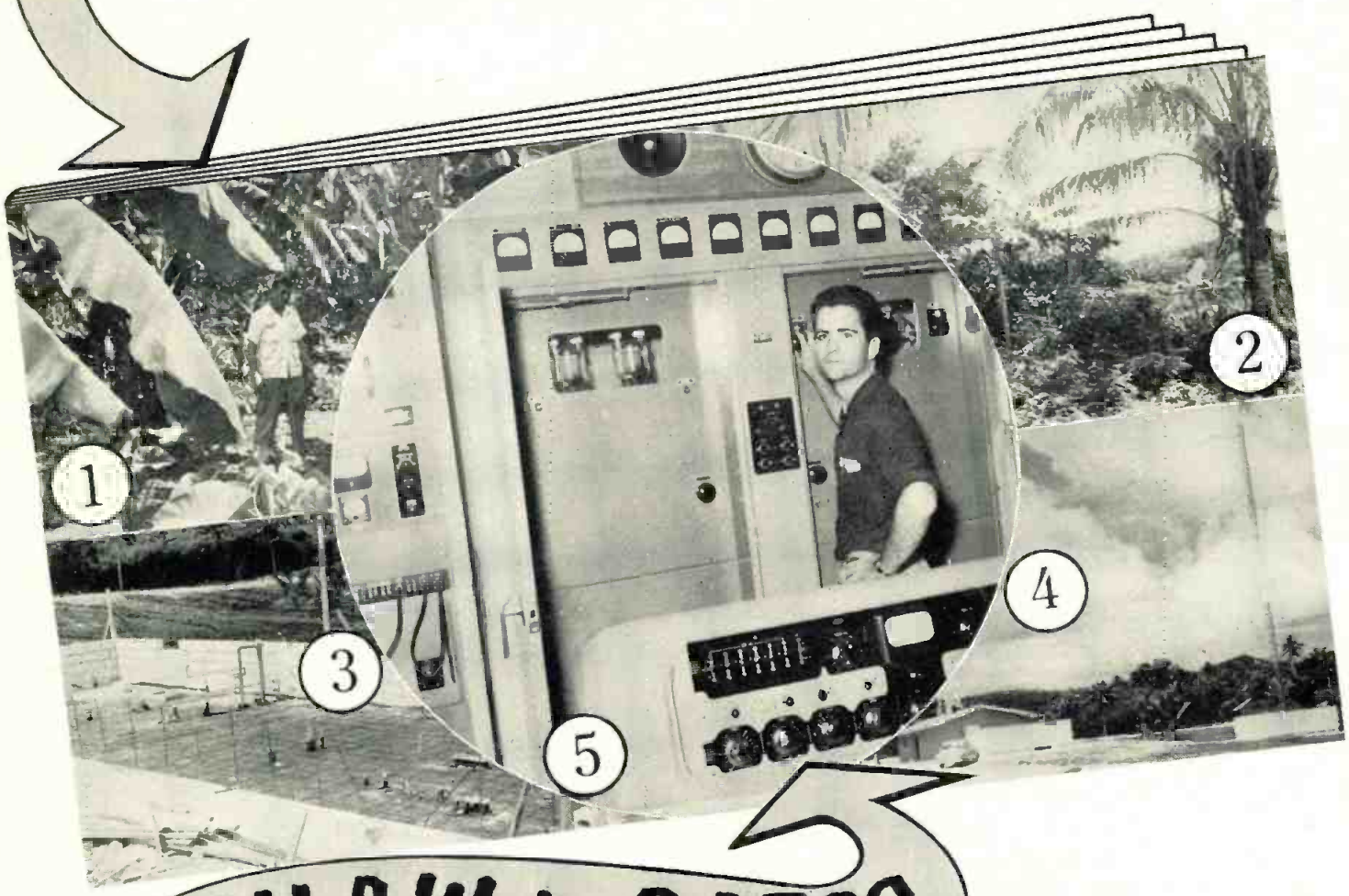
for reliable METAL-CERAMIC COMBINATIONS



for precision MACHINED Ceramics

This is GUAM

They cleared the jungle, (1) and (2), and built a modern radio station, (3) and (4). KUAM, Agana, Guam serves a nearly $100,000,000.00 retail market with a bonus of coverage on 610 Kc. in Saipan and Tinian. First F. C. C. licensed station in the Far East, KUAM programs both local and network in English, Guamanian, Tagalog and Filipino language.



At KUAM is GATES

KUAM is all Gates, (5), and their selection of the big, heavy Gates BC-1F kilowatter is logical for jungle climates. Temperatures high, humidity high and repair parts nearly halfway around the world demands reliability — the reason why more radio broadcasters buy Gates than any other make.

GATES

GATES RADIO COMPANY QUINCY, ILL., U. S. A.

Manufacturing Engineers Since 1922

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12,400 TO 50,000 MC

integrated equipment for Extremely High Frequencies

SIGNAL GENERATORS

SIGNAL SOURCES

SPECTRUM ANALYZERS

Now, Polarad has applied its advanced engineering techniques to produce **fully self-contained** microwave test equipment for use in the Extremely High Frequency region--12,400 to 50,000 MC

This new line of Signal Generators, Signal Sources, and Spectrum Analyzers is designed to save engineering manhours in the laboratory and on production lines—obviating experimental test set-ups.

The Extremely High Frequency Polarad Signal Generator, for example, furnishes monitored power output as well as measures external signal strength and frequency.

Highest accuracy and reliability of operation are assured by careful engineering and the use of highest quality components. For complete information write to your nearest Polarad representative or directly to the factory.

	SIGNAL GENERATORS		SIGNAL SOURCES		SPECTRUM ANALYZERS		
Frequency Range	Model Number	Output Power	Model Number	Power Output (Average)	Model Number	Sensitivity (Signal=Noise)	Dispersion (Average)
12.4 to 17.5 KMC	SG 1218	−10 DBM	SS 1218	15 mw	SA 1218	−70 DBM	30 MC
15.75 to 16.25 KMC	SG 1516*	−6 DBM	SS 1516	5 mw	SA 1516	−70 DBM	45 MC
16.25 to 16.75 KMC	SG 1617*	−6 DBM	SS 1617	5 mw	SA 1617	−70 DBM	45 MC
18.0 to 22.0 KMC	SG 1822	−10 DBM	SS 1822	10 mw	SA 1822	−60 DBM	40 MC
22.0 to 25.0 KMC	SG 2225	−10 DBM	SS 2225	10 mw	SA 2225	−60 DBM	40 MC
24.7 to 27.5 KMC	SG 2427	−10 DBM	SS 2427	10 mw	SA 2427	−60 DBM	40 MC
27.27 to 30.0 KMC	SG 2730	−10 DBM	SS 2730	10 mw	SA 2730	−60 DBM	45 MC
29.7 to 33.52 KMC	SG 3033	−10 DBM	SS 3033	10 mw	SA 3033	−60 DBM	45 MC
33.52 to 36.25 KMC	SG 3336	−10 DBM	SS 3336	9 mw	SA 3336	−50 DBM	45 MC
35.1 to 39.7 KMC	SG 3540	−10 DBM	SS 3540	5 mw	SA 3540	−50 DBM	45 MC
37.1 to 42.6 KMC	External Source Power Measurement Range: +6 to +30 DBM Accuracy with Correction: ±2 DB		SS 3742	Approx. 3 mw	I.F. Gain Control: 0 to 40 DB I.F. Band Width: 50 KC Sweep Frequency: 5 to 40 CPS		
41.7 to 50.0 KMC			SS 4150	Approx. 3 mw			

Modulation: All units except the SG 1516* and SG 1617* can be modulated as follows:

1. Internal
   1000 CPS Square Wave
2. External
   a. Pulse
      Pulse Width: 0.5 to 10 Microseconds
      PRF: 100 to 10,000 CPS
      Pulse Amplitude: 10 volts Pk to Pk Min.
      Polarity: Positive
   b. Sawtooth or Sinusoidal
      Frequency: 100 to 10,000 CPS
      Amplitude: 15 Volts RMS Min.

*Internal variable pulse and FM modulation

Polarad ELECTRONICS CORPORATION

43-20 34th St., Long Island City 1, New York

AVAILABLE ON EQUIPMENT LEASE PLAN

FIELD MAINTENANCE SERVICE AVAILABLE THROUGHOUT THE COUNTRY

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ANNOUNCING

...the Eimac 4X5000A Ceramic Radial-Beam Power Tetrode

The Eimac 4X5000A ceramic radial-beam power tetrode, with a 5kw plate dissipation rating and 16kw power output in typical Class-C telegraphy operation fills a power gap in the tetrode field. Rugged ceramic replaces glass, increasing immunity to damage by thermal and physical shock, and stack type production techniques assure uniform quality characteristics. Straightforward coaxial structure allows the advantages of low lead inductance. An integral finned anode permits improved cooling with low air pressure. Especially suitable for Single Sideband operation, the versatile 4X5000A handles high inputs without going into the positive grid region and delivers 10kw peak envelope power output with zero driving power in typical Class-AB_1 operation. High power gain, low inter-electrode capacitances, simple circuit needs and non-emitting grid wire, inherent Eimac tetrode features resulting from over 20 years of transmitting tube specialization are, of course, maintained.

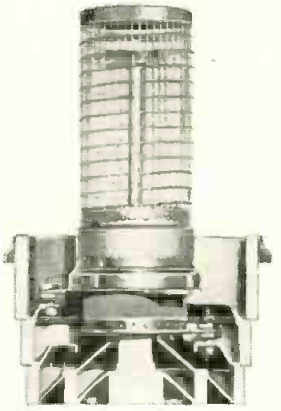
TYPICAL OPERATING CONDITIONS

Frequencies up to 30 Mc

	Class-C Telegraphy	Class-C Plate Mod.	Class-AB_1	
D-C Plate Voltage	7500	5000	7500	volts
D-C Screen Voltage	500	500	1250	volts
D-C Plate Current	2.8	1.3	1.9	amps
D-C Screen Current	.500	.170	.200	amps
D-C Grid Current	.250	.045	0	amps
D-C Grid Voltage	−350	−400	−300*	volts
Peak R-F Grid Voltage	590	520	300	volts
Driving Power	150	25	0	watts
Screen Dissipation	250	85	250	watts
Plate Power Input	21	6.5	14.2	kilowatts
Plate Power Output	16	5.5	10	kilowatts

**In the Class-AB_1 operating conditions listed, adjust grid bias to obtain 500 ma d-c plate current with zero driving voltage.*

The above operating conditions show approximate grid driving power and plate power output. Allowance must be made for r-f losses in practical circuits.



For further information, contact our Technical Services department.

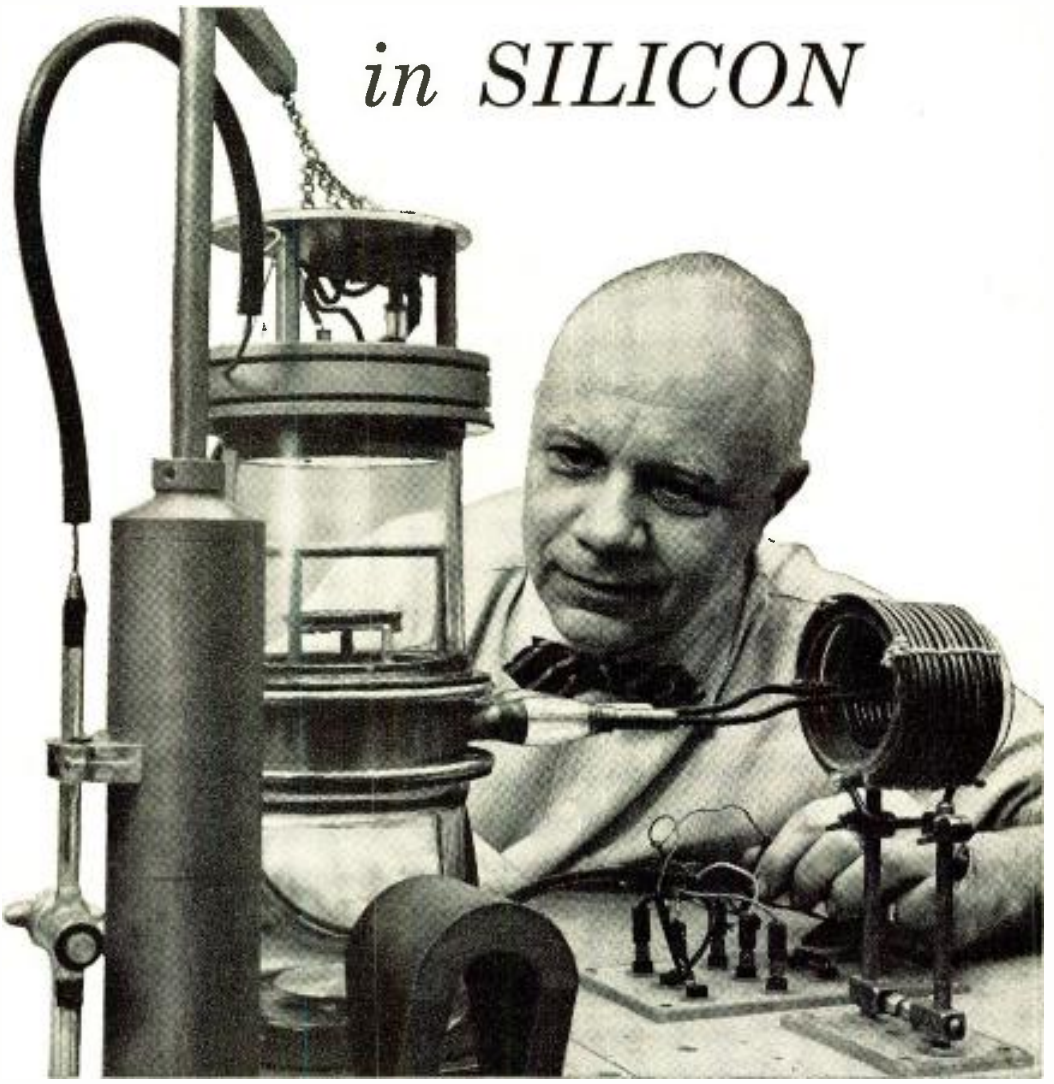
Eimac

EITEL-McCULLOUGH, INC.

SAN BRUNO, CALIFORNIA

The World's Largest Manufacturer of Transmitting Tubes

AN ADVENTURE *in SILICON*



One example of junction technology at Bell Laboratories. Here a junction is produced on the surface of silicon by bombardment with alpha particles. Bombardment enhances silicon's performance at very high frequencies.

One day in the 'thirties a revolutionary adventure began for Bell scientists. They were testing an experimental silicon crystal they had grown to make microwave detectors.

Intriguingly, they found that one end of the crystal conducted by means of positive charges, the other end with negative. Positive and negative regions met in a mysterious barrier, or junction, that rectified, and was sensitive to light. It was something entirely new . . . with challenging possibilities.

The scientists went on to develop a theory of junction phenomena. They showed that two junctions placed back-to-back make an amplifier. They devised ways to make reproducible junctions. Thus, junction technology came into being, and the 20th Century had a new horizon in electronics.

This technology has already produced at Bell Telephone Laboratories the versatile junction transistor (useful in amplifiers and switches); the silicon alloy diode (surpassingly efficient in electronic switching for computers); and the Bell Solar Battery which turns sunshine directly into useful amounts of electric current.

This is one of many adventures in science which make up the day-to-day work at Bell Laboratories... aimed at keeping America's telephone service the world's best.

Bell Telephone Laboratories

Improving telephone service for America provides careers for creative men in scientific and technical fields

TELE-TIPS

(*Continued from page 40*)

and is based on material prepared by professional educators and engineers. Recorded on five LP records, cost of complete course is $10.00 ARRL License manual is included.

WESTINGHOUSE HALTS STOCK BUYING plan whereby employees were permitted to purchase stock at a discount on a payroll deduction basis. Through the plan nearly 27,000 employees became part-owners of their company.

BELL SYSTEM INTERCITY TV service has 69,000 channel miles of facility at the present time. Of this 20,000 miles are of coaxial cable and 49,000 miles are on radio relay. Most of 1954 was devoted to converting these facilities to handle color-TV.

SMALLER - STILL — Ink was hardly dry on the contents page for our February issue when W. S. Sutherland at Centralab wrote in to say that they had just succeeded in further miniaturization of their model 3 Radiohm. The overall outside dimensions are ⅝-in. We had reported controls as being miniaturized down to ¾-in. diameters. Sorry!

NON - DESTRUCTIVE testing with electronic devices is playing a big part in insuring railroad safety. Basically, there are three different types of tests for detecting flaws in rails. The first is the electromagnetic technique whereby a magnetic field is set up in the rails by a current or magnet. Search coils mounted on a detector car seek out irregularities in the flux pattern of the rail caused by internal flaws. Such distortion is recorded on a strip chart, and a paint gun is actuated to splash the suspected spot. The second method employs ultrasonic reflections viewed on a crt in the detector car. Defects are also indicated in a variation of this method employing a back-pack unit and earphones. The third approach is the black light method. An oil suspension of fluorescent ferromagnetic particles is applied to the metal, and a magnetic field induced. Cracks produce leakage fields which are outlined by the glowing particles when illuminated by ultra-violet light.

INCOMPARABLE *Frequency Stability...*

for Airborne X-Band Radar Receivers

Now — at a New Low Cost — Varian announces the rugged VA-203 . . . most advanced reflex klystron ever developed for airborne radar and beacon local oscillator service. The exclusive brazed-on external tuning cavity provides frequency stability obtainable in no other klystron. This construction provides outstanding stability during shock, vibration and temperature cycling . . . takes punishing 50 to 100 G shocks and provides absolutely reliable operation at high altitude WITHOUT pressurization.

For Super-Rugged Service (Shocks to 250G) . . . Varian offers the VA-201 klystron. This tube is equipped with integral molded silastic leads, is similar to the VA-203 and performs with the same absolute reliability.

All these exclusive Varian features . . .

- ★ **Unique brazed-on external tuning cavity assures exceptional frequency stability.**
- ★ Reliable operation at low voltage and from poorly regulated power supplies.
- ★ Negligible microphonics.
- ★ Slow tuning rate . . . long tuning life . . . single shaft tuner adapts easily to motor tuning.
- ★ Withstands 50 to 100 G shocks (up to 250 G's for the VA-201)
- ★ VA-203 weighs less than 4 ounces. Both tubes mate directly to standard waveguide flanges.

GUARANTEED SPECIFICATIONS		
8500 to 9600 mc	VA-203	VA-201
Resonator Voltage	300 V	250 V
Heater Voltage	6.3 V	6.3 V
Heater Current	0.45 Amp	1.2 Amp
Power Output	20mW, Min	15mW, Min
Electronic Tuning Range	30 Mc, Min	30 Mc, Min
Vibration FM at 10 G	1 Mc, p-p, Max	0.2 Mc, p-p, Max

GET COMPLETE TECHNICAL DATA and specifications on the outstanding new VA-203 and its companion VA-201 . . . finest klystrons made for airborne radar. Write to our Applications Engineering Department today.

THE MARK OF LEADERSHIP

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"The World's Most Promising Technological Revolution"

The Electronics industry is truly "the world's most promising technological revolution."

Even though it grew phenomenally during World War II, Electronics really came into its own following the war. By 1948, it had become a $3,000,000,000 business, and was rapidly becoming a major industry.

Today, Electronics is a $9,000,000,000 industry —counting television, radio, military electronics, commercial electronics, broadcasting, and related areas. There is every indication that by 1960 it will be a $15 billion dollar industry and $20 billion by 1964. And it will keep right on climbing.

No other major industry will grow that fast in the next decade.

The Armed Services, by far the largest customers of electronic products, spent an estimated $145,000,000 in 1948 for electronic equipment for communications, navigation, gunnery systems, etc. Today, government electronic purchases amount to $2,300,000,000 (or 6.3 per cent) of its total defense expenditures. Within the decade, this may increase to 10 per cent of total government buying as the Armed Services become increasingly electronified. It is estimated that government electronic purchases will amount to over $4,000,000,000 by 1964.

The potential volume in commercial and industrial electronics is unprecedented, especially in the field of computers, the heart of data processing, and "automation." Sales of electronic equipment to commerce and industry amounted to $1,000,000,000 in 1954, and the surface was barely scratched. This figure will more than double within the next ten years, for this area of electronics has a future limited only by one's imagination.

The future of Electronics has no horizon. Many of the nearly 2,000 scientists and engineers throughout Sylvania are working on Electronics, constantly finding new and better ways to put Electronics to work. *They are keeping an eye to the future—assuring constant progress in the years ahead* . . . "the world's most promising technological revolution."

(Engineers: *Sylvania has many opportunities in a wide range of defense projects. If you are not now engaged in defense work, you are invited to contact David W. Currier, Supervisor of Professional Placement, Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.*)

SYLVANIA

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

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

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"44" RESIN, "RESIN-FIVE" and PLASTIC ROSIN—Kester Flux Core Solders belong at the very top of the solder hit parade when it comes to quality, speed, uniformity and economy. An unbroken record of dependability is what makes Kester a sure-fire "cure" for lagging production. Better switch now to Kester . . . a real production record maker!

WRITE TODAY for Kester's NEW 78-Page Informative Textbook, "SOLDER . . . Its Fundamentals and Usage."

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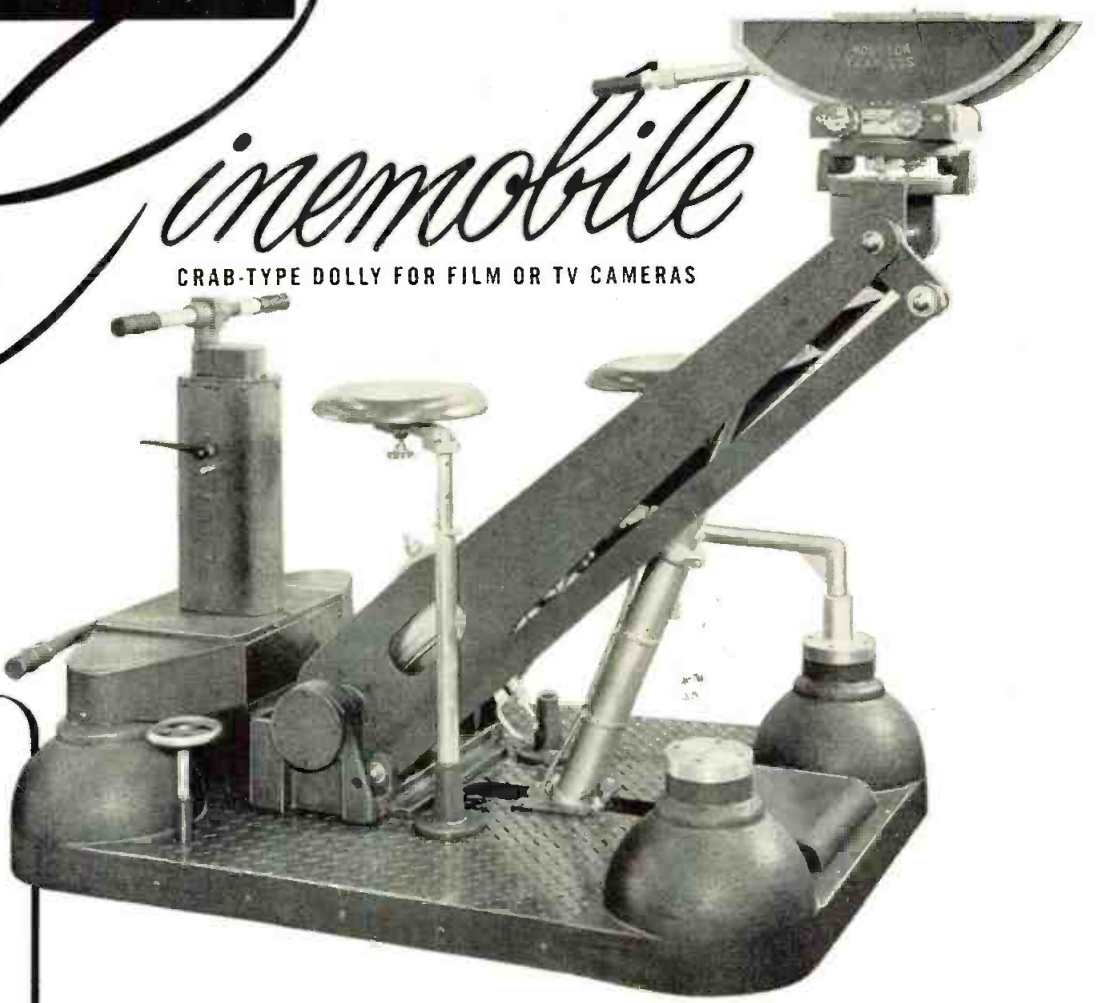
NEW! IMPROVED

Cinemobile*

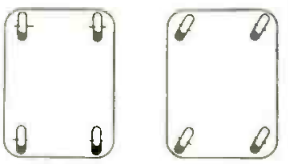
CRAB-TYPE DOLLY FOR FILM OR TV CAMERAS



NEW

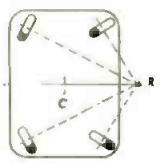
STEERING SELECTOR

Type of steering is easily and quickly changed by simply rotating steering bar — without removing hands from the bar. Turns on own axis, in any desired arc or tracks in a straight line.



STRAIGHT TRACKING

PARALLEL STEERING



CIRCULAR STEERING

PIVOTING

The most versatile, most maneuverable of all motion picture or TV camera dollies is now better than ever with many important improvements.

NEW BEARINGS. Rolls easily, smoothly on new, precision bearings in wheel spindles.

IMPROVED TRACKING. Tracks in a steady, straight line for running dolly shots.

NEW FLOOR LOCK. Cinemobile can be quickly locked in position for fixed location shooting.

NOW — 2 SEATS. Second seat provided for assistant cameraman.

LEVELING HEAD. Compensates for out-of-level floor condition.

NEW HYDRAULIC SYSTEM. Raises or lowers camera boom smoothly, quietly, automatically from extremely low to 57" high even with dolly in motion. New hydraulic fluid available everywhere.

*Shown with new H-F Cradle Head (not included).

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Send information on ( ) Cinemobile ( ) Panoram Dolly
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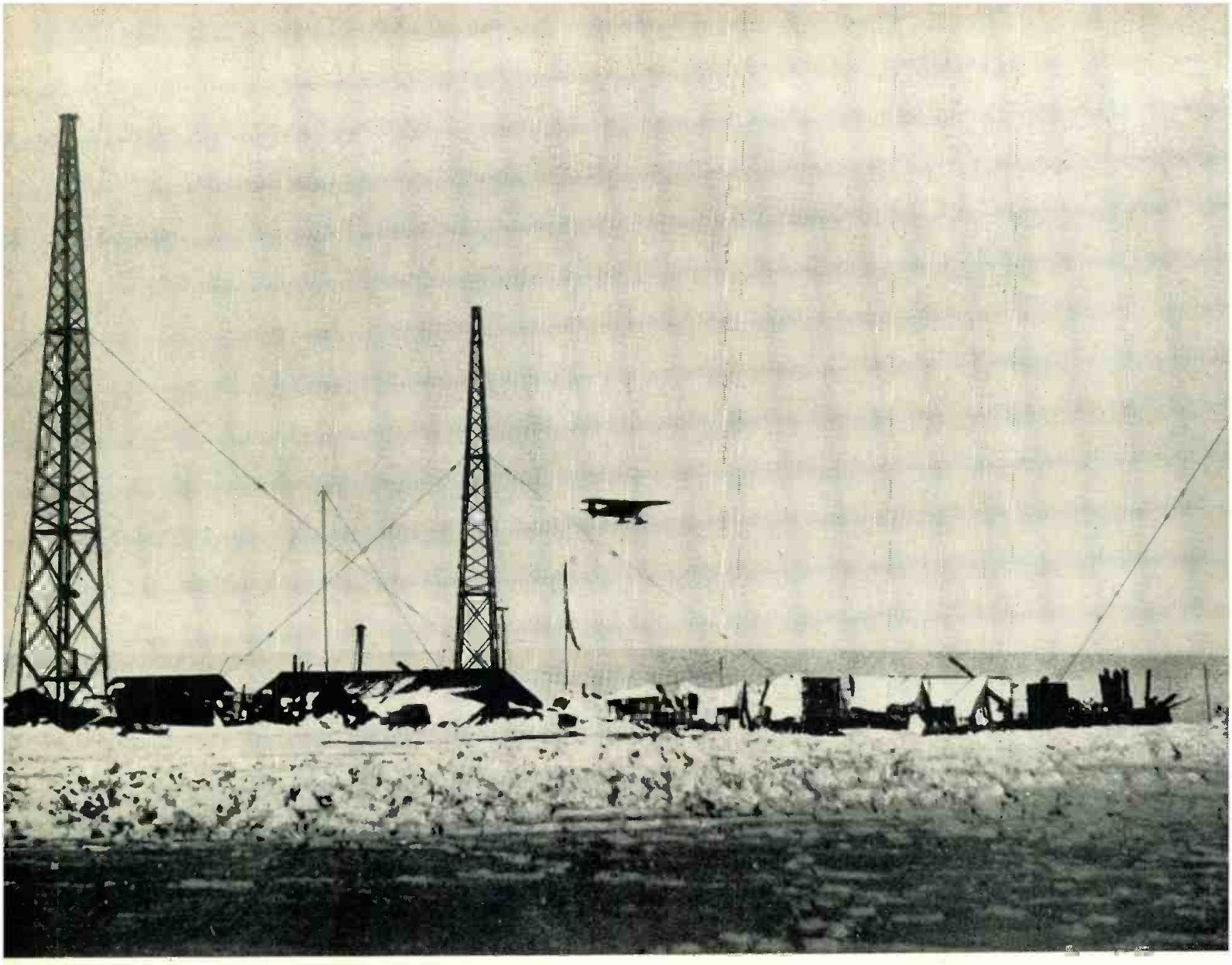
"WORLD'S LARGEST MANUFACTURER OF MOTION PICTURE FILM PROCESSING AND TV STUDIO EQUIPMENT"



latest Byrd Expedition finds BLAW-KNOX Towers . . . installed on first trip to Little America in 1928

Installed by the first Byrd Expedition to the South Pole in 1928, these three Blaw-Knox radio towers have stood firm against the antarctic's severest wind and weather conditions for more than a quarter-century.

And over forty years ago, at the other end of the earth, four 300-foot Blaw-Knox self-supporting "wireless" towers were installed at Ketchikan, Alaska. First of their type, these towers still provide good service, despite extreme cold, wind and ice conditions encountered in that arctic area.

While these two examples are rather spectacular, they typify the sturdy strength of all Blaw-Knox antenna towers . . . designed and constructed to meet your specific operating requirements.

For more complete information on the many modern types of guyed and self-supporting Blaw-Knox Antenna Towers, write for your copy of Bulletin No. 2417.

BLAW-KNOX COMPANY
BLAW-KNOX EQUIPMENT DIVISION
PITTSBURGH 38, PENNSYLVANIA

BLAW-KNOX

ANTENNA TOWERS

Guyed and self-supporting—for AM • FM • TV • radar • microwave • communications

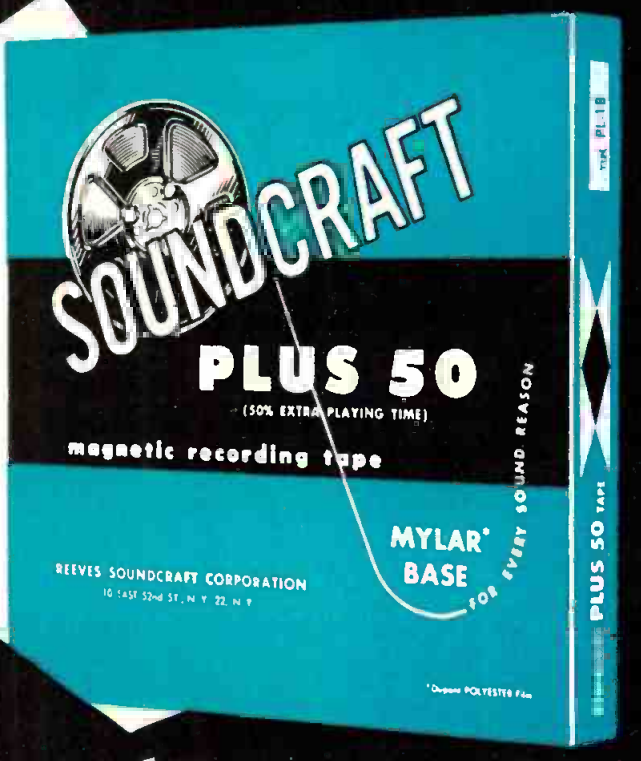
THE TAPE YOU'VE BEEN WAITING FOR!

SOUNDCRAFT

"PLUS 50"

(50% EXTRA PLAYING TIME)

magnetic recording tape



- 50% EXTRA PLAYING TIME
- EXTRA STRENGTH "MYLAR" BASE
- FULL DEPTH OXIDE COATING
- . . . YET COSTS NO MORE

PLUS 50 is the *perfected* "long-playing" magnetic tape, bringing you *50% extra* playing time with no compromise in strength or recording quality.

One reel of "Plus-50" is equal in recording or playback time to 1½ reels of standard tape. More listening per reel . . . less time changing reels. Best of all, Soundcraft "Plus-50" *actually costs less per foot* than quality acetate-base tapes!

The secret of "Plus-50" lies in its extra thin "Mylar" base (1 mil as compared to 1.5 mils in acetate tapes). "Mylar," DuPont's Polyester Film, contains no plasticizer. It will not cup or curl. Elongation and shrinkage from heat, cold and humidity are barely measurable. And it's far stronger than the thicker acetate . . . one third as strong as steel!

There has been no compromise in the development of "Plus-50"—a big advantage for you! The oxide coating is *constant, full-depth*—to maintain correct frequency response, output level, and bias characteristics. No machine adjustments are needed. "Plus-50" can be interspliced with other fine quality tapes without level change.

See your Soundcraft Dealer for "Plus-50" as well as these other famous Soundcraft Magnetic Recording Tapes:

Soundcraft Recording Tape (in the box with The Red Diamond) the all-purpose "Standard of the Industry."

Soundcraft Professional Tape (in the box with The Blue Diamond) for radio, TV and recording studios. Splice-free up to 2400 feet. Standard or professional hubs.

Soundcraft LIFETIME® Tape (in the box with The Yellow Diamond) for priceless recordings. DuPont "Mylar" base. For rigorous use . . . perfect program timing.

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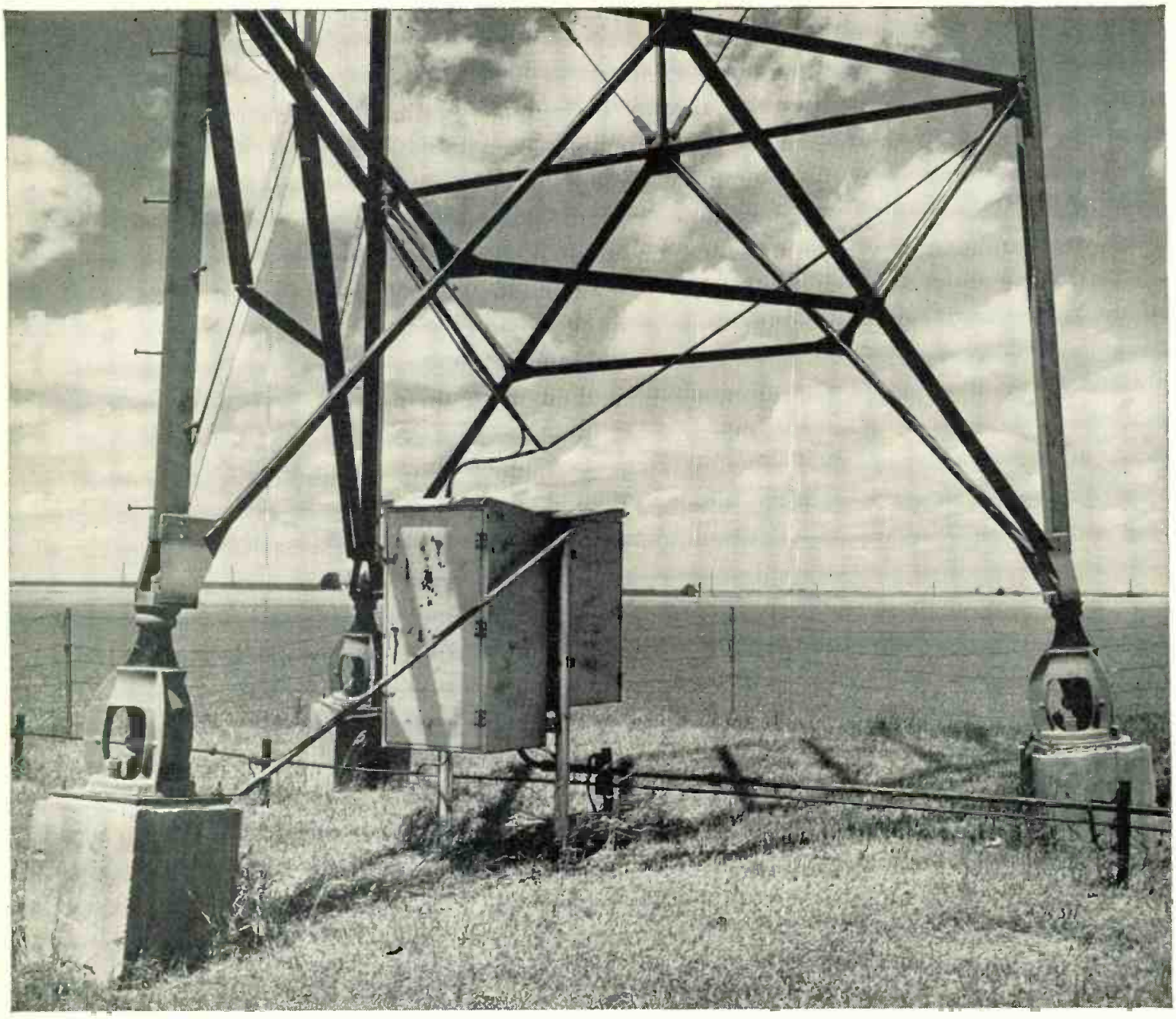

Base for Broadcasting

This is the base of a Truscon Self-Supporting Steel Tower. Standing sturdy and staunch astride the heart of the wheat country, it helps broadcast the AM signal of KFRM, Concordia, Kansas.

This picture of a firm, solid base, securely anchored, is but part of the story of Truscon "towers of strength." From this base rises a beautifully engineered, precision-manufactured steel spire that stands strong and steadfast against wind and weather.

Truscon knows towers. Truscon builds them for you tall or small . . . tapered or uniform in cross section . . . guyed or self-supporting . . . for AM, FM, TV, and Microwave broadcasting. Your phone call or letter to any Truscon district office, or to "tower headquarters" in Youngstown, will get your tower program under way without delay. Truscon® is a name you can build on.

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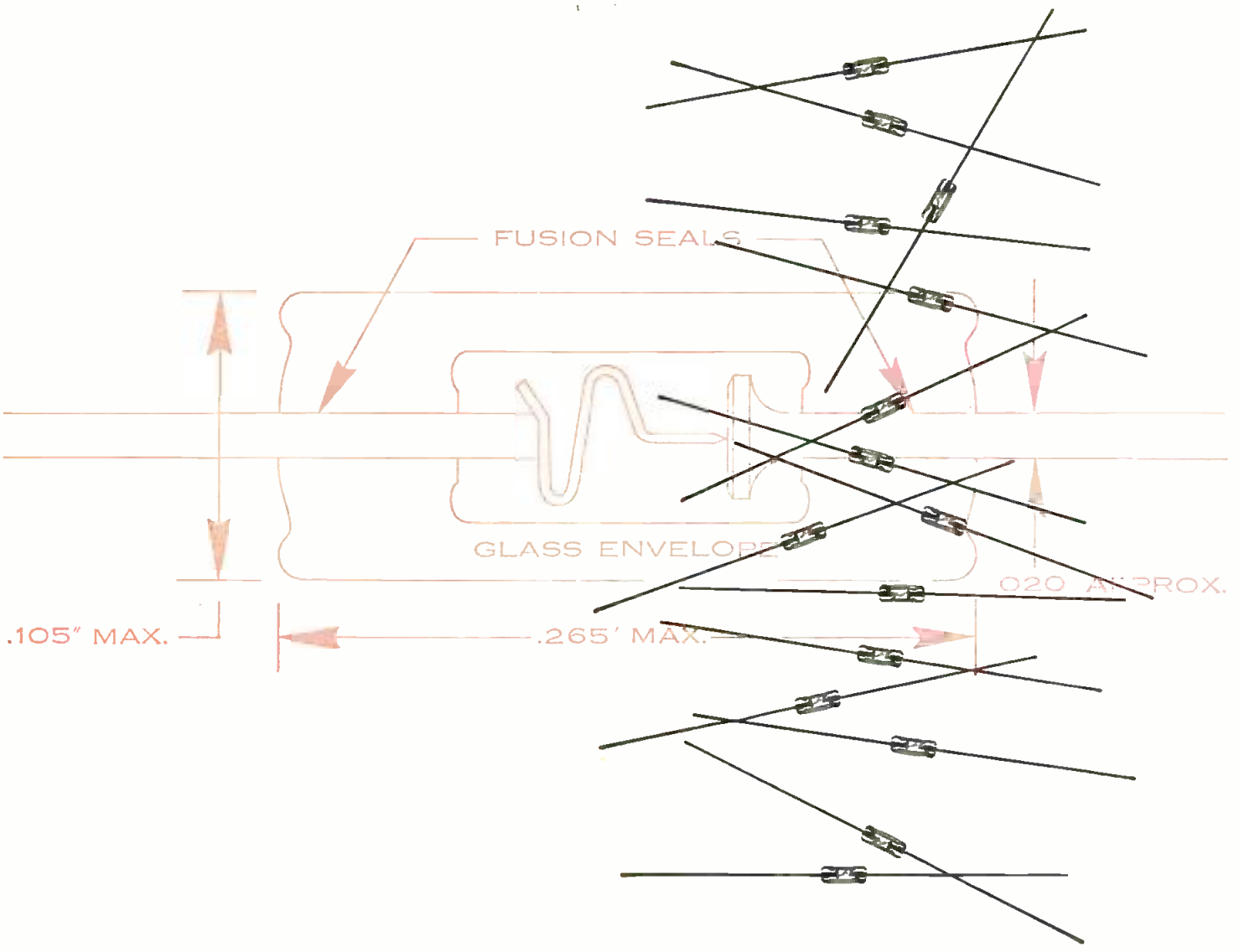
TRUSCON STEEL TOWERS • AM • FM • TV • MICROWAVE



FIRST OF ALL FOR **RELIABILITY**

HUGHES SEMICONDUCTOR PRODUCTS

Why should YOU *use Hughes semiconductors? First of all—for reliability. You can depend on these devices to stay within published ratings and specifications under varied and severe operating conditions.*

All diodes made by Hughes are:

MOISTURE-PROOF—Fusion-sealed in a one-piece glass envelope. This construction eliminates a major cause of diode failure.

RUGGED—Small volume and mass enable them to withstand physical shock and vibration.

STABLE—Internal elements are isolated from damage or contamination. Mechanical and electrical characteristics remain stable throughout a long operating life.

THOROUGHLY TESTED—All diodes are tested for electrical and mechanical characteristics. They operate faithfully over wide ambient temperature ranges.

SUBMINIATURE*—In miniaturized circuitry, the high component density possible with these diodes promotes greater volumetric efficiency.

For instance, Hughes subminiature diodes have now been used by many major manufacturers of electronic equipment. Without exception, available performance reports indicate that, in military and commercial installations alike, the Hughes components have maintained an extraordinary record of failure-free service. Today, these same diodes are continuing to add to the reputation for superior reliability synonymous with Hughes Semiconductor Products.

The Hughes line of semiconductor devices is being steadily expanded. It now comprises a wide selection of Germanium Point-Contact and Silicon Junction Diodes, and Photocells. New products, now under development, are being readied for commercial production. Watch for their release. They, too, will embody the same Hughes quality in design and manufacture that spell out unsurpassed stability and reliability. Specify Hughes—with confidence.

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**Maximum dimensions, standard germanium diode glass envelope: 0.265 inch by 0.105 inch.*

Letters . . .

Editors, Tele-Tech

In your February editorial "How Much Censorship" your fear that "voluntary cooperation" may take on a mandatory flavor is quite natural, but I can assure you that it won't happen here. Quite a bit of concern in this connection has been stirred up in certain newspapers, but nearly all of it traces back to a single source—Russell Wiggins, Chairman of the Freedom of Information Committee of the American Society of Newspaper Editors.

I can assure you that there won't be anything remotely resembling censorship coming out of this office. We are not even urging editors to submit matter to us for comment, and if an editor should seek our advice he will be entirely free to follow his own good judgment.

Wiggins asks "who will decide what will be published?" The answer is very simple. The individual editor will make his own decisions in every case, just as he has always done—in fact just as your editorial describes it: "Responsible editors usually screen out material of direct military value in any event since they are acutely aware of the significance of specific developments in their field."

If, then, editors will keep on doing just what they have always done, you may reasonably ask what, then is the function of OSI as far as the editors are concerned. The answer is to *increase the existing awareness* of certain areas where a responsible editor will wish to be watchful.

The Soviet Bloc

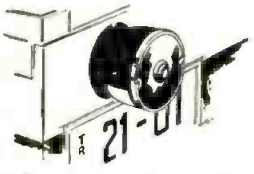
Another matter that has become subjected to considerable editorial punishment is the need of our own people for information. The false idea has gotten around that OSI would disapprove of the publication of any information that could be of a strategic help to the Soviet bloc. We would never consider taking such a position since we feel that practically all information will help the Soviet bloc—even a better way to bake bread. All we would hope for would be the application of balanced editorial judgment in each case to determine whether the net gain to our own people is greater than the damage done by passing useful information to an enemy.

One apparently reasonable ques-

(*Continued on page* 106)

TINNERMAN Speed Nut SAVINGS STORIES

Fewer tools, lower costs, no rejects ...with Tinnerman SPEED NUTS!



A change to Tinnerman SPEED NUT brand fasteners can eliminate production problems in addition to saving important assembly dollars! Here's proof. The Peterson Manufacturing Company, Kansas City, Missouri, formerly assembled its Combination Stop and Tail Lamp with four stamped and tapped brackets. Costly equipment was necessary to manufacture the brackets, and misalignment of holes often made assembly difficult. Damage to units on the assembly line averaged 5%!

Four SPEED NUTS have changed everything! Material costs have been cut a whopping 60%! The tools to manufacture the brackets are eliminated. The easy lead-in provided for screws by the SPEED NUT impression cuts assembly time 20%, increases production by 15%. Misalignment of holes presents no problem for SPEED NUTS and assembly-line damage is completely eliminated!

Let Tinnerman help with your fastening problems. Ask your Tinnerman representative or write for complete details on our Fastening Analysis Service.

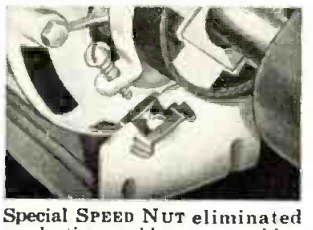
TINNERMAN PRODUCTS, INC. • BOX 6688, DEPT. 12, CLEVELAND 1, OHIO

Canada: Dominion Fasteners, Limited, Hamilton, Ontario. *Great Britain:* Simmonds Aerocessories, Limited, Treforest, Wales. *France:* Aerocessoires Simmonds, S. A., 7 rue Henri Barbusse, Levallois (Seine). *Germany:* Hans Sickinger GmbH "MECANO", Lemgo-i-Lippe.

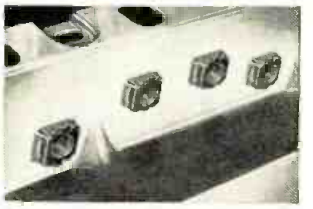
TINNERMAN Speed Nuts® FASTEST THING IN FASTENINGS®

TYPICAL USES

"U" type SPEED NUTS cut assembly costs, maintenance on farm equipment.

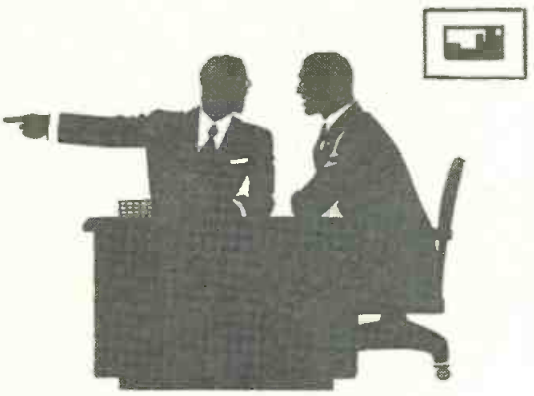


Special SPEED NUT eliminated production problems on washing machine motor mount bracket.



SPEED GRIPS eliminated costly repairing of truck radiators returned because of weld breaks.

YOU CAN RELY ON BUSS . .



for Fuses of Unquestioned High Quality

Here's why—Millions upon millions of BUSS fuses have given dependable electrical protection in homes, on farms and in industries over the past 40 years, thus establishing the unquestioned high quality of BUSS fuses.

With a reputation like this, BUSS can't afford to take a chance with faulty fuses that could injure its business and yours.

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

Fuses that give you double protection against loss of user goodwill are the result. Not only are users guarded against damaged equipment when there is trouble on the circuit, but they are also protected against irritating shutdowns caused by needless blows.

Then why not be sure your buying and stock records specify BUSS and FUSETRON fuses . . . you'll save time and trouble by using BUSS as the one source for all your fuse needs.

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

BUSSMANN MFG. CO.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Div. of McGraw Electric Co.

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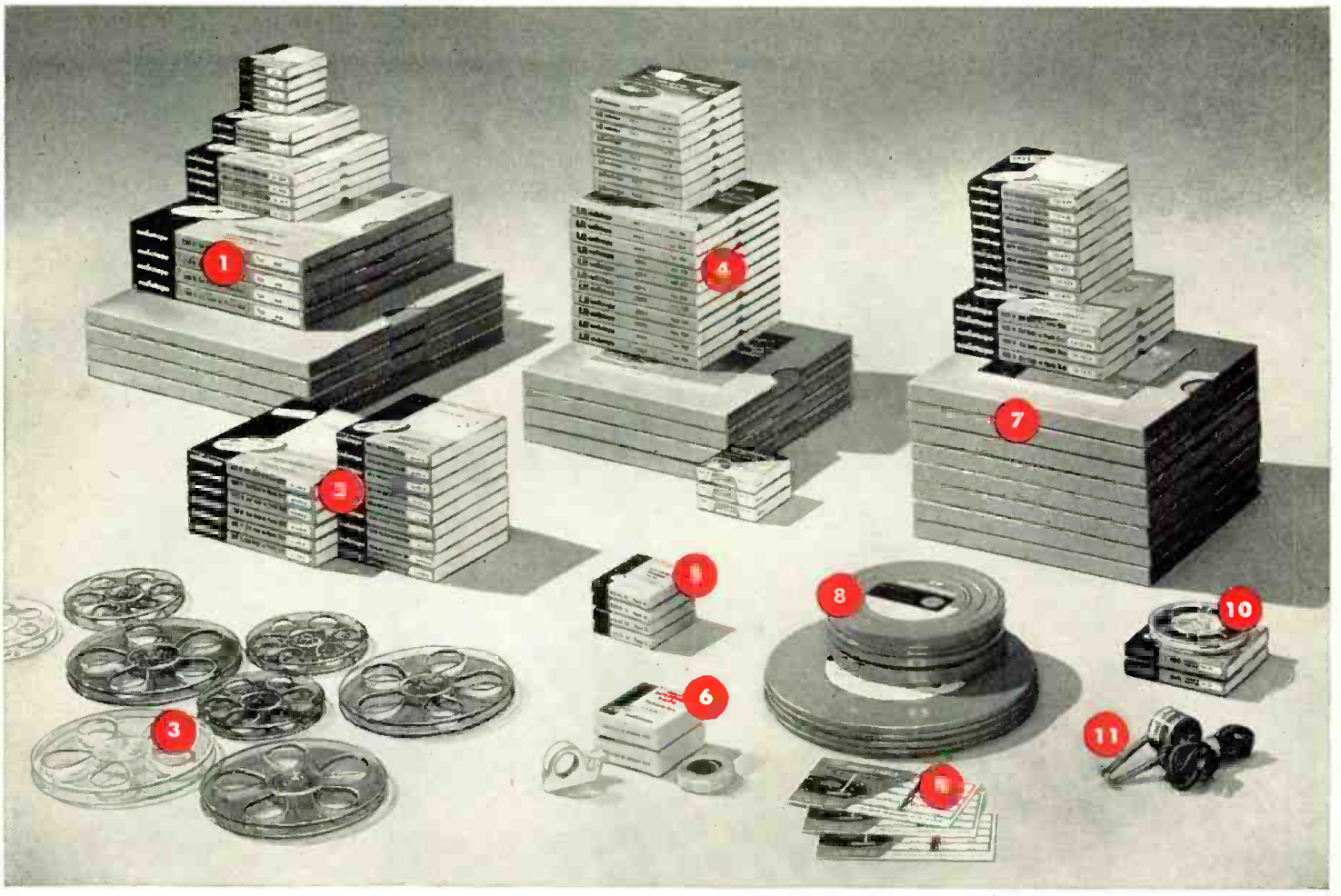

audiotape now offers you

THE MOST COMPLETE LINE

of recording tape and accessories

1 PLASTIC-BASE AUDIOTAPE
The finest, professional quality recording tape obtainable — with maximum fidelity, uniformity, frequency response and freedom from background noise and distortion.

2 COLORED AUDIOTAPE
Same professional quality as above, but on blue or green plastic base. Used in conjunction with standard red-brown tape, it provides instant visual identification of recorded selections spliced into a single reel — fast, easy color cueing and color coding. Available at *no extra cost!*

3 COLORED AUDIOTAPE REELS
Plastic 5" and 7" Audiotape reels in attractive, jewel-tone colors — red, yellow, green and blue — provide still greater flexibility of color coding any tape recorded material according to subject matter, tape speed, single or dual track, etc. Also available at no extra cost.

4 TYPE "LR" AUDIOTAPE
Made on 1-mil Mylar* polyester film, it provides *50% more* recording time per reel. The thinner, stronger base material assures maximum durability and longer storage life even under adverse conditions.

5 SELF-TIMING LEADER TAPE
A durable, white plastic leader with spaced markings for accurate timing of leader intervals.

6 SPLICING TAPE
Permacel 91 splicing tape is specially formulated to prevent adhesive from squeezing out, drying up or becoming brittle.

7 STANDARD AUDIOTAPE ON "MYLAR" POLYESTER FILM
High-strength, super-durable Audiotape that meets highest professional standards of performance. Available in 1, 1½ and 2 mil base thickness.

8 TYPE "EP" AUDIOTAPE
Extra Precision magnetic recording tape for telemetering, electronic computers and other specialized data recording applications.

9 ADHESIVE REEL LABELS
Provide positive identification of your tapes, right on the reel.

10 HEAD ALIGNING TAPE
Test frequencies, pre-recorded with precisely correct azimuth alignment, permit accurate aligning of magnetic recording heads.

11 AUDIO HEAD DEMAGNETIZER
Completely removes permanent magnetism from recording heads in a few seconds.

This complete Audiotape line is backed by more than 16 years of specialized experience in the sound recording field, by America's largest exclusive manufacturer of sound recording media, both discs and tape. For full details on any of these items, see your Audiotape dealer, or write to Audio Devices.

AUDIO DEVICES, Inc.
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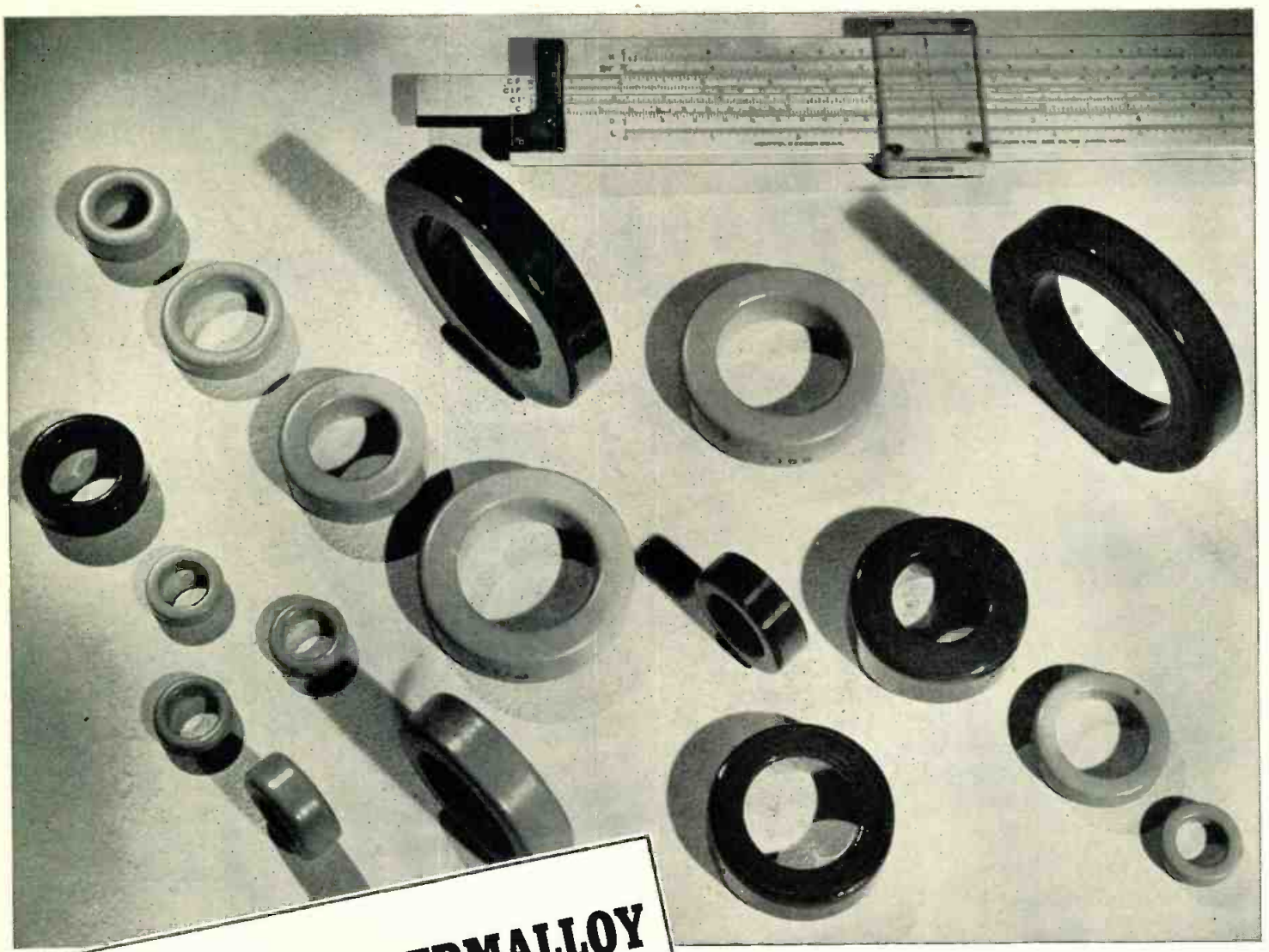


MOLYBDENUM PERMALLOY POWDER CORES*

(New technical data now available)
Write for Bulletin PC-104A, dated March 15, 1955

HIGH Q TOROIDS for use in Loading Coils, Filters, Broadband Carrier Systems and Networks—for frequencies up to 200 K C

COMPLETE LINE OF CORES TO MEET YOUR NEEDS

★ Furnished in four standard permeabilities—125, 60, 26 and 14.

★ Available in a wide range of sizes to obtain nominal inductances as high as 281 mh/1000 turns.

★ These toroidal cores are given various types of enamel and varnish finishes, some of which permit winding with heavy Formex insulated wire without supplementary insulation over the core.

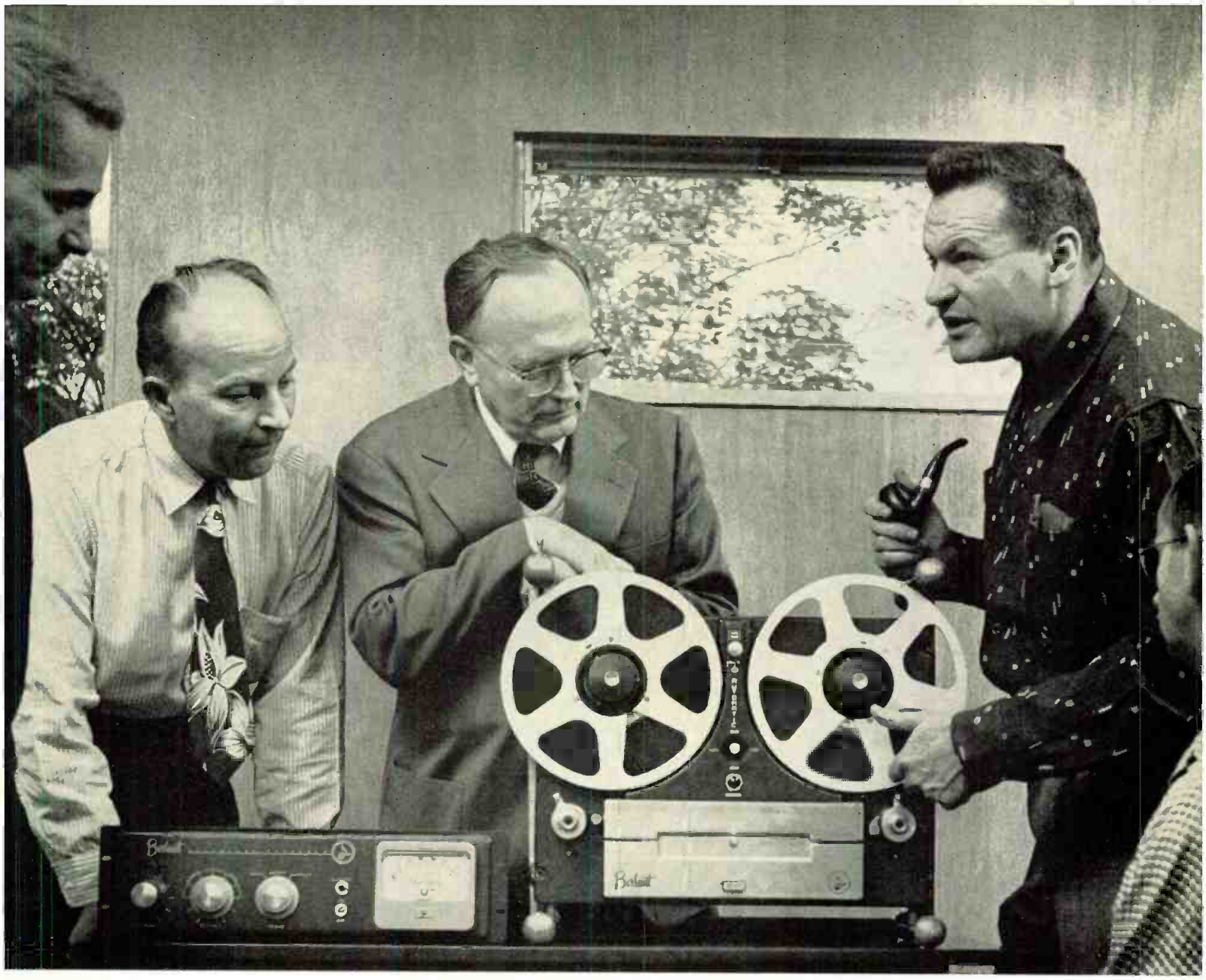
For high Q in a small volume, characterized by low eddy current and hysteresis losses, ARNOLD Moly Permalloy Powder Toroidal Cores are commercially available to meet high standards of physical and electrical requirements. They provide constant permeability over a wide range of flux density. The 125 Mu cores are recommended for use up to 15 kc, 60 Mu at 10 to 50 kc, 26 Mu at 30 to 75 kc, and 14 Mu at 50 to 200 kc. Many of these cores may be furnished stabilized to provide constant permeability ($\pm 0.1\%$) over a specific temperature range.

*Manufactured under license arrangements with Western Electric Company

W&D 4744

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION
General Office & Plant: Marengo, Illinois
DISTRICT SALES OFFICES . . . New York: 350 Fifth Ave.
Los Angeles: 3450 Wilshire Blvd. Boston: 200 Berkeley St.



"Better than pushing buttons..."

A quick flick of the thumb... it's on "RUN." At any speed, another flick stops the tape. Fast forward and reverse are just as simple. What's more, it can be fully operated from a remote position with the same easy *"joy stick control."*

In a final test session, the engineering team responsible for the design and production of the new Berlant Automatic Recorder BAR-1 was highly gratified with the final analysis and performance of the new machine. Meeting with Bert Berlant, president of Berlant Associates, they put the new recorder through a series of rigorous tests. They found the new automatic control fool-proof.

Tested under actual working conditions, the new *"joy stick control"* marks a new advance in the art of magnetic recording. It is an exclusive feature which has been added to all the outstanding advantages of the Berlant Broadcast Recorder BR-1.

The new Berlant Automatic meets every requirement of the recording studio, radio station or industrial application. Its provision for five heads (three are standard) permits both single and dual track operation. The BAR-1 also includes an A-B test fader which allows metering between incoming signal and playback without transients or clicks.

And these additional requested features: Hysteresis synchronous direct drive with 99.8% timing accuracy. Instantaneous *Reeloks*. Automatic cut-off. Tape tension arms. Adjustable bias. Simplified cueing and editing.

All of the above are what 382 different engineers asked for in a questionnaire before work was started. We considered the man in the figure department, too. He wants dependability and low maintenance cost... at the right price! We've given it to him.

$695 IS THE PROFESSIONAL USERS NET FAIR TRADED PRICE

You'll want to test it yourself, we know. For a distributor close to you, for more complete technical brochure, write: Berlant-Concertone,

4917 West Jefferson Boulevard,
Dept. M13, Los Angeles 16, California

THIS IS REPORT NO. 3 IN A SERIES OF FIELD TESTS.

Manufacturers of Concertone... world's foremost high fidelity recorders and accessories.

A SNAP FOR WIRING BOARD ASSEMBLIES

NEW Sprague Type 28D Push-Lok* Electrolytic Capacitors Give Fast, Fool-Proof Mounting

HERE'S THE BEST APPROACH yet to electrolytic capacitors for printed wiring board assemblies.

It's Sprague's new Type 28D Push-Lok Electrolytic. Just insert the connecting lugs through the slots in the wiring board, and the capacitor is held securely in place until the chassis is ready for dip soldering . . . so securely that solder gaps are eliminated. Spring action of the Push-Lok lugs is strong enough to hold relatively heavy capacitors in place, even when the board is carried sideways, or upside-down on a conveyor. Tab connections are always in close contact with the printed conductors. Yet, unlike other designs, no secondary operations are required for this fast and secure mounting.

Other advantages include:

Fool-Proof Positioning—A Push-Lok can only be inserted the right way. A wide index terminal is provided in the mounting ring to index the assembly on the chassis or other surface if desired.

The Ability to Print Wiring Boards on Both Sides—Shoulders on the Push-Lok lugs plus additional prongs keep the capacitors clear of the chassis.

Safety—Circular shield conforms with suggestions of Underwriters' Laboratories, Inc. Tools cannot be inserted easily between the bottom of the capacitor and the chassis.

FOR COMPLETE INFORMATION on these new Type 28D Push-Lok electrolytic capacitors, write for Engineering Bulletin to Sprague Electric Co., 233 Marshall Street, North Adams, Massachusetts.

**Push-Lok is a Trademark of the Sprague Electric Company*

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

SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

Export for the Americas: Sprague Electric International Ltd., North Adams, Mass. CABLE: SPREXINT

TELE-TECH
& Electronic Industries

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

Government Purchasing and Electronic Industries

In our editorial "Bargain Days for Uncle Sam" (Feb. issue), we pointed out that manufacturers were bidding for government contracts at prices which in some instances are even less than the cost of the materials involved. Now we feel a closer look at government procurement practices is in order because of the industry changes that these policies are creating and because of the possible effects these changes may have.

SINGLE WEAPON CONCEPT

Air Force procurement favors a "single weapons concept." Under this concept the manufacturer is given a contract to produce the complete end item or system desired. For example, an aircraft manufacturer provides the complete airplane—engines or power plant, electronic equipment, airframe and all. He in turn, as a prime contractor, subcontracts with other manufacturers the specialized equipment that he does not produce. From a government viewpoint this concept appears valid because it enables the procuring agency to minimize the number of contractors with whom it has to do business. But what are this concept's effects.

Airplane manufacturers have been constantly expanding their productive facilities to do more and more under their own roofs. As a result, the "old line" radio and TV manufacturers suffer because their available facilities are not being employed. One effect of this concept then, has been to multiply productive facility without providing the means of keeping them operating.

Frequently, these contracts involve research and development (R&D) work. Formerly the aircraft industries went to electronic manufacturers to get this phase of the work completed, since these were the only companies maintaining extensive R&D facilities. In due time, however, prime aircraft contractors established R&D facilities of their own with the result that we again have "facility twinning."

Small wonder then that the competitive bidding by electronic manufacturers on other government contracts has become so keen. The regular electronic producers, many of whom expanded to meet the initial equipment demands of the government for Korea, now strive desperately to retain their facilities!

R&D CONTRACTS

R&D contracts are contracts where the supplier is required to give the government an answer to a problem but actual production of equipment is not required. As such these contracts are welcomed by the industry.

But a more complicated situation occurs when R&D is associated with production. Here the government may let two or more individual contracts, one for the research and development and the others for actual production. The latter are based on lowest competitive bids and herein lies the pitfall.

A large electronic manufacturer working on an R&D contract frequently calls upon his regular specialized vendors to assist him in overcoming any specialized technical problems encountered. The vendors, in anticipation of ultimately receiving the production order, may provide their facilities at cost or even at a loss. The prime R&D contract holder may similarly provide some of his facilities on this basis. Then the R&D holder may lose the production contract through competitive bidding, despite the fact that the difference in bidding is much less than the money-saving, time-saving experience gained during R&D work.

Through R&D on a given project the performer gains know-how which can't be transferred along with the drawings to the lowest competitive production bidder. Small wonder that we find repeated instances of the R&D performer with idled production facilities being called on to assist his competitor to meet contractual obligations.

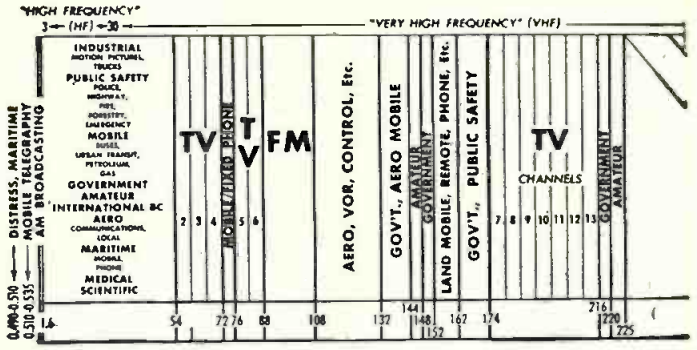
There is a final government procurement aspect which should be mentioned. It is not confined wholly to the electronic industries and can be regarded as being political in character. In the awarding of contracts the electronic manufacturer who has a substantial proprietary business may be at a disadvantage as contrasted to those whose production is 100% for the government. The reason here is that it is desirable to maintain in production any sizeable plants operating wholly for the government to avoid unemployment. Unemployment conditions, regardless of where they occur, always reflect unfavorably on the administration. Aircraft industries figure heavily in this respect.

WHAT TO DO?

There seems to be no direct solution to the complicated government procurement problems. Nearly all of us have run across one or more phases in our daily activities. The overall picture may, however, have escaped us. This we have tried to present herewith in the hope that through "open airing" a smoother procurement program will be achieved!

RADARSCOPE

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

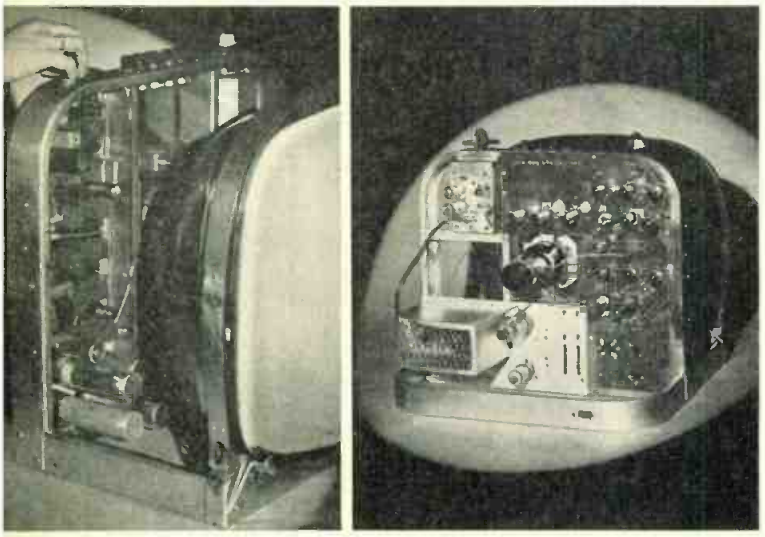


RADIO BROADCASTING and receiving of messages in the wellknown voices of some of our popular radio announcers is a requirement to prevent panic. Val Peterson, Civil Defense, says when we take to our backyard or basement "dugouts," if and when we have to, the human under such conditions craves communication with fellowman. Some tests may be run soon to find what frequencies penetrate into "dugouts," what type receiver and antenna is suited for this rather unusual service. It is rumored that Civil Defense is looking for a low-cost receiver using transistors which can be left running in the homes of our citizens, tuned to the broadcast frequency which will bring the first news of approaching enemy planes. The people in homes possessing such receivers might have the advantage of early warning at a time when a few extra minutes might be the difference between 95% protection from atomic "fallout" or no protection.

UNOFFICIAL REPORTS claim that Bell Telephone Laboratories has developed a low-power tetrode tube which operates at frequencies up to 500 mc, with bandwidths from 100 to 500 mc.

RETMA CIRCULATING new standard proposals for solder-ability; multiplex equipment telephone channels; and standard plating thickness for solderable surfaces other than wire.

PROJECT TINKERTOY TV



Photos show ACF Electronics progress in using Project Tinkertoy automation techniques (TELE-TECH Nov. 1953) in conjunction with printed circuitry in development of a modern TV receiver. This 21-in receiver featuring modular construction has 195 component parts plus the tuner. 153 parts are embodied in 17 modules. 42 remaining parts are represented by power resistors, electrolytic capacitors, hardware, tunable parts, iron core transformers, etc.

TAKE IT OR LEAVE IT: One of the world's foremost microwave engineers says that his group has enough information and experience to establish a U.S.-Europe microwave link in a single hop across the Atlantic Ocean. He estimates that about a year's time and a few million dollars would be required to complete development work and make the installations.

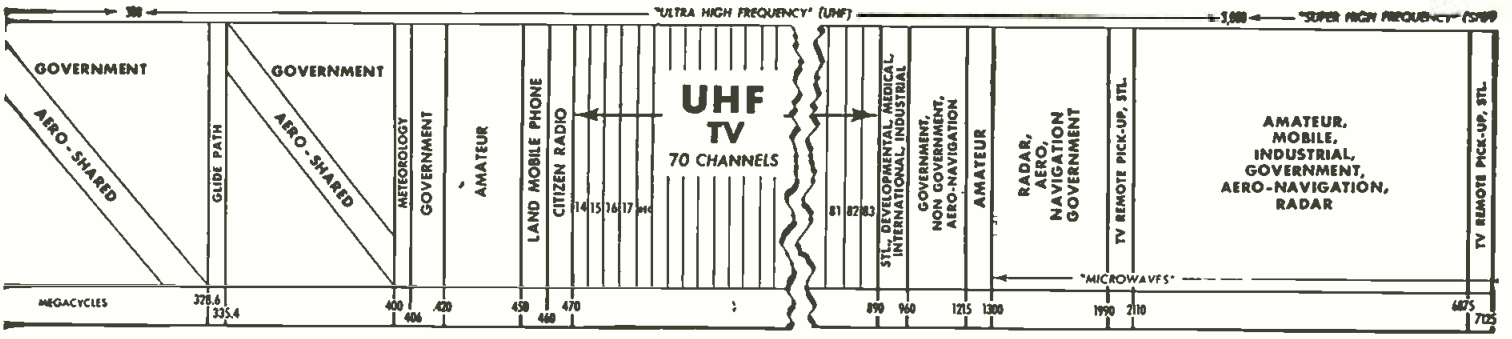
SILVER-MICA CAPACITOR failure in military electronic equipment due to the migration of silver caused some discussions between manufacturers and users of this type of component. An informal report from one large laboratory investigating this effect indicates that migration begins at once between two adjacent silver electrodes mounted on a porous insulator with 50% relative humidity, provided a voltage is applied to the electrodes. A metallic "tree" grows out from one electrode along the fibers of the insulation, increasing in size until a "short" circuit results. Usually there is sufficient current available to burn this away, whereupon it starts to grow again. With high humidity and some common but porous insulators, difficulty is experienced in 80 hours, but with other insulators having surfaces where moisture condenses with difficulty, 400 hours may pass before trouble is detected. Reliability-conscious design engineers may now use brass or some other base metal for contacts, or other current-carrying parts, mounted on insulating strips.

SIGNAL CORPS ENGINEERING LABS have embarked on an extensive program to apply power transistors in mobile equipment. The power transistors supplied by Transistor Products Inc., Waltham, Mass. are being used to replace vibrator and dynamotor type power supplies.

IRE's 24th professional group will be a Military Electronic Operations group. IRE committee number 27 has also been formed to deal with Radio Frequency Interference problems.

TRANSISTORS

Recent work of Dr. Walter K. Volkers and Norman Pedersen of the Millivac Instrument Corp. indicates that industry may be employing transistors at improper operating points when it comes to low-noise considerations. They claim that transistors are inherently less noisy than vacuum tubes if suitable operating parameters are selected. At the recent IRE show they demonstrated their new "Hushed Transistor Amplifier" which features less than 1 μv RMS noise over a 60 KC



band. In an early forthcoming issue they will detail operating parameter selection for the readers of TELE-TECH.

MICROWAVE

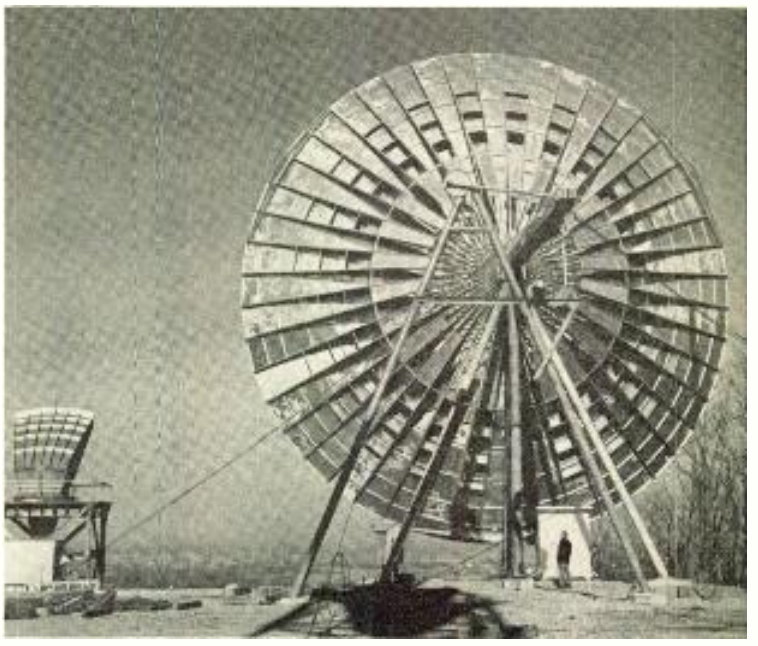
UNTIL RECENTLY the transmission of microwave frequencies was considered to be limited by the horizon, or by line-of-sight distances. Recent developments by Bell Telephone Laboratories and MIT now prove that it is possible to extend this range far beyond the nominal 30 miles to as far as 200 miles. By using higher power and concentrating the radiant energy in a straight-line beam aimed at the sky, sufficient signal is reflected to the ground by the atmosphere to actuate receivers. Experiments now use 10 kw transmitters and 60 ft. diameter antennas. See photo elsewhere on this page.

X-RAY ANALYSIS

IMPORTANT new applications where X-ray diffraction and spectrographic analysis instruments are helping to solve tough problems in more than a dozen different fields were announced recently by North American Philips Co. The cases involve:

1. Cattle raising—analyses for elements in fodder. Selenium in excessive amounts causes serious disease.
2. Electronic computers—analyses of impurities in $BaTiO_3$. Such impurities cause malfunctioning of electrical components.
3. Agriculture—analyses of ingredients related to killing power of insecticides.
4. Electronics—analyses of impurities in germanium. Important for effect on crystals, diodes and other components.
5. Dentistry—analyses of changes in structure of dentine and dental enamel.
6. Plastics—analyses of composition of woods prior to impregnation with resins and plastics.
7. Photographic Supplies—analyses of amount of silver on developed films.
8. Metals—analyses of amounts of silicon and aluminum in aircraft alloys.
9. Government inspection—analyses of contraband drugs in dilutants imported illegally.
10. Government Customs—analyses of dutiable elements imported as unprocessed raw materials.
11. Railroads—analyses of metals in used crankcase diesel oil to show unusual wear of engine parts.
12. Atomic energy—analyses of structure of *hot* samples.
13. Medicine—analyses of Fuller's earth and other laboratory materials for purity and characteristics.
14. Medicine—analyses of toxic elements in blood.
15. Oil Industry—analyses of trace amounts of vanadium and other contaminants in crude and refined oils.
16. Oil Industry—analyses of trace amounts of sulphur in gasoline, naphtha and other fuels.
17. Rubber Industry—analyses of amount of free and combined sulphur in cured stock.

MICROWAVES—BEYOND HORIZON



Rear view of new 60-ft. experimental antenna for TV and telephone microwave signals which receives from a station more than 200 miles distant. Bell Telephone Laboratories and Massachusetts Institute of Technology developed over-the-horizon transmission technique. Scoop-shaped antenna at left is new smaller unit employing round waveguides for application along regular line-of sight microwave routes. In these routes stations are spaced approximately 30 miles apart

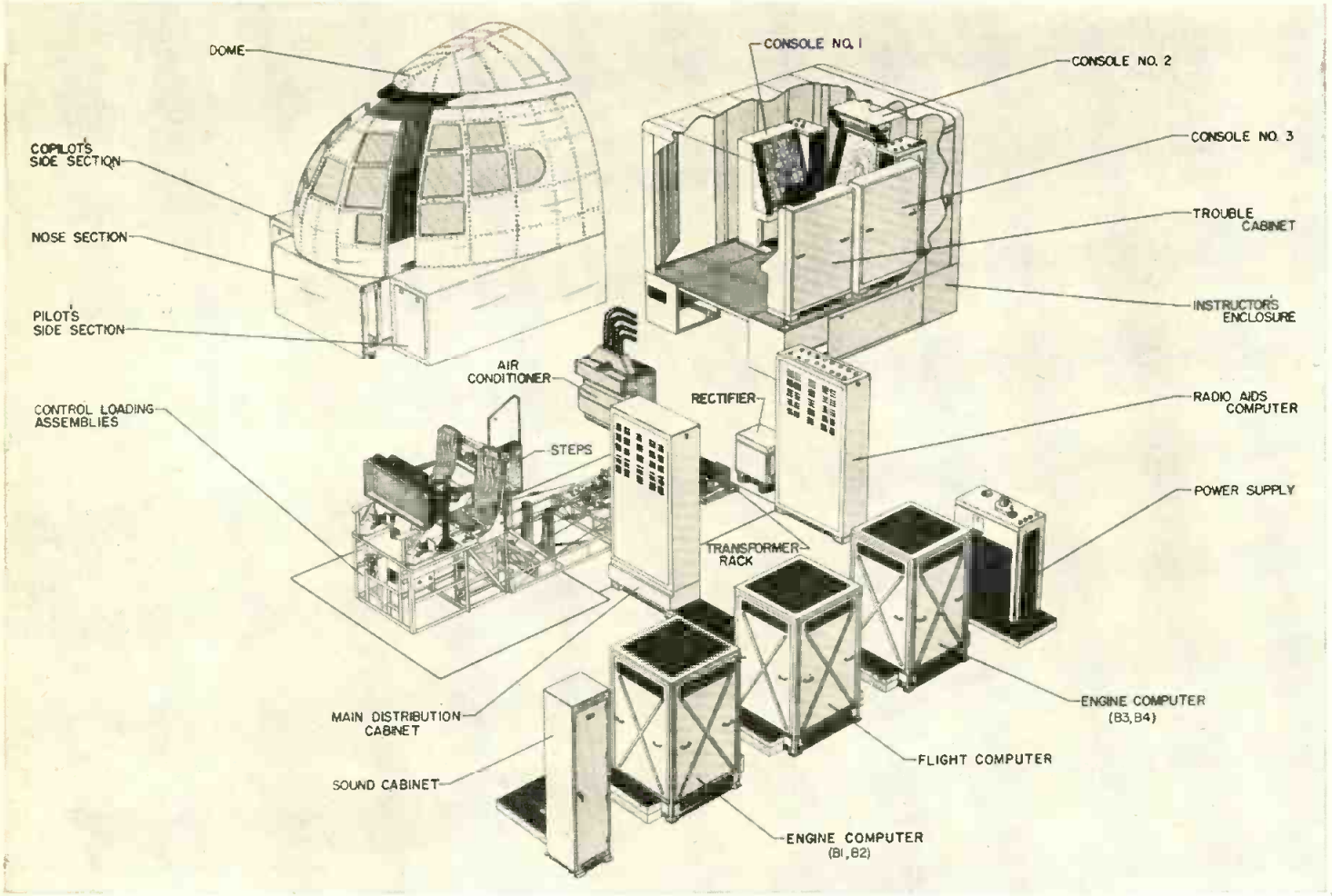


Fig. 1: Exploded view of Curtiss-Wright's simulator for C-97 transport shows four engine computers, flight and radio aids computers

Electronic Flight Simulators

By ALBERT J. FORMAN
ASSOCIATE EDITOR
TELE-TECH & ELECTRONIC INDUSTRIES

ELECTRONIC flight simulators are playing an increasingly vital role in Air Force operations. Adoption of these systems by commercial airlines is also on the rise. Their construction, operation and field maintenance should be of interest not only to engineers who design equipment for aircraft applications, but to electronic engineers generally. Much of the experience gained in field use is also applicable to gun fire controls, servo indicators, computers and similar devices.

The flight simulator, as defined here, is an electro-mechanical training device which faithfully reproduces the operation, performance and design of a specific type of aircraft. This should not be confused with missile-design computers or small basic instrument trainers or duplicators, which are also referred to occasionally as simulators.

Flight simulators are among the most complex electronic devices manufactured in production quantities outside of the laboratory. Their cost is high, between $800,000 and $1,000,000 for a four-engine unit. The Air Force, which has ordered close to 200 simulators, with about 115 already delivered, declares that they pay for themselves several times over, both in direct savings and intangible benefits.

The purpose of the flight simulator is to familiarize an already experienced pilot with the cockpit arrangement, procedures and terminology of a particular aircraft. In other words, part of the training (about 50%) which would normally require actual flight is given right in the simulator on the ground. In addition, by exactly duplicating how the aircraft would perform under adverse conditions, it is invaluable for practicing emergency procedures that would be dangerous or impossible to perform in the aircraft. So the first prime advantage of flight simulators is improved flight safety.

Direct saving in costs is another important attraction. The cost of flying a modern four-engine passenger plane of the stratocruiser type has been estimated at $550 per hour. The direct cost of operating a flight simulator is approximately $30 per hour. So every 1000 hours of simulator flight training effects a total savings of $520,000.

Another benefit is that no training time is lost due to bad weather or

Hundreds of flight simulators, costing up to $1,000,000 each, are being manufactured and placed in service to train pilots for specific aircraft types. Article discusses how these servo-computer systems exactly simulate aircraft's performance, and how preventative maintenance keeps down time down.

refueling requirements. Also, the reduced need for actual flying (without any reduction in training proficiency) is a big help to noise abatement, a problem which has plagued Air Force public relations in a number of residential communities.

Simulator Construction

The working heart of a simulator consists of the computer system which contains the formulas for aircraft and engine performance, the trouble console with which an instructor can realistically introduce various flight difficulties, and the power supply. See Figs. 1 and 2.

One typical simulator required the following:

7500 engineering drawings
700 electron tubes
66 motor-generator sets
250 transformers
4000 resistors
500 potentiometers
1000 gears
170,000 feet of wire
380 servo or computer stages
400 relays
plus a 3-ton air conditioner.

Basically, the electronic system contains five types of circuits: servo drive amplifier, summing amplifier, phase sensitive amplifier, thyratron control relay and audio amplifier. Servo units perform integrating and positioning functions.

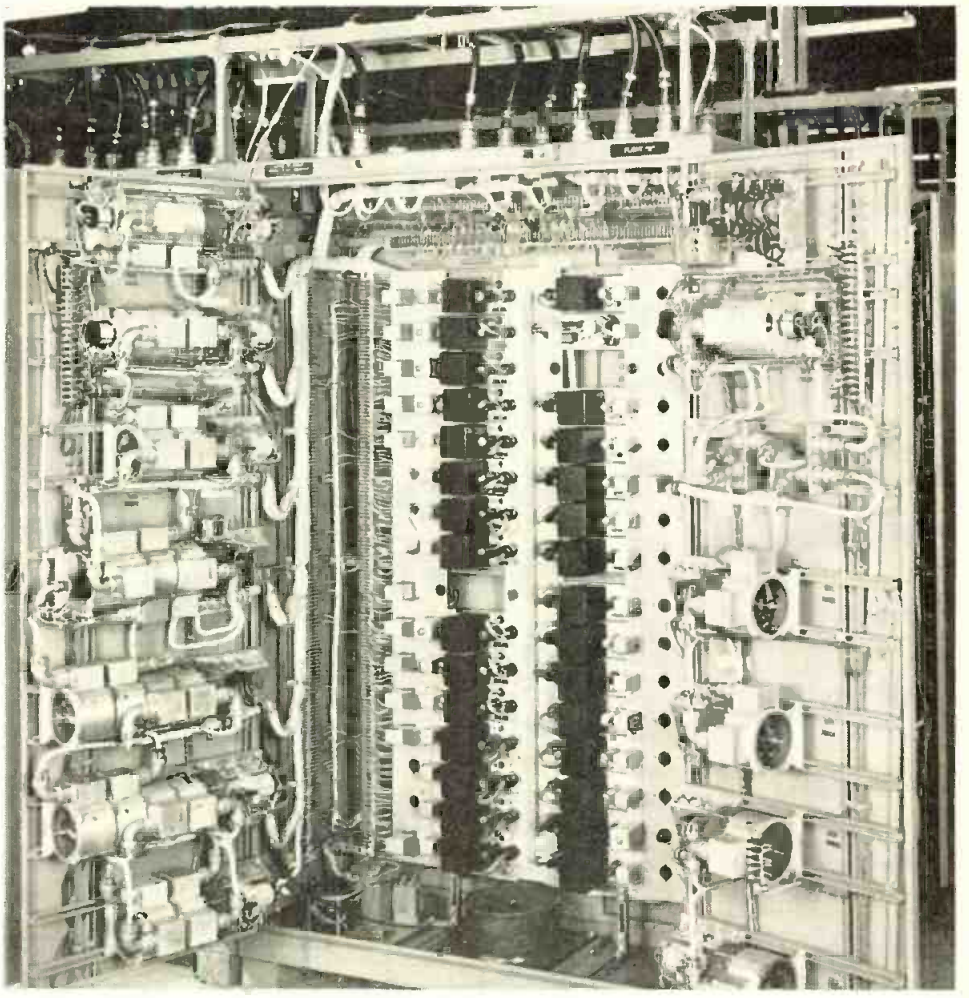
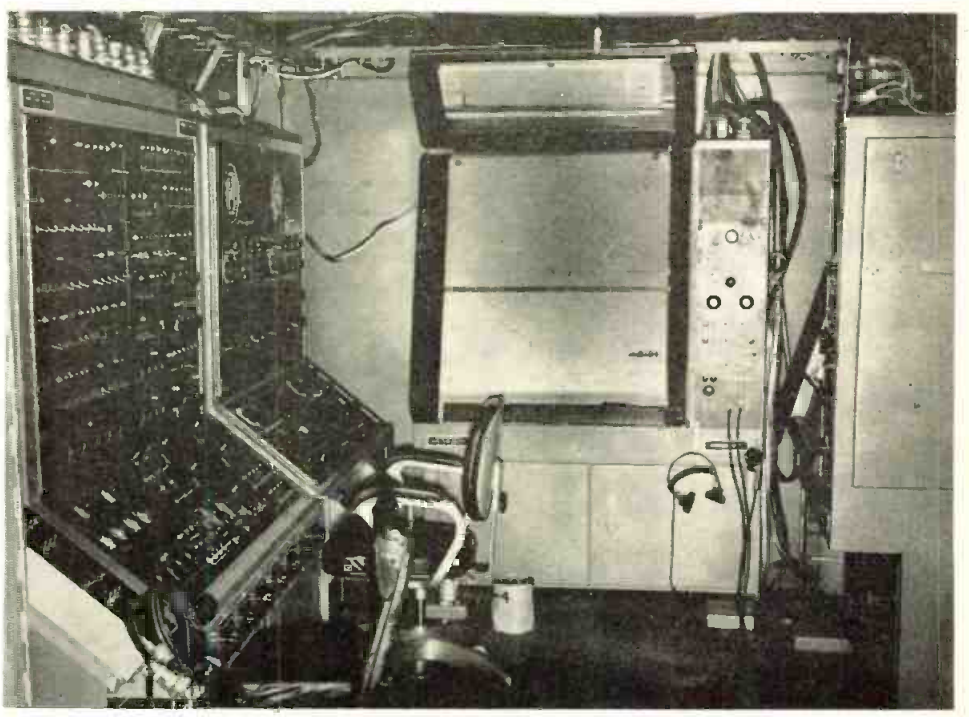


Fig. 2: Flight computer with doors open indicates easy accessibility. Servos for particular functions, such as rate of climb, air speed, flaps, etc., are on doors; amplifiers at center

Streamline Air Force Operations

Integrated with the simulator is a radio aids computer, recorder and control console which simulates high and low frequency stations in any combination to provide navigational training. See Fig. 3.

Fig. 3: Rear housing of Curtiss-Wright simulator installed at Palm Beach Air Force Base, Fla., shows (l to r) trouble console, radio aids console, and course recorder



Operation

In operation, the instructor adjusts the potentiometers at the simulator control console to establish the gross weight load, fuel supply, and other similar initially fixed quantities. The pilot, co-pilot and flight engineer are seated in their places. See Fig. 4. One engine is started. Immediately engine sounds and instrument readings come into play in the exact same manner as they would were this a real aircraft.

For a particular engine speed, the equivalent electrical signals make

Flight Simulators (Continued)

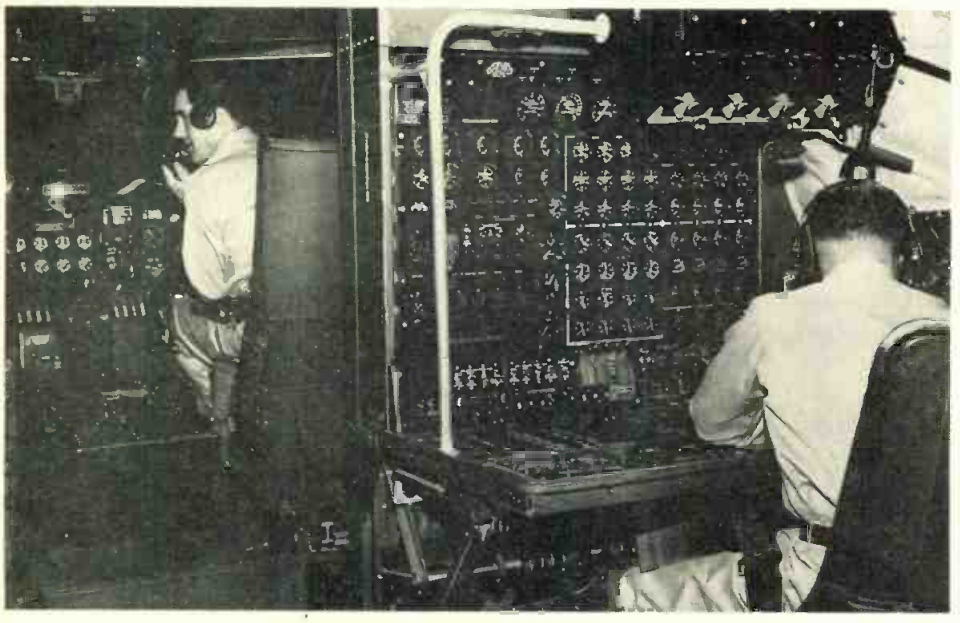


Fig. 4: Front housing of simulator exactly duplicates pilot's cockpit (l) and flight engineer's control panel (r). Instrument readings are determined by analog computers in next room

the rpm, oil pressure, ignition and other gages read as they would in the aircraft. When the lengthy preflight procedure is completed, the pilot takes off. At any time the instructor may insert a mechanical fault or a change in conditions, without the student knowing anything about it . . . until he detects it in instrument readings and the feel of the stick.

A simplified example of the critical interrelation of the computer stages is indicated by what happens when the simulator is "flying." Suppose the instructor inserts a small drop in oil pressure. He notes whether the student notices this on the meter. Next, the instructor might kill one engine while climbing. Immediately the rate-of-climb servo would make all pertinent instruments show a reduced climb, the stick would kick, the craft's horizontal position would change, though not physically in the simulator, as would all other related instrument readings fed by the servo stages.

Thousands of problems and combinations of troubles may be inserted in the simulator by the instructor, who is seated behind and out of the view of the students.

Servo System

Let's examine more closely how one particular stage of the massive analog computer operates, such as the aileron trim system. This type of servo system contains a source of signal, an input network, an amplifier, a servo unit and usually a fail or limit network. The source of signal is the aileron trim potentiometer, which is center tapped and has a signal voltage on both sides representing the amount of aileron trim available in both directions. The brush on the potentiometer picks off the amount of signal that represents the number of degrees the aileron trim control is positioned for, and feeds it to the input network of the aileron trim servo amplifiers.

The signal is united with any other input that may be utilized to drive the servo, plus the answer voltage developed by the servo, should it be a positioning type servo unit. In the case of the aileron trim system, the trim potentiometer is the only servo input. Therefore, the input network unites this signal with the servo answer voltage, and the combined signal is fed to the servo amplifier, the output of which drives the servo.

Within the servo itself, a wire-wound potentiometer, called a servo card, has a voltage applied to each end which represents the servo answer voltage. The potentiometer brush is mechanically linked to the servo shaft. When the servo rotates the brush on the servo card rotates and picks up a voltage that is 180° out of phase with the input signal to the servo.

When the servo rotates far enough so that the brush on the answer card picks up a voltage equal to, but 180° out of phase with the input signal, they will cancel each other out when united in the network input to the servo amplifier, and the servo will stop rotating. This position of the servo represents the degree of aileron trim with the control pressures being affected accordingly.

In order to simulate no control force effect at slow speeds, such as taxiing and beginning a take-off, the voltage for the aileron trim potentiometer as well as the voltage for the servo answer card are routed through a relay. The relay is open whenever airspeed is below 70 mph, thereby de-activating the aileron trim system.

Field Maintenance

Considering the complexity of simulator equipment, the extremely low down time experienced after several years of practical experience is fairly impressive. At Palm Beach

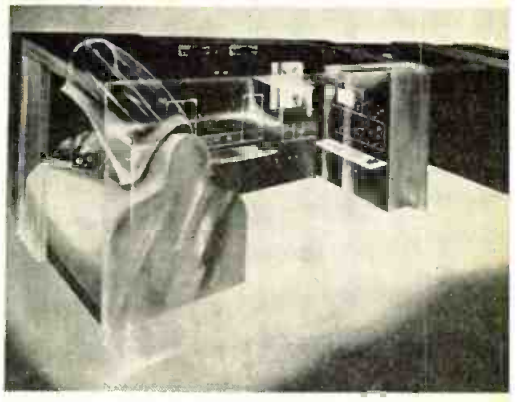
(*Continued on page* 148)

TABLE I

Simulator Operation at Palm Beach Air Force Base

	C-97 #1	C-97 #2	C-97 #3	C-124 #1	C-124 #2	Total
Available for training	11/14/52	3/24/53	6/30/53	8/1/53	8/2/54	
Power on total time	11,006	8972	8370	7439	2674	38,461
Total time scheduled	6543	4644	4320	3619	859	19,985
Total time training	6863	4850	4351	3389	628	20,081
Down time total	9:05	31:15	22:45	60:30	14:30	138:05
Average hrs. daily schedule	11	10	11	13	11	
Average days scheduled/week	5	4-6	5	5	5	
Number of crews trained	343	242	217	169	32	

Air Force Demonstrates Supersonic Flight Simulator



(l to r) Cockpit, control panel and computer racks for supersonic flight simulator

THE Air Force has demonstrated what is reportedly the first supersonic F-100A Flight simulator at Nellis Air Force Base, Las Vegas, N. M. This supersonic flight simulator was made by Westinghouse Air Brake Co. at Melpar, Inc., Falls Church, Va., a wholly-owned subsidiary. The device includes a replica of the cockpit of the F-100A aircraft with instruments electronically actuated to provide a realistic representation of flight situations.

It affords training in the safety of a classroom and allows practice in those emergency procedures too dangerous to perform in the air, such as a flame-out, or a landing gear failure. This device also provides a facility for evaluating pilot performance prior to flight in an expensive and critical weapon. Production models of the F-100A Simulator are being manufactured at the firm's Union Switch & Signal Div., Swissvale, Pa.

The Air Force has used flight simulators as a training aid since 1946, but the F-100A is claimed as the first to simulate a supersonic aircraft. The F-100A Flight Simulator occupies an area 47 x 18 ft. and consists of seven major assemblies and five electronic computer racks. Major assemblies include a cockpit in which are duplicated controls and instruments found in the actual F-100A fighter aircraft. Flash tubes simulate the effect of lightning, and twin speakers reproduce flight and engine noises for the pilot trainee. A flight instructor's console contains a duplicate of the simulator cockpit instruments and two control panels. By means of the control panel switches, the instructor can set up various problems and observe the pilot's reaction to the problem. This simulator is designated as type MB-3.

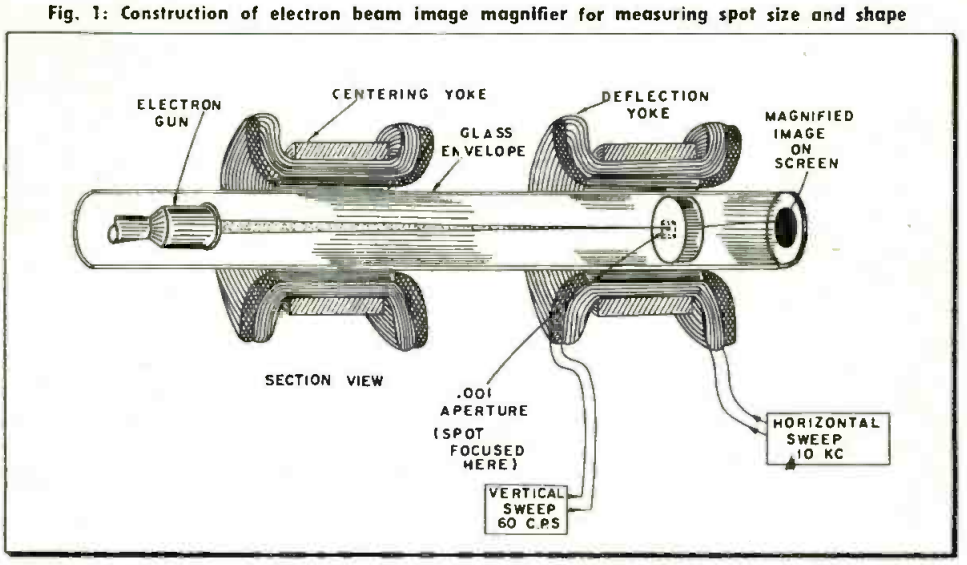
The MB-3 simulator computing system is connected to the instruments and controls of the cockpit. The basic principles employed in this computer are quite simple. For example, nothing more complex than 60 and 400 cycle voltages are used to represent mathematical quantities. In the various computers used in the simulator, specific mathematical operations are performed by analogy, where voltages are used to represent the terms of equations which may contain quantities such as feet, pounds or seconds. Five computer cabinets containing 80 pull-out drawers, constitute the brain center of the MB-3.

Magnifying Electron Beam Images

IN the development of electron guns for kinescopes, cathode-ray tubes and similar devices, it is desirable to measure the exact size and shape of the spot illuminating the phosphor screen. The direct method of visual observation is inadequate because of the effects of stray light and secondary electrons. RCA has devised a method whereby an undistorted magnified image of the spot may be produced on a phosphor screen, magnified electronically up to forty times.

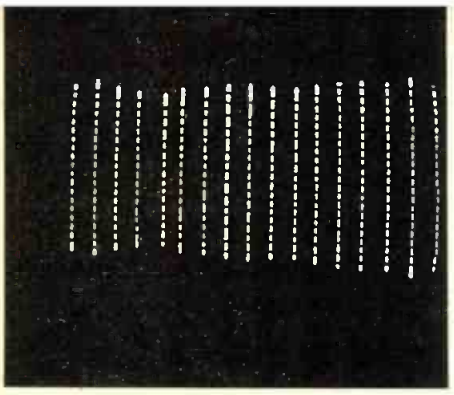
The principle is illustrated in Fig. 1. The component parts are: the tube, containing the gun to be tested, a plate in which is punched a tiny aperture, and a phosphor viewing screen; a deflection yoke, of the type commonly used with television kinescopes, together with horizontal and vertical sweep circuits; and an auxiliary deflection yoke, used for obtaining rough centering and for calibrating the magnification.

Fig. 1: Construction of electron beam image magnifier for measuring spot size and shape



The electron beam is ordinarily brought to a focus in the plane of the aperture. In the absence of the aperture, the main deflecting yoke would deflect the entire beam through an arc. At the aperture plane, the deflected position of the beam is considerably less than at the screen. With the aperture plate in position, only a small part of the beam current passes through the hole and is deflected to the screen. The part of the beam from which this small current is taken is a function of the deflection current in the yoke. The position on the screen where this current falls is likewise a function of the yoke current. Thus, every point

(*Continued on page* 124)



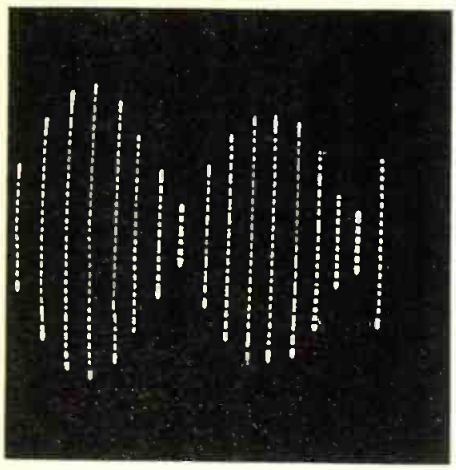


Fig. 1: Excitation from 1 and 2 speakers

Microphonics In Vacuum

Exciting vibration for this microphonic detector is obtained from two loudspeakers placed at right angles and fed with signals 90° out of phase

By ROBERT GOLDMAN & IRVING WEIMAN
Philco Corp.
Philadelphia, Pa.

BY definition, a microphonic tube is one which develops spurious electrical signals in its associated circuit when subjected to mechanical vibration. Such vibration causes relative motion of the electrodes with a consequent variation in the operating characteristics of the tube. Since the modern vacuum tube is a complex mechanical structure having more than one possible mode of vibration, there are usually several frequencies at which mechanical resonances appear. At these frequencies, the response to mechanical vibration can be quite large causing correspondingly large spurious electrical signals. In a strict sense, all amplifier tubes are microphonic; however, the term commonly describes tubes in which the effect is either abnormally large or sufficiently large to be troublesome in particular applications.

The microphonic effect of a tube may be measured under a particular set of tube operating conditions by vibrating the tube structure and observing the electrical effect in the output circuit. For a tube operating class A, for example, the alternating voltage developed across the load resistor is a convenient quantity to measure.

Characteristics

In the course of developing a practical arrangement for making such measurements, certain interesting characteristics of microphonism were observed. For example, the magnitude of the microphonic effect was seen to depend on the line of action of the vibrating force with respect to the tube structure. Since it is desirable to eliminate the orientation of the tube as a variable, especially where many measurements are involved, the tube should ideally be vibrated in a large number of directions simultaneously.

A second observation was that the output-frequency curves of many tube samples were not always reproducible. A single mechanical impulse, or even the removal and restoration of electrode potentials, resulted in changes in the amplitude and frequency of the output peaks. In some excessively microphonic tubes, for example, a sharp peak initially occurring at a certain frequency might shift in frequency or disappear altogether upon application of a mechanical tap to the tube envelope. In addition, a new peak not present in the first output-frequency curve might appear. For this reason, transient mechanical impulses of this sort were considered unsuitable as a means of excitation.

Although a particular curve could be reproduced if the tube under test were not disturbed either electrically or mechanically, such a

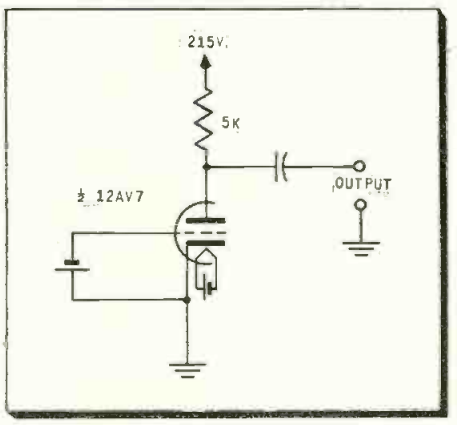


Fig. 3: Test circuit was heavily bypassed

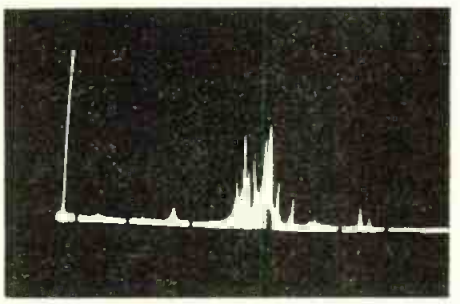
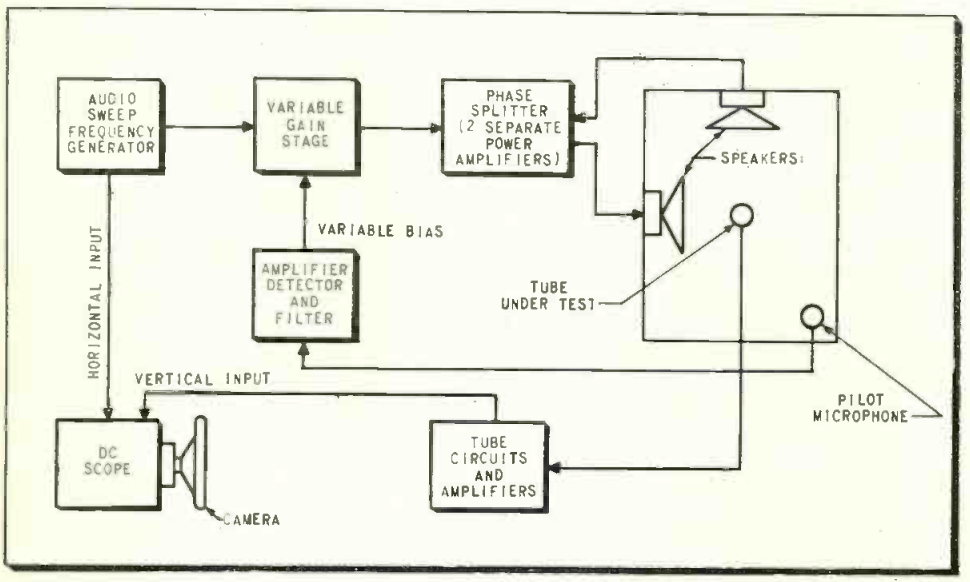


Fig. 4: Microphonics shown on scope face

Fig. 2: Block diagram of microphonic detector. Audio freq. generator sweeps spectrum in 30 sec.



curve would not necessarily indicate all the frequencies at which the tube was microphonic. In view of this effect, a method was desired which would show all frequencies of possible microphonic activity.

Finally, it was noted that a tube responded linearly to vibration only for small values of excitation. For small applied forces, such as those obtained when the tube under test was placed in a sound field, the tube output-versus-frequency curve consisted of a set of sharp peaks corresponding to the various mechanical resonances in the tube. For large values of excitation, such as provided by a mechanical shaker, the response at the resonant frequencies was not much greater than at other frequencies.[1] This is probably due to the fact that structural parts are limited in their amplitude of vibration by the presence of other members (e.g., the limiting action of a mica spacer on a vibrating grid post). These considerations suggested that small values of excitation would give the most information concerning the resonant behavior of vacuum tubes.

Test Apparatus

With the factors just discussed taken into account, an apparatus was constructed which would automatically plot on an oscilloscope screen a curve depicting tube output as a function of mechanical excitation frequency. Mechanical excitation was provided by an acoustical field obtained from two loudspeakers placed at right angles to one another and energized by signals of equal amplitude about 90° out of phase. At the point of intersection of the axes of the speakers, there was a rotating force field of essentially constant amplitude. As a result, the output of a tube placed at this point (with its axis perpendicular to the axis of both speakers) was independent of the orientation of the tube. The photographs in Fig. 1 show this in addition to the varying amplitude obtained with single-speaker excitation.

The block diagram of the two-speaker test system is shown in Fig. 2. The output of an audio signal generator, which sweeps the audio-frequency spectrum in about 30 secs., was fed to a specially designed electronic phase splitter[2] where it was split into two signals which were amplified in separate channels. The two outputs of the phase splitter differed in phase by nearly 90° and were fed to the two speakers. Over

(*Continued on page* 149)

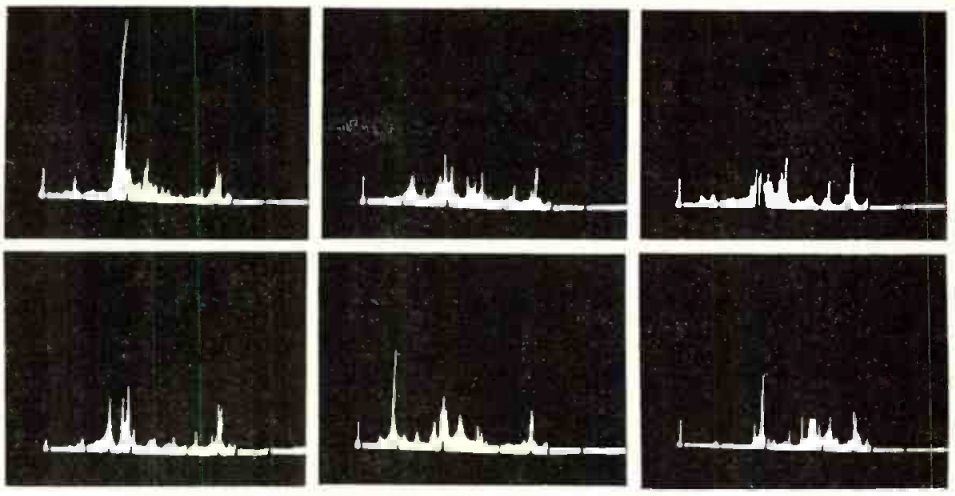


Fig. 5: Changes in tube output resulting from isolated machanical impulses

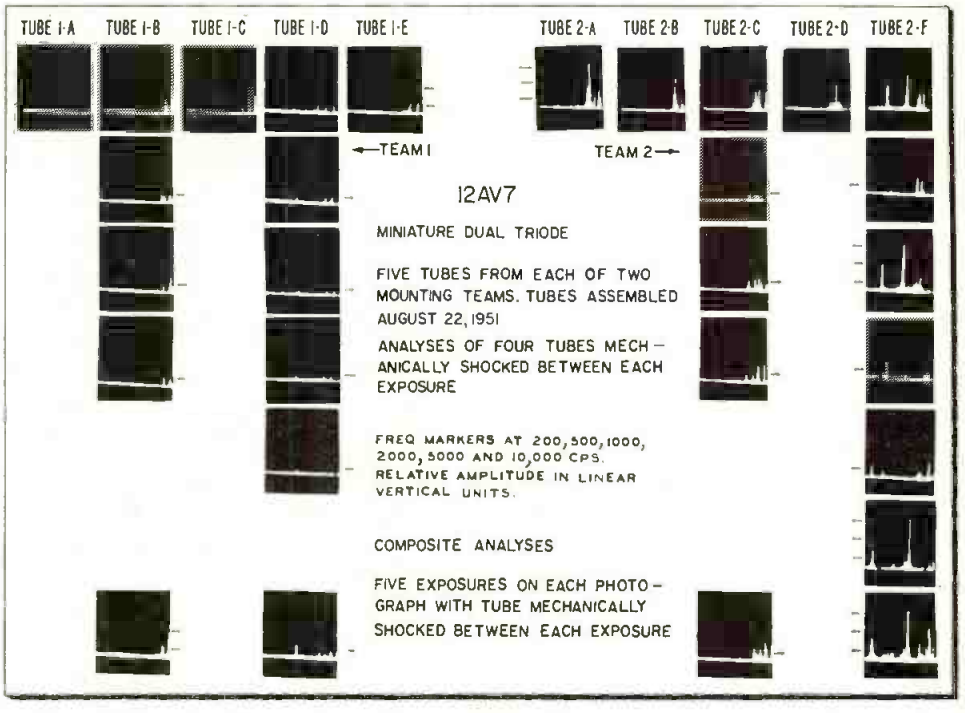


Fig. 6: Tests on 12AV7 twin triodes. Tubes were tapped between sweeps. At bottom is composite

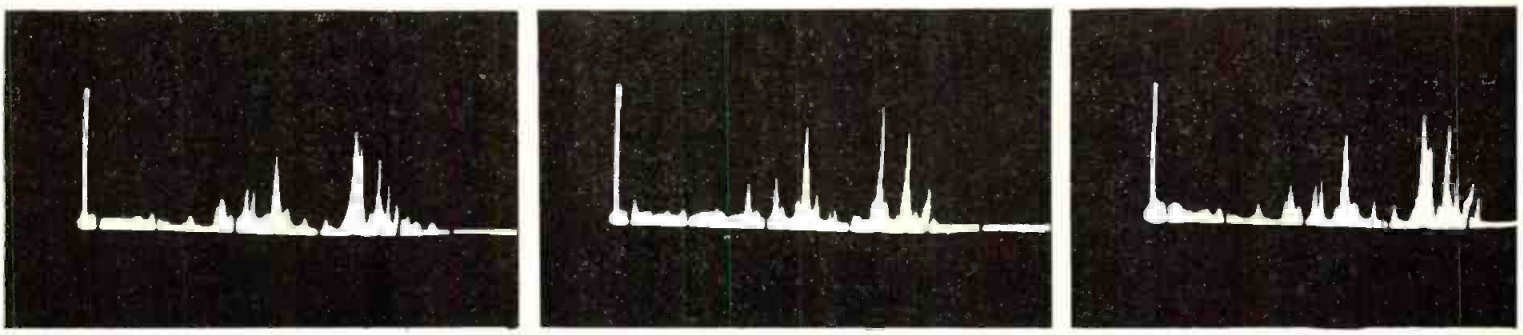
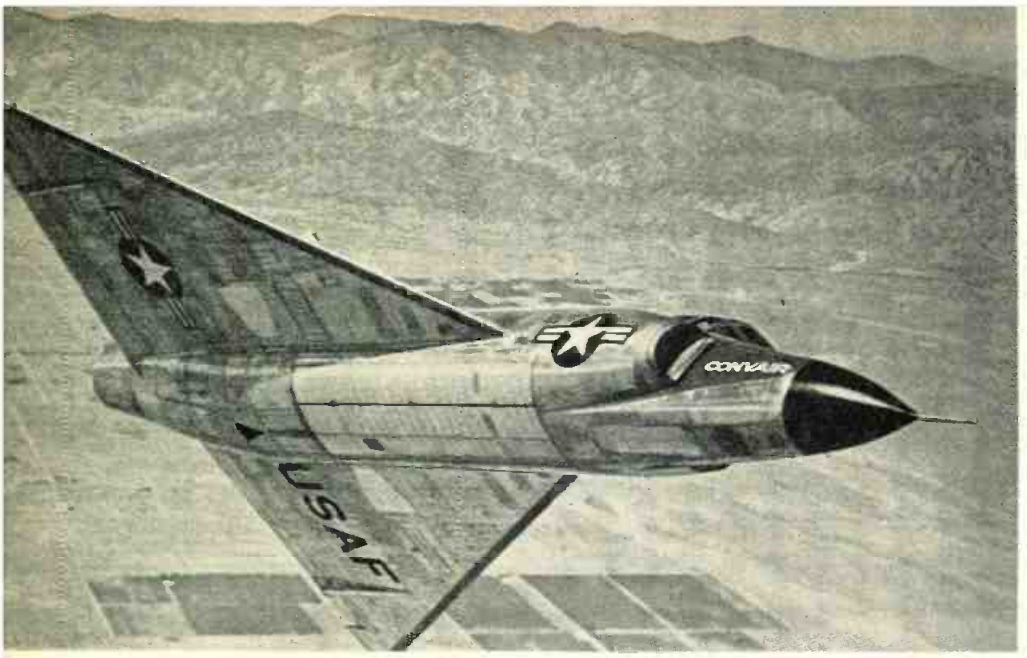


Fig. 7: Output variations due to plate voltage interruptions. Photos are composites to show up microphonic tendencies

Preview of



Air Force jet thrusts skyward . . . a symbolic representation of rapidly growing avionic field

AVIONIC progress will be the focus of attention May 9-11 when top engineers gather at the 1955 National Conference on Aeronautical Electronics, to be held in the Biltmore Hotel, Dayton, Ohio. Some 60 exhibitors (see accompany list) will display latest product developments, while well over 100 technical papers will be presented (see program below).

Filled out registration order blanks mailed by May 4 will be accepted as advanced registration at a reduced fee of $1.50 for IRE and IAS members, and $2.50 for non-members. Address mail to E. J. Weiss, 1955 Conference on Aeronautical Electronics, P. O. Box 621, Far Hills Branch, Dayton 9, Ohio. Regular registration at the Biltmore Hotel will start Sunday, May 8, with fees of $2.50 for IRE or IAS members, and $3.50 for non-members.

PROGRAM

MORNING SESSIONS	9:00-11:30
LUNCHEONS	12:00
AFTERNOON SESSIONS	2:00-5:00
BANQUET AND BALL (TUESDAY)	6:45

Monday Morning

SEMICONDUCTORS SESSION I (TRANSISTORS AND RECTIFIERS)

Engineers Club—Auditorium

Medium Powered, Hermetically Sealed, Silicon Rectifiers for High Temperature Applications; *A. Bergson and W. G. Mitchell—Raytheon Mfg. Co.*

Semiconductor Power Rectifiers; *J. W. Thornhill—Texas Instruments, Inc.*

Some Practical Considerations Concerning the Limiting Operating Voltages of Junction Transistors; *W. E. Sheehan—Raytheon Mfg. Co.*

Pulse Operation of Junction Transistors; *E. A. Hoskinson—North American Aviation, Inc.*

Silicon Power Transistors and Their Applications; *J. W. Lacy, P. D. Davis, Jr.—Texas Instruments, Inc.*

ANTENNAS AND PROPAGATION SESSION I

Engineers Club—Italian Room

Scale Model Measurements of Low Frequency Transmitting Antennas; *S. Rosenberg, P. Wilson—Rome Air Development Center, USAF.*

Aircraft Antenna System Lightning Protection; *R. F. Huber—Joslyn Mfg. Co. and M. M. Newman, J. D. Robb—Lightning & Transients Research Institute.*

An Evaluation of Liaison Antennas for a Large Jet Airplane; *O. C. Boileau, Jr.—Boeing Airplane Co.*

Helicopter Antenna Design Considerations; *A. R. Ellis—Stanford Research Institute.*

The Antenna Crossover Problem in Conical Scan Radar; *M. S. Wheeler—Westinghouse Electric Corp.*

MANAGEMENT SESSION (ENGINEERING & PRODUCTION)

Biltmore Hotel—Main Ballroom

Management of a Study Program; *N. V. Petrou, J. E. Darr—Westinghouse Electric Corp.*

The Role of Electronics Research in Systems Engineering; *S. Wald—The Glenn L. Martin Co.*

Management Considers Airborne Electronic Production for Atomic War; *A. S. Brown—Stanford Research Institute.*

A New Packaging Design Well Suited to Automation; *D. H. Westwood—Radio Corp. of America.*

An Approach to the Packaging of Subminiature Electronic Equipment; *A. H. Stoney—Sylvania Electric Products, Inc.*

Miniaturization and Unitization in Equipment Design; *S. M. Stuhlbarg—Crosley Division, AVCO Mfg. Co.*

ELECTRONIC COMPONENTS SESSION

Biltmore Hotel—English Room

Optimum Design of Airborne Foil Wound Transformers Cooled by Forced Air Convection; *A. B. Cicero—Sylvania Electric Products, Inc.*

Airborne High Temperature Transformer and Reactor Components; *A. Lucie—North American Aviation, Inc.*

A Tunable Audio Frequency Selective Relay; *G. Zomber—Avion Instrument Corp.*

The Model 307 Photo-electric D. C. Chopper; *F. H. Davis—Avion Instrument Corp.*

Practical Design Criteria for High Order Mode Cavities; *A. Pratt—Kearfott Co., Inc.*

Casting Waveguides Complete With Flanges by the Shell Molding Process; *S. Freedman—Chemalloy Electronics Corp.*

Monday Afternoon

SEMICONDUCTORS SESSION II (CIRCUITS)

Engineers Club—Auditorium

Microwave Video Detection Characteristics of Crystals; *R. E. Henning—Sperry Gyroscope Co.*

Characteristics and Circuit Design for High Power Transistors; *H. T. Moores—Minneapolis-Honeywell Regulator Co.*

Transistor AC-DC Converters; *D. A. Paynter—General Electric Co.*

A Silicon Transistor Resolver Amplifier; *W. W. Wells—North American Aviation, Inc.*

Transistor Communications Receiver; *H. J. Woll—Radio Corp. of America.*

ANTENNAS AND PROPAGATION SESSION II

Engineers Club—Italian Room

Loop Antennas; *P. A. Kennedy, T. Kaliszewski—Harvard University.*

Evaluation of Structural Dielectrics for Use in Flush Type Cap Antennas; *B. M. Sifford, H. J. Sang—Stanford Research Institute.*

VSWR Circle Transformations; *D. A. Cope—The Glenn L. Martin Co.*

Obtaining a Uniform Field in the Diffraction Zone of a Large Aperture; *J. O. Stenoien—Boeing Airplane Co.*

Absolute Backscattering Measurements Employing the Synchrodyne Principle, Hybrid-T, and Image Plane in the K-band; *Capt. L. A. Yarbrough—USAF Institute of Technology.*

Characteristics of Meteor Bursts on 15 MC Over a 608 KM Path; *H. T. Castillo—Wright Air Development Center, USAF.*

RELIABILITY SESSION

Biltmore Hotel—Main Ballroom

Measuring, Assessing and Predicting Equipment Reliability; *C. M. Ryerson—Radio Corp. of America.*

System Function or Information Flow as a Measure of Reliability; *A. Kohlenberg—Melpar, Inc.*

Airborne Radar Reliability; *L. A. Mayberry—Motorola, Inc.*

Reliability in Complex Airborne Electronic Equipments; *G. H. Scheer—Wright Air Development Center, USAF.*

Field Support of Complex Airborne Electronic Equipment; *H. W. Brown, Jr.—Radio Corp. of America.*

MEASUREMENT AND TEST SESSION I

Biltmore Hotel—English Room

Characteristics of X-band Radar Test Set; *M. Kaye—Sperry Gyroscope Co.*

A Calorimeter for Microwave Low Level Power Measurements; *L. D. Strom—Texas Instruments, Inc.*

Improvements in Calorimetric Wattmeters and Water Loads; *S. Freedman—Chemalloy Electronics Corp.*

Design Considerations for a New Type of Dummy Load; *D. Self—Sperry Gyroscope Co.*

Recent Developments on the National Bureau of Standards Microwave Refractometer; *M. C. Thompson, Jr.—National Bureau of Standards.*

A Method of Wavelength Measurement for the Microwave and Millimeter Wave Regions; *W. W. Balwanz, M. B. Rapport, E. W. Ward—Naval Research Laboratory, USN.*

Tuesday Morning

FERROMAGNETICS & PLASTICS SESSION

Engineers Club—Auditorium

Bimag Applications in Airborne Control Systems; *I. L. Auerback—Burroughs Corp.*

A New Passive Magnetic Binary for Digital Applications; *J. R. Horsch—General Electric Co.*

Ferrite Duplexers for Microwave Radar Applications; *T. N. Anderson—Airtron, Inc.*

Plastics Material; *J. H. DuBois—Mycalex Corp. of America.*

A New Class of Artificial Dielectrics for Microwave Applications; *W. O. Puro, H. T. Ward, Jr., D. M. Bowie—Melpar, Inc.*

HUMAN ENGINEERING SESSION

Engineers Club—Italian Room

A Miniature Airborne Pictorial Plotter; *S. Romano—Avion Instrument Corp.*

Some Operational Advantages of Pictorial Navigation Displays; *F. S. McKnight—CAA Technical Development & Evaluation Center.*

Problems of Simulations with Human Subjects; *M. Goetz—Westinghouse Electric Corp.*

Development of a Pilot Analog for the Single-Degree-of-Freedom Case; *R. J. Mead, N. D. Diamantides—Goodyear Aircraft Corp.*

Some Human Engineering Problems in Fly by Wire Techniques; *Arthur Kahn—Westinghouse Electric Corp.*

COMPUTERS SESSION

Biltmore Hotel—Main Ballroom

Gain Compensation for Airborne Analogue Computers; *T. G. Nichols—Westinghouse Electric Corp.*

An Analogue Surface Function Generator; *J. J. Earshen—Cornell Aeronautical Lab., Inc.*

Analysis of Systems Containing Digital Computers; *E. Arthurs—Radio Corp. of America.*

The Flying Spot Scanner as a Digital Data Read Out Device; *C. E. Jones—Federal Telecommunication Labs., Inc.*

SERVOMECHANISMS SESSION

Biltmore Hotel—English Room

Gain Equalization of Linear Servomechanisms Which Solve Non-linear Equations; *G. E. Adams—Farnsworth Electronics Co*

1955 Aeronautical-Electronic Meet

Extensive program of technical papers and manufacturer exhibits highlight May 9-11 engineering conference in Dayton, Ohio

Feedback Control Systems Using Sampled Data; *L. E. Mertens—Radio Corp. of America.*
Some Loading Effects on Servomechanism Performance; *G. Axelby—Westinghouse Electric Corp.*
Non-linear Boost System Flow Characteristics and Their Effect Upon Autopilot Stability; *A. M. Fuchs, F. J. Huddleston—Westinghouse Electric Corp.*

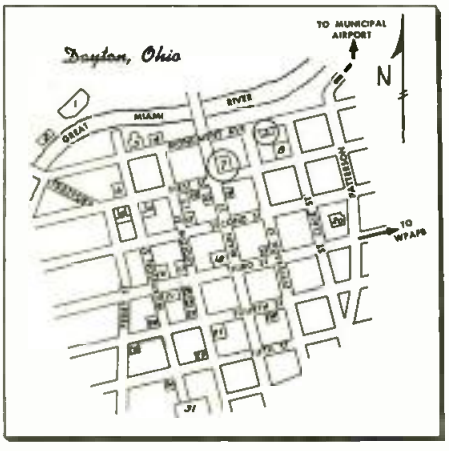
Tuesday Afternoon

FORUM

Engineers Club—Auditorium

Forum Subject: "The Weapons Systems Concept and how it affects 'Aeronautical Electronics'."
Moderator: Dr. Ivan A. Getting, Vice President of Engineering & Research, Raytheon Manufacturing Co.

Representing Airframe Manufacturers—
A. Esenwein, Convair
E. Uhl, Glenn L. Martin Co.
Representing Electronic Equipment Mfgs.—
W. R. Persons, Emerson Electric Co.
N. L. Winter, Sperry Gyroscope Co.
Representing Weapon System Users—
Maj. Gen. C. S. Irvine, AMC, USAF
Brig. Gen. M. C. Demler, ARDC, USAF



1—Art Institute	16—YWCA
2—Masonic Temple	17—Municipal Bldg.
3—YMCA	18—Court House
4—1st Baptist Ch.	19—Beckel Hotel
5—Engineers Club	20—Public Library
6—Bus Terminal	21—Post Office
7—Biltmore Hotel	22—Gibbons Hotel
8—Memorial Hall	23—Moraine Hotel
9—West. Presbyt. Ch.	24—Sacred Heart Ch.
10—1st Lutheran Ch.	25—Radio St. WHIO
11—Van Cleve Hotel	26—Unit. Brethren Ch.
12—Christ Episcop. Ch.	27—Keith Theatre
13—Loew's Theatre	28—State Theatre
14—Victory Theatre	29—Colonial Theatre
15—Miami Hotel	30—Holden Hotel

31—Union Station

RADIO INTERFERENCE SESSION

Engineers Club—Italian Room

Low-Impedance Gaskets for Radio-Frequency Applications; *V. Pulsifer, A. J. Hoehn—Armour Foundation.*
Measurement of Interference Fields About Aircraft; *J. R. Stahmann—Lightning and Transients Research Institute.*
Radio Interference Control in Aircraft; *A. L. Albin, J. E. McManus—Armour Research Foundation.*
A Study of Interference Between Messages from Independent Multiple Sources on a Single Channel; *Lt. B. Buchanan—Cambridge Research Center, USAF.*
Study of Noise Reduction by Feedback in Ultra-high Frequency Amplifiers; *A. B. Glenn—Radio Corp. of America.*

BANQUET & BALL

The 1955 Banquet will be held in the Main Ballroom of the Biltmore Hotel, and will begin promptly at 6:45 p.m. The Ball will follow the Banquet, and will also be held in the Main Ballroom. Dress for both functions is informal.

Wednesday Morning

ELECTRON TUBES SESSION I

Engineers Club—Auditorium

Some Results of a Comprehensive Program to Improve Tube Reliability; *A. Kohlenberg—Melpar, Inc.*
Developmental Low Noise T-W Tubes for L-, S-, and C-band; *P. R. Wakefield, A. G. Hogg—Radio Corp. of America.*
A Developmental High Power Tunable X-band Pulse Magnetron for Airborne Applications; *W. F. Beltz—Radio Corp. of America.*
A High Power X-band Klystron; *R. A. LaPlante—Philips Laboratories.*

EQUIPMENT SESSION

Engineers Club—Italian Room

A Precise 60 CPS 6.5 KVA Power Source; *F. A. Kahl—Bendix Radio.*
Ultra Linear, Wide Range AC to DC Converter; *D. Krucoff—Melpar, Inc.*
Pod-mounted Electronic Equipment Has Advantages; *H. A. Brelsford—Radio Corp. of America.*
A Comparison of the Thermal Efficiencies of Subminiature Tube Shields Using a New Method of Measurement; *L. C. Calhoun—Westinghouse Electric Corp.*
Relationship Between Heat and Temperature or How is a Dissipation in Watts Related to the Temperature of Parts; *A. S. Gutman—Sylvania Electric Products, Inc.*
General Design Aspects for Cooling Electronic Equipment; *M. Mark—Raytheon Mfg. Co.*

NAVIGATION SESSION I

Biltmore Hotel—Main Ballroom

Precision Ranging with a Pulsed Optical Radar; *L. Geller, J. Lawton—Cornell Aeronautical Laboratory, Inc.*
Model Measurements of Rotor Modulation for Vor Antennas; *W. E. Barrick—Electronics Research, Inc.*
Measurement of Tacan and Vor Bearing Errors; *D. T. Latimer, Jr.—Naval Air Test Center, USN.*
Recent Developments in Distance Measuring Equipment (DME); *R. C. Borden—CAA Technical Development & Evaluation Center.*
Radio Beam Coupler System; *H. Hecht, G. F. Jude—Sperry Gyroscope Co.*
The Rho in Navarho; *R. Alexander—American Machine & Foundry Co.*

MEASUREMENT AND TEST SESSION II

Biltmore Hotel—English Room

Propeller Blade Angle—and Deflection-measurement System; *J. C. Camm—Electronics Corp. of America.*
A Pulse System of Strain Recording; *P. L. Toback—Armour Research Foundation.*
A Versatile 200 Channel Recorder for Static Stress Analysis; *T. C. Fletcher—Beckman Instruments, Inc.*
A Miniaturized Telemetering System Resulting from Modern Design Techniques; *I. P. Magasiny—Raymond Rosen Engineering Products, Inc.*
Signal Generator; *N. Greenberg—Avion Instrument Corp.*

Wednesday Afternoon

ELECTRON TUBES SESSION II

Engineers Club—Auditorium

Magnetron Beam Switching Tube; *H. Moss—Burroughs Research Center*
Recent Developments in the Raytheon Recording Tube; *R. C. Hergenrother, A. L. Luftman, C. S. Sawyer—Raytheon Mfg. Co.*
Stacked Ceramic Tubes; *H. E. Sorg—Eitel-McCullough, Inc.*
Status of Stacked Tube Development; *W. R. Wheeler—Sylvania Electric Products, Inc.*
Ceramic Techniques and Parts Fabrication for Vacuum Tube Applications; *T. S. Stanislaw—Sylvania Electric Products, Inc.*

INFORMATION THEORY SESSION

Engineers Club—Italian Room

Z Transform for Multiple Sampled Systems; *N. T. Simopoulos—University of Dayton.*
Modern Network Theory Design of Crystal Filters for Communications and Navigation; *M. Dishal—Federal Telecommunication Labs., Inc.*

(*Continued on page 156*)

Equipment Exhibitors

Abrams Instrument Corp.
Lansing, Michigan
Aircraft Radio Corp.
Boonton, New Jersey
Airtron, Inc.
Linden, New Jersey
Alfred Crossley & Asso.
Chicago, Illinois
American Phenolic Corp.
Chicago, Illinois
Ampex Corp.
Redwood City, Calif.
The Barry Corporation
Watertown, Mass.
Bendix Aviation Corp.
South Bend, Indiana
Bird Electronic Corp.
Cleveland, Ohio
Bomac Laboratories, Inc.
Beverly, Mass.
Boonton Radio Corp.
Boonton, New Jersey
CEC Instruments, Inc.
Pasadena, California
Cannon Electric Co.
Los Angeles, California
Century Geophysical Corp.
Tulsa, Oklahoma
Collins Radio Company
Cedar Rapids, Iowa
Cubic Corp.
San Diego, California
Dale Products, Inc.
Columbus, Nebraska
J. R. Dannemiller Asso.
Cleveland, Ohio
The Daven Company
Newark, New Jersey
The Davies Laboratories
Riverdale, Maryland
Electric Regulator Corp
Norwalk, Connecticut
Emerson Radio & TV
Jersey City, N. J.
T. R. Finn & Co., Inc.
Hawthorne, N. J.
Ford Instrument Co.
Long Island City, N. Y.
General Electric Co.
Syracuse, New York
General Precision Equipment Corp.
New York, New York
General Radio Company
Cambridge, Mass.
Hoffman Laboratories, Inc.
Los Angeles, Calif.
Hycon Mfg. Company
Pasadena, Calif.
Hughes Aircraft Company
Culver City, Calif.
The Institute of Radio Engineers
New York, New York
International Telephone & Telegraph Corp.
Nutley, New Jersey
Kaiser Metal Products, Inc.
Bristol, Connecticut
Kay Electric Company
Pine Brook, N. J.
Lavoie Laboratories, Inc.
Morganville, N. J.
G. H. Leland, Inc.
Dayton, Ohio
The W. L. Maxson Co.
New York, New York
Measurements Corp.
Boonton, N. J.
Micro Switch
Freeport, Illinois
Motorola, Inc.
Chicago, Illinois
Mycalex Corp. of America
Clifton, N. J.
Neal Bear Corp.
West Richfield, Ohio
M. P. O'Dell Company
Cleveland, Ohio
Olympic Radio & TV, Inc.
Long Island City, N. Y.
Panoramic Radio Products, Inc.
Mount Vernon, N. Y.
Polarad Electronics Corp.
Brooklyn, New York
Radiation, Inc.
Melbourne, Florida
Radio Corp. of America
Camden, New Jersey
Radio Receptor Co., Inc.
Brooklyn, New York
Raytheon Mfg. Company
Newton, Mass.
REF Mfg. Corp.
Mineola, New York
Robinson Aviation, Inc.
Teterboro, New Jersey
Sanders Associates, Inc.
Nashua, N. H.
The Satullo Company
Royal Oak, Michigan
S. Sterling Company
Cleveland, Ohio
Superior Electric Co.
Bristol, Connecticut
Surprenant Mfg. Co.
Boston, Mass.
Sylvania Electric Products, Inc.
New York, New York
Harvey Teplitz
Dayton, Ohio
A. C. Wahl Company
Cincinnati, Ohio

Evaluation of Junction Diodes

Manufacturing and performance considerations establish relative advantages and limitations of three types of semiconductors

By FRANK FINNEGAN, Raytheon Mfg. Co.
55 Chapel St., Newton 58, Mass.

Examination of silicon and germanium junction diodes, including small-area, diffused and grown junction types, defines characteristics making one best suited for a particular application. Practical aspects of performance, such as stability, noise and reverse transient response time are discussed. Temperature considerations are presented.

A REFINEMENT in diode manufacture is the successful formation of a true junction, which allows many advantages to be obtained over the conventional whisker type. There are three main types of junction diodes; (1) the small area junction or bonded type, (2) the diffused or alloy type, and (3) the grown junction type.

The bonded or small-area junction is formed by passing a heavy pulse of current through the contact between a small diameter wire and a properly cleaned semi-conductor chip. An extremely rugged eutectic bond is formed if the wire used is of the proper material such as a gold alloy. As the bond area is much larger than that obtained by mechanical point pressure, as is done with the conventional point contact, the resulting diode is much more stable mechanically and the lower current densities allow higher reverse voltages and higher forward currents. Thus, the devices exhibit much higher ratios of reverse to forward resistances.

The larger area junction is not without its limitations, however. The greater junction area, in addition to increasing the diode capacity, degrades the transient response, due to the fact that a longer time is required to clean out current carriers within the barrier layer. This detrimental effect can be minimized by proper processing during manufacture.

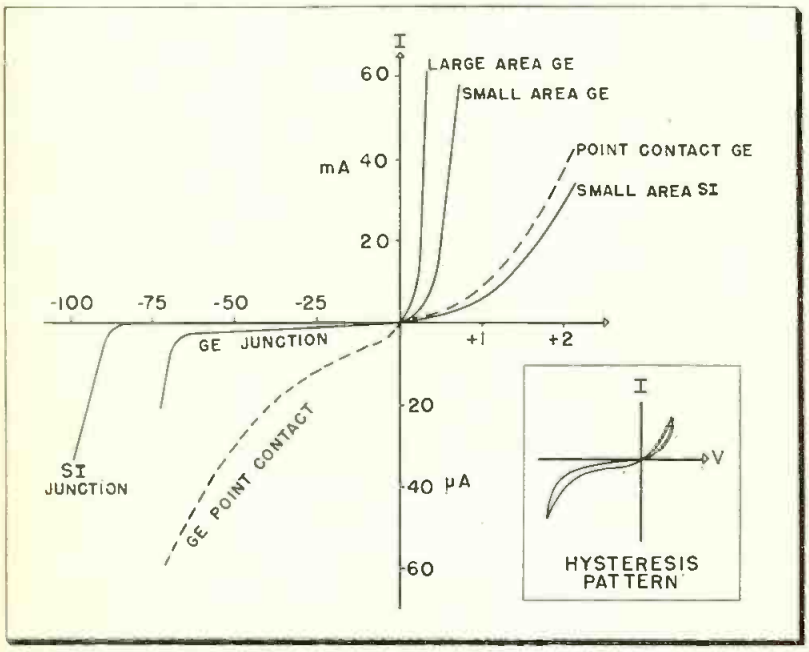
The diffused or alloy-junction diode is formed by melting a pellet of pure metal (from Group III or Group V of the periodic table) on a specially prepared germanium or silicon chip. An alloy results between the two materials with the transition between the alloy and the base material being the rectifying junction. The barrier area is many times that of the point contact diode, and hence, such devices are intended for relatively high current operation.

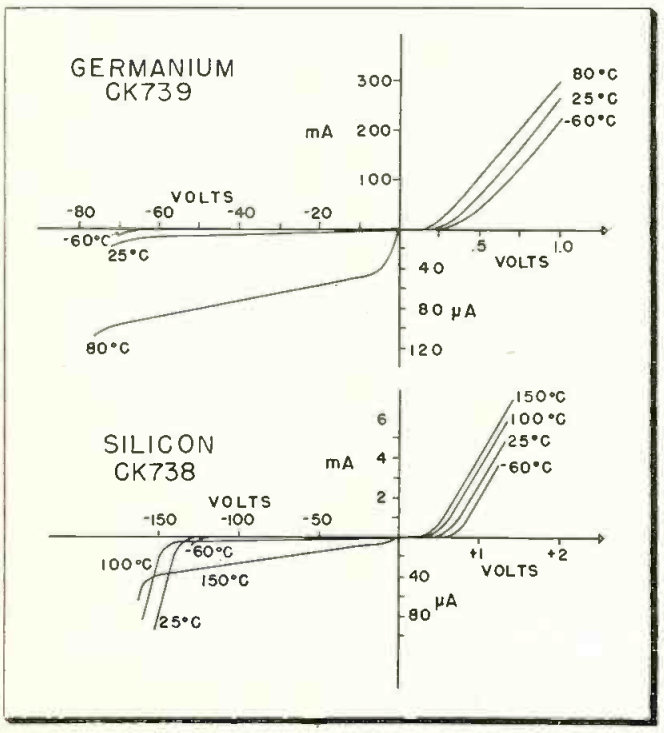
Grown junction diodes are made during the process of growing the crystal itself. In order to maintain a high degree of control during the processing of a germanium or silicon single crystal, careful growing methods (such as the pulling technique or zone leveling technique) must be used to prevent dislocations, harmful impurities, and grain boundaries, from interfering with the orderly crystalline lattice necessary to minimize variations in devices to be fabricated.

P-N Junction

A p-n junction can be grown by introducing a proper acceptor element to form a "p" region and then adding a donor element to convert remainder to "n" material while growing the crystal. These diodes are characterized by very low forward impedance, lower saturation currents, higher peak inverse voltage (depending on resistivity, etc.), increased junction capacity, better stability and uniformity.

Fig. 1: (l) Typical performance curves of silicon and germanium diodes
Fig. 2: (r) Static characteristics vs temperature for small area units





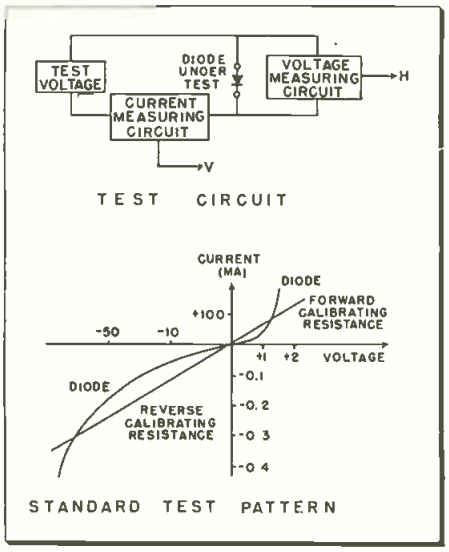


Fig. 3: Diode dynamic test circuit

Reliability and reproducibility are important factors to the manufacturer as well as to the circuit designer. Proper treatment of the surface of the base material and junction boundary more nearly insures uniform electrical characteristics, better service reliability, and long shelf life.

Of prime importance to those working with semiconductors is the use of a good etch, which can clean a surface and leave it free from cracks and strains. Then, the removal of spent etch and maintenance of the clean surface during diode fabrication are the remaining problems. When using high resistivity material, precaution against "inversion-layer" or surface charge formation must be taken as this effect reduces the diode back resistance, increases forward resistance and surface life-time while distorting the energy level picture below the surface.

In addition to careful processing during manufacture, an adequate testing program must be utilized, to check quality as well as to insure that only stable diodes are shipped to customers. Static testing is used for preliminary classification and 60 cycle dynamic testing is used for final evaluation.

In the dynamic tester, the basic diode driving circuit is essentially that described by Crawford and Heath of IBM at the 1952 annual IRE Convention. The block diagram for this circuit is shown in Fig. 3. The

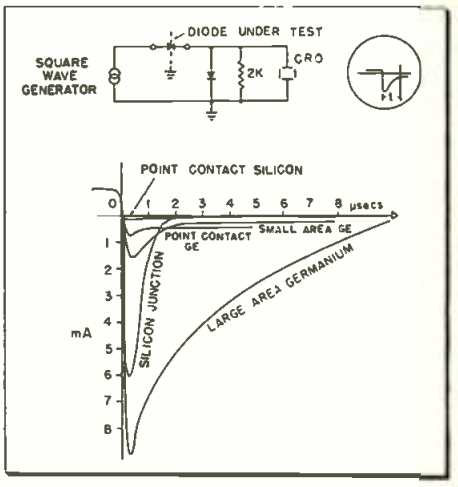


Fig. 4: Transient response circuit and curves

circuit consists of (a) a voltage source (b) a current measuring circuit, and (c) a voltage-measuring circuit as shown in the diagram. The test voltage is a 60 cps sine wave, which is isolated from ground by a transformer. The current reading circuit is designed to produce a voltage at V which is directly proportional to the current flowing through

(*Continued on page* 141)

Eliminating Power Plant Radiation

By GROTE REBER
G. P. O., Hobart
Tasmania, Australia

Causes of objectionable electromagnetic radiation from power plants are discussed and their cures are explained. Practical experiences with the operation of a diesel engine power plant at an altitude of 10,020 ft. are described.

RADIO astronomy experiments conducted from the top of Mt. Haleakala at an elevation of 10,020 ft. on the island of Maui, Hawaii, indicate that if the cosmic static is to be effectively measured, the environment must have no extraneous electromagnetic disturbances. Far more power is required than can be conveniently or economically supplied by batteries. A number of approaches to this problem are possible.

The entire power plant could be enclosed in a large tight sheet metal box with filters at the electrical outlet terminals. Such a box makes difficult the servicing of the machinery and the passage of cooling air and water. Vibration will tend to loosen joints in the box and vitiate its effectiveness.

The individual sources of electromagnetic disturbance may be separately shielded. Bypass capacitors and chokes may be installed at numerous places, and this is reasonably effective. Unfortunately, the accessories are quite complex and often difficult to keep in order. Loose joints are frequent as the result of vibration, and some of the gear inhibits the proper maintenance of the machinery. Every power plant examined here so far, when given this treatment, still had a radiation field far too large to allow the proper measurement of the weak celestial energy.

The final alternative is to remove all the objectionable sources of electromagnetic disturbance. On the face of it, such procedure seems impossible. Actually it is less difficult than the second alternative. Furthermore no cans are needed and all parts of the machinery remain accessible for servicing.

The most objectionable source of

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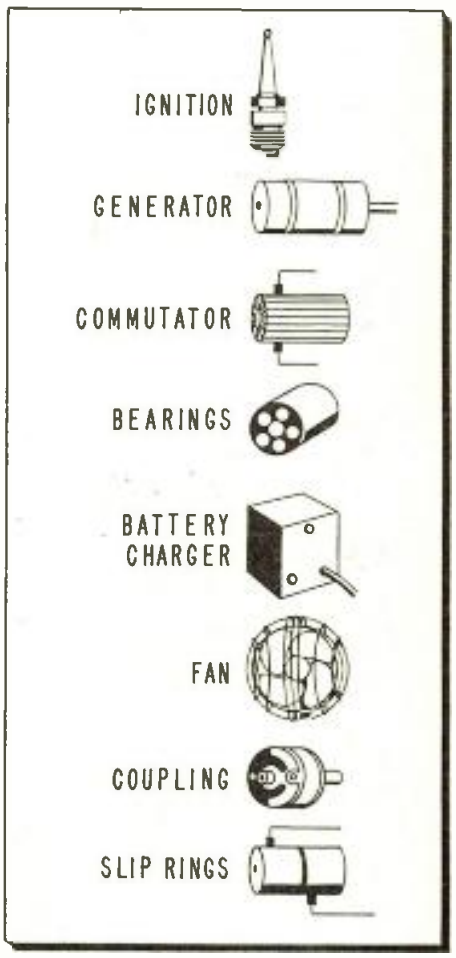


Key sources of electromagnetic radiation from power plant used for radio astronomy studies

Fig. 1: Cutaway view of Heliax cable

Flexible Air Dielectric

Unique construction, utilizing outer conductor of copper clad steel, provides desirable characteristics of both air and solid dielectric lines

By J. S. BROWN, Director of Engineering
Andrew Corp., 363 E. 75th St., Chicago 19, Ill.

COAXIAL RF transmission lines that have been available in the past have all been compromises in respect to desirable mechanical and electrical properties. Air dielectric lines have been required for applications where low attenuation and good VSWR characteristics are of primary importance, but these lines have been relatively rigid and hard to handle. Where ease of handling and flexibility have been the primary requirement, solid dielectric lines have been used, but the accompanying inferior attenuation and VSWR performance have left much to be desired.

Several attempts at producing a flexible air dielectric line have been made. So-called semi-flexible lines, made of soft temper copper or aluminum conductors, are somewhat easier to handle than rigid lines, and can be made to provide acceptable electrical performance, but they leave much to be desired with respect to flexibility and ease of handling in the field. Cables available to date have been made of materials that harden with handling; a few cycles of coiling and uncoiling in the field and the outer conductor becomes so hard that kinking results. Heliax is a newly-developed coaxial line that provides the desirable electrical properties of rigid air dielectric lines and approaches the flexibility of solid dielectric lines.

Construction

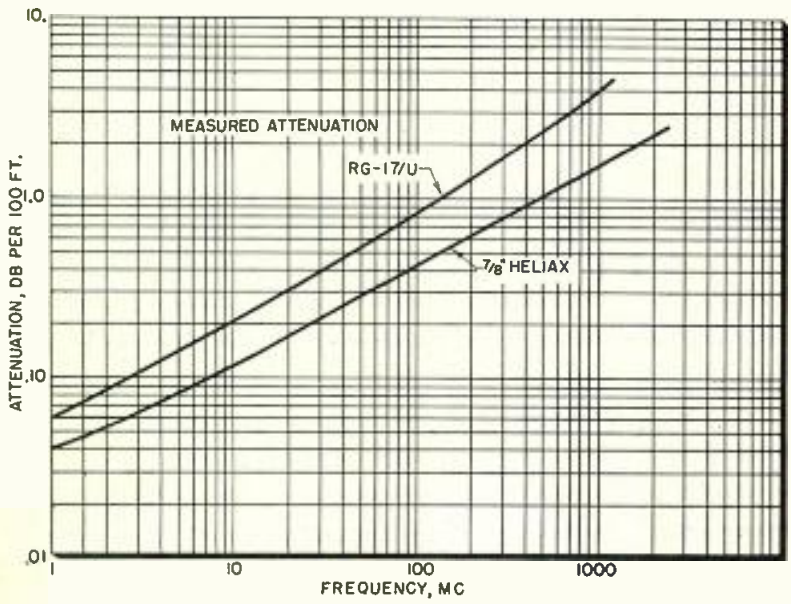
The construction of Heliax is shown in Fig. 1. A copper inner conductor is supported by a continuous polyethylene helix. Two insulating tapes are wrapped over the helix. The outer conductor is made of steel, copper clad on the inside to provide good conductivity. The manufacturing process starts with copper clad steel strip which is formed into a tube and continuously seam welded to produce a pressure tight tube. During the welding process the inner conductor and helical insulation are inserted into the outer conductor. The outer tube is then helically corrugated, producing an outer conductor that is very flexible and resistant to crushing.

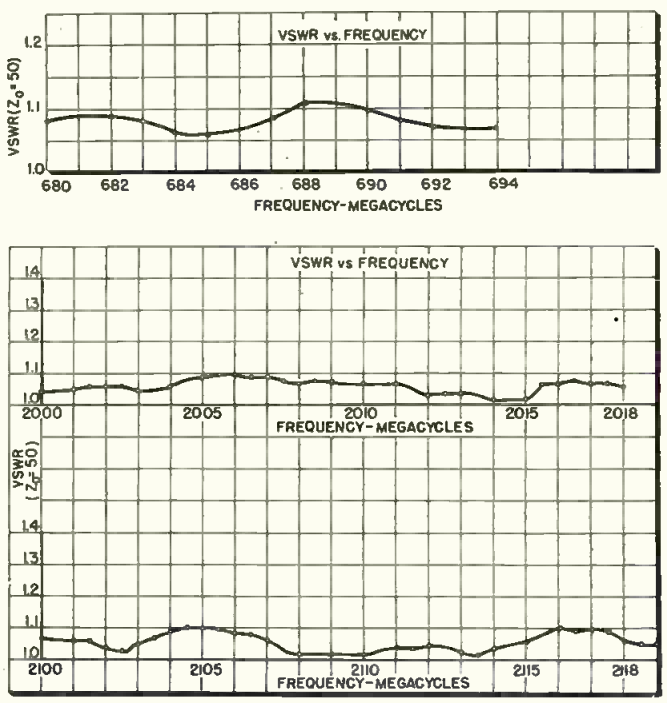
After the outer conductor is corrugated, it is coated with Polyment, a bitumen compound, over which tapes are wrapped. A polyvinyl chloride jacket is extruded over the outside to complete the manufacturing process. The process is continuous, with no basic limit to the length of a single cable. Lengths of over 2,000 ft. are currently being produced.

The electrical performance of Heliax is shown on Figs. 2, 3 and 4. Fig. 2 shows measured attenuation data for 7/8 in. nominal size Heliax. The attenuation of RG-17/U cable is included for comparison. Measured VSWR curves are shown in Fig. 3. It might be thought that the corrugations in the outer conductor would produce poor VSWR performance. This is not the case, however; the corrugations are small compared to a wavelength, and as long

Fig. 2: (below) Comparable attenuation of Heliax and standard RG-17/U

Fig. 3: (r) Cable provides good VSWR performance despite corrugations





Coaxial Cable

as they are uniform along the line good VSWR performance results. Uniformity, which is to say close control over production, is the limiting factor in keeping VSWR low.

Power Handling

The power handling capacity of 7/8 Heliax is shown on Fig. 4. Two ratings are shown. Curve B is based on an ambient temperature of 104° F., which is the basis used for solid dielectric cable ratings. The other rating (Curve A) is based on an outer conductor temperature of 130° F. It has been determined experimentally that the jacket on Heliax reaches approximately this

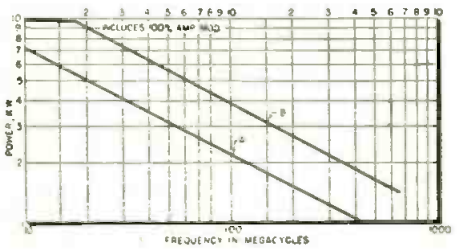


Fig. 4: Power ratings for 7/8 Heliax

temperature if exposed to the direct sun when the temperature in the shade is 104° F. The limiting inner conductor temperature is 175° F. in both cases.

The ratings shown are for CW unmodulated power and a VSWR of unity. Power handling capacity under other conditions can be easily calculated.

Mechanically, the unique design of the outer conductor is the principal factor in providing the desirable performance features the cable offers. Its configuration allows extreme flexibility without kinking or rupture. Fig. 5 shows samples of outer conductor tubing which have been bent on their own diameter, without any evidence of failure or permanent distortion. It is evident that the bending radius of the coaxial cable is limited by the inner conductor and insulating helix, and not by the outer conductor.

Thermal Expansion

The use of steel for this conductor almost completely eliminates cold working and hardening due to coiling and uncoiling in the field. Thermal differential expansion, always a potential problem when different materials for inner and outer conductors are used, has been taken care of by proper design of the cable. Correct proportioning of the design parameters results in an inner conductor that is stiffer than the outer conductor. The inner conductor therefore tends to pull the outer with it as it expands or contracts. The differential force between inner and outer conductor is small enough that no tendency for the inner conductor to buckle within the outer conductor is present.

Insulators

No attempt has been made to anchor the inner conductor to the outer conductor by using tightly-fitting insulation, as experimental work has not indicated that this can be done over wide temperature ranges. The inner and outer conductors in Heliax are fixed with respect to each other by the use of undercut anchor insulators in each end fitting.

The same factors that overcome the differential expansion problem also eliminate cold flow of the polyethylene helix. Since the outer conductor tends to "follow" the inner conductor, forces on the polyethylene are reduced. Experiments conducted over the normal operating temperature range have not revealed any progressive flow of the insulation.

Corrosion protection is a major design problem where uncoated steel is used in a product such as Heliax. However, the two coatings that are applied over the outer conductor provide adequate protection. The Polyment coating is a tar product to which synthetic plasticizers have been added to produce the necessary characteristics. It was developed specifically to solve this problem. It has good adhesion properties, and is applied hot to the corrugated conductor in the manufacturing process, which further insures a good bond to the metal. It provides a continuous coating that protects the steel from corrosive elements, and the Polyment itself is resistant to deterioration by these elements. The temperature range over which Polyment remains plastic is much greater than that of most conven-

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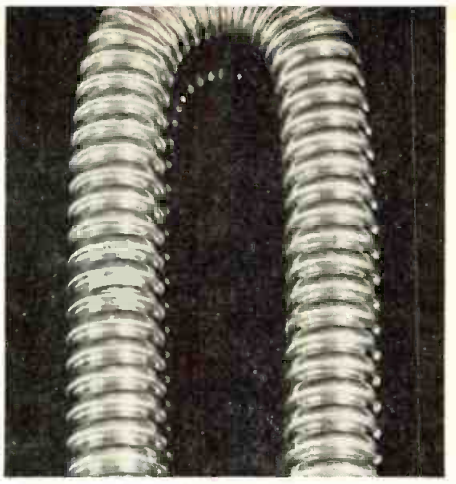

Fig. 5: Cable bends sharply without kinking

Fig. 6: Connector, Heliax to standard flange

Fig. 7: Various adapters are available

Fig. 8: Cable is flexible, easily handled

PART ONE
OF TWO PARTS

Systems Engineering For Flight

With the technical excellence of the aircraft instruments established, attention is now turning to their primary function—to convey information to pilot

By
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IN the early days of flight, the concern was to make the instruments perform their intended measurements. To a large extent, this problem has been solved, so that now we may turn our attention to the study and evaluation of instruments with regard to their function for which they are intended—the transmission of information to the human operator.

The pilot is a vital link in the aircraft communication channel. It is, therefore, extremely important that the cockpit, the instruments and controls be designed so as to mate with human input and output characteristics. It was because of this that human engineering was applied

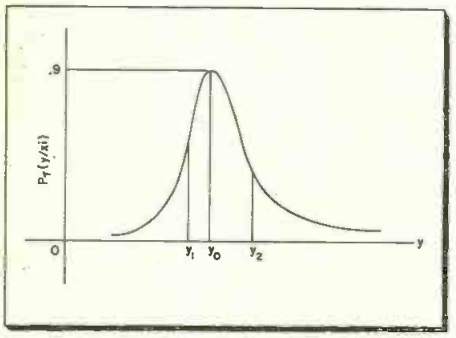


Fig. 1: Probability of reading displayed value

in an effort to design the aircraft to use the pilot most efficiently. Human engineering comprises three subjects: physiology—the study of the environmental design in which the man can best operate and the limiting conditions he can withstand; engineering—the study of techniques to determine the feasibility and physical design of the proposed equipment; and psychology—the study of the information input, output and transfer characteristics of the human operator.

Much work has been done in the first of these categories, for example, by Dr. Ross A. McFarland, whose article[1] clearly discusses the present state of the art in compact form. The second category, engineering, has advanced by leaps and bounds until today most problems may be treated in textbook fashion. The amount of published material is extremely large and the particular design of any instrument is just a matter of the availability of time and money. On the other hand, this is far from the case encountered in psychology.

In the past, empirical data were obtained and from these the art of display design has developed. Here, however, it should be emphasized that it is an art, not a science. Several publications[2,3] have compiled all available related data and it is from these recommended display layouts that the instrument designer must choose a "satisfactory" configuration.

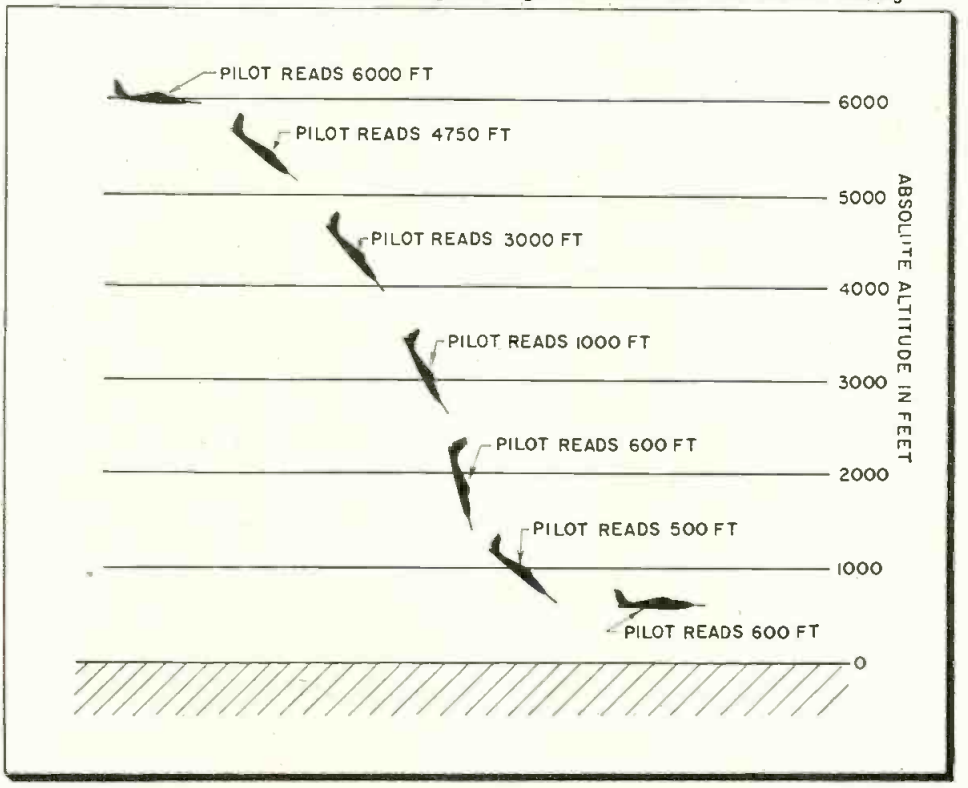
Human Element

In such a brief note as this, it is impossible to examine all those human properties which provide design criteria for every aspect of the cockpit.

What follows is a framework of thought which leads to certain principles of instrument display design procedure. From this, it will be a simple and obvious step to generalize the same engineering framework to cover control, cockpit and crew station design. This analytical approach to the psychological aspect of human engineering will establish a new viewpoint from which further insight may be obtained.

The perennial questions facing the instrument display designer have been, "What is the difference between these displays?," "Which one is better and why?" In the past, the answers were based upon pilot opinion, simulator tests and sometimes even flight performance. Each of these has something of value to contribute, but none of them produce the answer to "Why?", or resulted in principles by which the designer can sit down and sketch a new instrument for future aircraft

Fig. 2: "Safety-modulated" altimeter integrates angle of descent and true altitude readings



Instruments

Fig. 3: Human engineering is investigating fatigue brought on by complex instrument panel

which he knows will meet the requirements of instrument information transmission to the pilot. The expense of simulation and flight tests should, at that time, only be undertaken to verify the design and may even be completely avoided in the long range future. This is not to leave the impression that we are ready to do this "drawing board finished design" today. The reason we can not is the lack of certain data concerning the psychology and information measure of flight. Further in this outline, the required data will be indicated and such experiments will undoubtedly be devised and accomplished by aviation psychologists in the near future to obviate this difficulty.

Let us describe the indicator-pilot communication link qualities and then compare these to the specification which the instrument must meet to do its intended job. A measure of this communication can be obtained from the conditional probability curve for any display. As shown in Fig. 1, this curve indicates the probability of reading a displayed scale value on scale x, as each scale value on the perceived scale y, in a particular time interval of observation τ. From the shape of this curve, we can see that the pointer on the x scale is most probably at y_0, but under the conditions prevailing during this experiment, the observer thought the pointer to be at other values on the observed scale y (as indicated by the other conditional probabilities $p_\tau(y/x_0)$ (read "probability of y given x_0 as a condition"). Let me emphasize that y is the observer's subjective perception scale, while x is the true instrument displayed scale. Many of the qualities we normally attribute to a display can now be numerically evaluated from these empirical results. For instance:

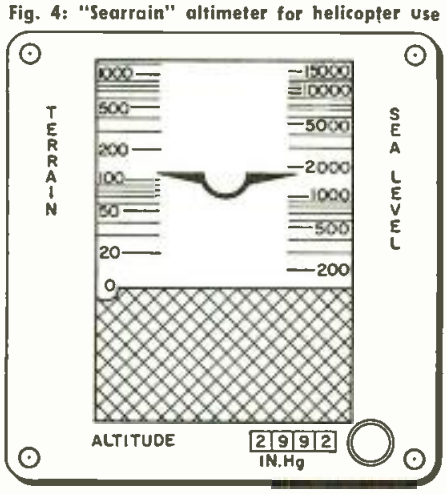
Accuracy can be considered to be the probability of an exactly correct reading (presuming no gross errors such as parallax) of the displayed value. Numerically, this corresponds to the peak of the probability curve, in this case, .9 or 90%.

Reliability is a measure of the confidence which may be placed in the received message. It may be defined as the minimum percentage of correct message receptions within the specified limits of acceptable error for the displayed message. In other words, reliability is the ratio of the area under the conditional probability curve within the "acceptable reading" limits from say, y_1 to y_2, to the entire area under the curve. Since this entire area always equals unity, the mathematical definition may be taken to be

$$\text{reliability} = \operatorname*{Min}_{x_i} \int_{y_1}^{y_2} P_\tau\,(y/x_i)\,dy$$

where x_i is any particular value presented on the displayed scale. The acceptable limits are a function of the parameter being displayed. For example, temperature might have a wider acceptable range than altitude or air speed. In general, this acceptable range will be non-symmetrical with respect to the displayed x scale value. The integral is evaluated for the display at that x_i which will give the minimum value and therefore furnish a most conservative measure of reliability. Usually the conditional probability curve will be a function of fatigue and so will vary with time. The reliability will also change accordingly. This relation can be readily obtained from test results. The above definition can easily be extended to specify a quality of the sensing equipment design as is indicated in Appendix.

Fig. 4: "Searrain" altimeter for helicopter use



Readability may be defined as a measure of the ease of judgment of the displayed information. It may be computed from the same conditional probability by using the directly related quality $H(y/x_i)$, an information transfer measure. To provide generality and lead to a percentage figure of readability, the conditional uncertainty may be normalized with respect to the maximum received uncertainty $H(y)_{max}$. Examination of this ratio $H(y/x_i)/H(y)_{max}$ indicates it to have a unity value when the observed probability distribution is uniform over the entire scale range, but this intuitively corresponds to the most unreadable situation. Therefore, to give meaning to the expression, it is necessary to subtract this ratio from unity. This gives the definition

$$\text{readability} = \operatorname*{Min}_{x_i} \left[1 - \frac{H_x'(y/x_i)}{H_x'(y)_{max}} \right]$$

It may be seen that the maximum readability of 100% corresponds to a simple possibility (100% reliable with 0% acceptable error range), and a readability of 0% corresponds to a uniform distribution (maximum uncertainty). Thus, readability is the subjective measure of received information and its related conditional probability curve. You may note that the above definition of readability bears a striking resemblance to the standard definition for redundancy of the received message. Work has therefore been carried on to relate this subjective redundancy (readability) to the redundancy of display with incident experimental noise.

Various other qualities of communication from the display to the man have been defined mathemati-

(*Continued on page* 154)

Modulation Sideband Splatter of

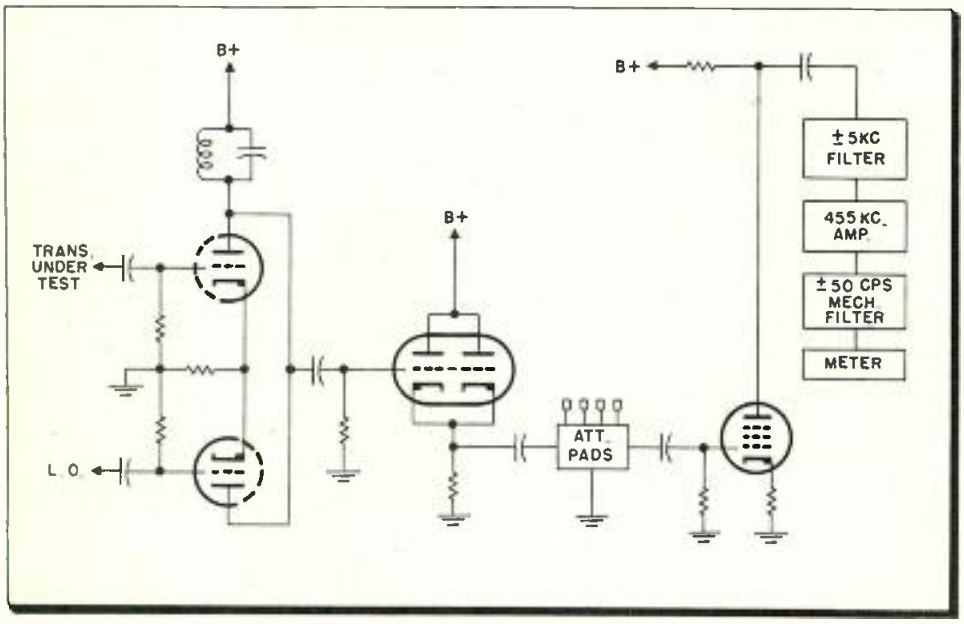


Fig. 1: Basic circuit of receiver used to measure sideband splatter

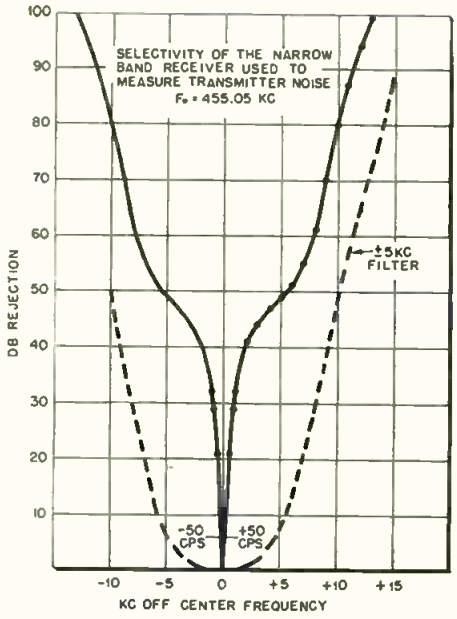


Fig. 2: Receiver selectivity characteristics

Byproducts of modulation process limit channel spacing beyond expectations of simple theory. How to measure and reduce splatter

By DR. WM. FIRESTONE, ANGUS MACDONALD & HENRY MAGNUSKI
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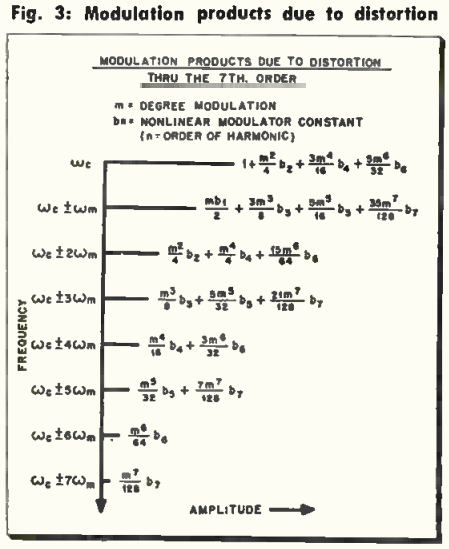
THE ever-growing ranks of users of VHF and UHF communication equipment, particularly for mobile and emergency services, demand additional channel assignments from the FCC. On the other hand, the available frequency spectrum is limited and the only way additional channels can be provided is to assign a narrower frequency band per channel by splitting the existing channels in two or three, or by otherwise closely spacing the channels.

Many technical problems arise when a large number of radio channels in the same band are put into service in a small area. Receiver selectivity and desensitization, receiver and transmitter intermodulation and frequency stability, transmitter noise, and finally, transmitter modulation sideband splatter are some of the important considerations.

Strangely enough, all these problems except the last one have been given considerable attention, and, for example, we've learned to make receivers having as narrow a bandwidth as desired and with practically any desired degree of selectivity; also we know how to control the frequency stability of our transmitters and local oscillators. The intermodulation and desensitization problems are also recognized and even though absolute solutions are not known, techniques are available which permit the attainment of a reasonable degree of protection.

Fig. 3: Modulation products due to distortion



On the other hand, very little material has been published on the subject of transmitter sideband splatter. This problem is not only gaining daily in importance, but may prove to be one of the limiting factors which prevents us from using extremely narrow channels successfully.

In order to show that an extremely minute amount of sideband splatter can be disturbing, let us consider a typical VHF mobile operation. The transmitter power may be, for example, 50 watts or +17 dbw (decibels above one watt). On the other hand, a typical receiver sensitivity may be ½ μv across 50 ohms antenna coax cable which corresponds to —143 dbw (decibels below one watt). The difference between the transmitted power and the minimum power the receiver is capable of detecting is therefore about 160 db.

In mobile communication practices, it quite often happens that the mobile receiver is in close proximity of a powerful VHF transmitter working on adjacent channel and laying down a signal at this receiver of an order of, say, 0.5 v or —23 dbw. At the same time, the desired station may be far away and therefore the receiver may attempt to receive

VHF & UHF Transmitters

The growing requirement for additional communication channels in the VHF and UHF bands demands closer spacing between channels, as well as adjacent channel operation. One of the major problems involved is the control and reduction of modulation sideband splatter. This paper studies the transmitter splatter created as the by-products of modulation processes in typical AM, PM, and FM transmitters. Measurements show that this splatter exceeds the theoretical expectations based on simple theory. Techniques are discussed for measuring the splatter and for reducing it in practical transmitters.

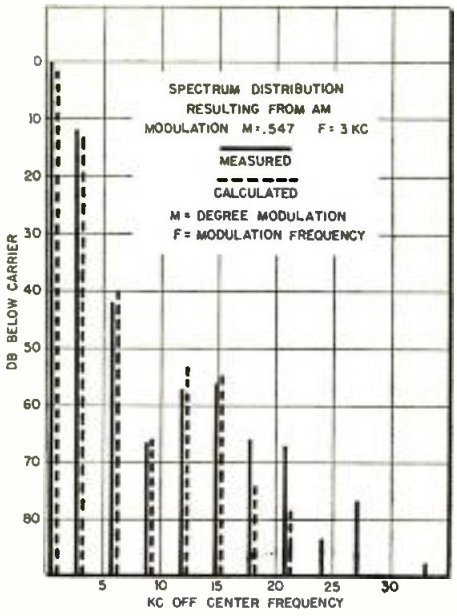


Fig. 6: AM spectrum distribution

a desired signal of 0.5 μv. It is clear then that the undesired signal (on the adjacent channel) is 120 db stronger than the desired signal. Obviously, this rather extreme case was selected as an example just to point out that we would be interested in eliminating transmitter splatter down to 120 db below the transmitter power if we could do it. It is important to realize that 120 db means very minute sidebands, having a power equal to one millionth of one million of the carrier power, and even these minute sidebands can disrupt adjacent or alternate channel operation.

Before discussing sideband splatter, the technique developed to measure such splatter will be described briefly.

To measure transmitter noise directly over a 100 db range, however, presents certain problems. The receiver has to be very highly selective, variable in frequency, and possess a converter having the 100 db dynamic range. Dynamic range of a converter may be defined as the range of input levels over which a given linearity limit may be met. (Linearity refers to the output vs. input relationship).

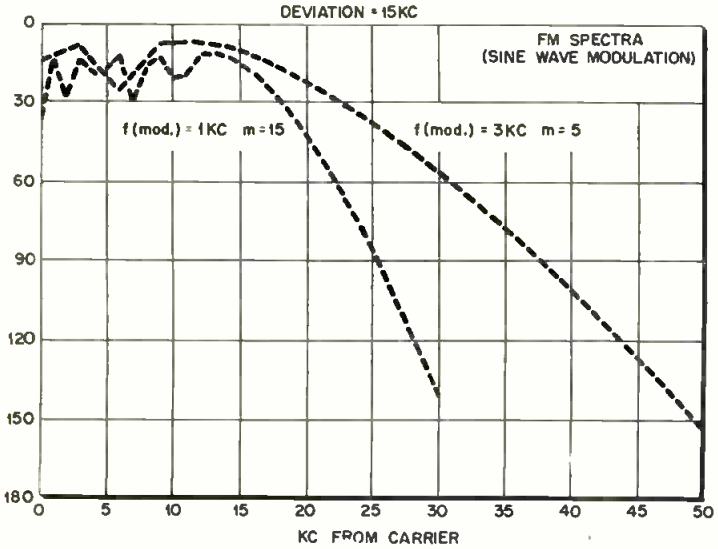
Such a receiver would be difficult if not impossible to find or construct because of the last requirement. D. A. Alsbert[1] in 1952 was at best able to construct a converter having dynamic ranges between 50 to 60 db for linearities of 0.01 db.

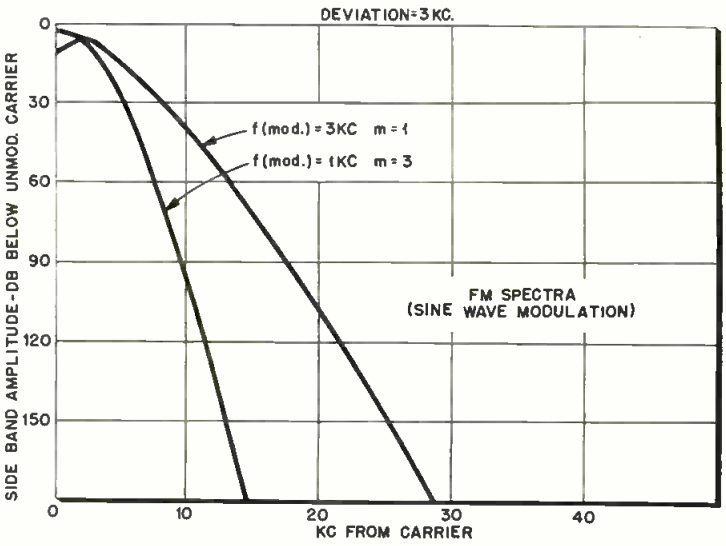
Fixed Input

Rather than requiring the converter to operate over 100 db dynamic range, it was decided to always operate the converter at a fixed input level (0 db range) regardless of the portion of the transmitter spectrum to be investigated. The circuitry required may be seen in Fig. 1. The levels of the local oscillator and the transmitter under test are held constant at all times, thereby permitting the converter to operate under constant conditions of grid current, plate current, etc. This mode of operation maintains a constant relationship between the input and output signals of the converter. The plate circuit of the converter is tuned to 455 KC and consequently rejects the two input RF signals. Initially the L. O. (local oscillator) is 455 KC away from the transmitter carrier signal, resulting in an "on frequency" signal to be received by the rest of the receiver. As the L. O. is tuned more than 455 KC away from the transmitter carrier, it beats with the sideband spectrum of the transmitter and part of the sideband spectrum is thereby converted to 455 KC which is then amplified by the receiver. The attenuator pad permits the receiver portion of the receiver to receive signals of fixed amplitudes and always operate under identical conditions. The difference in attenuator readings between the "on frequency" signal and some other portion of the transmitter spectrum to yield a given receiver limiter indication will then indicate the relative level between these signals. Hence, the sideband spectrum can be measured.

As can be observed, a unique type of mixer is employed. This mixer was selected because of its low noise output and the isolation it provides between the signals being mixed. The transmitter signal is generally of the order of many volts

Fig. 4: (l) Frequency modulation spectra with 15 kc deviation. Fig. 5: (r) FM spectra with 3 kc deviation





Sideband Splatter (Continued)

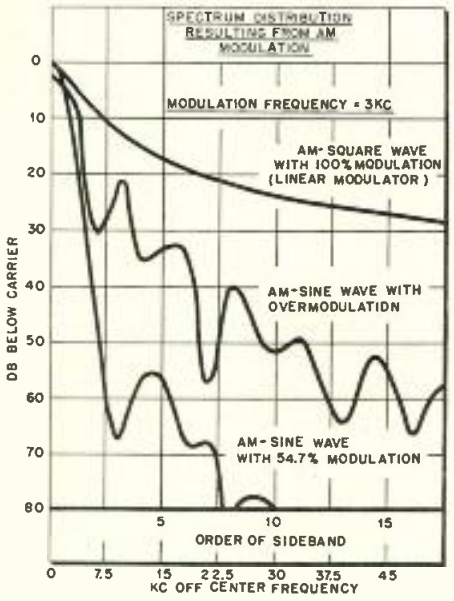


Fig. 7: AM spectrum distribution

on the mixer grid and L. O. always provides 1 volt on the other mixer grid. The 12AU7 is used to match the attenuator output to the filter input.

With the L. O. tuned 455 KC from the transmitter carrier, the attenuator is made to read 100 db. As the L. O. is tuned to a greater difference frequency than 455 KC, it is necessary to remove some of the 100 db pad to achieve the same output reading; therefore, a plot of attenuation removed versus frequency yields a transmitter sideband spectrum curve. It is of course necessary to tune in each sideband separately. In order to tune in each sideband separately while rejecting strong adjacent sidebands a great deal of selectivity is required. This selectivity was achieved by use of a narrow band permakay filter. The resultant selectivity curve is shown in Fig. 2.

AM Measurements

While the above technique is suitable for measuring FM or PM sidebands because of constancy of the amplitude of the r-f it is not suitable for AM measurements due to the required dynamic amplitude range. For AM it is necessary to eliminate the mixer, due to its non-linearities; to have the output frequency of the modulator operator at the i-f frequency and to limit the absolute amount of voltage feeding the measuring system. This is all required in order that non-linearities of the measuring system do not enter into the creation of new AM sidebands which could be falsely attributed to the modulator. To measure the spectrum it is necessary to shift the frequency of the r-f generator.

Let us now compare the theoretical sideband structure of AM, FM, and PM systems. We will limit our consideration to voice frequencies with the highest frequency equal to 3000 cycles. Let us, too, consider first a transmitter modulated by single tones of either 1 KC or 3 KC.

Theoretical Spectra

Fig. 4 shows the theoretical spectra of an FM transmitter being deviated 15 KC with modulation indices of 5 and 15 respectively. If the deviation is decreased to 3 KC and the same modulating tones are used the new modulation indices will be 1 and 3 respectively. This is portrayed in Fig. 5. As we would expect the sidebands now do not extend as far out frequency-wise. These curves are obtained by the usual Bessel function expansion method.

In order to save bandwidth, low modulation factors are now being used for FM, thus reducing the S/N improvement factor and making FM quite similar in operation to AM. As one can see from the theoretical viewpoint AM has a great advantage in this case, having only two sidebands spaced from the carrier by the modulating frequency, while FM and PM sidebands extend over a considerable spectrum. However, this is only a theoretical advantage. Contrary to general belief AM transmitters can be particularly serious offenders with regard to sideband splatter. This can be explained by the fact that in a practical AM modulation process, distortions occur, and even if they are very small can cause considerable splatter. The AM sideband splatter may therefore be analyzed as follows.

Linear Modulation

As linear modulation characteristic could normally be expressed as

$E_{RF}=1+E_m$, (E_{RF} is normalized to unity for full r-f output with no modulation)

Where $E_m=O$ when the normal unmodulated plate voltage is applied to the modulator and $E_m=1$ on the peak and $E_m=1$ on the trough of a 100% modulated signal.

If the modulation is not linear it may be expressed as a power series of the following form.

$$E_{RF}=1+b_1E_m+b_2E_m^2+b_3E_m^3+\ldots+b_nE_m^n$$

The above equation not only matches the modulation characteristic to any desired degree but a trigonometric expansion of it when $E_m=a_1 \cos W_m t$ yields the spectrum for the given non-linearities. Fig. 3 shows the expected sidebands as a function of the AM modulation index and the b coefficients of the modulation characteristic. Fig. 6 shows the measured sidebands for m=0.547 down to 90 db and the theoretically calculated sidebands when the modulation characteristic is expressed by a seventh order equation. If one is willing to accept the work involved it is possible to match the modulation characteristic to any desired degree and hence predict the r-f spectrum to any desired degree. Fig. 7 shows the expected spectra for three different types of AM modulation conditions while Fig. 8 compares two different AM modulation conditions (m=0.547, and about 20% overmodulated) with two different FM modulation conditions (m=1 and 5). Since the operating condition of

(*Continued on page* 129)

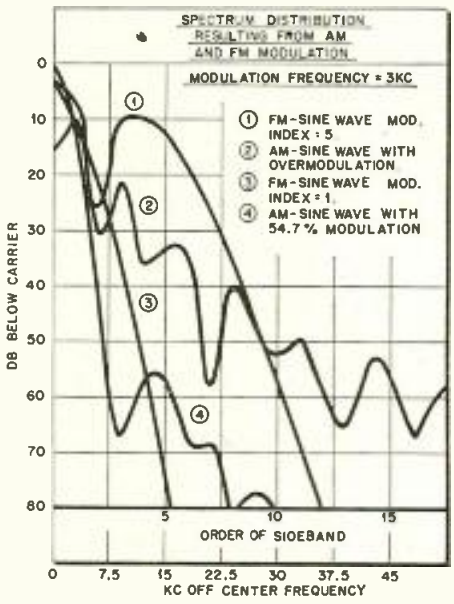
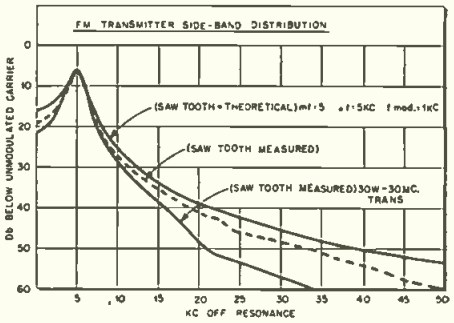


Fig. 8: AM and FM spectrum distribution

Fig. 9: FM transmitter sideband distribution



9th Annual

NARTB Engineering Conference

THE 9th annual Broadcast Engineering Conference, concurrently with the 33rd annual Convention of the National Association of Radio and Television Broadcasters, will be held at the Shoreham and Sheraton-Park Hotels, May 22-26, inclusive.

The Broadcast Engineering Conference will hold two day sessions—May 25-26. Formal opening of the BEC and Convention sessions is Tuesday, May 24. Tuesday will be known as "Government Day" at which time joint Management-Engineering conferences will be held. That evening the Engineering Reception is scheduled.

The first day of the Engineering Conference (Wednesday) will be called "Radio Day." Discussions will feature automatic transmitter and programming techniques, economics of new transmitter and audio developments, and the importance of FCC decisions and Rule Makings. Raymond F. Guy, director of Radio Frequency Engineering, National Broadcasting Co., New York, will be the presiding officer and make the opening address. The technical papers program is as follows:

EXHIBITORS

Adler Communications Laboratories
Alford Mfg. Company, Inc.
Altec Lansing Corporation
Amperex Electronic Corp.
Ampex Corporation
Andrew Corporation
Berlant Associates
Blaw-Knox Company
Caterpillar Tractor Co.
Century Lighting, Inc.
Collins Radio Company
CONRAC, Inc.
Continental Electronics Mfg. Co.
Crouse-Hinds Company
Dage Electronics Div. of. Thompson Products, Inc.
Hughey & Phillips, Inc.
Dresser-Stacey Co.
Allen B. DuMont Laboratories, Inc.
Electro-Voice, Inc.
Elgin Metalformers Corp.
Emsco Mfg. Company
Gates Radio Company
General Communications Co.
General Electric Company
General Precision Laboratory, Inc.
Gray Research & Development Co., Inc.
The Harwald Company
The Houston-Fearless Corp.
International Business Machines Corp.
Kay Lab, Inc.
Kliegl Bros.
Machlett Laboratories, Inc.
Musicolor, Inc.
Nems-Clarke, Inc.
Phelps Dodge Copper Products Corp.
Philco Corp.
Prodelin, Inc.
RCA Victor Division
Raytheon Mfg. Company
Paul Schafer Custom Engineering
Standard Electronics Corp.
Telechrome Sales, Inc.
Teleprompter Corp.
Tel-Instrument Company, Inc.
Tower Construction Co.
American Telephone & Telegraph Co.
ABC Film Syndication, Inc.
Cheryl T-V Corporation
CBS Television Film Sales, Inc.
Flamingo Films
General Teleradio, Inc.
Guild Films Company, Inc.
Hollywood Television Service, Inc.
M & A Alexander Productions, Inc.
MCA TV Ltd., Film Syndication Div.
Minot TV, Inc.
National Broadcasting Company
National Telefilm Associates, Inc.
Official Films, Inc.
Screen Gems, Inc.
Sterling Television Co., Inc.
Television Programs of America, Inc.
Unity Television Corporation
Ziv Television Programs, Inc.
A-V Tape Libraries, Inc.
Harry S. Goodman Productions
Lang-Worth Feature Programs, Inc.
Radio Corporation of America
SESAC, Inc.
Standard Radio Trans. Services, Inc.
World Broadcasting System, Inc.
Frederic W. Ziv Company
The Associated Press
International News Service
Bonded TV Film Service, Inc.
Keystone Broadcasting System, Inc.
The Headley-Reed Company
George P. Hollingbery Company
Robert Meeker Associates, Inc.
Meeker TV, Inc.
Edward Petry & Company, Inc.
Weed & Company

RADIO DAY

Wednesday, May 25

Presiding Officer: Raymond F. Guy, Director of Radio Frequency Engineering, National Broadcasting Company.

Opening, address, Raymond F. Guy.

"Remote Control of High Power Transmitters and Directional Antenna Systems," A. Prose Walker, Manager of Engineering, NARTB.

"Automatic Programming Systems," Philip Smaller, Research Engineer, Ampex Corp.

"Improvements in Broadcast Audio Equipment Design," Norbert L. Jochem, Director of Engineering, Gates Radio Company

"A Transistorized Remote Amplifier," Paul G. Wulfsberg, Assistant Director of Engineering and Research, Collins Radio Company.

"Tape and Disk Recording—How To Do It," Thomas J. Merson, Vice President, Audio-Video Recording Company.

"The Engineer—The Builder," Everett S. Lee, Manager, Technical Public Relations, General Electric Company.

LUNCHEON

Radio Day—Afternoon Session

Presiding Officer

"Acoustics Measurements and Studio-Re-Design," Dr. Leo L. Beranek, President, Bolt, Beranek and Newman, Inc.

"The Operation and Economics of Phase to Amplitude Modulation in AM Broadcast Transmitters," Charles J. Starner, Design Engineer, Broadcast Transmitter Section, Radio Corporation of America.

"FM Broadcasting—Growing Pains and Expansion Strains"—A panel. A. Prose Walker, Moderator, Manager of Engineering, NARTB

Panel: John H. Bose, Staff Engineer, Electronics Research Laboratory, Columbia University. William Halstead, President, Multiplex Development Corporation. Stanley Joseloff, President, Storecast Corporation of America. Ross Beville, Chief Engineer, Radio Station WWDC, Washington, D. C.

"Will FCC Bandwidth Proposals Increase Your Operating Costs?"—A panel. Robert E. L. Kennedy, Moderator; Partner, Kear and Kennedy

Panel: Ernest W. Pappenfus, Assistant Director, Engineering and Research, Collins Radio Company.
James O. Weldon, President, Continental Electronics Manufacturing Company. A. Earl Cullum, Jr., Consulting Radio Engineer. Fred Damm, Transmitter Design Engineer, Gates Radio Company. Harold G. Towlson, Manager, Broadcast Transmitter Engineering, General Electric Company. John E. Young, Manager, Broadcast Transmitter Engineering Section, Radio Corporation of America. Ralph N. Harmon.

(*Continued on page* 110)

Improved Localizer Antennas For ILS

Course "bends" due to reflections of the transmitted wave can be largely eliminated by arrays which produce a null in other than the desired direction

By
HOWARD S. STOKES
Corvey Engineering Co.
Jefferson Davis & Calvert Sts.,
Alexandria, Va.

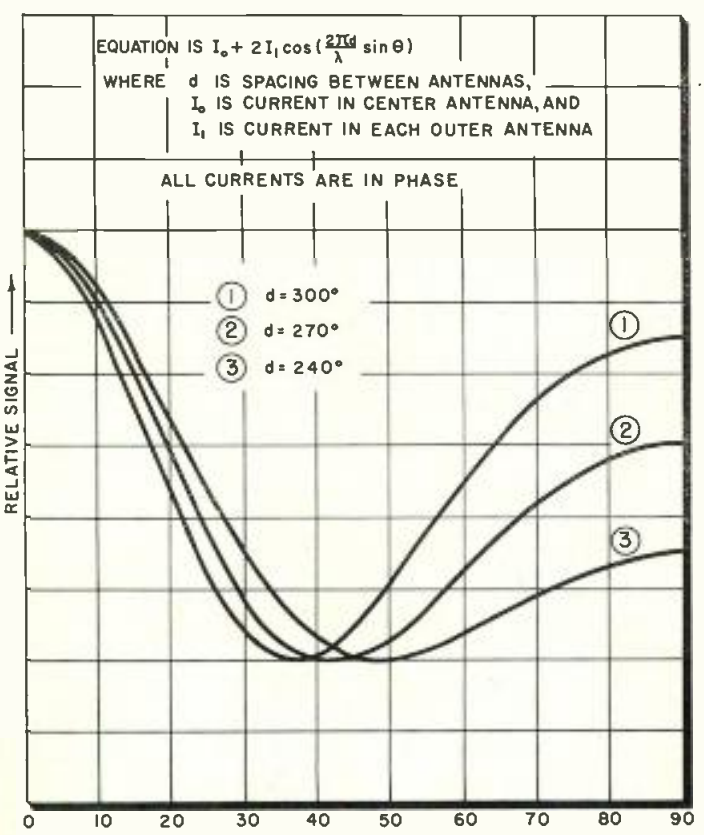
THE International Civil Aviation Organization (ICAO), has adopted as a standard the instrument landing system (ILS) which it describes in its Annex 10. It is incumbent on each member state of ICAO to install this system at such of its airports as are designated for international flights if the weather and traffic conditions there warrant a radio aid for instrument approach and landing.

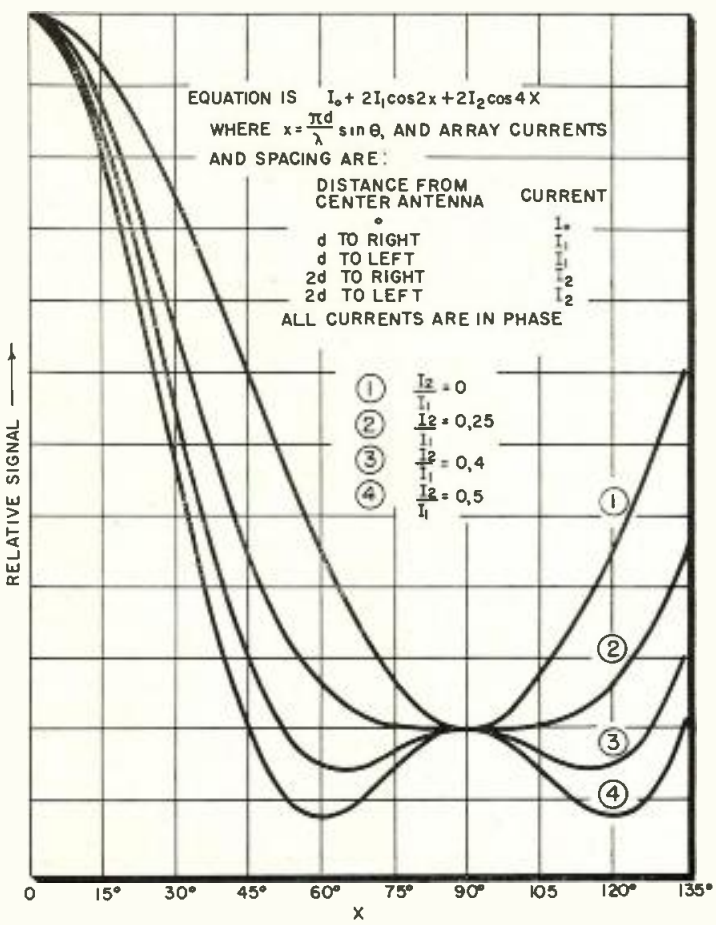
The deficiencies that existed in the ILS some years ago are now largely corrected, or at least the corrections are known and are being applied as rapidly as time and money permit. For example, the concentration and effort formerly required of the pilot flying the ILS can largely be eliminated today with approach couplers that permit the automatic pilot to fly the plane on final approach, or by such devices as the Sperry Zero Reader or the Collins Steering Computer that constantly calculate for the pilot any corrections needed in the aircraft controls. A new glide-slope facility has been designed in the U. S. within the past few years that corrects the few weaknesses of the original design. Distance measuring equipment should soon be available for use with the ILS, so that the pilot will have a constant and accurate indication of the distance to the ILS reference point where his plane should contact the runaway. It appears that on only one problem has progress lagged, namely, correcting the "bends" that exist in some of the ILS localizer courses.

Localizer Function

The localizer of the ILS is the radio aid that furnishes lateral guidance to the aircraft on final approach. In the absence of bends, an aircraft following the localizer course remains directly above the extended runway center-line during its final approach. Bends exist when the received signal consists not only of energy coming directly from the localizer antenna (and reflected by the ground immediately in front of this antenna), but includes as well energy reflected by the airport administration building, hangars, or other reflecting surfaces on or near the airport. When such reflected en-

Fig. 1: (below) Radiation diagram of 3-antenna reference pattern array
Fig. 2: (r) Curves for 5-antenna array. Antenna current ratio fixes null





ergy is present, the course is no longer straight, and it becomes difficult to follow. Bends can cause trouble even with the approach coupler/automatic pilot combination, as either the response of this equipment must be made so sluggish as to disregard these bends or the plane's efforts to follow the bends will produce a rough ride. As indications that this problem of localizer bends is still with us, it may be worth mentioning that the recent ICAO Communications Div. meeting had this item on its agenda (Item 2.2) and the work program of the U.S. Air Navigation Development Board continues to include projects relating to this problem.

Problem

The most obvious correction for localizer bends is to reduce or eliminate the energy directed toward the reflecting object. A second general line of attack is to redirect this reflected energy so that it will not reach the course. Although such measures as redirecting the reflected energy may not seem very practical, they have not been completely ignored. We find, for example, in the Civil Aviation Radio News Letter No. 9 published by the CERCA Central Office, London, the suggestion that airport buildings be in the form of truncated cones if they must be erected where, were their sides vertical, energy would be directed to the course. It is also suggested there that the sides of hangars producing unwanted reflections be built out, using wire-mesh or light sheeting, to present a suitably reoriented face. Herein we will not consider further this line of attack, but will limit ourselves to an examination of changes in the form of the radiated signal intended to reduce the energy directed toward surfaces that produce unwanted reflections.

Directive Antennas

One approach to this problem has been made by Watts at the CAA's Technical Development and Evaluation Center, Indianapolis, Ind. His work is reported in TDEC Report No. 155 and in the Proc. of the IRE for October, 1952. He has designed an ingenious antenna of high directivity using a large radiating waveguide; its deflection patterns reach their maximum value at 5° off the course, and already have fallen to about ¼ of this maximum value at 15° off the course. Where there are a number of surfaces producing unwanted reflections so that the radiation must be suppressed over a wide sector, an antenna of the type described by Watts appears to be the solution. If only one or two reflecting surfaces are producing the difficulty, however, the radiation at these angles may be largely suppressed with a more conventional antenna array as will be explained in the following paragraphs.

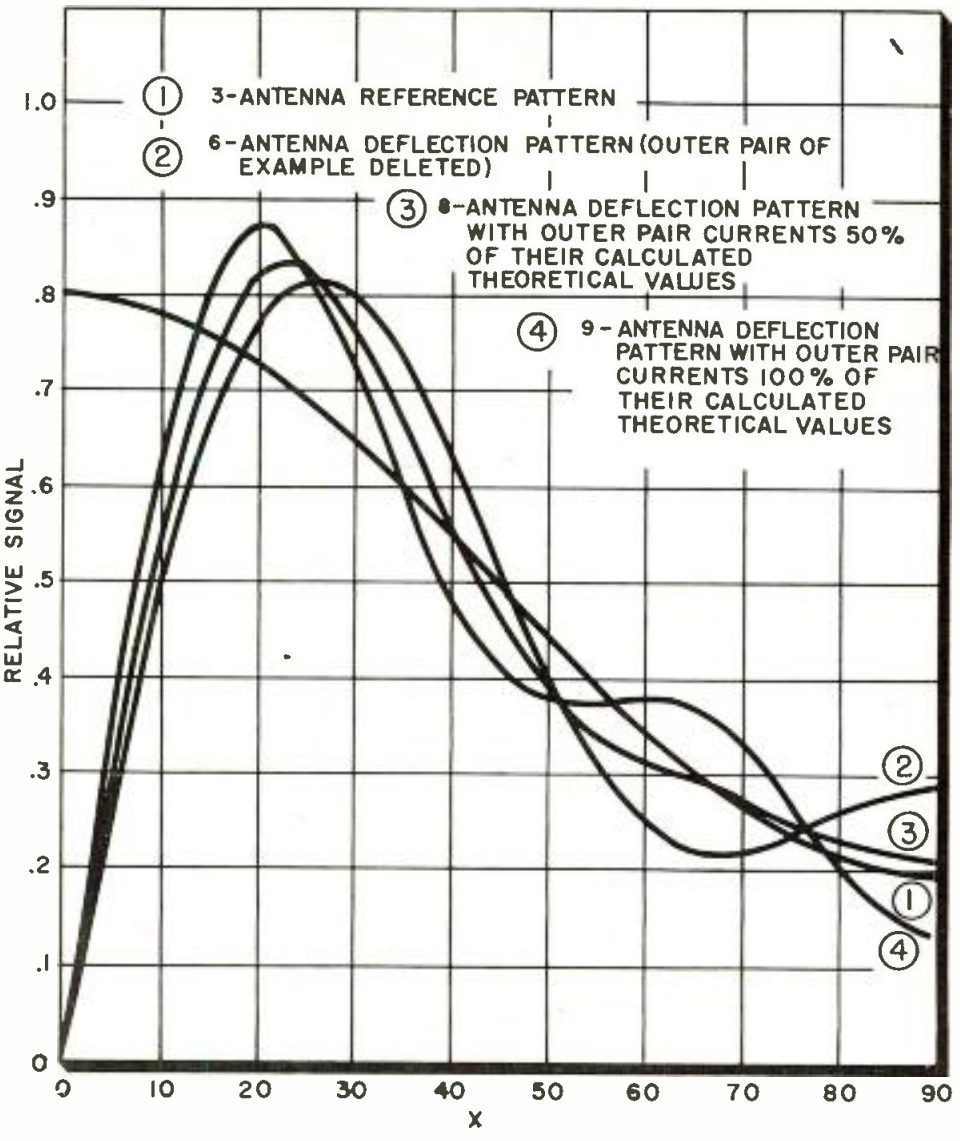


Fig. 3: Radiation diagram plotted as function of $x = \pi d \sin \theta/\lambda$

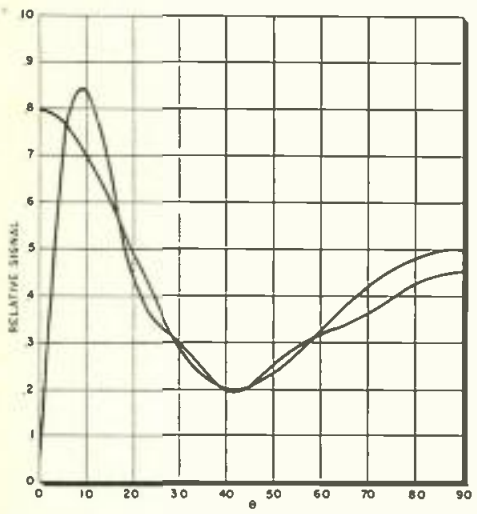
Reference Pattern

A localizer radiates two signals simultaneously. One is the reference pattern and this has "even" symmetry with respect to the course. The second is the deflection pattern and it has "odd" symmetry with respect to the course. Except for a narrow sector centered on the course, the two patterns should have essentially identical form. Initially we will consider only the reference pattern and later we will investigate the design of a deflection pattern that matches it.

Present designs of localizers commonly use one or two antennas for the reference signal, with horizontal polarization in both cases. The antenna used singly normally has a slight inherent directivity, and is oriented so that the signal radiated along the course is greatest. For the two-antenna array, the antennas radiate in phase and are on a line perpendicular to the course, with the spacing between antennas chosen so that the signal in the direction of the course is about twice that radiated along the line of the antennas.

What simple array will allow us to put a null or a deep minimum in this reference signal at some angle where we are encountering objectionable reflections? One consists of three non-directional antennas in a line perpendicular to the course, all radiating in phase. If d is the separation between adjacent antennas and s equals π d/λ, the pattern of this array becomes:

Localizer Antennas (Continued)



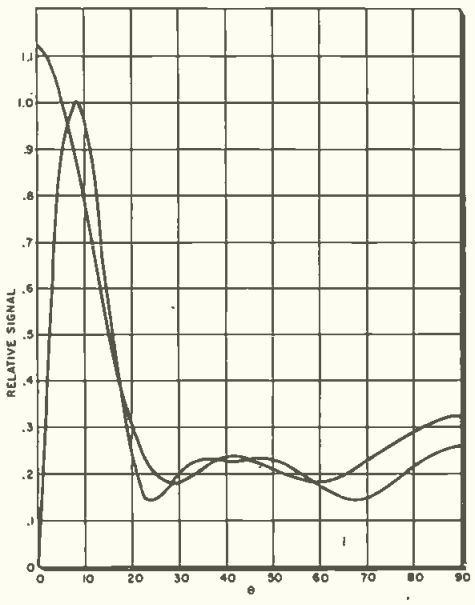


Fig. 4: (above) Radiation, using 60% current Fig. 5: (r) Diagram for 5- and 8-antenna arrays

$$K\,[I_o + 2I_1 \cos (2s \sin \theta)]$$

Where K is a proportionality factor, I_0 is the current in the center antenna, I_1 is the current in each outer antenna, and θ is the angle measured from the course. To put a minimum at any angle θ_1, we make d, the spacing between adjacent antennas, equal to $\lambda/2 \sin \theta_1$. Then, as the currents in the outer antennas, I_1, are raised so that they approach 0.5 I_0, the minimum becomes deeper and finally becomes a null. Fig. 1 shows a diagram of this array in rectangular coordinates for various values of s. No scale has been shown for the ordinates. inasmuch as its zero point may be positioned arbitrarily by the choice of the ratio of I_1/I_o.

Let us now imagine a similar array but with five equally-spaced antennas instead of three, all with currents of the same phase. The pattern is now:

$$K\,[I_o + 2I_1 \cos (2s \sin \theta) + 2I_2 \cos (4s \sin \theta)]$$

Here, I_0 is still the current in the center antenna, but I_1 is the current in the second and fourth antennas, and I_2 is the current in the outer two antennas. Plotting the directional diagrams of this array as we have done in Fig. 1 for the 3-antenna array becomes laborious, as we have an additional variable, I_2, and various families of curves become necessary. We can avoid this problem and plot diagrams applicable to any spacing by substituting x for s sin θ. in which case we have the curves of Fig. 2. As an example of how this figure is used, let us suppose we have selected a separation of 3 λ/4 for d, then s = 3π/4, and the signal radiated on the azimuth of 90° will be read on the vertical line where x = 135° sin 90° or simply 135°. For an azimuth of 30° the value of x will be 135° sin 30° or 67.5°, etc. Again, no values are shown for the ordinates on this figure, as the adjustment of the current in the center antenna can be used to bring the minimums just as close to zero as is desired; that is, we can draw the horizontal line representing zero field at any distance we wish below these curves, as it is controlled solely by the ratio of the current in the center antenna to the currents in the remaining four antennas.

Adding another pair of in-phase antennas so as to make the array length 6d would permit a further narrowing of the lobe radiated in the direction of the course, but probably five reference antennas is a reasonable maximum.

We must now determine how an antenna array for the deflection pattern may be selected that will match the reference pattern at all azimuths except in the sector close to the course where its polarity must reverse. The reflections of this deflection pattern cause the course bends, so the sharpened reference patterns we devised in the preceding section are valueless unless we can design matching patterns but with "odd" symmetry.

Starting with the expression given earlier for the 3-antenna reference array, and again substituting x for s sin θ, we have,

$$KI_o + 2KI_1 \cos 2x$$

Our deflection-pattern antennas will consist of pairs radiating out of phase, and to maximize the spacing between them and the reference-pattern antennas, we will place them at ± (n — ½) d from the center of the array, where n = 1 for the first pair, n = 2 for the second, etc. (The spacing between antennas of the reference pattern is d.) Adjacent antennas will thus be separated by d/2 except toward the ends of the array where there are only deflection antennas, and the spacing will become d. The radiation diagram of this deflection pattern may now be written as,

$$2KI' \sin x + 2KI'' \sin 3x + 2KI''' \sin 5x + \ldots\ldots$$

(*Continued on page* 112)

TABLE I

Reference or Deflection	1 Antenna or Pair	Current	Phase	Distance from Center
Ref.	One	I_o	0°	0
Ref.	Pair	0.31_o in each	0°	± 3/4λ
Def.	Pair	$0.5093I_o$ in each	±90°	± 3/8λ
Def.	Pair	$0.4414I_o$ in each	±90°	± 9/8λ
Def.	Pair	$0.2183I_o$ in each	±90°	±15/8λ
Def.	Pair	$0.1504I_o$ in each	±90°	±21/8λ

TABLE II

Reference or Deflection	1 Antenna or Pair	Current	Phase	Distance from Center
Ref.	One	I_o	0°	0
Ref.	Pair	$0.4464I_o$	0°	± 3/4λ
Ref.	Pair	$0.1786I_o$	0°	± 3/2λ
Def.	Pair	$0.4320I_o$	±90°	± 3/8λ
Def.	Pair	$0.4558I_o$	±90°	± 9/8λ
Def.	Pair	$0.3890I_o$	±90°	±15/8λ
Def.	Pair	$0.2775I_o$	±90°	±21/8λ

1955 NATIONAL TELEMETERING CONFERENCE 1955

WEDNESDAY, MAY 18, 1955

8:00 A.M. — **REGISTRATION**

Registration and all sessions will be held at the Morrison Hotel, Chicago, Illinois. The registration charge includes admission to all meetings.

Morning Session — 10:00 to 12:00

1. COMPONENTS I—INDUSTRIAL TELEMETERING
CHAIRMAN: DR. K. C. BLACK, Raytheon Mfg. Co.

a. "A NEW HI-SPEED TELEMETER TRANSMITTER FOR DC MEASUREMENTS"
R. M. Stuart, General Electric Co.

b. "AN INCREMENTAL REMOTE POSITION CONTROL SYSTEM"
Jonathan Moss, Kiryat Motzkin, Haifa, Israel

Afternoon Session — 2:00 to 5:00

2. SYSTEMS I—INDUSTRIAL TELEMETERING
CHAIRMAN: P. A. BORDEN, Bristol Co.

a. "A NEW TIME INTERVAL TELEMETER SYSTEM"
W. H. Howe, The Foxboro Company

b. "AUTOMATIC TELETYPE TRANSMITTING SYSTEM"
J. R. Cunningham, Beckman Instruments, Inc.

c. "ULTRA SONIC LIQUID LEVEL INDICATOR SYSTEM"
R. L. Rod, Bogue Electric Mfg. Co.

d. "CHANNELS FOR TELEMETERING, SUPERVISORY CONTROL AND OTHER PURPOSES"
H. A. Rhodes and R. W. Ralston, A. T. & T. Co.

e. "MECHANICAL SAMPLING DEVICES IN TELEMETERING AND RELATED FIELDS"
J. F. Brinster, General Devices, Inc.

3. COMPONENTS II—PICK UPS AND TRANSDUCERS
CHAIRMAN: K. M. UGLOW, Washington, D. C.

a. "VIBROTRON DIGITAL TELEMETERING SYSTEM"
J. Ohmon, Southwest Research Institute

b. "A COMMUTATORLESS DIRECT CURRENT MOTOR"
H. D. Brailsford, Brailsford & Company, Inc.

c. "PRECISION DATA RECORDING AND REPEATING SYSTEM (THE INDUCTOSYN)"
J. L. Winget, Farrand Optical Company

d. "A PHASE MODULATED TRANSISTORIZED PRESSURE OR ACCELERATION TELEMETERING CHANNEL"
A. I. Dranetz & J. L. Upham, Gulton Mfg. Corp.

e. "NEW DEVELOPMENTS IN MINIATURE TELEMETERING PICKUPS" L. A. G. TerVeen, Pacific Division, Bendix Aviation Corp.

THURSDAY, MAY 19, 1955

Morning Session — 9:30 to 12:00

4. SYSTEMS II—FLIGHT TESTING
CHAIRMAN: C. A. TAYLOR, Burroughs Corp

a. "NEW AKT-6 FLIGHT TEST"
J. E. Spooner, Radiation, Inc.

b. "TELEMETRY AS A FLIGHT TEST INSTRUMENT"
J. J. Dover, Air Force Flight Test Cntr., Edwards Air Force Base

c. "A PDM-FM TELEMETERING SYSTEM FOR LOW LEVEL DC INPUTS" R. H. White, National Advisory Committee for Aeronautics, Langley Field, Va.

d. "AN ANALOG CROSS-SPECTRUM ANALYZER FOR CERTAIN TELEMETERED DATA"
R. L. Kenimer, National Advisory Committee for Aeronautics, Langley Field, Va.

e. "A CAPACITANCE COMPENSATED STRAIN GAGE SUBCARRIER OSCILLATOR" R. A. Runyon and J. B. Horry, Electro-Mechanical Research, Inc.

Afternoon Session — 2:00 to 5:00

5. SYSTEMS III—MULTIPLEXING TECHNIQUES
CHAIRMAN: E. L. GRUENBERG, W. L. Maxson Corp.

a. "A NEW SUBMINIATURE AIRBORNE FM DEMULTIPLEXER"
L. Finkel, F. Shandelman, J. Piontkowski

b. "THE MAGNETRON BEAM SWITCHING TUBE"
H. Moss, Burroughs, Corporation

c. "HIGH SPEED MERCURY JET COMMUTATING SWITCH" W. R. Davis, Detroit Controls Corp.

d. "MINIATURIZED AIRBORNE ELECTRONIC COMMUTATOR"
R. O. DuBois, Electro-Mechanical Research, Inc.

e. "TELEMETRY FILTERS AND THEIR EFFECT ON THE DYNAMIC ACCURACY OF MULTIPLEX FM SUBCARRIER INSTRUMENTATION SYSTEMS"
G. S. Sloughter, R. A. Runyan, W. H. Duerig, G. E. Tisdale, Electro-Mechanical Research, Inc.

PROGRAM CHAIRMAN:
CONRAD H. HOEPPNER
Stavid Engineering, Inc.,
Plainfield, N. J.

EXHIBIT CHAIRMAN:
GILBERT H. BRITTAIN,
Armour Research Foundation,
Chicago 16, Ill.

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CONFERENCE INFORMATION FEES

Registration	
Members	$2.50
Non-Members	3.50
Luncheon	3.25
Banquet	5.25
Conference Report	3.50

— Send Reservations to —
GILBERT DANIELS
Panellit, Inc.
Skokie, Ill.

ANNUAL BANQUET — 7:30 p.m.

"PROBLEMS IN ULTRA HIGH SPEED FLIGHT"
Dr. Hugh L. Dryden—After Dinner Speaker
Director, National Advisory
Committee for Aeronautics

6. COMPONENTS III—NEW DEVELOPMENTS IN TELEMETRY AND REMOTE CONTROLS
CHAIRMAN: J. T. MENGEL, Naval Research Lab.

a. "MIXING AIRBORNE TELEMETERING SUBCARRIERS FOR MAXIMUM ISOLATION WITH MINIMUM LOSS"
W. F. Link, Pacific Division, Bendix Aviation Corp.

b. "A NEW CRYSTAL CONTROLLED GROUND STATION TELEMETERING RECEIVER" M. S. Redden and H. W. Zancanato, Nems-Clarke, Inc.

c. "A NEW INSTRUMENTATION DIRECT WRITING RECORDER AND ITS APPLICATION TO TELEMETRY"
G. E. Bower, Century Electronics Co.

d. "PRECISION MULTI-CHANNEL HEADS FOR MAGNETIC TAPE RECORDING"
A. V. Gangnes, Ampex Corporation

e. "A DIGITAL APPROACH TO TELEMETER TESTING"
C. R. Reid, Aerophysics Department, Goodyear Aircraft Corp.

f. "AN AUTOMATIC LANDING SYSTEM FOR AIRCRAFT"
M. H. Goldstein, Jr. and C. W. Merriom III, Massachusetts Institute of Technology

FRIDAY, MAY 20, 1955

Morning Session — 9:30 to 12:00

7. SYSTEMS IV—NEW DEVELOPMENTS IN TELEMETRY AND REMOTE CONTROL
CHAIRMAN: W. J. MAYO-WELLS, Applied Physics Lab., Johns Hopkins Univ.

a. "RADAR BEACON TELEMETER"
J. W. Poliseo, Stavid Engineering, Inc.

b. "A 14 CHANNEL SYSTEM FOR REMOTE CONTROL OF AIRCRAFT FLIGHT"
W. H. Eggerton, Melpar, Inc.

c. "A PULSE TELEMETERING SYSTEM FOR USE ON BALLOON-LAUNCHED ROCKETS"
L. R. Davis, Naval Research Laboratory

d. "A SEQUENTIAL PULSE TELEMETERING SYSTEM"
T. B. Jackson, U. S. Naval Ordnance Lab.

e. "SILICON TRANSISTOR APPLICATIONS IN TELEMETERING EQUIPMENT" C. E. Earhart and O. A. Becklund, Texas Instruments

f. "COHERENT PULSE TELEMETRY"
A. H. Cooper, E. M. I. Engineering Development, Ltd., Hayes, Middlesex, England

LUNCHEON — 12:45 to 2:15 p.m.

"IN-ACCURATE TRANSMISSION OF MIS-INFORMATION"
Luncheon Talk by: William A. Wildhack,
National Bureau of Standards

Afternoon Session — 2:30 to 5:00

8. COMPONENTS IV—DATA PROCESSING
CHAIRMAN: C. F. WEST, Soroban Engineering, Inc.

a. "THE ROLE OF MAGNETIC TAPE IN DATA RECORDING PROCESSING & ANALYSIS"
G. L. Davies, The Davies Laboratories, Inc.

b. "TALKING TO A COMPUTER" R. F. Shaw, Electronic Computer Div., Underwood Corporation

c. "A PRECISION PRESSURE TELEMETERING SYSTEM WITH DIGITAL DATA HANDLING"
J. Prast, S. H. Calhoun, G. S. Hartloff, G. W. Liske, Bell Aircraft Corp.

d. "AN AUTOMATIC DIGITAL DATA REDUCTION SYSTEM UTILIZING PDM TELEMETERING"
R. F. Hummer, R. M. McClung, D. J. Simmons, U. S. Naval Ordnance Test Station, Inyokern, Aviation Ordnance Dept.

e. "AUTOMATIC DATA REDUCTION OF MISSILE TELEMETERING" H. D. Greif, Hughes Research & Development Laboratories, Hughes Aircraft Co.

MAY 18, 19, 20 CHICAGO

New Mobile Radio Transmitter

Exceptional frequency stability, ready conversion to either 6- or 12-volt operation, and increased r-f power outputs are the notable improvements

By R. L. CASSELBERRY,

Communications Equipment Div.
General Electric Co.

THE most urgent problem confronting the present and the potential user of VHF communication equipment is availability of frequencies. The demand for frequency assignments in an ever-increasing number has now resulted in action by the FCC in the form of Docket #11253, which proposes to allocate 20 KC channels in the 25-50 MC band on an adjacent channel same-area basis, and 15 KC channels in the 152-162 MC band on an alternate channel same-area basis. The exact allocation program is not yet definite, but it is a reasonable certainty that some form of channel-splitting will be adopted. In order to achieve good communications under these conditions without disruptive adjacent channel interference, transmitter designs must assure operation within much more rigid frequency and radiation tolerances. This places severe requirements on transmitter oscillator and multiplier designs for overall stability and low spurious emission. It also requires efficient modulation limiting.

Since the user is primarily concerned with what comes out of the loud-speaker, the value of channel splitting and improved performance standards will be lost unless increased attention is given to the audio characteristics of transmitters and associated system components so as to provide maximum intelligibility.

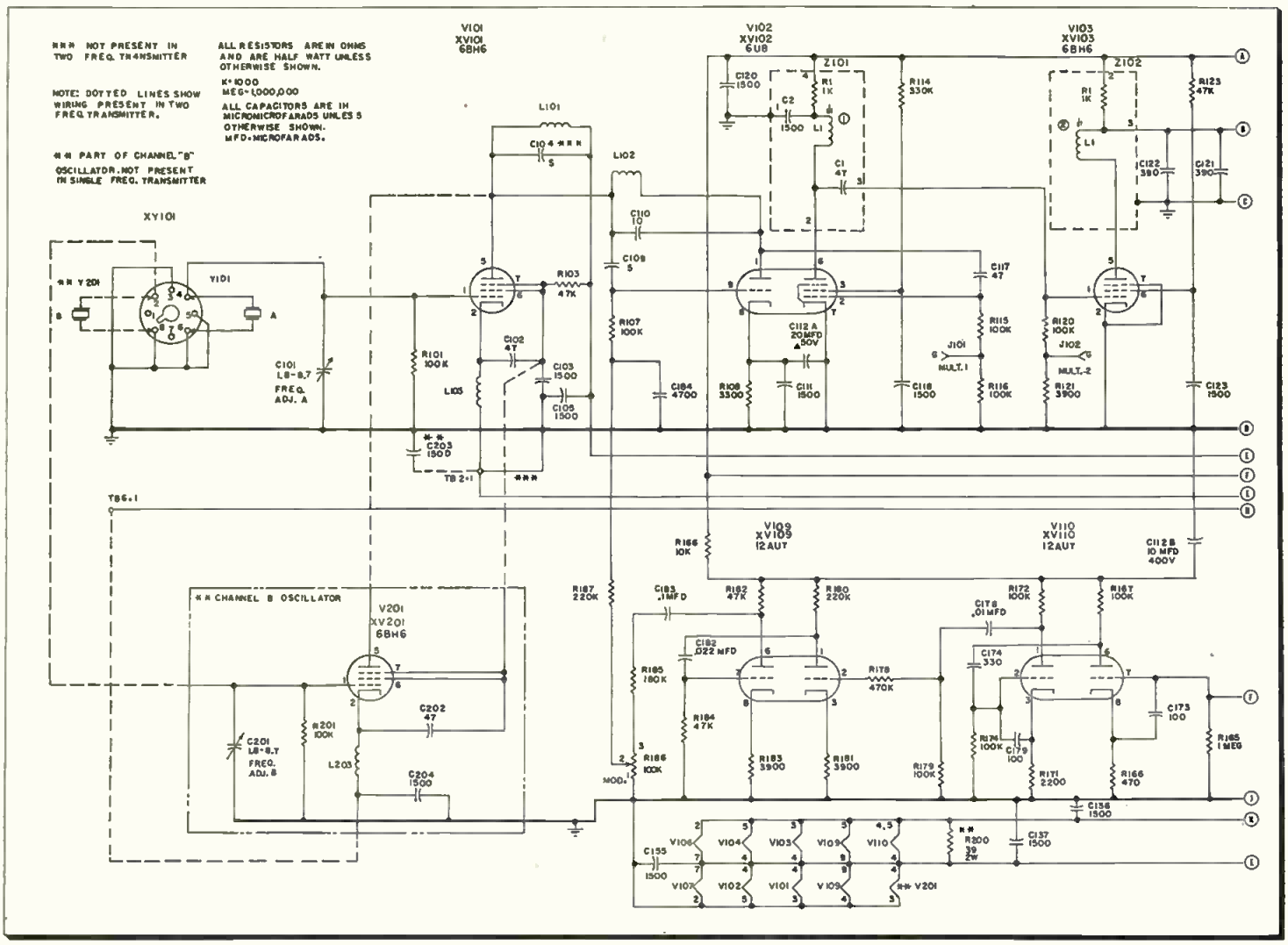
Design Consideration

A recent announcement that 12 v. ignition systems will be standard equipment on nearly all automobiles by 1956 makes any transmitter design obsolete which does not provide for interchangeable 6 v. and 12 v. operation.

New power amplifier tubes, such as the beam type GL-6146 are available to supply transmitters with increased r-f power outputs at very little increase in cost.

The split reed interrupter type vibrator provides a practical and efficient solution to the 6 and 12 v. power

Fig. 1: Complete schematic of new transmitter. Frequency stability is provided by electron-coupled crystal controlled Colpitts circuit.



Designs

supply interchangeability problem. Selenium and silicon rectifiers are available to give longer trouble-free life and better regulation characteristics. New GE-patented circuit designs can provide greatly improved power supply efficiencies.

Objectives

The requirement for a new design having been established, the determination of the major design characteristics logically follows. One of the first decisions to be made concerns transmitter power output. A critical appraisal of the arbitrary power output classifications of 10, 30, and 60 watts which have been commonly used in the past indicates that there is no logical reason for these precise ratings now.

From the viewpoint of the user, the maximum value will be represented by the design which obtains the optimum operational output with the most economical combination of power supply and r-f power amplifier components. The proper combination can be determined by objective analysis. This analysis assumes a power supply which is switched between the transmitter and the receiver and is based on the premise that differences in costs required to obtain higher r-f power outputs will be directly related to costs of power supply components and power amplifier tube complement and design.

Fig. 1 is based on the following:

a. R-F power output in watts is plotted against total amperes input to the mobile combination.

b. Zero r-f power output corresponds to Standby Current Drain.

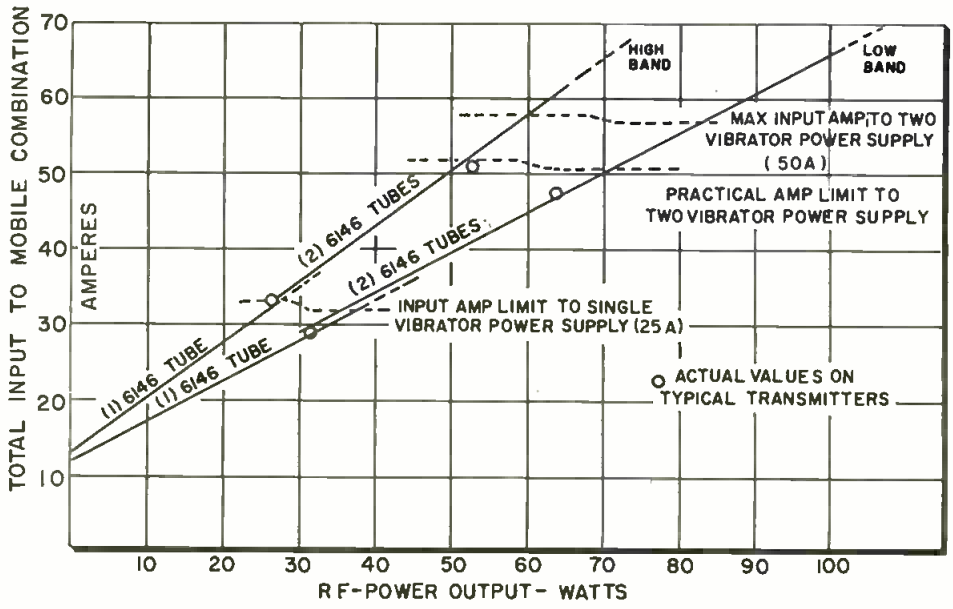
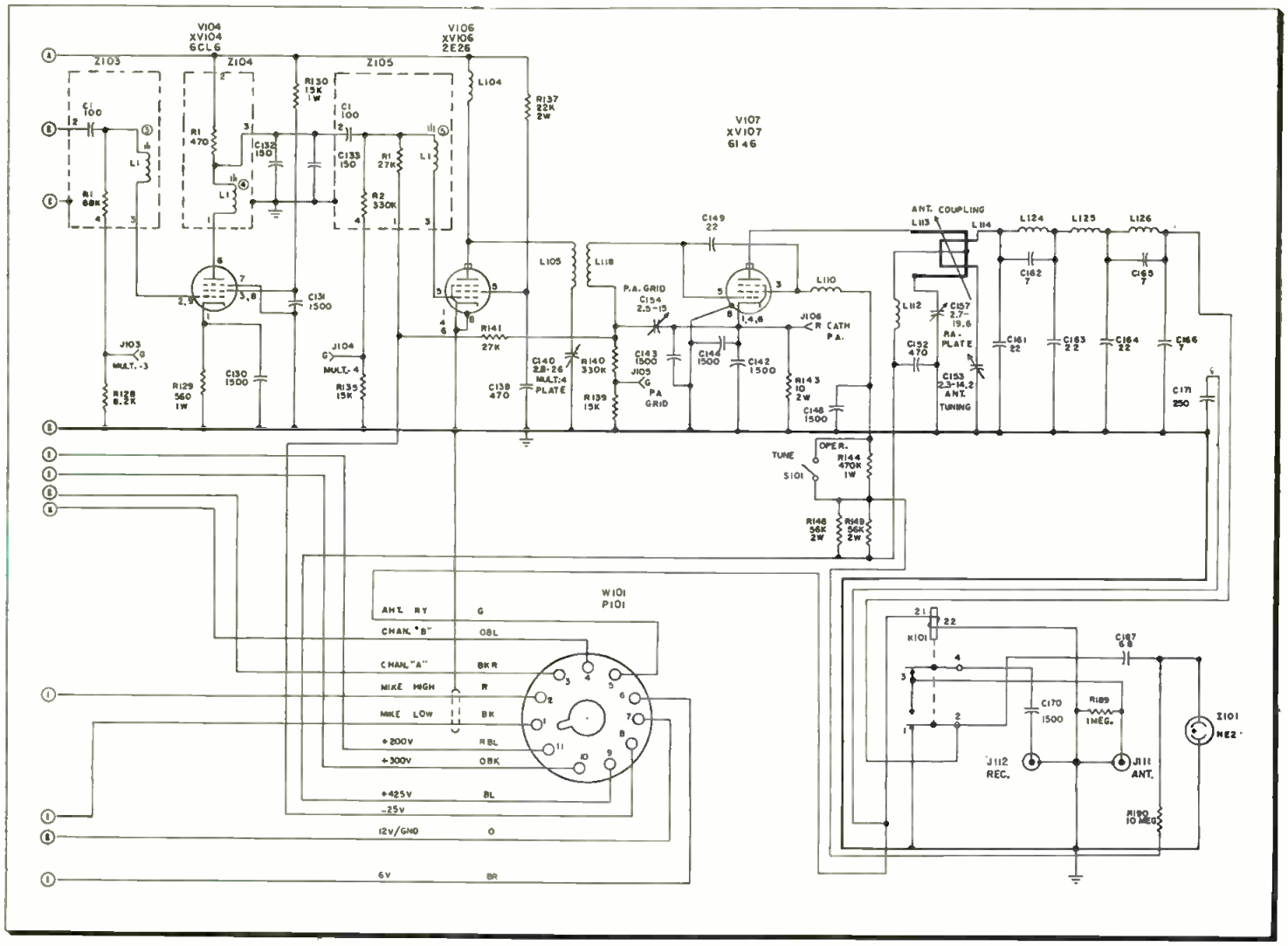


Fig. 2: Input amperes for given values of r-f output power, for typical transmitters

Separate oscillator sections are provided for each channel, selecting being accomplished by closing the cathode circuit of the appropriate oscillator tube.



Mobile Transmitters (Continued)

This includes all filament and B+ requirements.

c. The slope of the Output vs. Input curve is determined by using practical experience in estimating final amplifier design effciencies, and the driving power required per unit of r-f output. The addition of these two factors establishes the predicted slope lines. As a first approximation, the slope is not materially changed by the choice of final amplifier tubes.

d. Limits of Input Amperes to one-vibrator power supplies and two-vibrator power supplies can be established from manufacturers' recommendations and practical experience. It will be noted that the practical limits for two-vibrator supplies are below theoretical limits because of provision for load imbalance.

e. From the chart the anticipated r-f power output from a one-vibrator power supply would be approximately:

(a) Low Band—38 watts
(b) High Band—27 watts

and from a two-vibrator power supply would be approximately:

(a) Low Band—71 watts
(b) High Band—52 watts

These are approximate, and will be affected by final choices of power supply voltages, tubes, and driving arrangement as well as final amplifier effciency.

f. The choice of the final amplifier tube can be made only after a careful study to determine the best combination of tubes, power supply voltages, and driving powers. In this case, the tube selected was the GL-6146, and the power supply a single or dual vibrator, operating into a tapped-bridge rectifier circuit of GE patented design. Adequate driving power was provided to insure full output of the tubes under adverse conditions.

Actual values obtained from tests on typical transmitters are also plotted on Fig. 1. It can be seen that anticipated and actual values are very close together. The designs arrived at will produce the following power outputs:

	Min.	*Max.*
Low Band in the 30-50 MC range		
High Power	55	65
Medium Power	27	33
High Band in the 152-162 MC range		
High Power	50	60
Medium Power	25	30

In the high frequency band, the limiting factors are permissible plate supply voltage and dissipation ratings for ICAS standards.

Fig. 3: High band (144-174 MC), 25-30 watts

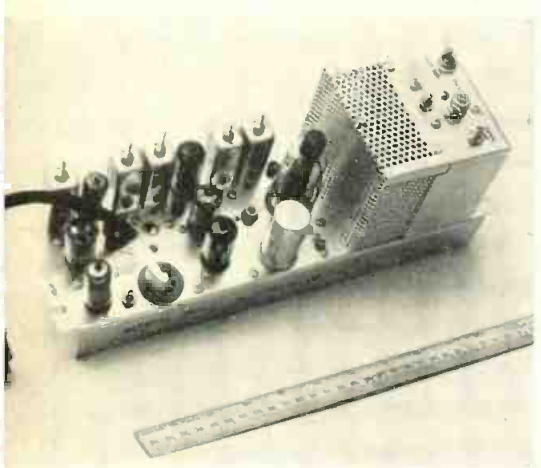


Fig. 4: Progress Line case, measures 17 in.

In the low frequency band the capability of the power supply already chosen for high band usually establishes the upper limit for power output.

As will be brought out later, the application of the same transmitter designs to different power supplies and particularly to those power supplies commonly used with AC operated stations was also carefully considered in making decisions regarding desirable r-f power outputs. From the user's point of view, the design objectives established by this method will furnish him with the best r-f value for his money. From the manufacturer's viewpoint, the design objectives represent a step forward in standardization, the full effects of which will be discussed later.

Reliability

Having determined our objectives for r-f power output, it would be well to pause and consider the general design considerations which will guide us in the exact electrical and mechanical design development. Reliability of operation is considered of paramount importance. During the last decade, the art of VHF communication equipment design has progressed steadily and most of the problems concerned with achieving maximum reliability have been encountered and solved. It has been our observation that progress is made in these matters not so much by brilliant innovation as by painstaking attention to minute detail which can sometimes be overlooked in the urge to "try something new."

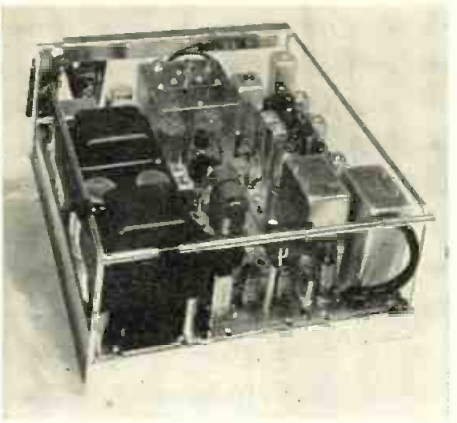


Fig. 5: (l to r) Power supply, xmtr, receiver

The requirement for transmitter stability was mentioned earlier. To meet this design objective an electron-coupled crystal controlled Colpitts circuit has been employed as shown in the High Band Medium Power Transmitter Schematic, Fig. 2. This circuit is notable for its overall stability and provisions are made for the use of either unheated or heated crystals. Objective analysis of operational requirements indicates that an overall frequency stability in the transmitter of ±0.002% over the temperature range −30° C. to +60° C. is adequate to insure satisfactory system operation even with 20 KC channels on low band and 30 KC channels on high band frequencies. These characteristics can be achieved most economically and satisfactorily by the use of unheated crystals. For those users who feel that heated crystals are required to meet their own operational situation, heated crystals are available as an option and will insure stabilities in the order of ±0.0005% in the range −30° C. to +60° C.

Multi-frequency operation is to be provided by a separate oscillator tube for each channel. Selection of the desired channel is to be performed by closing the cathode circuit of the proper oscillator tube rather than by switching crystals with relays. This contributes greatly

(*Continued on page* 120)

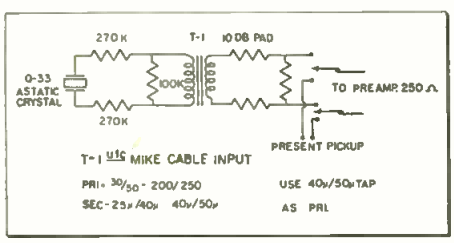
CUES for BROADCASTERS

Practical ways of improving station operation and efficiency

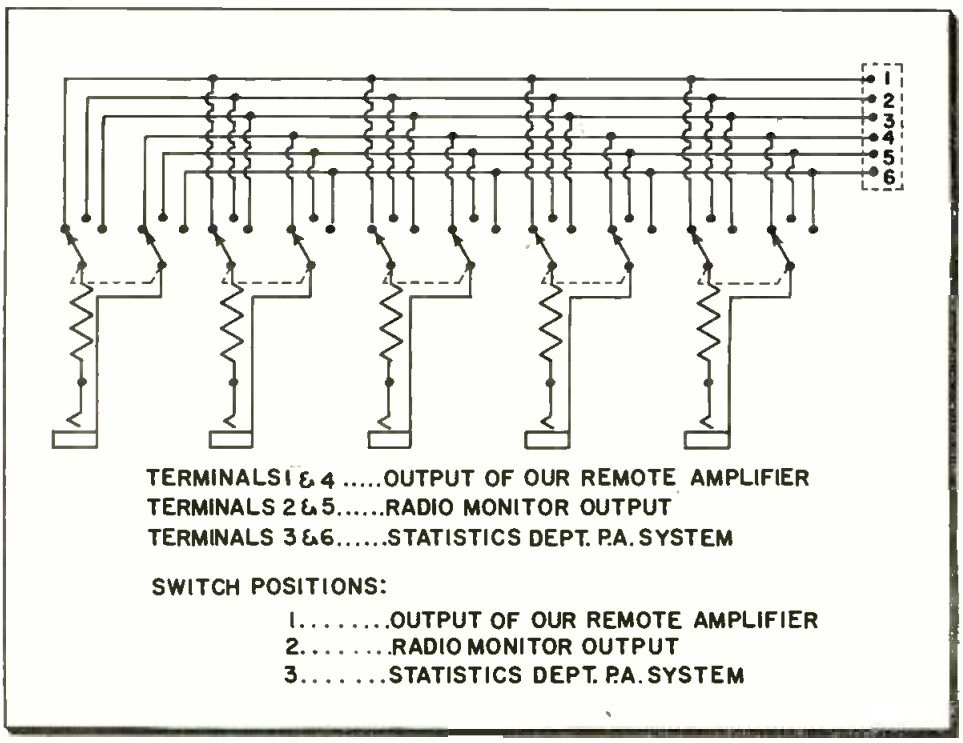
Simple "45" Input

GERALD G. DeVORE,
WPEO, Peoria, Ill.

WITH the advent of "45"s, we here at WPEO were faced with the problem of obtaining suitable equipment fast. Due to the heavy ordering other sources had to be found. The accompanying sketch shows the temporary setup we used to very good advantage. The quality of the system is satisfactory for temporary use and the price is reasonable.



Temporary input circuit for 45 rpm pick-up



Earphone cue system requires only five resistors, switches and jacks

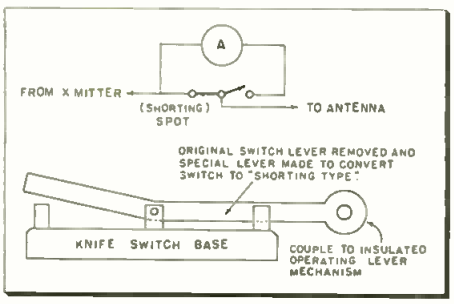
R-F Ammeter Lightning Protection

J. J. DENNIS, Chief Engineer,
KJRL, Pocatello, Idaho

AN earlier issue of TELE-TECH described a method of RF Ammeter lightning protection. We have been employing a modification of this system, which we consider to be less cumbersome, and less liable to meter breakage by accidental dropping.

The heart of the system is a modified SPDT knife switch large enough to handle the station's carrier. The movable lever of the switch must be removed and a special lever made up of copper strip of suitable dimensions. The lever is shaped to make the switch into a shorting type, i.e., make before break. The lever is linked to either a rotary or push-pull operating mechanism by means of an insulated strip. If the voltages require greater standoff than the switch base provides, inexpensive stand-offs will be satisfactory. This arrangement removes the meter from the circuit although one side of the meter is still in contact. It may be desirable in some locations to employ a double pole double throw switch to remove both meter terminals from the circuit.

Modified knife switch protects r-f ammeter



Earphone Cue System for Sports

JOHN WHITACRE, Chief Engineer,
WILS-AM, Lansing, Mich.

AFTER engineering all the home Michigan State College football games for WILS for some years we have finally come up with an earphone cue system satisfactory to all the personnel working on these remote broadcasts. It gives everyone a ready selection of any one of three monitoring sources by merely turning a switch. In the past the sportscaster, announcer, and two spotters have expressed a desire for a pair of earphones and it seemed everyone wanted to listen to a different source. The three sources they were interested in were the program as it left our remote amplifier, the MSC statistics department (they feed us such information as substitutions, injuries, and scores of other football games), and WILS tuned in on a receiver in the press box for obtaining off-the-air cues. WILS is assigned the same press box every year and after obtaining permission we installed the following permanent system.

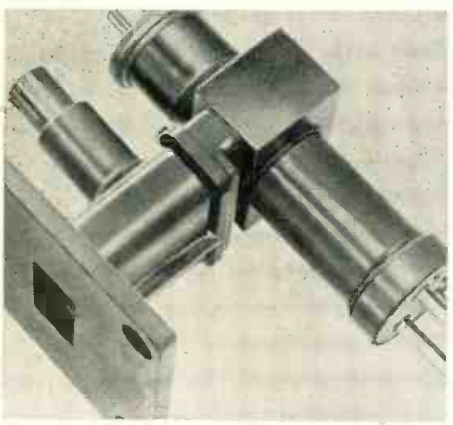
The only parts necessary are as follows: five-small aluminum "Mini-boxes," five- 4700 ohm, ¼ watt resistors, five- three position-double pole rotary switches, five-earphone jacks with insulating grommets, and a small quantity of six conductor cable.

The earphone jack grommets are necessary to isolate the circuit from any possibility of shorting out the remote line or amplifier output to ground. If an ac-dc radio is used it is strongly urged that it be equipped with an isolation line transformer to minimize any chance of getting a shock by touching the radio and any ground such as the remote amplifier or microphone. We use crystal earphones with this circuit and in case of a short in any part of the phones the 4700 ohm resistors in each phone jack assure us the short will have no effect on the rest of the circuit.

New Avionic Equipment

REFLEX KLYSTRON

The VA-203 reflex klystron is a low cost unit for airborne X-band radar receiver and beacon local oscillator service. The device features a brazed-on external tuning cavity to assure fre-



quency stability. Withstands shocks of 50 to 100 G's without malfunction or damage. Among its characteristics are negligible microphonics, slow tuning rate, long tuning life, and a single shaft tuner which is easily adapted to motor tuning. Mates directly with standard waveguide flanges. Weighs 8 oz. **Varian Associates, 611 Hansen Way, Palo Alto, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-39)

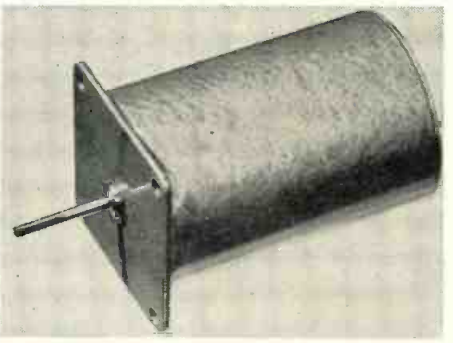
SERVO-GEAR MOTOR

A servo-gear motor, 1⅛ in. in diam. and 2 17/64 in. long, weighs only 4½ oz. Various rpm and torque combinations are transmitted through precision-cut gears mounted in miniature precision ball bearings. Modifications include hysteresis-synchronous and capacitor induction motors. Operate from 115 v. input voltage, 2 phase, 400 cps. No load

speed 180 rpm. Full load 135 rpm. Gear reduction, 28.4. Duty, continuous. Suitable for instrumentation, missiles, and control devices. **Eastern Air Devices, Inc., 359 Central Ave., Dover, N.H.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-42)

TRANSDUCER

The Model 154 linear displacement transducer is a new type of variable-reluctance pickup for converting linear motion into electrical output. Consists



of two coils in a magnetic circuit, the configuration of which enables an armature shaft, when displaced, to vary the coil inductance. Output voltage is a function of input voltage. Input voltage ranges from 28 to 115 v. **General Cybernetics Corp., P.O. Box 987, Beverly Hills, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-44)

WAVEGUIDE ASSEMBLY

An aluminum waveguide bulkhead assembly for use with C-band or X-band commerial airborne weather penetration radar enables passage of a run of ridge waveguide through aircraft bulkheads—particularly those pressurized. Consists of a ridge waveguide section and a radially brazed circular plate. A rubber gasket provides an airtight seal between a retaining

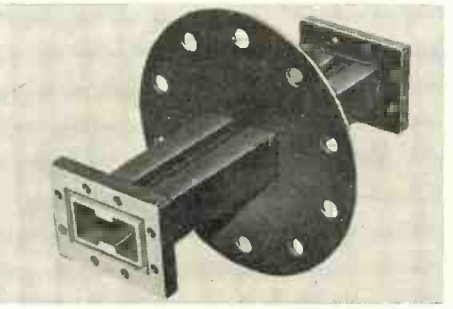


plate used to bolt the waveguide plate to the bulkhead. Vibration-proof stop nuts insure airtightness under all conditions of operation. **Airtron Inc., Dept A, 1103 W. Elizabeth Ave., Linden, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-40)

MORE TECHNICAL INFORMATION *describing the new products presented here may be obtained by writing on company letterhead to New Products Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.*

ACCELEROMETER

A potentiometer type accelerometer, the Model GOH, is available in ranges between ±1G and ±3G. A thermostatically-controlled heater incorporated in the instrument enables opera-

tion between −50°F. and +160°F. without damping variation in excess of 0.1 critical. Can be stored between −65°F. and +180°F. Four limit stops enable the instrument to withstand 40-G shocks. The precious metal contact-brush is attached to and travels along the resistance winding with the mass as it is displaced. **Genisco, Inc., 2233 Federal Ave., Los Angeles, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-43)

SELF-COOLED SERVO

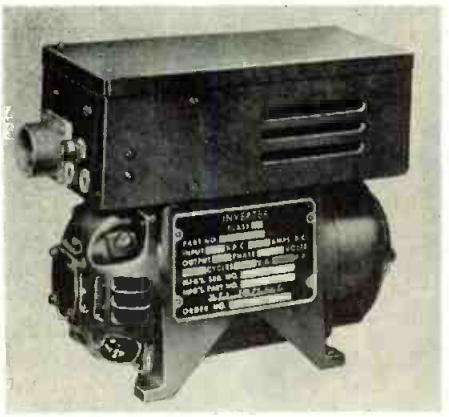
The Series 5100-2237 self-cooled servo weighs 3.188 lbs., pulls as much as 1/15th h.p. at 6,000 rpm. and has 22 oz./in. stall torque. An integral blower prevents overheating. The motor is a 2 phase, 115 v., 400 cps unit with a no load speed of 10,000 rpm. and a full load speed of 6,000 rpm. Stalled power input is 150 w./phase. Acceleration is 31,000 radians/sec² minimum. Rotor inertia is

50 gram cm² maximum. The blower is a 1 phase, 115 v., 400 cps motor with a total power input of 35 w. **John Oster Manufacturing Co., Avionic Div., 1 Main St., Racine, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-41)

New Power Supply Equipment

AIRCRAFT INVERTER

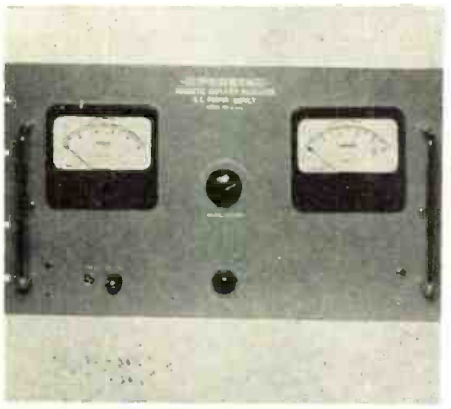
The new Model SE-16-2 aircraft inverter has a rated output of 250 va., either 3-phase or single phase, at altitudes up to 50,000 ft. and a half-load rating up to 65,000 ft. Power comes



from only 13.0 lbs. of electrical machinery which includes a three-dimensional, shock-mounted, electronic voltage and frequency regulator and radio noise filters. Self-cooled, but easily adaptable to blast cooling. Meets BuAer Spec. Dwg. 51A1A9 (Part No. E-5109-2) and MIL-I-7032A. **Leland Electric Co., Div. of American Machine & Foundry Co., Dayton 1, O.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-15)

POWER SUPPLY

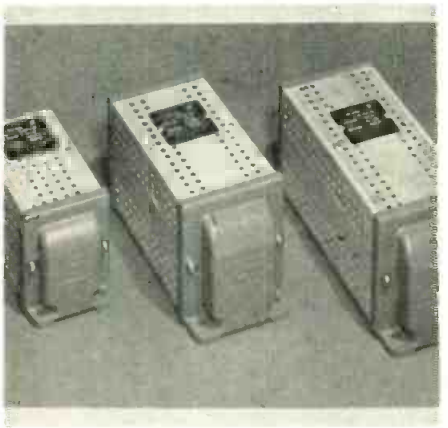
A new tubeless magnetic amplifier regulated power supply has a dc output of 6 v. ± 10% at 5 amps. continuously and is magnetic-amplifier regulated to ± 1% for ac line input changes of 95-130 v. as well as for dc load changes from 10% to full load. Response time is 0.2 seconds maximum. Ripple is 1%.



AC input is 1 phase, 60 cps. Overall dimensions are 19 x 11 x 8¾ in. Weight, 55 lbs. Contains no tubes. Supplied with or without meters or cabinet. **Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-14)

VOLTAGE REGULATORS

The first four models of a line of magnetic voltage regulators, or regulating transformers, are available. These units have capacities of 15, 30, 60, and 120 va. Other units will have 250, 500,



and 1,000 va capacities. Intended for incorporation in other equipment, however the units can be used as auxiliary line stabilizers. Input voltage range, 95-130 VAC, single phase, 60 cps. Output range, 115 VAC, RMS, single phase. Regulation accuracy, ±0.5% against line changes. **Sorensen & Co., Inc., 375 Fairfield Ave., Stamford, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-16)

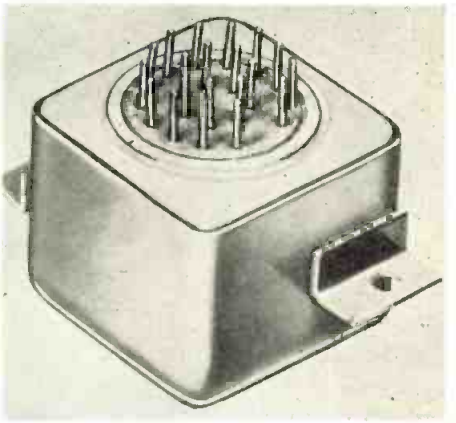
DIFFERENTIAL VOLTMETER

The Model 800 differential vacuum tube voltmeter is a 0 to 500 v. potentiometer with better than 0.1% accuracy. Resolution is 0.01 v. over the entire range and read directly off last decade. A two range (1-0-1 and 10-0-10 v.) zero counter vacuum tube voltmeter serves as a null indicator and a calibrated deviation meter. Input resistance is infinite at null and 2,000 megohms/v.

of input when 0.005 v. off null. A third 500-0-500 v. range enables unit's use as a VTVM with 10 megohms input resistance. **John Fluke Mfg. Co., Inc., 1111 W. Nickerson St., Seattle 99, Wash.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-17)

POWER TRANSFORMER

The newly designed CAC high-cycle power transformer has a range of 400 to 6,000 cps with efficiency up to 95%. Volume is less than 1.65 cu. in. Wattage is 6 mw to 200 w. Operating tempera-



tures, −55°C to +155°C. Plug-in type unit is in a hermetically sealed case. Additional information available at **Communication Accessories Co., Hickman Mills, Mo.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-19) for 5-19)

VOLTAGE KIT

The PS-3 variable voltage power kit is designed for the laboratory or the service shop. The unit provides hum-free dc output for B-plus, and 6.3 v. ac at 4 amps for filaments. Output is continuously variable from 0 to 500 v. dc at no load. Linear from 0 to 10 ma. at 450 VDC and O to 130 ma. at 200 VDC. Output voltage or current monitored on a 4½ in. meter. High voltage dc and low voltage ac are isolated from ground for use with ac-dc circuits, or to furnish a negative test chassis voltage value. **Heath Co., 305 Territorial Rd., Benton Harbor, Mich.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-13)

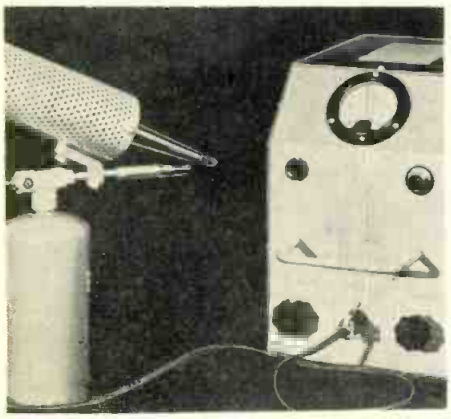
DC POWER SUPPLY

The Model "EF" dual range dc power supply is said to have ac hum or ripple of less than 1% at 5 amps. The unit provides a filtered power supply with a continuously variable source for voltages from 0 to 14 v. and 0 to 28 v. for all current loads from 0 to 5 amps. Intermittent loads up to 10 amps can be obtained. Exact current and voltages are indicated on D'Arsonval-type meters. A single control enables continuous voltage adjustment. Size, 12 x 7 x 8½ in. Weight, 28 lbs. **Electro Products Laboratories Inc., 4503 N. Ravenswood, Chicago 40, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-18)

New Plant & Lab Equipment

SOLDERING IRON

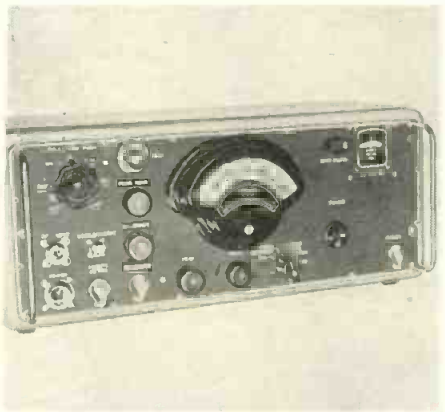
Two models of the "Glennite" ultrasonic soldering iron, U 610 and U 611, can join aluminum, magnesium, and their alloys without flux, or where corrosive fluxes must be avoided. Useful



for soldering refractory oxide forming metals without tinning or special surface pre-treatment. The U 610 is gas fired; U 611 is electrically heated. Each has a soldering tip attached to a transducer powered by a Model U 600G ultrasonic generator requiring a 35 w. output. The U 610 is mounted on a torch with a small propane tank and handle. **Vibro-Ceramics Corp., Metuchen, N.J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-33)

INTERFERENCE METER

The NM-30A radio interference-field intensity equipment can be used as a two-terminal voltmeter, with a 50-ohm coaxial input, frequency selective over the range 20 to 400 MC. Radio signals or



interference, radiated or conducted, can be measured in the laboratory or field with accessories that are available for the equipment. Sine wave, pulsed r-f, impulsive and random noise also can be measured and average quasi-peak or peak values of complex wave forms can be selected. **Stoddart Aircraft Radio Co., Inc., 6644 Santa Monica Blvd., Hollywood 38, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-36)

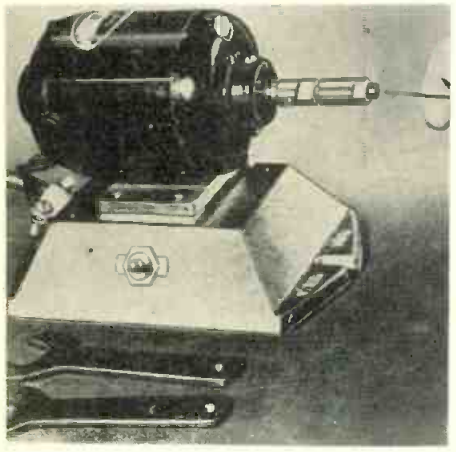
RECORDERS

The Types 230A-6 and 230A-12 Alden "30-Channel Fact Finders" have tape speeds of 1 and 6 in. and 1 and 12 in. respectively, and monitor up to 30 phases of an experiment and provide

continuous, simultaneous recordings of the activities on one paper. Can be set up anywhere and monitor any mechanical, electrical, chemical, or physical operation, where information can be picked up from a motion-controlled switch or sensing device to provide current marking power for the stylus that applies to "Alfax," an electrically sensitive paper. **Alden Electronic and Impulse Recording Equipment Co., Dept O, Westboro, Mass.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-38)

WIRE STRIPPER

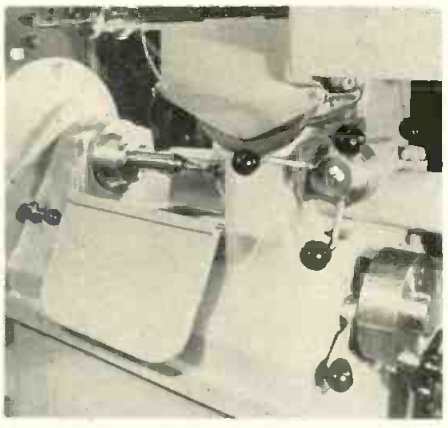
The Model L-1 rotary wire stripper is readily adjusted to strip sizes 20 to 29 AWG. The unit can strip to within 1/32 in. of the component and is particularly adapted for use on coils such as choke coils. The wire end is simply inserted and withdrawn without pedals or levers. Stripping insert is easily resharpened. Available complete, or the



stripping head can be purchased and attached to a 10,000 rpm motor. Other units are available for larger wire sizes. **Rush Wire Stripper Div., The Eraser Co., Inc., 1068 S. Clinton St., Syracuse, N.Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-34)

AUTOMATIC GRINDER

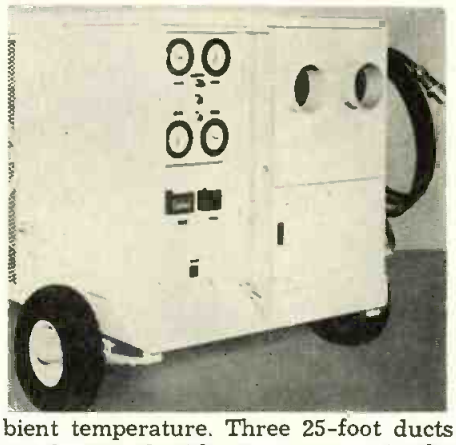
A new, fully-automatic, 48 x 36 x 70 in. spur and helical gear grinder (3/4 in. to 7 1/2 in. pitch diam.; 4 to 48 dimetral pitch) is said to cost about 1/3 as much as the market's leading grinder. Weighs 2,700 lbs. Uses less than 1.7 h.p. Setup can be made by one average machine-tool operator in 60 min. One operator can tend several machines. Operating



cycles are programmed on the control console. Console-set intervals and eventual automatic grind wheel positioning completes dress operation in 30 secs. **Belock Instrument Corp., College Point, N.Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-37)

GROUND COOLING UNIT

Ground air conditioning unit for cooling aircraft electronic components and comfort cooling is supported by four wheels with pneumatic tires. The instrument panel indicates output temperature and pressure, compressor suction and discharge pressures, and includes controls for setting output temperature. Continuous duty. Capacity is 80 lbs./min. at 3 psig and 45°F. Output capacity is fully automatic for any am-

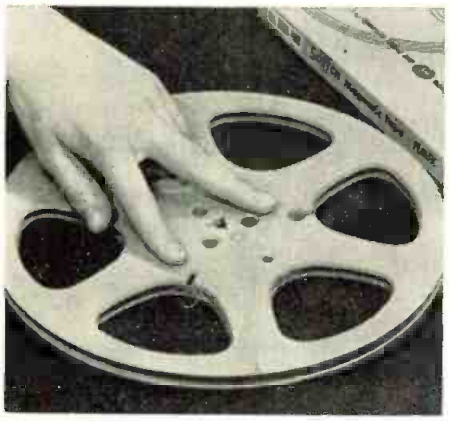


bient temperature. Three 25-foot ducts are furnished with storage space in the unit. **Electroflow, Inc., Equipment Div. of American Electronics, Inc., 2112 Chico Ave., El Monte, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-35)

New Equipment for Broadcasting

TAPE REEL

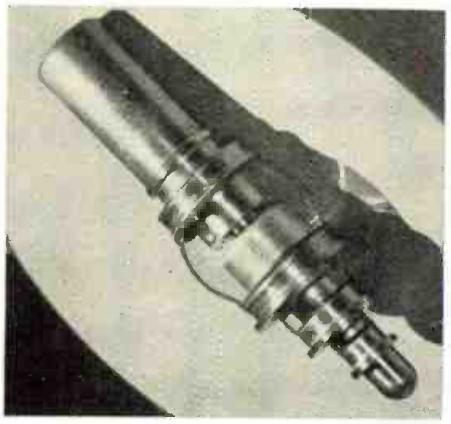
A new 10½ in. magnetic tape reel features a 5/16 in. center hole, one-piece precision construction, and superior tape handling characteristics. Made of glass-reinforced plastic, the reel cannot



be permanently bent out of shape or distorted. Has V-slot and conventional threading, and smooth labeling surfaces that can be written on with a pen or an ordinary or grease pencil. Raised beads around the hub and reel-rim prevent scratching the unit surface. **Minnesota Mining and Manufacturing Co., Dept. M5-39, 900 Fauquier St., St. Paul 6, Minn.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-27)

COAXIAL TRIODES

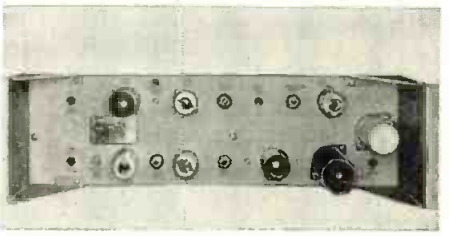
The Types ML-6420 and ML-6421 coaxial-terminal triodes, employing thoriated-tungsten filaments, are designed for industrial and broadcast equipments of 5-10 kw power output. As replacements for Types 5666 and 5667, respectively, the new triodes provide improved performance ratings, safety margins, and strength. The new



filaments greatly reduce power requirements, and life is increased 100%. Plate and grid current ratings are increased by better than 10%. **Machlett Laboratories, Springdale, Conn.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-28)

DRIVE GENERATOR

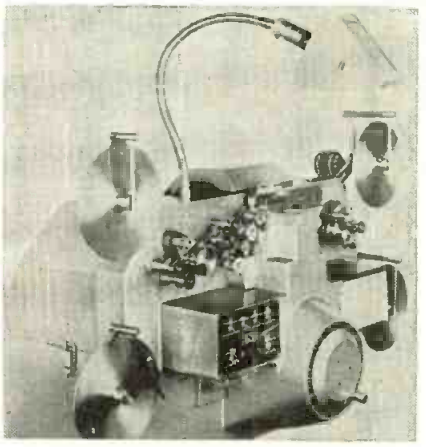
A small, portable, inexpensive drive generator, Model 302-AR, provides blanking, horizontal sync, vertical drive, and color burst flag for driving most color and monochrome signal generating equipment where standard sync is not available. The unit also provides driving pulses for signal gen-



erating equipment, such as multi-burst, window, stairstep, and linearity checkers from remote check points, mobile units, and transmitters, where studio sync is not available. **Telechrome, Inc., 632 Merrick Rd., Amityville, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-30)

CONTACT PRINTER

A continuous contact printer for 16mm black and white or color motion picture film obtains the proper light value for each scene. The value, as predetermined by a scene tester, is ac-

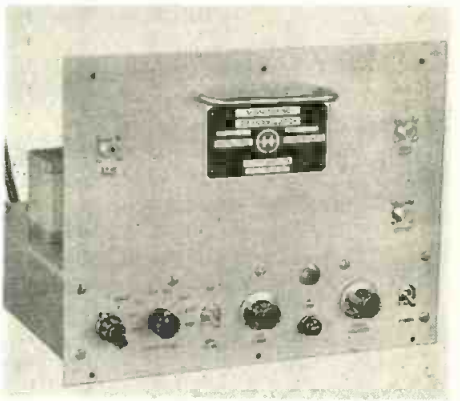


curately controlled by a light selector dial pre-set for each scene. Index cards with the proper light value for each scene are held in a special holder. A pointer shows the scene being printed. **Houston-Fearless Div., Color Corp. of America, 11085 W. Olympic Blvd., Los Angeles 64, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-26)

MORE TECHNICAL INFORMATION *describing the new products presented here may be obtained by writing on company letterhead to New Products Editor, TELE-TECH & ELECTRONIC INDUSTRIES, 480 Lexington Ave., New York 17, N.Y., listing numbers given at end of each item of interest. Please mention title of position held.*

DEMODULATOR

The Model 1813 monitoring demodulator enables TV broadcast personnel to make rapid checks of color encoders. Using a standard high-gain scope as a null indicator, it detects incorrect phas-



ing in the I, Q, or burst channels and serves as a precise alignment tool. Enables analysis of phase distortion and measurement of chrominance signal incremental phase errors with ±1.0 of any specified reference axis. Inputs: composite video, CW subcarrier, and 60 w. 115 vac, 60 cps. Mounts in a standard "scopemobile". **Hazeltine Electronics Corp., 59-25 Little Neck P'kway, Little Neck, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 5-57)

RECORDER-PLAYBACKS

Two magnetic tape recorder-playback instruments, designated the M90 and M81, feature remote control fidelity and economy for radio broadcasting stations and professional and industrial users. Push button controls, including high-speed forward and rewind, provide ease of operation at 7½ and 15 in./sec. or 7½ and 3¾ in./sec. tape speeds. Two-

speed tape drive. Interchangeable head assemblies enable full track, half track, or instrumentation without loss of head alignment. **Magnecord, Inc., 1101 S. Kilbourn Ave., Chicago, Ill.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-32)

New Electronic Test &

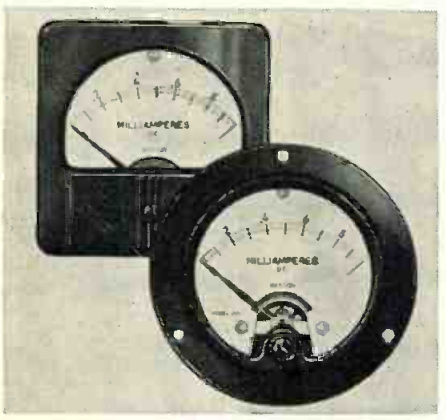
SPECTRUM SELECTOR

The Model SD-1 multiphase spectrum selector is designed to display and select a specific train of microwave pulses as well as any one pulse in a train for spectrum analysis. It will

select and gate a group of pulses up to 100 μsecs in length. Also, it will work with fast narrow pulses and can be adjusted to gate any pulse including the first, at zero time. Special circuitry discriminates automatically once pulses have been selected. Operates at all microwave frequencies that can be selected by Polarad spectrum analyzers. **Polarad Electronics Corp., 43-20 34th St., Long Island City 1, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-1)

PANEL INSTRUMENTS

The 1301 line of core-magnet, self-shielded panel instruments are available in 3½ in. size for dc or as ac rectifier instruments in either round or rectangular shapes. The "Cormag®" mechanism employed provides shielding from external magnetic fields and thus eliminates any inter-effect when instruments are mounted close together. Can be mounted on magnetic or



non-magnetic panels interchangeably without special adjustment. Accuracy is within ±2% of full scale range; ± 3% for ac rectifier types. **Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-2)

AC VOLTMETER

The Model 207A log scale ac vacuum tube voltmeter provides a logarithmic voltage scale and a linear db scale. The stated accuracy of the log scale becomes the accuracy at any given point

on the scale and is not affected by the position of the pointer. The scale division gives the user an effective scale length of 7½ in. Meter ranges, volts full scale, —0.001 to 100 by factors of 10 (calibrated RMS value of sine-wave) —0.003 to 300 by factors of 10. Db ranges, —60 to +50 in steps of 10 db. **Shasta Div., Beckman Instruments, Inc. P.O. Box 296, Sta. A., Richmond, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-3)

FREQUENCY STANDARD

The Model 620 frequency standard can deliver up to 5 v. at a precise frequency of 60 to 120 cps—factory set to within ±0.01%. Other precisely set frequencies can be supplied on request. Temperature variations from —40°C. to +85°C. or line voltage variations from 105-125 v. affect frequency of oscillation by less than ±0.01%. Output distortion is less than 1%. The output amplifier is transformer-coupled en-

abling isolated output or grounding one output terminal. Dimensions, 9 x 15 x 8 in. Weight, 17 lbs. **Industrial Test Equipment Co., 55 East 11th St., New York 3, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-9)

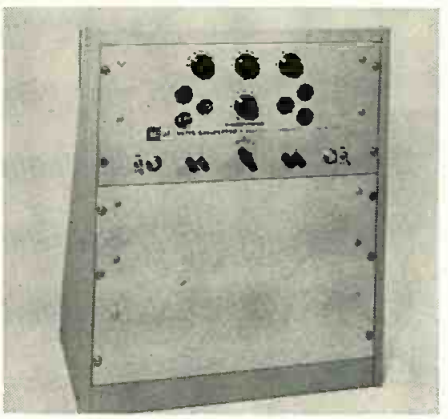
STRAIN-GAUGE CONTROL

The Type 335 strain gauge control can be used with any cathode ray oscillograph with suitable preamplifiers, or directly with the Du Mont Type 324 cathode-ray oscillograph. Also, it can

be used with indicating devices such as recording galvanometers and meters. The self-contained unit contains battery supplies and balance system to operate any strain-gauge setup that is used. Internal voltages from 6 to 90 v. in 8 steps can be selected, or an external voltage can be applied. **Allen B. Du Mont Laboratories, Technical Sales Dept., 760 Bloomfield Ave., Clifton, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-12)

METER CALIBRATOR

The meter calibrator, Model M100A-20, is a standard dc reference that provides both voltage and current calibration ranges from 0 to 1,000 v. at 200 ma. maximum and from 0 to 100 ma. at 1,000 v. maximum. Maintains long time stability of 0.01%, accuracy of 0.05%, and regulation for ±10% line voltage change of 0.01%. Voltage output is vari-



able in 0.10 v. steps. Current output is adjusted in four ranges. In the range 0 to 0.10 ma., the output varies in 0.01 μamp steps. **Kalbfell Laboratories, Inc., P.O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-11)

Measuring Equipment

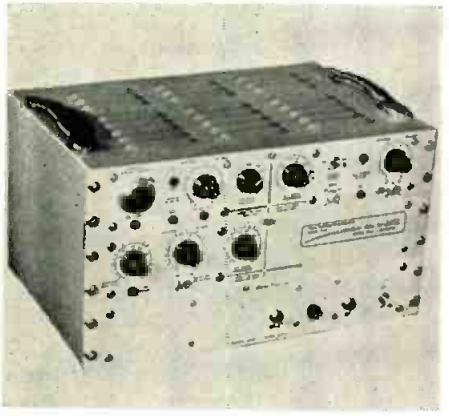
DISPLACEMENT INDICATOR

The Model 300 displacement indicator for differential transformer transducers shows the value of a measured quantity—force, displacement, pressure, stress, strain, flow, weight, etc.,—on an

illuminated 4½ in. panel meter. The unit also provides a suitable external output for directly operating Esterline-Angus type recorders and auxiliary alarm and control devices. Drift is less than 1% in four hours. Overall linearity is better than 1%. Repeatability of measurement is better than ½%. Basic sensitivity, 1 millionth of an inch. **Daytronic Corp., 216 S. Main St., Dayton, O.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-6)

DELAY GENERATOR

The Model 1310A long time delay generator provides accurately controlled and continuously variable time delays over the range 20 μsecs to 10 seconds. Instrument is designed for wide use in pulse width and spacing measurements, gating circuit control, geophysical and biological studies, and other timing applications. Controlled by a 10-turn potentiometer, delay is covered in 5



decade ranges. Long term accuracy is 1% of full scale for each range; 0.5% with standard modification available. Jitter is 0.01%. **Electro-Pulse, Inc., 11811 Major St., Culver City, Calif.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-10)

"PROBESCOPE"

The Model PO-1 is a portable probe and oscilloscope designed for quick trouble-shooting and wave-form analysis. It consists of a mu-metal shielded CRT in a small probe, a 3½ ft. shielded

cable, and a 6 x 9 x 5 in. control cabinet. Weighs only 7½ lbs. Voltage requirements, 105-125 v., 50-60 cps. Power consumption, 35 w. Spot size, 0.27 mm. Deflection sensitivity; vertical amplifier, 100 mv. full scale, horizontal, sweep only, 1½ times full scale. Vertical input impedance, 2.2 megohms shunted by 100 μμf. Cathode follower input. **Probescope Co., 44-05 30th Ave., Long Island City 3, N. Y.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-5)

Z-g DIAGRAPH

A new instrument that is available in two models, Types ZDU and ZDD, produced by Rohde and Scharz, Munich, Germany, instantly plots, by means of a small light spot, complex impedances and admittances directly on a Smith or similar chart. Eliminates measurements and involved calculations. The "Diagraph" uses as a signal source any oscillator capable of supplying between 1 and 3 v. at the measuring frequency.

Operation is based on a pair of wide band reflectometers. Requires no special accessories. Distributed in the U.S. by **Federal Telephone and Radio Co., 100 Kingsland Rd., Clifton, N. J.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-7)

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FREQUENCY STANDARD

The Model 101 secondary frequency standard eliminates both frequency transfer unit and selective amplifiers

over all commercial ranges used for AM and FM broadcasting, and VHF, UHF TV stations. Integral circuits synchronized with the 100 kc oscillator give outputs of 1.0, 10.0, 50, 100, and 250 kc. Harmonics of these fundamentals are useful, with communication type receivers, for measuring 1.0 kc to 30 mc, 10.0 kc to beyond 160 mc., 50 kc to beyond 20 mc, 100 kc to beyond 200 mc, and 250 kc to beyond 900 mc. **Continental Communications, Inc.,** 452 West Chicago Ave., Chicago 10, Ill. TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-72)

OSCILLOSCOPE

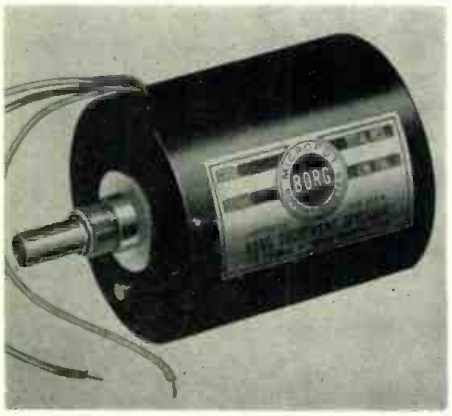
The Model 670R oscilloscope has dc amplifiers for square wave response down to dc. The technical features of the instrument are: Sensitivity, 0.015 (15 mv) RMS/in. Demodulator circuit, for viewing r-f signal modulation. Recurrent linear sweep, 3 cps to 50,000 cps. Reversing switches for horizontal and vertical deflection. Fixed sweep frequency for horizontal and vertical wave forms to TV receivers. Negative and positive synchronizing. Line phas-

ing control (approximately 180°). Wide band vertical amplifier, useful beyond 2 mc. Provision for Z-axis modulation. **Hickok Electrical Instrument Co., 10606 Dupont Ave., Cleveland 8, O.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-4)

New Potentiometers

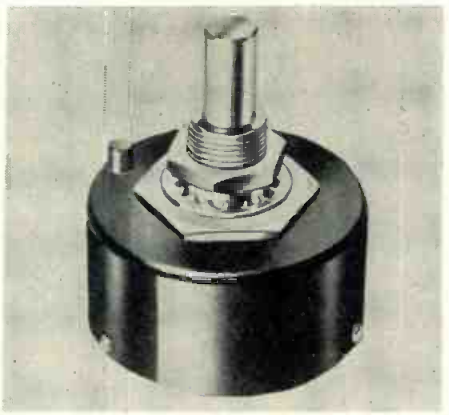
TEN-TURN POTENTIOMETERS

The Series 1100, 10 turn "Micropot" is designed for commercial applications. It is fabricated with lead wires instead of terminals which simplifies wiring problems. Leads are 9 inches long, flexible, and color-coded for easy assembly. Rear shaft extension is optional for both single units and ganged installations. The shaft is supported on bearings at each end. Standard resistance values are from 50 to 100,000 ohms. Available in independent linearity to 0.1% to 0.5% accuracy. **George W. Borg Corp., Equipment Div., Janesville, Wis.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-51)



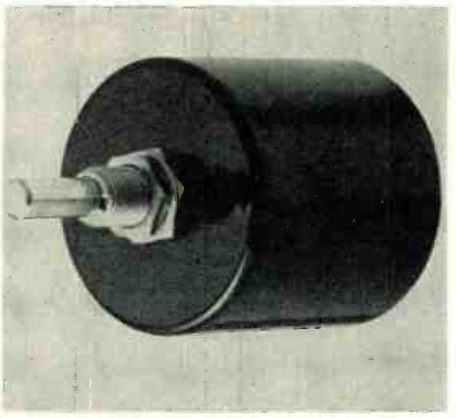
HIGH PRECISION POTENTIOMETER

The "Helipot" series G are high precision, single turn, continuous rotation potentiometers $1^{15}/_{16}$ in. in diameter. Designed for bushing mounting. Up to 8 taps can be added and each can be spot-welded to a single turn of resistance wire without shorting out adjacent turns. Approximate length of coil is 3.1 in. Mechanical rotation is 360° continuous, electrical 352° ± 2°. Resistance 5 to 30,000 ohms. **Helipot Corp., Div. Beckman Instruments, Inc., 916 Meridian Ave., South Pasadena, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-52)



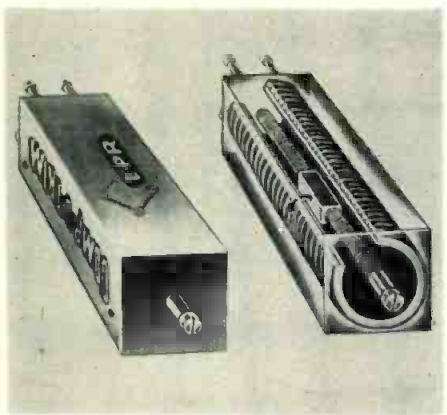
HIGH-RESOLUTION POTENTIOMETER

The "Esipot" offers the equivalent of a 10 turn potentiometer although any setting can be made within less than two revolutions of the single control shaft. The unit consists of a high resolution single turn potentiometer that actuates a 10 position attenuator switch. The switch transfers the potentiometer to any one of the 10 voltage positions. **Electro-Measurements Inc., 4312 S. E. Stark St., Portland 15, Ore.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-53)



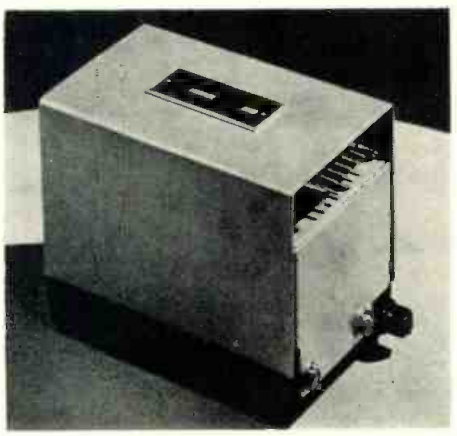
TRIMMING POTENTIOMETER

"Comp-U-Trim," a departure in trimming potentiometer design, combines such features as encapsulation to protect against humidity, and a wide range of temperature coefficients. It also offers especially selected, amply-aged resistance wire to assure minimum stability. The unique design enables the combination of fixed and variable resistor that makes feasible fixed values up to 1 megohm with a variable as little as 50 ohms. **Eastern Precision Resistor Corp., 130-11 90th Ave., Richmond Hill, N. Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-54)



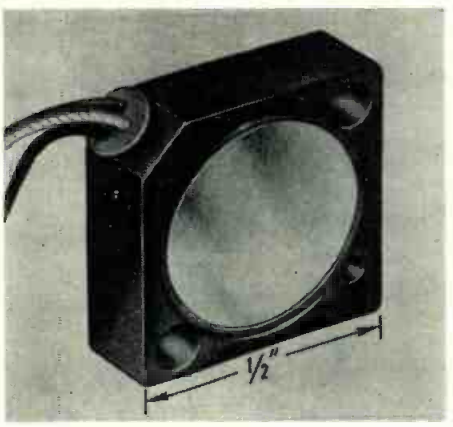
PRESSURE-OPERATED POTENTIOMETER

The Type 1100 pressure operated potentiometer is used where the output voltage is to be a non-linear function of pressure. Operates in an hermetically-sealed, evacuated container in the instrument case. A board, to attach loading resistors, is external to the case and can be reached by removing the outside cover. **Trans-Sonics, Inc., Bedford Airport, Bedford Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-55)



TRIMMING POTENTIOMETER

Weighing less than 2 grams and measuring only 1/2 x 1/2 x 3-1/16 in., the "Tiny Trim" is furnished in standard resistance ranges from 10 to 25,000 ohms. Other ranges are available on special order. Moisture, and corrosion proof, the unit sustains high accuracy under extremes of temperature, vibration, shock, and acceleration—the two latter up to 100 G's. Stability is maintained within the AN temperature range and above +250° F. **Daystrom Potentiometer Div., Daystrom Pacific Corp., 1509 Colorado Blvd., Santa Monica, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-56)

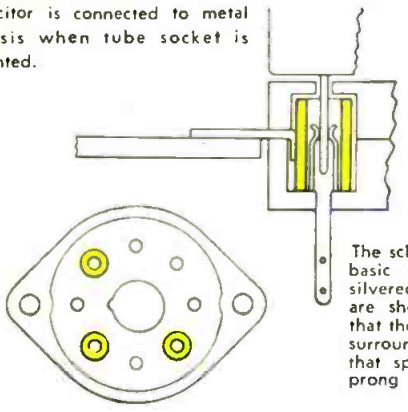


SHORTEST ELECTRICAL PATH TO THE GROUND···SIMPLIFIES WIRING ···REDUCES SPACE REQUIRED BY CIRCUIT COMPONENTS—

A JOINT DEVELOPMENT OF ERIE RESISTOR CORP., AND CINCH MANUFACTURING CORPORATION,

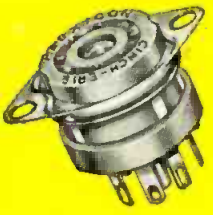
now in universal use, commercial and military types, available in seven pin miniature, nine pin Noval, and Octal

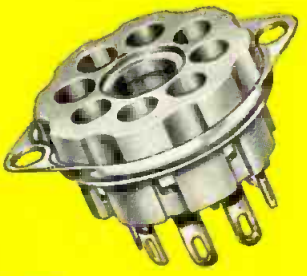
Capacitors built into socket may be either by-passed to ground directly, or left open for coupling applications. On by-pass applications, ground strap contacting outer plate of capacitor is connected to metal chassis when tube socket is mounted.



The schematic diagram shows basic design principle. The silvered ceramic condensers are shown in yellow. Note that the condenser completely surrounds the tube pin, and that specially designed tube prong terminals are used.

CINCH-ERIE "Plexicon" VACUUM TUBE SOCKET





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.

Reduces set assembly costs—saves space; permits moving other components closer to tube socket. Where space and weight make compactness mandatory, as in airborne equipment, the Plexicon socket is the solution.

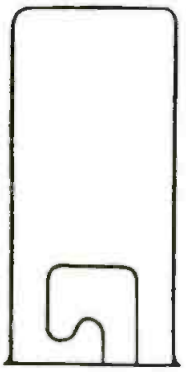
Cinch ELECTRONIC COMPONENTS

CINCH components available at leading electronic jobbers—*everywhere.*

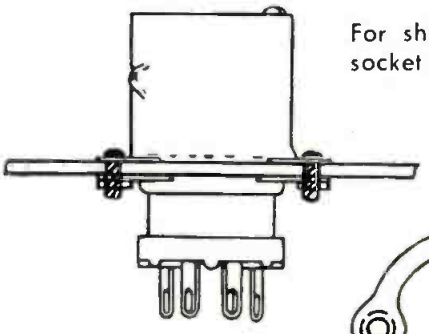
CINCH MANUFACTURING CORPORATION

1026 South Homan Ave., Chicago 24, Illinois

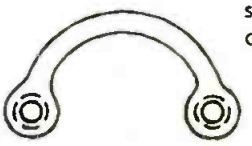
Subsidiary of United-Carr Fastener Corporation, Cambridge, Mass.



SHIELD



BAYONET SHIELD BASE



MOUNTING STRAP

For shielding tube, two types are available for miniature socket as shown, Bayonet with three lengths of shield cans available and Snap-on, two lengths of shields available. Bayonet type shown here.

The Mounting strap is a CINCH development for ease and simplicity in mounting miniature sockets. One strap nut takes the place of two conventional type nuts and is generally used in assembling sockets having attached base.

Write for detailed information

WASHINGTON
News Letter

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

FM SPECIAL SERVICES—Opportunities designed to provide a financial "shot in the arm" to the FM broadcasting field were provided by the FCC for business development, in authorizing functional music and related "subsidiary" services by FM stations on both a simplex, for one year only, and a multiplex basis, effective May 2. The FCC rules allow FM transitcasting, but on a local option basis subject to interpretation and regulation by local public utility commissions. Each specific subsidiary service will be licensed by the Commission through the issuance of a "Subsidiary Communications Authorization," termed an SCA. It was specified, however, that FM stations could not compete with mobile or dispatching radio services. Multiplex transmitting and receiving equipment, the FCC said, will be available within a relatively brief period on the basis of reports from manufacturing companies like multiplex Development Corp., Crosby Labs., Field Enterprises, and others.

MODIFY PROTEST RULE—In order to prevent obstructionist tactics by competitors for radio broadcast and TV station grants as well as in the mobile field, the FCC has asked Congress to amend Sec. 309(c) of the Communications Act, one of the major revisions of its statute in the 1952 McFarland legislation. Commissioner John C. Doerfer, in a separate proposal, advocated outright repeal of the protest rule which permits any party in interest to object to a grant made without a hearing for 30 days after the authorization by the Commission. The FCC stressed to Congress that the protest rule has resulted in substantial delays in the construction and operation of new television and radio stations.

ADDITIONAL FCC FUNDS—Despite the Eisenhower administration drive, the House recognized the budgetary needs of the FCC for additional staff to expedite the processing of television and mobile radio applications and for a special study of the televsion and radio-broadcast fields. The latter has been proposed by the Senate Interstate Commerce Committee. In approving the FCC funds in the Independent Offices Appropriations bill, the House added $117,000 to the $6.7 million budget for the 1956 fiscal year, starting July 1, which had been sent to Congress by President Eisenhower. An additional $90,000 was approved for the processing of TV and mobile radio applications and an added amount of $80,000 was authorized for the Commission's study of the TV and radio broadcast operations which will delve into the role of networks, particularly in television. In the hearings before the House Appropriations Committee, FCC Chairman McConnaughey and veteran Commissioner Webster stressed how the mobile radio services were being retarded through the lack of an adequate staff.

AVIATION EXPANSION—A Program prepared by Arthur D. Little and presented at the annual meeting of Aeronautical Radio Inc. research firm in the latter part of April, aimed to meet the future needs of aeronautical communications for the next decade. The program forecast an investment of at least $10 million in the requirements for point-to-point and air/ground civil aeronautical communications for the next ten years. It was proposed that approximately 40% of aeronautical circuit miles could be replaced economically by a microwave system at an investment of $12.4 million. Participation in the program by all air lines and the Civil Aeronautics Administration was recommended, while private and business aircraft would pay for the use of the facilities under regular rate tariffs. The use of microwave was stressed in the program not only as the most economical system but also in the interest of conservation of frequencies.

RULES PLANNING—Approximately 80 radio engineers and attorneys specializing in mobile radio services from all regions of the country and the FCC staff have engaged in two intensive conferences in the past two months to formulate recommendations and rules for the establishment of an operational microwave radio service for private communications purposes. The goal is to set up a rules blueprint for private microwave services in the industrial and safety fields with a delineation of the scope and operational requirements for the future use of frequencies above 890 megacycles. The various services —police, fire, forestry-conservation, highway maintenance, power, petroleum, forest products, special industrial, motor carrier and railroad—are at present operating microwave systems on a developmental basis. The proposed rules would place these private microwave systems on a permanent regular status.

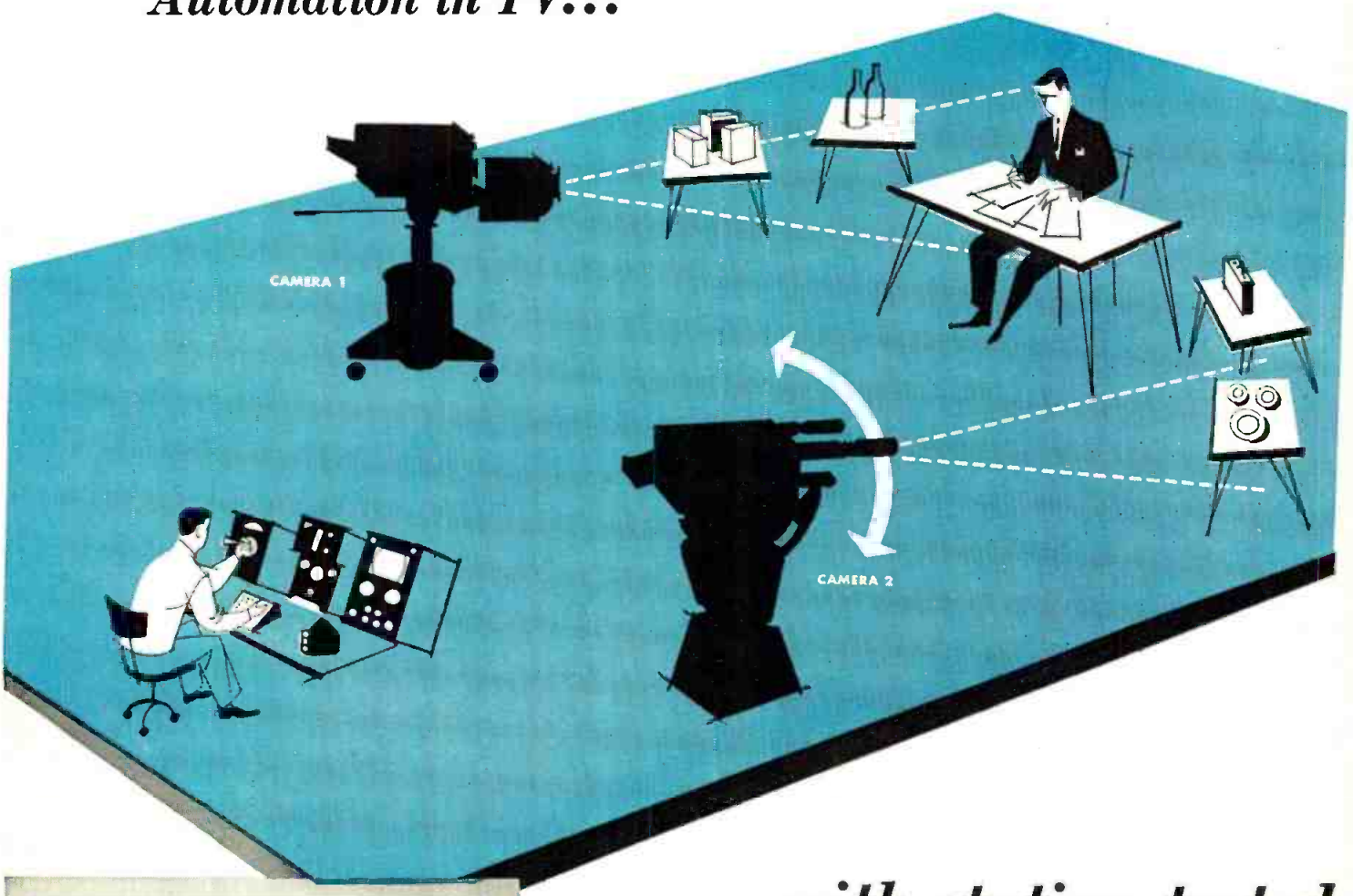
SPLIT-CHANNEL VIEWS—The FCC proposal to split radio channels in the 25-50 and 152-162 MC bands for the land mobile radio services on a 20 KC spacing basis has precipitated a wide division of views from the major radio user organizations. The Utilities Radio national committee voiced agreement with Commissioners Bartley and Lee who called for study of a general VHF band reallocation rather than the spilt-channel plan. Leadership of the police radio services sounded a note of caution that the proposed standards might result in a degraded mobile service. On the other hand, the organizations representing state highway departments and state forestry and conservation agencies supported the principle of the split-channel plan.

National Press Building
Washington, D. C.

ROLAND C. DAVIES
Washington Editor

NEW COST-CUTTING IDEA!

Automation in TV...



HOW IT WORKS!...

Camera 1, in scene above, is a GPL or other standard make, plus GPL-Watson Vari-focal lens with zoom and focus run from Control Room.

Camera 2 is a GPL full remote control: pan and tilt, lens change, focus and iris run by remote, plus a "memory" of 6 pre-set positions switched by push-button to correct aim, lens, iris and focus.

In typical sequence, station's day begins with newscast. Announcer is covered by 1 from close-up to full set, allowing optional use of wall maps, props or guest interviews.

Camera 2 covers active area and switches automatically by push-button to any of 6 easels or displays for advertising commercials.

Opening live news is followed by film and *entire first program is run with only two men in building.*

...with station-tested GPL studio technique!

This is a typical pattern of what you can do with equipment planned for quality with economical operation. There are many variants. Add a GPL-Watson 3″–30″ focal length lens to any make black and white or color camera—operate one camera only for most shows.

These are not dreams; smart station operators developed these techniques with GPL equipment. You can share in their savings.

GPL will be glad to analyze your present operations and give you engineering recommendations for a cost reduction program. For complete literature on remote control units and for engineering studies, at no obligation, write, wire or phone.

GENERAL PRECISION LABORATORY
Incorporated • Pleasantville, New York

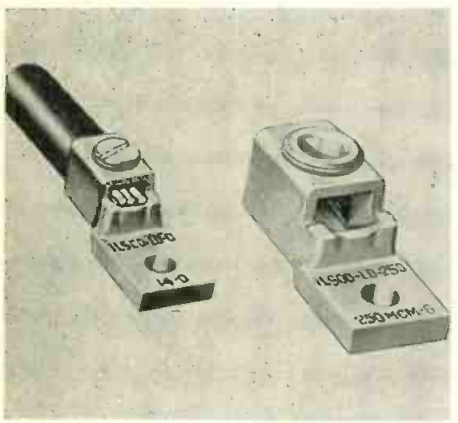
A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

GPL

New Electronic Products

SOLDERLESS LUGS

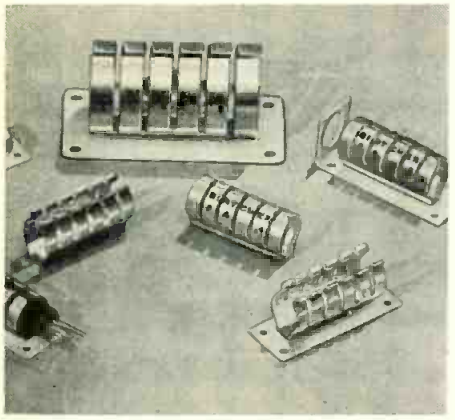
The new line of LO solderless lugs being produced with an open barrel is being offered in 125, 225, 300, and 400 ampere sizes. It is said that the new construction affords two important ad-



vantages; greater wire-holding space, and visual cable insertion. The new design is produced from extremely hard tempered copper tubing of unusual strength. Tests show twice the torque actually specified by UL can be applied as compared with former construction. Heat tests show about one-half the permitted temperature rise. **Ilsco Corp., Mariemont, Cincinnati 27, O.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-46)

SLEEVE CLAMP

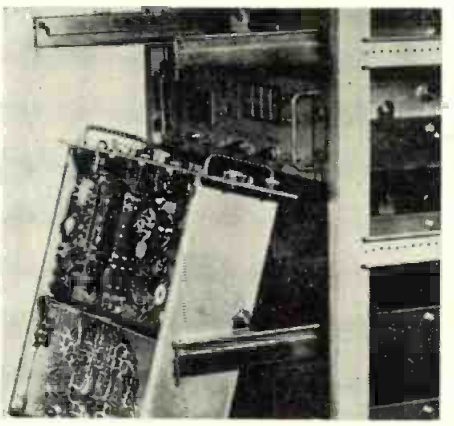
The 6A-3 "Kool Klamp," designed for miniature tubes with T-6½ and T-7 envelopes features "multiple finger" construction. The so-called fingers act independently and provide excellent contact between tube and clamp. The construction, it is claimed, improves heat conduction, simplifies tube insertion, and reduces tube breakage, par-



ticularly those that are slightly irregular in shape. The same design is also available for T-5 and T-5½ envelopes. **Birtcher Corp. 4371 Valley Blvd., Los Angeles 32, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES (Ask for 5-47)

CHASSIS SLIDES

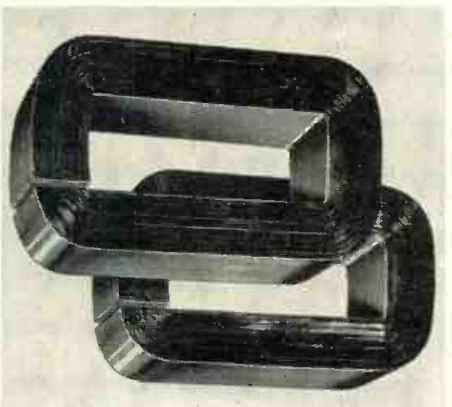
Type H-5798 chassis slides have been designed to fit most standard relay racks. Though light in weight, the units will support 100 lbs. without distortion. Manufactured in accordance with MIL-



E-16400 (Ships). Supplied with steel rails, bronze rollers, stainless steel pins, and "Nylon" bushings. Slide features include lubricationless roller action and easy tilting access to chassis bottom. Chassis dismounts by removal of two locking pins. **Radio Frequency Laboratories, Inc., 20 Powderville Rd., Boonton, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-45)

ONE-PIECE CORE

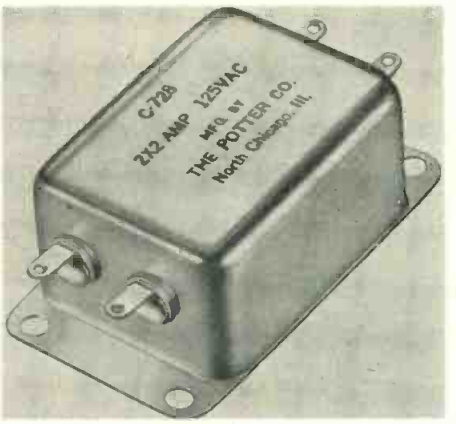
The new "Hyflux" one-piece wound core, the first of its type, provides certain cost advantages over conventional two-piece cores used in transformers and certain other electronic devices. Made the same as "C" cores, rather than as the sheared and punched core that is plastic impregnated and cut in two places, the "Hyflux" is varnished and cut in only one corner. The result is



from 20 to 30% greater efficiency over sheared and punched cores which enables an equal reduction of transformer size with retained performance. **Indiana Steel Products Co., Valparaiso, Ind.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-49)

LINE FILTER

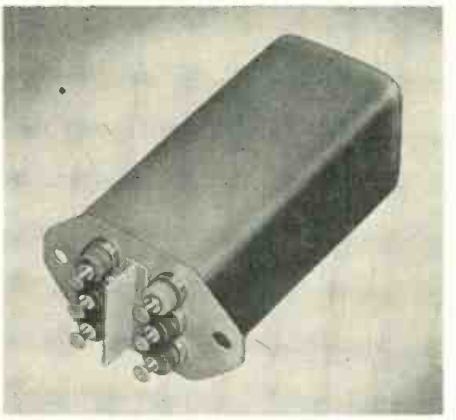
The new C-728 line filter is intended to be used as a component in high frequency units such as diathermy and ultrasonic oscillators. Its use enables units of this type to meet FCC radia-



tion requirements at 15 micro-volts/-meter at 100 ft. The unit meets UL requirements of 5 ma current to ground, and is for 115-120 v. ac. operation. The filter is available for any current rating and in a wide variety of shapes and mounting arrangements. Complete information can be obtained at the **Potter Co., 1950 Sheridan Rd., N. Chicago, Ill.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-58)

CHOPPER

The Model 307 electronic chopper has no moving parts and is able to modulate dc to frequencies up to 400 cps for a minimum life of 3,000 hours. Modulation is accompanied by illumination of a photoconductive element in a typical voltage divider. New features are temperature insensitive operation over a range of −50 to +100°C; dc to ac



conversion ratio over 0.5; noise pickup of less than 200 uv rms; 115 v., 3 ma., ac exitation. **Avion Instrument Corp., Subsidiary of ACF Industries, Inc., Highway No. 17, Paramus, N. J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-59)

PLUG-IN AMPLIFIERS FOR BROADCAST USE!

Provide These Outstanding Benefits...

SMALL SIZE . . . Considerably smaller than previous Broadcast Audio Amplifiers the RCA printed circuit series occupies about ½ the rack and shelf space formerly needed. You free rack space for other AM and TV equipment, reduce rack and mounting shelf costs.

HANDLING EASE . . . Quick, safe and effortless installation or removal is assured by compact, light weight construction. Dependable 15-pin keyed connectors provide fool-proof positioning for rapid "in and out" handling. Connecting pins are gold plated to assure excellent electrical contact.

UNIFORM PERFORMANCE . . . The printed circuit assures uniformity and excellent frequency response. All units achieve extra dependability through use of hermetically sealed transformers. Each amplifier is provided with output terminals and a switch to facilitate current metering.

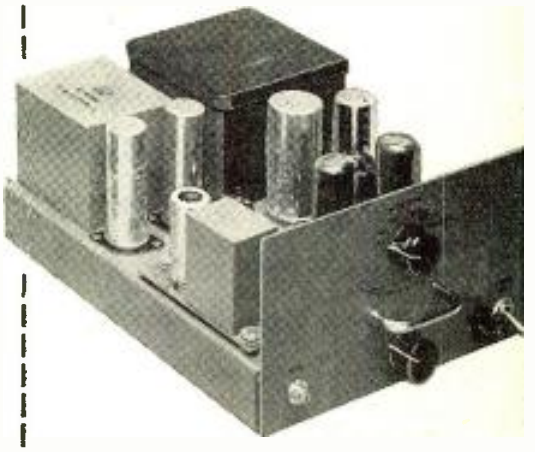
REDUCED-SIZE ACCESSORIES . . . Accessories such as BR-22A mounting shelf and BX-21A power supply used with the printed circuit amplifiers have also been "miniaturized." Example: shelf BR-22A, only 5¼" high can accommodate the following combinations of equipment: 10 BA-21A Preamplifiers, 3 BA-23A Program Amplifiers plus 1 BA-21A, 2 BX-21A Power Supplies plus 2 BA-21A. 2 BA-24A Monitor Amplifiers.

For complete details of the many further advantages of RCA's printed circuit amplifiers, call your nearest RCA Broadcast Representative. Ask for literature.

RADIO CORPORATION of AMERICA
ENGINEERING PRODUCTS DIVISION **CAMDEN, N.J.**

BA-21A PREAMPLIFIER . . . Ideal as a micr phone preamplifier, turntable preamplifier booster amplifier. May be used as isolati amplifier by adding an MI-11278-E or F bridgi volume control. Due to its small size, it may placed in a control console, control desk or tra cription turntable cabinet. One to ten of the units may be installed in a single BR-2 panel and shelf assembly.

BA-23A PROGRAM AMPLIFIER . . . A vers tile high-fidelity amplifier using special hig quality components and providing maximu accessibility. High gain and low distortion ma it without equal as (1) program or line amplifie (2) bridging amplifier, (3) isolation amplifie Three BA-23A amplifiers can be mounted BR-22A shelf with space for an additional amplifie



BA-24A MONITORING AMPLIFIER . . . A hig fidelity, high-gain, flexible 8-watt amplifi suitable for monitoring, audition, recording ar talk-back uses. Also serves as a program or lir amplifier. Excellent for transcription playba booths, since the 105 db gain will operate speaker (LC-1A) directly from the output of turntable (70-series). Also an excellent recor ing amplifier.

Letters

(*Continued from page 58*)

tion very often asked is "Why not simply classify anything that should not be published?" The answer is that there are certain types of dangerous information that cannot, as a practical matter, be classified. Many examples are found in the field of air photographs. It is a simple matter to forbid photographs of atomic energy installations and certain types of military installations. There are other installations which would be unwise to classify by name and which would be impossible to handle intelligently by any general rule. The only practicable procedure in this field seems to be for each editor to be on the lookout for air photos that might do considerable damage and then use his own good judgment.

Classification is also impossible when a highly confidential weapon is placed in the hands of troops who must maintain and operate it. Classified material can not legally be handled by troops, so it is necessary to declassify the weapon although information regarding it would be of very great value to an enemy.

Since both Mr. R. K. Honaman and I are on loan here from industry, and since neither of us has any ambition to build an "empire" or a government career, you can be sure that anything we do here will be based on our sincere desire to help our country in the light of common sense and a practical understanding of the industrial, scientific, and publishing problems involved.

Philip W. Swain
Assistant Director
Office of Strategic Information
Department of Commerce

Editors, Tele-Tech

In the article entitled "Reliable Connections" appearing on Page 87 of the March issue of TELE-TECH & ELECTRONIC INDUSTRIES, I inadvertently failed to mention that the illustration used was from "Procedure for Fabricating Delay Lines from Bulk Cable" as covered in Engineering Note E-437, prepared by the Digital Computer Laboratory, Massachusetts Institute of Technology, dated November 29, 1951." I would greatly appreciate your bringing this fact to the attention of your readers.

R. George Roesch
President
The Eraser Company, Inc.
Syracuse 4, New York

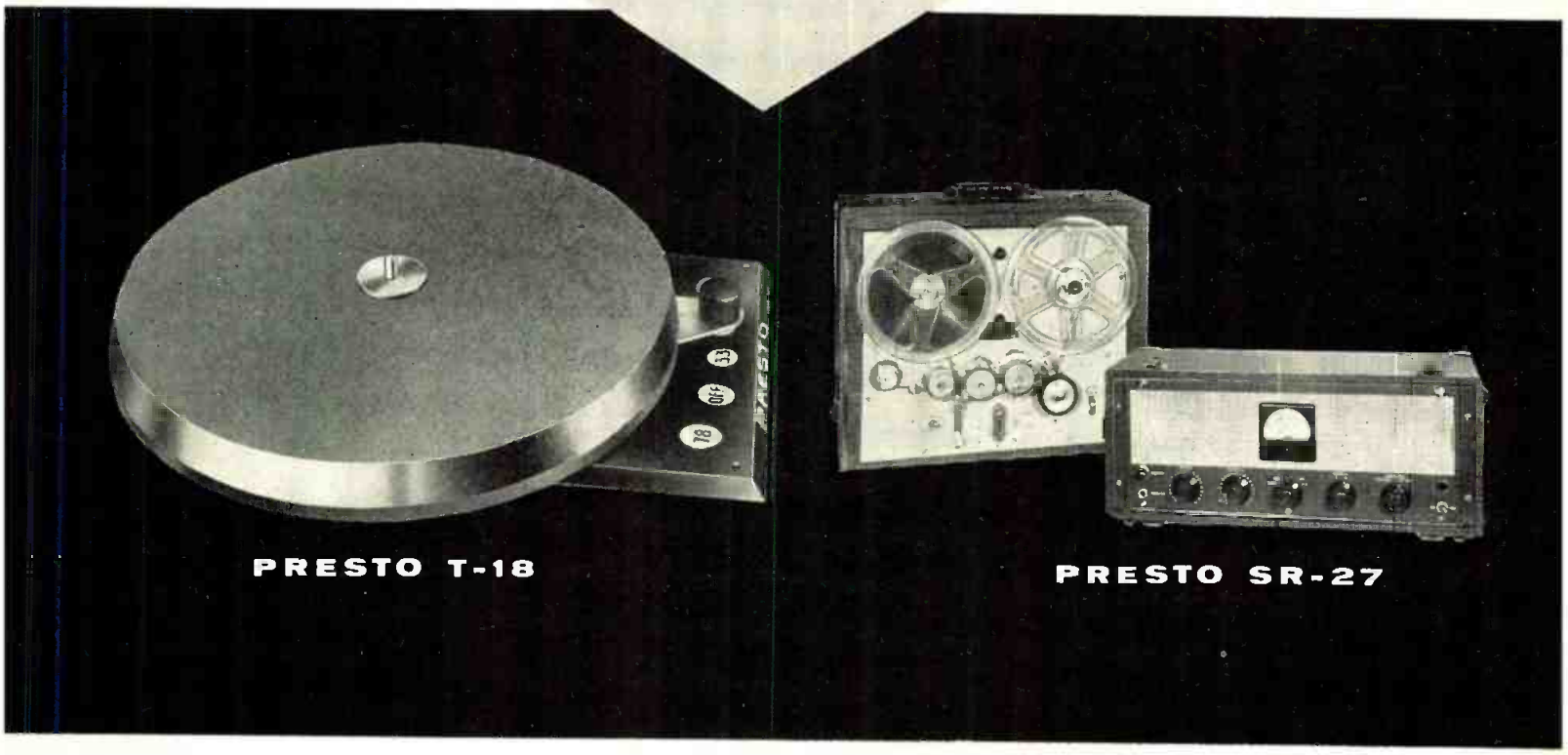
TWO NEW PRESTO UNITS

PRECISION THREE-SPEED TURNTABLE

T-18

LOW-COST PROFESSIONAL TAPE RECORDER

SR-27



PRESTO T-18

PRESTO SR-27

PRESTO T-18 TURNTABLE

introducing new flick shift!
one sideway motion
selects 3 speeds—33⅓, 45, 78 rpm.

The new streamlined T-18 sets the highest standards in turntable design and performance today. Most revolutionary is the exclusive 3-speed shift—with 3 idlers mounted on a single movable plate. A sideway flick of the single control lever automatically engages the proper idler. Trouble-making arms and shift cams are eliminated. Other advantages! Extra heavy weight, wide-bevel table, precision deep-well bearing, built-in adapter for 45 rpm discs, smart telephone black and brushed chrome finish. Only $53.50. Also available with hysteresis motor, $108.

PRESTO SR-27 TAPE RECORDER

featuring top-performance features
of finest PRESTO units—
economy priced for the first time!

Top value as well as top performance are yours in this 2-unit combination—SR-27 tape recorder and A-920 amplifier. The recording unit features 3-motor drive; separate record, erase and playback heads; fast forward and rewind. No take-up reel clutch, no idler pulley. A truly professional performer! Companion amplifier has 10 watt output at 16 ohms, self-contained power supply, separate preamps and VU meter, 2 playback speakers. Playback head can be monitored during recording. This combination is your best buy in hi-fi at only $485.

PRESTO RECORDING CORPORATION

PARAMUS, NEW JERSEY

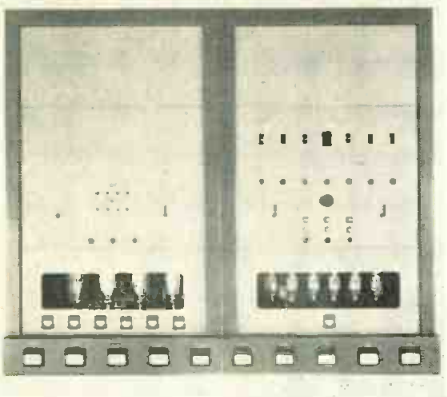
Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Instantaneous Recording Service, 42 Lombard Street, Toronto

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISC

New Electronic Products

COOLANT UNIT

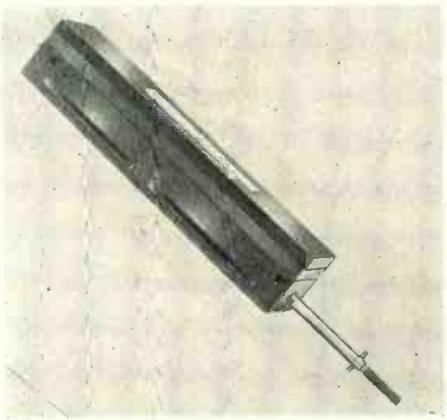
Designed for automatic control of fluid output temperature for cooling electron tubes in aircraft, the Model RR-10850 unit incorporates a heat exchanger, air blower, and motor-driven



oil circulating pump. Also includes thermal switches, a by-pass valve, flow switch, supply tank, etc. The pump has a capacity of 2 gpm at 2,700 rpm. The coolant is Monsanto OS-45 hydraulic fluid. Maximum pressure, 110 psia. Motor, 0.30 h.p., 115 v., 400 cps, single phase, 5,400 rpm, continuous duty, 700 w. max. **Lear, Inc., Lear-Romec Div., Elyria, O.** TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-84)

POTENTIOMETERS

The Types 2134 and 2135 potentiometers are designed for applications where a system voltage exceeds that desired across the potentiometer. Internal regulation of the units insures



that each position of the wiper corresponds to a fixed fraction of system voltage which remains stable despite wide temperature variations. Output stability is maintained because potentiometer element and fixed resistors are matched in temperature coefficient of resistance. Type 2134, stroke 1¾ in. Type 2135 stroke, 3⅛ in., **Markite Corp., 155 Waverly Place, New York 14, N.Y.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-82)

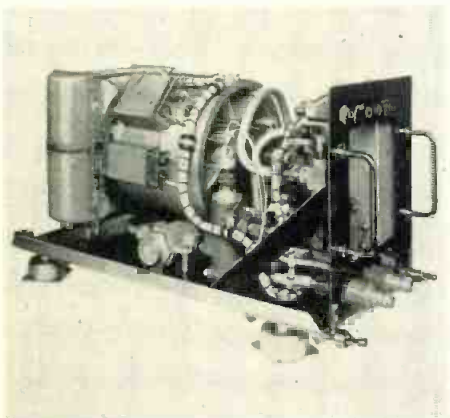
DC "MIDGETSCOPE"

The Model 534 dc "Midgetscope" combines linear sweep with dc amplifier for color television restorer circuits and for complex wave forms. Other features include provisions for ac coupling, full

vertical and horizontal expansion of trace, automatic astigmatism control, circuit, linear time base and sweep, automatically blanketed returned trace, and vertical or horizontal operation. Frequency range, dc to 50 kv. Sensitivity, better than 50 mv. Push-Pull deflection throughout. **Radio City Products Co., Inc., Centre and Glendale Sts., Easton, Pa.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-81)

POWER SUPPLY

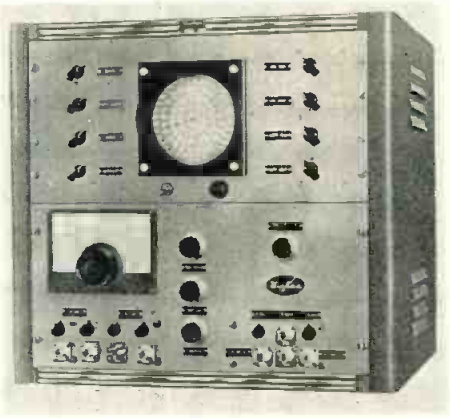
The Type PP-20-A electronic power supply is used in an aircraft and missile component and structure vibration testing system. Power output, 20,000 w. into matched load at all output impedance taps. Output impedances, 0.5, 1.0, 2.0, 4.0, 8.0, 16.0, 32.0 and 64.0 ohms with front panel interlocking switching. Total harmonic distortion,



less than 5% at full rated output. Noise and Hum, 60 db below full rated output. Input Impedance, 20,000 ohms. Input voltage, 1.0 v. RMS for full power output. **L. M. Electronics, Inc., 5017 Exposition Blvd., Los Angeles 16, Calif.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-79)

PHASE DISPLAY EQUIPMENT

The PDE-1 phase display equipment displays the transfer function of any network, amplifier, or system as a simultaneous vector plot of amplitude response and phase shift. Measures phase distortion, and covers the entire frequency range of 100 kc to 10 mc. A built in marker generator provides markers at 500 kc intervals for Z-axis



modulation of the display oscilloscope. A common time base controls the sweep oscillator and provides horizontal sweep for the display oscilloscope. **Wickes Engineering and Construction Co., 12th St., and Ferry Ave., Camden 4, N.J.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-83)

PRESSURE TRANSDUCER

The TIC potentiometer type dual element pressure transducer translates static and dynamic air pressures to equivalent electrical voltages for a variety of instrumentation applications. The high outputs of the unit make additional amplification unnecessary for many purposes. The transducer contains two pressure sensitive bellows elements. One responds to the differ-

ential between ambient and air-flow pressures, as from a Pilot tube or Venturi; the second responds directly to static atmosphere pressure as does an aneroid device. **Technology Instrument Corp., 531 Main St., Acton, Mass.**—TELE-TECH & ELECTRONIC INDUSTRIES. (Ask for 5-80)

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. . . it is worthy of note that Stackpole Fixed Resistors are one of the most widely used brands in meeting today's exacting specifications.

Speaking of resistor supplier co-operation

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Backed by the keen personal interest and full co-operation of the specialists who produce them

NARTB Conference

(*Continued from page 85*)

Vice President for Engineering, Westinghouse Broadcasting Company.

TELEVISION DAY

Thursday, May 26

Presiding Officer: Glenn C. Boundy, Director of Engineering, Storer Broadcasting Company.

"Advancements in Color Film and Slide Programming," Fred F. Bartlett, Headquarters Supervisor of Sales Engineers, Broadcast Products Philco Corporation.

"The Conversion of Iconoscope Chains to Vidicon Operation," Joseph W. Belcher, General Precision Laboratories.

"General Characteristics of Color Television Displays," Bernard D. Loughlin, Consulting Engineer, Hazeltine Corporation.

"Network Transmission of Monochrome and Color Television," James R. Rae, General Methods Engineer, American Telephone and Telegraph Company.

"A CBS-TV Color Studio," Robert B. Monroe, Senior Project Engineer, CBS-Television.

"The Integration of Color Equipment and Existing Monochrome Installations," Anthony H. Lind, Manager, Broadcast Audio and TV Projector Engineering, Radio Corporation of America. Lannes E. Anderson, TV Systems Engineering, Radio Corporation of America. Nils J. Oman, Development Engineer, Broadcast Transmitter Section, Radio Corporation of America.

"Design, Construction and Operation of Television Boosters and Satellites"

1. Design Problems: Dr. George Brown, Director, Systems Branch Laboratory, Radio Corporation of America.
2. Construction: Benjamin Adler, Owner, Adler Communications Laboratories.
3. Operations: Eugene E. Overmeir, Manager Commercial Engineering Department, Sylvania Electric Products, Inc.

TELEVISION DAY

Afternoon Session

Presiding Officer: James L. Middlebrooks, Engineering Director, TV Station KING-TV, Seattle, Washington.

"A Review of Color Encoding Principles," Robert Deichert, C.R.L. Color Dept., Research Division, Allen B. DuMont Laboratories, Incorporated.

"Proof of Performance Measurements for a VHF TV Station," Richard K. Blackburn, Technical Director, TV Station WHEC-TV, Rochester, New York. Bernard C. O'Brien, Chief Engineer, TV Station WHEC-TV, Rochester, New York.

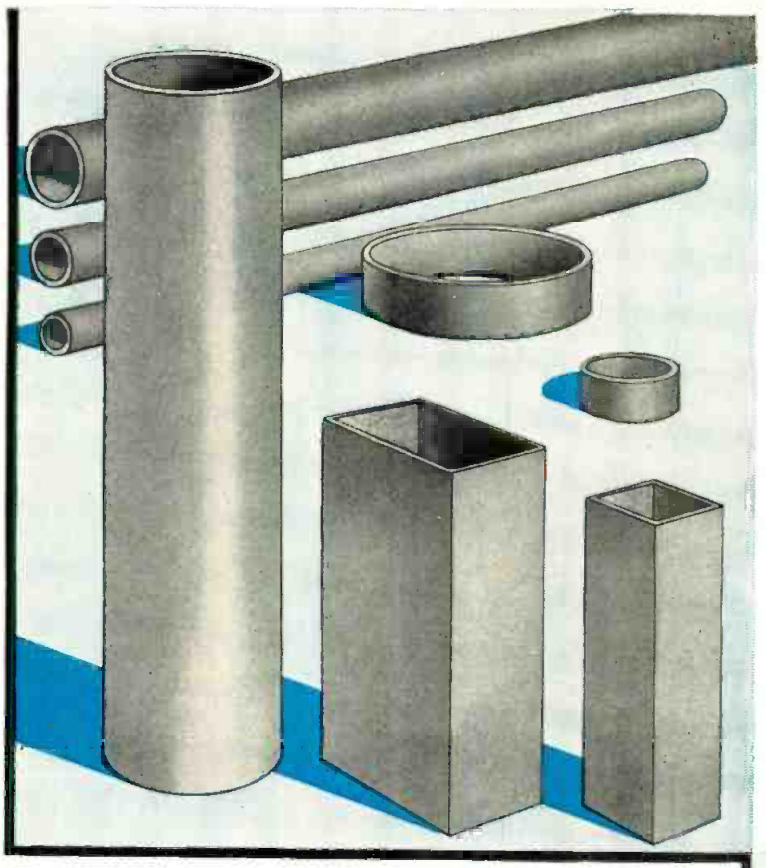
"Achieving One Megawatt ERP At UHF," Frank J. Bias, Supervisor of UHF Transmitter Engineering, General Electric Company.

"Considerations of Microwave Installations," Richard C. McLaughlin, Assistant Manager, Communications Products Planning, Raytheon Manufacturing Company.

"A Low Power Television Station for $50,000," F. Dan Meadows, General Sales Manager, Dage TV Division, Thompson Products, Incorporated. Joseph W. Alinsky, Chief Engineer, Dage TV Division, Thompson Products, Incorporated.

Airlines Add Selective Call Radios

Pan American World Airways has ordered 47 Motorola dual airborne "Quik-Call" units for "Selcal" on aircraft. United Air Lines is buying 198 single units for fleet-wide installation. The new equipment, built to ARINC "Selcal" specifications, permits selective calling of individual or groups of aircraft in flight. Only those messages intended for a particular pilot's attention pass through the selective decoder and are heard by the pilot.



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Localizer Antennas

(*Continued from page 88*)

Where I′ is the current in each antenna of the first pair, I″ the current in the second pair, etc. We know from Fourier Analysis that to obtain a curve such as that given above for the reference pattern but with odd symmetry, we need only sine terms and that only the odd harmonics of these terms are present. These are exactly the terms provided by the deflection antennas placed as indicated above, so it is now only necessary to determine the values of I′, I″, etc., to provide the deflection pattern which matches the reference pattern.

Let us consider I′ to be made up of the components I_o' and I_1'; I″ to be made up of I_o'', and I_1'', etc. The components I_o', I_{o1}', etc. will be those needed to match the first term in the expression for the reference pattern, while I_1', I_1'', etc., will be those needed to match the second term. To match the first term with a pattern of odd symmetry, we have a problem analogous to the square wave of Fourier Analysis. Thus,

$$I_o' = \frac{2}{\pi} I_o \quad I_o'' = \frac{2}{3\pi} I_o \quad I_o''' = \frac{2}{5\pi} I_o$$

and so on, insofar as additional pairs are installed.

The solution must be computed for the terms I_1', I_1'', etc., according to the principles of Fourier Series, as this is not a well-known result as was the first set of components. We proceed as follows to determine the amplitude of the n th component:

$$b_n = \frac{2}{\pi} \int_o^{\pi} \cos 2x \sin nx \, dx$$

$$= \frac{4}{\pi} \left[\frac{n}{n^2 - 4} \right] \text{ for } n = 1, 3, 5, \text{ etc.}$$

The currents in the various pairs of deflection pattern antennas may now be written as the sum of these two components:

$$I' = \frac{2}{\pi} I_o \left(1 - \frac{2I_1}{3I_o} \right)$$

$$I'' = \frac{2}{\pi} I_o \left(\frac{1}{3} + \frac{6I_1}{5I_o} \right)$$

$$I''' = \frac{2}{\pi} I_o \left(\frac{1}{5} + \frac{10I_1}{21I_o} \right)$$

$$I'''' = \frac{2}{\pi} I_o \left(\frac{1}{7} + \frac{14I_1}{45I_o} \right)$$

and so on, for as many pairs of antennas as are to be used.

If we add another pair of refer-

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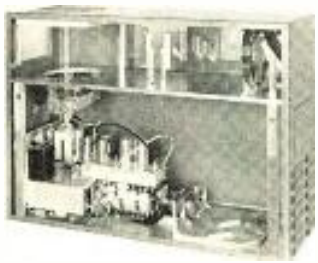

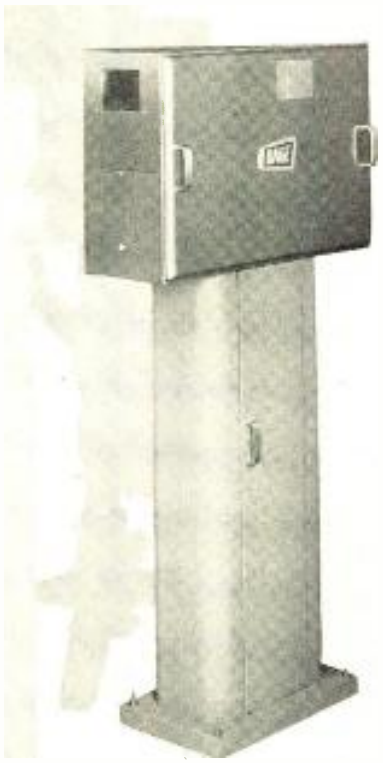

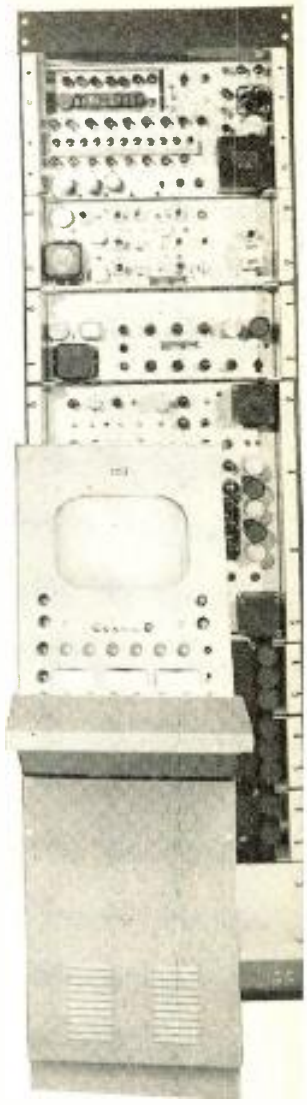

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DAGE TELEVISION DIVISION | THOMPSON PRODUCTS, INC., MICHIGAN CITY, INDIANA

Localizer Antennas

(*Continued from page 112*)

ence antennas, each antenna spaced 2d from the center, we may readily calculate the components that must be added to each deflection antenna to maintain matched patterns. Following the same procedure as before,

$$b_n = \frac{2}{\pi}\int_0^{\pi} \cos 4x \sin nx\, dx$$

$$= \frac{4}{\pi}\left[\frac{n}{n^2-16}\right] \text{ for } n = 1, 3, 5, \text{ etc.}$$

Thus, the additional components that must be added to the various pairs of deflection antennas are:

$$\text{1st pair} - \frac{4I_2}{15\pi}$$

$$\text{2nd pair} - \frac{12I_2}{7\pi}$$

$$\text{3rd pair} + \frac{20I_2}{9\pi}$$

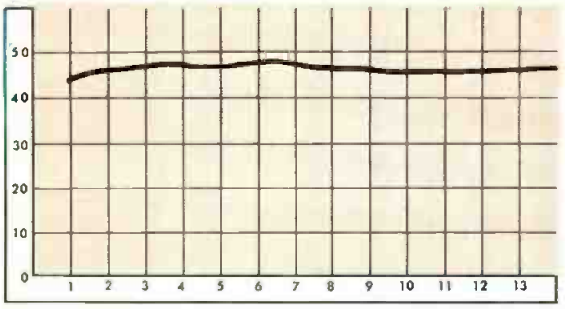
$$\text{4th pair} + \frac{28I_2}{33\pi}$$

and so on, for as many pairs of antennas as are to be used.

Before considering several examples to demonstrate how this theory is applied, one fact should be noted regarding the reconstruction of desired waveforms by the addition of Fourier Series components. Taking, for example, a square wave, if it starts at t=O, we know it to be,

$$\frac{4}{\pi}\left[\sin\theta + \frac{1}{3}\sin 3\theta + \frac{1}{5}\sin 5\theta + \ldots.\right]$$

If we draw a curve consisting of only the first two terms, we find oscillations superimposed on the curve, and a visual inspection will indicate to us that the next component, that of 5θ, is needed to take them out. When we add the component of 5θ, however, another form of oscillation appears and a component of 7θ is needed to correct it. This process continues as long as we add components in the proportions indicated by the theoretical relation. Suppose we add the last component in only about one-half of the prescribed amplitude; in this case, we eliminate the oscillations of the first type on the curve but do not produce those of the second type. Thus, if we wish to form a square wave using only the three components θ, 3θ, and 5θ, and we are willing to have the sides inclined a little further from the vertical in the interests of eliminating the oscillations on the top of the



Tangential Sensitivity of IN358
The input signal level, expressed in db below 1mw required to produce an output pulse of amplitude tangential to the noise level.

Transition—matches the crystal to N-Type connector over a broad frequency range.

Simplify front-end design

over a BROADBAND microwave frequency range

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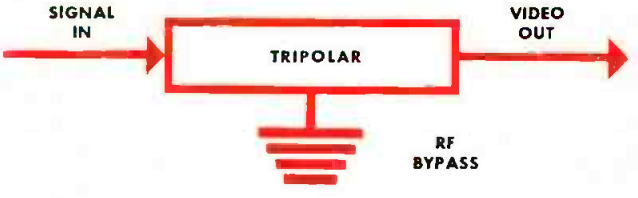

By matching the inherent broadband characteristics of coaxial cable, the Tripolar crystal diode introduces an entirely new concept in broadband microwave circuitry and opens a fresh, simplified approach to front-end design.

The IN358 video detector is the first of these new broadband crystal diodes. In a simple holder, it covers the frequency range from 1 to over 12 kmc. The IN358 is connected in series with standard coaxial cable between the signal source and amplifier.

Other broadband video types are available now and broadband mixer types will be ready soon.

SPECIFICATIONS

Frequency Range:	1,000—12,400 Mc
Figure of Merit: (1)	10 min. at 6750±10 Mc
Tangential Sensitivity:	−40 DBM over frequency range @ 25°C
Video Resistance:	450 ohms—18000 ohms @ 25°C
Ambient Temperature:	−40—70°C

Note 1. Measured in untuned broadband holder

ANOTHER REASON WHY IT PAYS TO SPECIFY SYLVANIA

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Localizer Antennas

(*Continued from page* 114)

wave, the best combination is approximately,

$$\frac{4}{\pi}\left[\sin\theta + \frac{1}{3}\sin 3\theta + \frac{1}{10}\sin 5\theta\right]$$

The same situation holds true with regard to the currents in our deflection antennas, namely, the current in the outermost pair should be only about half the calculated value if we wish superimposed oscillation on the pattern to be a minimum.

Examples

Let us start with a three-antenna reference pattern with the outer antennas $3\lambda/4$ from the center antenna. The minimum signal will occur for a value of θ for which $\cos(3\pi/2 \sin\theta) = -1$ or for $\sin^{-1} 0.667$, which is about 41°50′. The curve of this pattern is included in Fig. 1. Let us make the ratio of I_1/I_0 such that the maximum on the course is four times the minimum of 41°50′. It is easily determined that I_1/I_0 must then equal 0.3, as can be confirmed by

$$\frac{1 + 2\text{x}0.3}{1 - 2\text{x}0.3} = 4.$$

Our array is shown in Table I The currents shown for the deflection pairs were calculated from the formulas given earlier after substituting $I_1/I_0 = 0.3$. Figs. 3 and 4 show the calculated patterns, although Fig. 3 represents only trials at fitting the patterns. From Fig. 3 it appeared that 50% of the calculated current for the last pair was hardly enough to give the best fit between patterns, so 60% was used for the final pattern of Fig. 4 (i.e., 0.6x 0.1504 or 0.0902).

What are the advantages, if any, of the diagrams of Fig. 4 compared with the diagrams of the conventional localizer? Keeping in mind that it is only the deflection-pattern signal that causes objectionable reflections, we see that we have reduced the signal in the vicinity of 40° off the course, and hence reduced the harmful effect of any reflecting object near this angle. Likewise, the deflection pattern follows the reference pattern much more closely; as indicated by Fig. 3, with three pairs of deflection-pattern antennas, the two patterns coincide about as closely as they do for the conventional localizer. Thus, in comparing this 11-antenna array (3 ref-

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AMERICAN'S famous Dynamic Omni-directional Microphone (D-33). "Slide-lock" device permits fast removal from stand for hand use. Attractively finished in gold and black. Available in all popular impedances.

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Localizer Antennas

(*Continued from page 116*)

erence and 8 deflection) with the 8-antenna array (2 reference and 6 deflection) of the usual localizer, we can conclude that the extra reference antenna is chargeable to the pulling in of the signal near 40° and that the two extra deflection antennas are chargeable to the better fit of the deflection to the reference pattern.

Naturally, the signal in the vicinity of 40° could have been further reduced simply by raising I_1 so that it approached $0.5I_0$ more closely, and we could have calculated a deflection pattern to match it using the same formulas. However, an almost complete suppression of the signal at any angle raises two problems; (1) the 360° coverage requirements of ICAO Annex 10 probably can no longer be met, and (2) the requirements as to fit between reference and deflection patterns become increasingly severe if we are to avoid poor "clearance" or even course reversals in this sector of low signal.

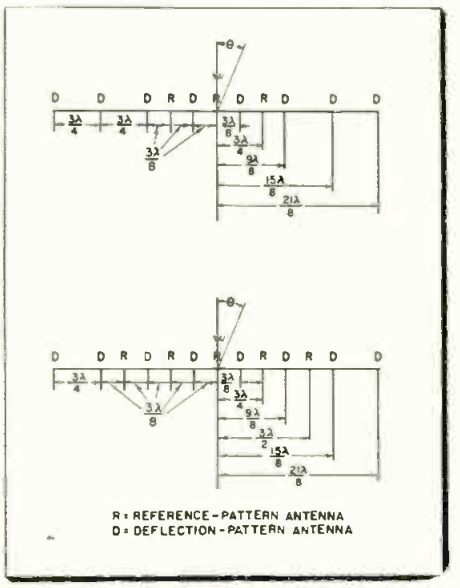

Fig. 6: Localizer antenna array pattern

Another example will now be worked out, this one for 5 antennas in the reference array and 8 in the deflection array. It was decided after examining Fig. 2 to make I_2/I_1 equal to 0.4, and I_0 was then chosen to make the ratio of the maximum to minimum reference signal equal to 6. The details of the arrays are seen in Table II.

As explained earlier, it is not advisable to use the full calculated current for the last pair, and only 60% of this value, or $0.1665I_0$, was used. Fig. 5 shows the curves calculated on the basis of the above values. Possibly there may be a little doubt

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Localizer Antennas

(*Continued from page* 118)

about the procedure for calculating the above currents, so the current for the second deflection-pattern pair will be calculated to demonstrate how it is done.

$$I'' = \frac{2}{\pi} I_o \left(\frac{1}{3} + \frac{6I_1}{5I_o} - \frac{6I_2}{7I_o} \right)$$

$$= \frac{2}{\pi} I_o \, (0.3333 + 1.2 \times 0.4464 - 0.8571 \times 0.1786)$$

$$= \frac{2}{\pi} I_o \, (0.3333 + 0.5357 - 0.1531)$$

$$= \frac{2}{\pi} I_o \times 0.7159 = 0.4558 I_o$$

No additional eaxmples will be given, as the procedure demonstrated is applicable to the calculation of a matching deflection pattern for any reference pattern of this general type.

Transmitter Designs

(*Continued from page* 92)

to stability and reliability of the oscillator circuits since it eliminates effects of changing relay contact resistance and capacitance. Up to four frequencies can be accommodated in standard designs. Six frequencies have been handled in special applications.

The requirement for operation under crowded channel conditions emphasizes again the importance of low spurious and harmonic output. An excellent figure for low spurious radiation is easily obtained because of the nine high Q multiplier and amplifier tuned circuits (eight in the low frequency design), each contributing to the virtual elimination of such emissions.

To provide the necessary protection against over-modulation, the double triode modulation limiter and triode phase modulator combination, which have proven so successful in previous units, are employed again in this design.

The most important contribution to overall speech intelligibility lies in provision for the use of the controlled reluctance microphone driving a 12AU7 twin triode audio amplifier which is followed by the modulation limiter discussed above. The conventional carbon microphone can still be employed with this transmitter design but the use of the reluctance microphone is highly rec-

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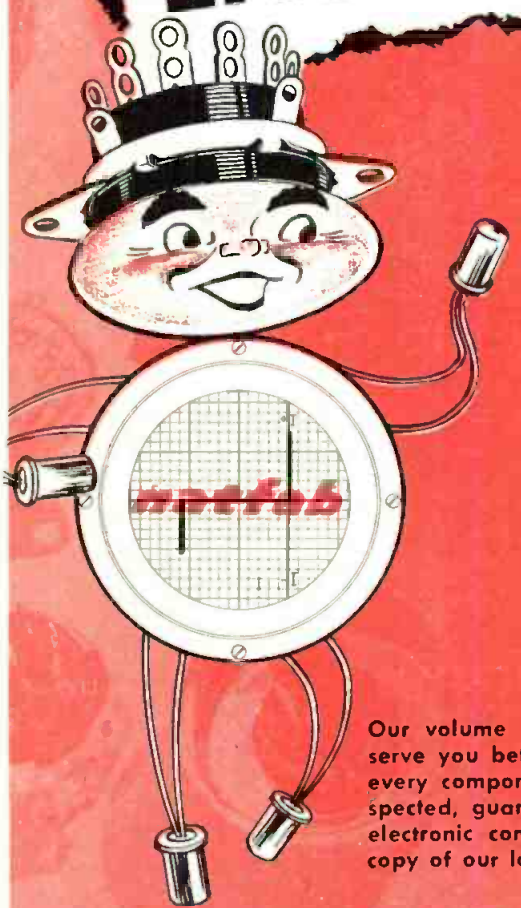

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Transmitter Designs

(*Continued from page 120*)

ommended in view of its greatly superior audio performance characteristics.

The filament wiring is arranged for either 6 or 12 v. operation. The type of operation is determined by the cable accessory which is plugged into the unit. Nothing need be changed within the unit itself to go from 6 to 12 v. operation.

Metering is provided by means of measurements from pin jack to ground with a 0-3 volt 20,000 ohms v. DC voltmeter.

A new feature most likely to receive attention is the neon lamp tuning indicator which indicates adjustments for maximum power into the antenna as well as power amplifier plate tuning. Fixed bias and a "tune-operate" switch have been incorporated to protect the power amplifier tubes during tuneup and these still allow the usual tuning indications.

The circuits have been accommodated on a chassis having outside dimensions of 12½ x 4 x 5⅞ in.

One reason for the excellent serviceability of this equipment is that the first five multiplier tank coils (six in low band) and most of their associated components have been placed above the chassis in shield cans. (See Fig. 3) The coils are individually shielded, reducing undesired coupling. The desired coupling is conveniently controlled by "low side" capacitive coupling.

Both the high and low frequency transmitter units are "plug-in" for quick exchange for servicing and are identical to transmitter units which are utilized in station equipment.

The high and low frequency transmitters are similar with respect to layout and circuitry; the different powers are identical in design except for the finals for easy familiarity in servicing, and all controls are accessible from above the chassis with a simple tuning tool.

Construction

In order to understand the overall concept of these new designs, it is necessary to see how these transmitters are incorporated into mobile combinations. The mobile transmitters will be provided in single unit cases in association with power supplies and receivers. Standard mobile case sizes are 14⅜ x 15 x 6, 17⅜ x 15 x 6, and 20½ x 15 x 6 in. A typical case is shown in Fig. 4.

The mobile rack construction

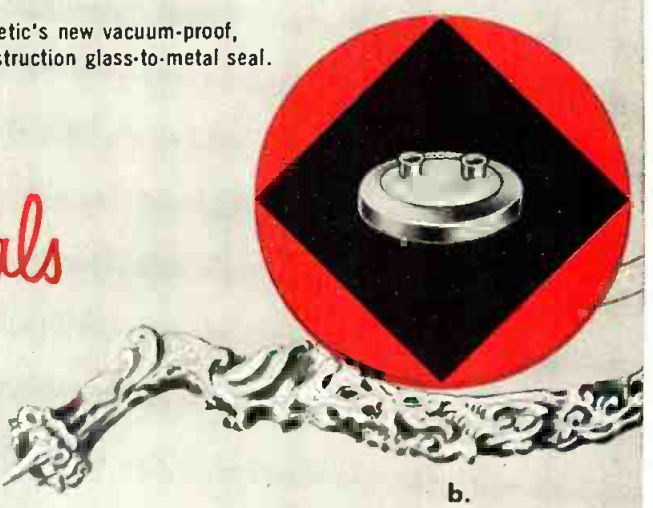
Variety that spurs imagination

a.

Designed with either matched glass or Vac-Tite* compression construction . . . with O. D.'s that range from .152 to .962 . . . these Hermetic Condenser Seals are produced to fit standard condenser cans. They provide the design engineer and manufacturer with an unprecedented variety of economical, low-cost packages for use in the design and production of impregnated paper capacitors, rectifiers and filter networks.

*Vac-Tite is Hermetic's new vacuum-proof, compression construction glass-to-metal seal.

Hermetic Condenser Seals

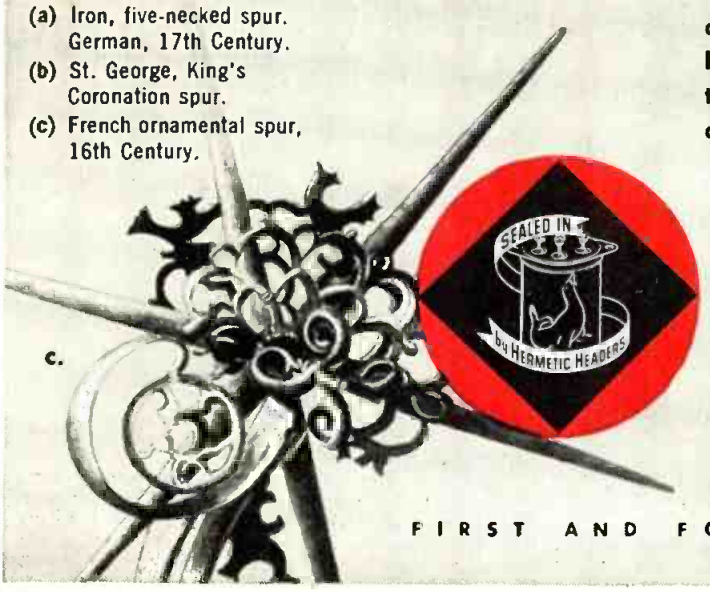


b.

Design Variations . . . Hermetic Condenser Seals are offered in 2-tube configurations from .377 O. D. and 3-tube configurations from .477 O. D.

Mounting Variations . . . These Condenser Seals can be supplied with mounting lugs attached to the tubular terminals or with flattened and pierced tubing. They can be mounted on flat sheet metal covers that have a recess in which the part can be positioned and the solder confined.

(a) Iron, five-necked spur. German, 17th Century.
(b) St. George, King's Coronation spur.
(c) French ornamental spur, 16th Century.



c.

Write for engineering data, drawings, prices and samples on these and the many other Hermetic standard parts available that satisfy the most extreme requirements of industry and the Services.

Hermetic Seal Products Company

33 South 6th Street, Newark 7, New Jersey

FIRST AND FOREMOST IN MINIATURIZATION

Transmitter Designs

(*Continued from page 122*)

(Fig. 5) on which the individual chassis are mounted is unique in the mobile field. Previous designs have attempted to secure rigidity by utilizing the chassis as a structural member. This has not always been successful. In the Progress Line design, it was determined that the structural requirement would be made independent of the chassis design and a mobile rack was devised on which the individual transmitter, receiver, and power supply chassis are mounted. The rack provides mechanical strength which gives more freedom in design of individual chassis units and also gives flexibility to special system problems which cannot be accommodated by conventional case designs.

Electron Beam

(*Continued from page 71*)

on the screen has a one-to-one relationship to a point on the cross section of the beam. To a good approximation, this relation is linear; the deflection of the current passing the aperture gives a magnification which is limited only by the presence of stray ac magnetic fields.

In use, the deflection yoke is operated with deflection currents similar to those employed in a television set, and a clear magnified image of the electron spot is viewed on the phosphor screen. The finest details may be observed, such as lens aberrations and spot asymmetry. Resolution is limited by two factors: the aperture size; and spread of the beam passing through the aperture. The first limitation may be overcome by use of a small aperture, and the second is negligible at suitably large magnification.

The size of the magnified spot is sufficient to carry out any qualitative and semi-quantitative measurements visually. A ruler may be placed against the face of the tube to measure the magnified spot size to reasonable accuracy. While viewing of the magnified spot is sufficient for some applications, the use of this technique to obtain precise quantitative data on characteristics of a gun or focusing system requires the addition of a few refinements.

An extra deflection yoke is mounted near the gun, at some distance from the swept yoke. Direct current in this yoke centers the beam on the resolving aperture. It may also be used to determine ac-

curately the degree of magnification. This is carried out as follows: a deflection of the beam by this centering yoke will shift the beam with respect to the aperture. This shift is magnified on the phosphor screen by the magnification ratio of the system. It is convenient to begin with no sweep on the main yoke. By means of the centering yoke, the spot is moved a known distance (an inch or more) at the aperture. This distance can be scribed on the aperture plate, the beam's position being observed by means of a phosphor dusted on the aperture plate. The current required in the centering yoke for this motion is recorded. With the sweep turned on and the magnified image in view, the current in the centering yoke is changed to shift the image a fixed distance on the screen. By taking the ratio of the deflection currents for equal deflections at the screen and at the aperture, the magnification is obtained.

An alternative method of calibration would be to use two resolving apertures, a known distance apart. Two images of the spot would appear. The ratio of their spacing on the screen, to the known aperture spacing, is the magnification. This method of calibration is not good when extremely large magnifications are desired or when the spot is large. In the former case, images from both apertures may not appear at the same time on a small screen. In the latter case, the images may overlap, making observation of spot shape more difficult.

Characteristics and Limitations

One of the important features of this technique is that magnification is, for fixed geometry, solely a function of the beam voltage. In fact, to a first approximation, it is even independent of beam voltage. It is readily seen that magnification is the ratio of deflection after the aperture to deflection before the aperture. If the deflection yoke produces substantially linear deflection vs. current, the distortion of the image will be negligible. The magnification and distortion are entirely independent of the amplitude of sweep. It is therefore possible to decrease the brightness of the magnified image by increasing the amplitude of sweep. For this reason it is convenient to derive sweep currents from two independent adjustable sources. Vertical sweep at 60 cps, was obtained from a Variac and step-down transformer, while horizontal sweep at 10 kc came from an audio signal generator.

It is not necessary that the sweeps

Electron Beam

(*Continued from page* 124)

be sawtooth in form. If photometric measurements are desired, sawtooth sweep insures that the beam will spend equal times on equal areas of the image. With sinusoidal sweep, the outer edges of the image will be slightly brighter than the center. With sinusoidal sweep of large amplitude, the departure from uniformity is entirely negligible.

If available, a 60 cps vertical sawtooth sweep is further to be preferred because it lessens the image distortion caused by ripple in the various electrode voltages. With a 60 cps sawtooth, each part of the beam is imaged once each cycle. With sine sweep, each part is imaged twice each cycle. It is instructive to operate the vertical sawtooth slightly off line frequency. The "wiggling" of the image at the difference frequency indicates the severity of ripple distortion.

The range of beam power over which this method has been successfully used is about 0.25 to 25 watts. The maximum power is determined by the heating which the aperture plate can stand. The minimum power (or beam current) is largely determined by the size of the resolving aperture and of the beam. At 25 kilovolts, assuming that 0.001-inch resolution is desired, and a magnification of ten, the minimum spot current density giving a useful image is about eight milliamperes per square centimeter.

The only precaution which need be taken when assembling apparatus is to make certain that the horizontal and vertical coils of the deflection yoke do not have different centers of deflection. The result would be slightly different horizontal and vertical magnifications. While in itself not disastrous, two calibrations are needed to establish magnification, one along each axis. It appears, however, that standard deflection yokes designed for use in television receivers are entirely adequate for this application.

Coaxial Cable

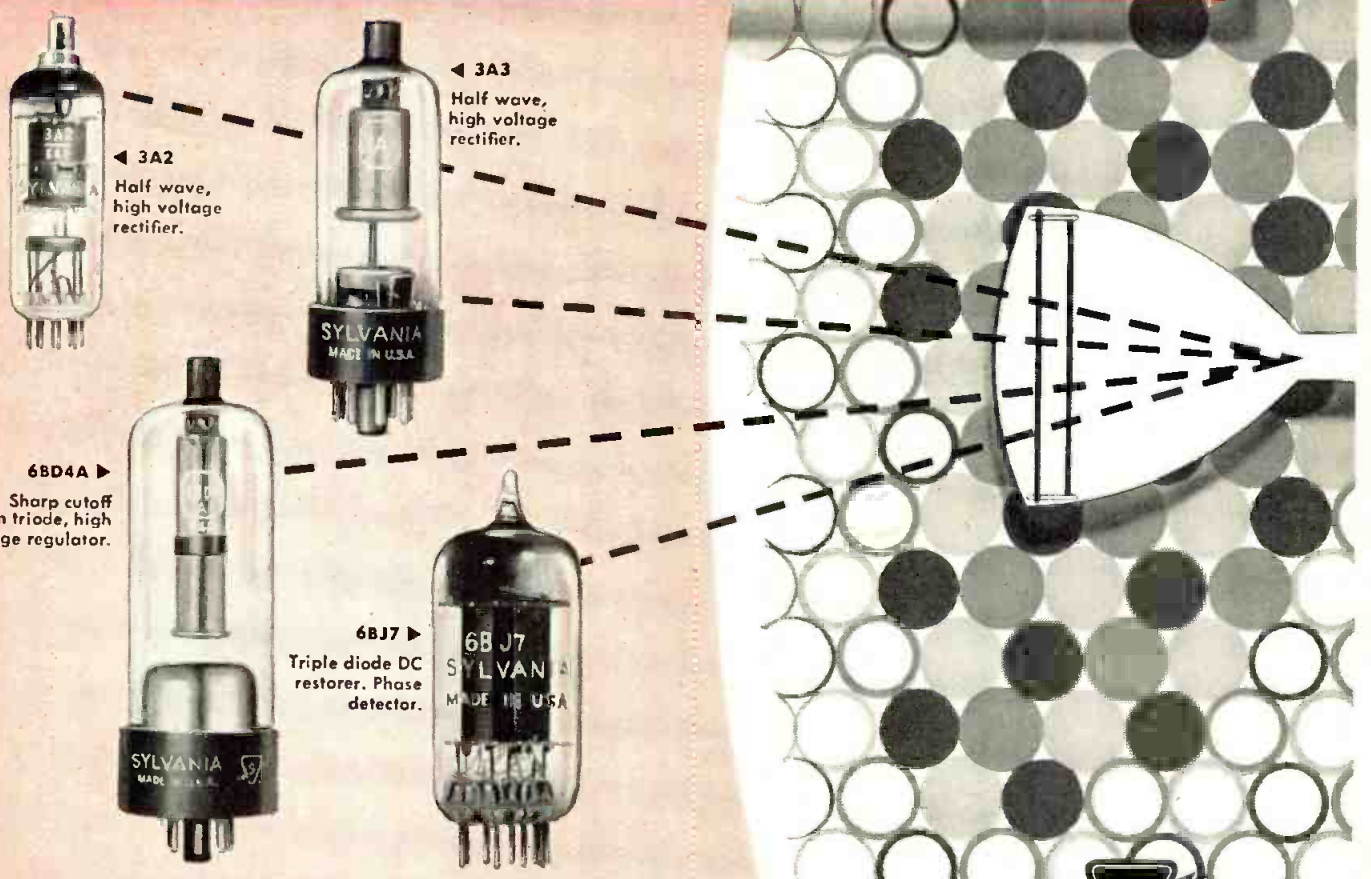
(*Continued from page* 79)

tional bitumen compounds.

While the Polyment provides adequate corrosion protection, it must be covered with a coating that has better handling properties. Polyvinyl chloride (PVC) has been chosen as the most satisfactory outer coating.

Important developments in

COLOR TV Receiving Tubes



Expect them to keep coming from Sylvania

To make the color TV picture better as it gets bigger, Sylvania tube research, in close liaison with leading set designers, is busy developing and testing new tube types . . . designed especially for big-screen color TV.

Development of the 6BD4A to fill the need for a higher-rated voltage regulator is a typical example of Sylvania pioneering in color TV receiving tubes.

These tubes, together with important Sylvania prototypes being offered to the industry today, will be color TV's "bread and butter" types tomorrow, and will be available from Sylvania in production quantities.

Expect Sylvania to supply your color TV picture tube requirements, too.

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LIGHTING · RADIO · ELECTRONICS · TELEVISION · ATOMIC ENERGY

Coaxial Cable

(*Continued from page* 126)

The corrosion protection provided by this type of construction has been extensively field tested. Steel jacketed cables with this type of covering have been in use in telephone and power cable service for over 15 years, with completely satisfactory performance records.

An end fitting for 7/8 in. Heliax is shown in Fig. 6. It provides for connection to any standard flanged fitting, such as an adapter, reducer, gas barrier, etc. Fig. 7 shows several other end fittings.

Applications

The applications for this type of cable are widespread. It will fill almost any requirement for a high quality cable. Electrically, its performance is fully as good as that of any rigid or semi-flexible line of comparable size. Its flexibility makes it easier to handle in the field, thereby reducing installation costs. Elimination of joints and splices also simplifies installation.

Heliax can be used in semi-permanent installations, which formerly were forced to use relatively high

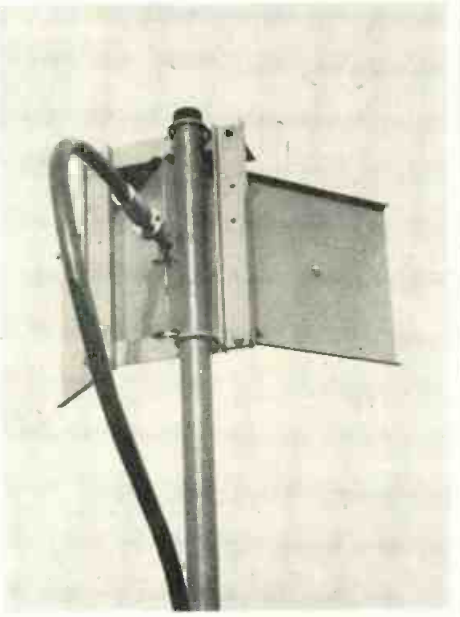

Fig. 9: Heliax connected to standard antenna

attenuation solid dielectric cables. It can be installed, taken down, and reinstalled many times without the work hardening and kinking that occurs in semi-flexible cables.

The flexibility of Heliax allows it to be installed in conduit, which is usually impossible with other air dielectric cables. Runs up to 300 ft. have been pulled into conduit, with the same pulling techniques used to install power wiring.

No special equipment is required to handle Heliax. Fig. 8 shows a length of 7/8 cable being uncoiled. It can be installed on a tower by pulling it directly off the reel and up the tower with a block and tackle or similar means, with the reel supported so that it is free to turn on an axle. No straightening boxes are required.

Heliax is easily attached to a tower or other support. Conventional strapping techniques can be used. Horizontal runs can be supported on messenger cable, with the cable strapped to the messenger approximately every three feet. Liners should be used under the steel strapping to protect the vinyl jacket from damage.

Connection to the ends of a transmission line are frequently difficult to make, and often involve either complicated combinations of elbows or adapters and solid dielectric flexible connections. The flexibility of Heliax simplifies this problem. Fig. 9 shows a length of Heliax connected to a standard communications antenna, with a 90° bend in the cable. Such bends in 7/8 Heliax can be easily made in the field by one man while working on a tower.

Sideband Splatter

(*Continued from page* 84)

m=0.547 corresponds to a total distortion of only 3.3% it is clear that the splatter from AM transmitters can easily be more severe than the normal expected FM or PM spectra. The 3.3% distortion of the AM modulation characteristic would normally be considered as very good for mobile applications. Also it is clear that these distortions increase rapidly when the AM transmitter is permitted to be heavily modulated approaching 100% or somewhat overmodulated. The greatly increased distortions while they may not be objectionable to the listener, certainly play havoc with the adjacent channel operation.

The first important conclusion therefore is that higher order sidebands do occur in amplitude modulation systems and can be accounted for by distortion in the audio system or by the non-linearities of the modulating characteristic. Also while very small distortions will result in a somewhat better sideband spectra situation than that of FM or PM, it is also clear that moderate or large distortions or overmodulation will cause a spectrum which is much more severe than the normal FM or

Sideband Splatter

(*Continued from page 129*)

PM spectra. It follows then that the AM modulation characteristic must be carefully controlled in order that an AM system be significantly better sideband spectra wise than an FM or PM system.

To help complete the splatter picture, we would like to mention that any type of modulation limiter in AM or deviation limiter in FM will aggravate the transmitter splatter spectrum. Furthermore we will briefly discuss deviation limiters, particularly that type of instantaneous deviation limiter which operates on the modulation waveform either by squaring it or making it triangular as in the case of PM operation. Fig. 9 shows the theoretical spectrum to be expected when a square wave signal modulates an FM transmitter or a sawtooth waveform modulates a PM transmitter. The second curve indicated is that obtained when the modulating sawtooth waveform is made as good as possible with existing equipment. The proximity of these two curves is to show the high degree of correlation between theory and practice. A final curve is included to show what might be expected in practice from a communications type transmitter employing instantaneous deviation limiting. Since no effort has been made to generate a perfect triangular modulating waveform the triangular waveform actually generated has somewhat less sharp corners and hence a somewhat smaller amount of high frequency components. The result of course is less sideband splatter than from a perfect triangular waveform. It is obvious that this type of deviation limiter is bad from the splatter point of view.

Fig. 10 shows the expected spectrum for squarewave FM modulation (or triangular PM) for three different deviations. The shapes of all the curves are practically the

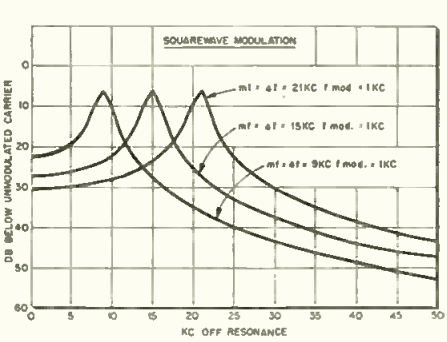

Fig. 10: Squarewave FM modulation characteristics for deviations of 21 kc, 15 kc, and 9 kc

same except that the energy peak always occurs at the instantaneous deviation limits, this is as it should be insofar as the transmitter spends most of its time at these frequencies. The amount of interference on the adjacent channel is obvious.

To fully appreciate the transition from sinewave to squarewave (FM) modulation and their effects on sideband splatter additional calculations were made to include sinewave plus 3rd harmonic (a first approximation to a squarewave), and a trapezoidal modulating wave. The

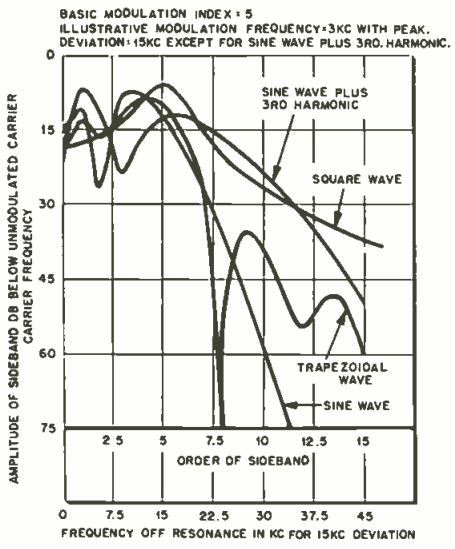

Fig. 11: Sideband spectra for different FM modulation waveforms. Deviation is 15 kc

spectra for all of these cases is presented in Fig. 11. The trapezoidal-modulated spectrum was calculated by a method outlined by Corrington[2] and is seen to lie roughly midway between those due to the sinewave and the squarewave as would be expected. The violent oscillations in the magnitudes of the spectral components are in great contrast to the smoothly varying nature of the other (though it should be noted that the odd-order sidebands of the square wave signal have all vanished.) The excess of the sinewave plus third harmonic spectrum over that due to a squarewave, between the 7th to the 11th sidebands, merely reflects the fact that the peak deviation ratio for this complex modulating signal is approximately 5.8 as against a value of 5 for the square wave. It is concluded that squarewave modulation represents the worst case both with respect to the total sideband energy content and the production of the peak sideband energy content and the production of the peak sideband amplitude outside the peak deviation.

From all of the above we can conclude that while deviation limiters do definitely limit the maximum in-

Sideband Splatter

(*Continued from page* 130)

stantaneous deviation, the sideband splatter picture is made worse because these limiters cause distortion of the modulation. This distortion causes the generation of higher harmonics which are the main offender as far as transmitter splatter is concerned.

The addition of a low pass filter after the limiting process is extremely helpful in this case in that it eliminates the high frequencies outside the audio band. If a sufficiently good low pass filter is used it is possible to reduce all the indicated sidebands by some 50 or 60 db and hence for all practical purposes eliminate the splatter problem down to 100 db over the frequency range of interest. In practical transmitters, however, filters having 50 or 60 db attenuation beyond say 4 kc are somewhat expensive or bulky and hence in practice some compromise is indicated. Distorting types of deviation limiters should not be used to increase the average modulation level of speech. Gain controls should be set so that deviation limiting only occurs on speech peaks. A deviation limiter should be followed by a low pass audio filter to remove the splatter components introduced by the limiter. If this is properly done sideband splatter will be improved materially over the case where no deviation limiter is used.

Even if limiters are not used at all, we must keep in mind that since the splatter increases with the modulation frequency and amplitude of the modulating wave, it is very important to examine the modulation input and/or the audio circuits. Any unnecessary higher frequency components should be eliminated from the audio input circuits by using a low pass filter.

Therefore, the important conclusion in avoiding transmitter splatter is to utilize a low pass filter in the transmitter audio circuit, which should be placed as close to the modulator tube as possible, and which should reject all high frequency components as much as possible.

In this connection we should mention that sometimes the modulation tube or modulation circuit generates sufficient noise so that even with the audio input circuit disconnected, sideband splatter occurs. This can happen if, for example, a high resistance is present in the grid circuit of the modulator tube. This

can be proven by a simple test; if the value of this resistor is decreased (without affecting the modulation capabilities), the sideband splatter will decrease. In this case the whole modulation circuit has to be carefully examined and the generation of high frequency noise components have to be eliminated from the modulation circuit.

In spite of all the above discussed precautions and improvement techniques, we feel that closer channel spacings than 20 kc in AM or FM systems will be very difficult to achieve and will, if used, certainly be a compromise as the sideband splatter will not be eliminated down to a level of 120 db and some disturbances in mobile operation will be expected to occur.

Conclusions

1.) Contrary to general belief AM and single sideband AM transmitters are no better in practice than FM transmitters because of A.F. distortions and modulator non-linearities. This is particularly true if sidebands down to —120 db are considered.

2.) Instantaneous type deviation limiters which operate on the modulation waveform either by squaring it (FM and AM) making it triangular as in the case of PM cause an increase in sideband splatter and hence will limit channel spacing.

3.) Channel spacings closer than 15 or 20 kc will be very difficult to achieve and the addition of a low pass filter as the last component in the audio system is a must in both AM and FM.

The authors wish to acknowledge the able assistance of Richard Dronsuth, who made most of the measurements and to Dr. Edward Bedrosian and Carrol Lindholm who were very helpful in making many of the calculations.

1. D. A. Alsbert, "Principles and Applications of Converters for High Frequency Measurements," *Proc. IRE*, p. 1195, Oct. 1952.
2. M. S. Corrington, "Variation of Bandwidth with Modulation Index in Frequency Modulation," *Proc. IRE*, pp. 1013-1-20, Oct. 1947.

This paper was presented at the 1954 National Electronics Conference, Chicago, Ill.

AF Seeks UNIVAC Employes

The Air Force has a number of vacancies existing for personnel experienced in maintaining, operating, and programming high speed, electronic data processing devices. UNIVAC experience is preferred, however, experience in similar devices is acceptable. Salaries range from $3410.00 to $7040.00 per annum depending upon education and/or experience. Long range program assures continuing interest in the data processing field. Interested persons contact the following address for further details: Commander, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio, Attn: WCPCU-3.

PERSONAL

Wendell Tietsworth, formerly head of Eastern Commercial Engineering of General Electric's Tube Dept., has joined Sonotone Corporation, Elmsford, N.Y., as assistant sales administrator of the Tube Division. Mr. Tietsworth was with G-E as an electrical engineer for 20 years.

W. Tietsworth

R. Olson

Roy H. Olson has been appointed director of engineering in the Communications & Electronics Div. of Motorola, Inc., Chicago, Ill., where he will be incharge of engineering co-ordination for industrial products and non-military research and development. He has been associated with Motorola since 1951.

Trevor Clark has been appointed assistant to the engineering manager of Westinghouse Electric Corporation's air arm division. Prior to his present appointment, Mr. Clark was associate director of Southwest Research Institute in San Antonio, Texas.

L. C. Spoor, formerly in the engineering sales department of G. M. Giannini Co., has joined DeMornay-Bonardi, Southern California microwave instrument manufacturer, as chief field engineer. Mr. Spoor previously had been with G-E and the Eicor Co.

Gerard A. Albert, formerly staff manager, has been made manager of manufacturing for National Vulcanized Fibre Co., Wilmington, Del. He has been with the company since 1929. Henry C. Guhl, formerly manager of process engineering, has been made manager of engineering. He was formerly manager of the Micarta Div. of Westinghouse Electric Co.

New Chief Signal Officer

Major General J. D. O'Connell has replaced Major General G. I. Back as Chief Signal Officer, U.S. Army. Here General O'Connell addresses banquet gathering of Washington D.C. AFCA chapter.

Power Plant Radiation

(*Continued from page 77*)

electromagnetic disturbance is the electric spark type ignition system necessary for gasoline and semi-diesel engines. This may be eliminated by using a full diesel engine.

The particular engine used is a four cylinder Buda-Lanova model 4DT-212, with a spring governor set for 1800 rpm operation. Under constant load the engine holds constant speed within ¼% over several hours after warming up. Electrical governors will provide better speed regulation on widely and rapidly varying load but are to be avoided because of the electromagnetic radiation from such devices. If the load is expected to vary, the engine should be made amply oversize to provide the desired constancy of speed.

Starting System

Most engines are cranked by an electric starter. This is convenient and the few seconds time this device operates is of no importance from the viewpoint of electromagnetic disturbance. Unfortunately the starting battery charging generator is a major source of such disturbance. The cure is to remove the generator drive belt. Another source of battery charging energy will be needed. Most diesel engines have a 12 or 24 volt starting battery; the higher the voltage the better as will be discussed below.

Excitation System

The alternators supplied with some power plants, particularly the smaller variety, are of the stationary field, rotating armature type. The large alternators have stationary armature and rotating field with a separate exciter. In either case the commutator will produce objectionable electromagnetic disturbances. The remedy is to pull out the commutator brushes. Another source of field excitation will be needed.

The starting battery may be charged and the alternator field excited from dry disk rectifiers such as iron-selenium or copper-magnesium types. These operate without electromagnetic disturbance if sufficiently large to remain cool. If the battery and alternator field are of widely different voltages two separate rectifiers may be needed. However, there is great advantage in simplicity and performance if it can be arranged to have the alternator field voltage slightly less than that of

Power Plant Radiation

(*Continued from page* 135)

the starting battery. Then only one rectifier is needed with a capacity sufficient for both loads. The battery floats on the rectifier and provides a filter and a good regulated source to field voltage for the alternator. The particular machine used is of 10kva capacity, and had the four field windings in series with a 40 volt exciter. The field windings were reconnected in parallel giving a 10 volt field which is slightly below that of the 12 volt starting battery. A new field rheostat of larger current capacity and lower resistance was required.

Battery Charger

The rectifier used is a full-wave three-phase device operating from three transformers connected "delta" on both primary and secondary sides. The "delta" connection on secondary is important because the harmonics will then circulate around the transformers and not get out into the load system. With a three-phase full-wave system the rectifier ripple voltage is only 5% at 360 cycles. This is not objectionable because of the low battery impedance and high reactance of the alternator field. Thus no additional smoothing filter chokes or capacitors are needed. If a single phase rectifier system is used some filter may be required. Immediately after cranking the engine the battery voltage will be low and the charging current high. As the battery comes up to charge its voltage will rise and so will the output voltage of the alternator. However, during this period the field of the alternator is also warming and increasing in resistance. These two effects counteract each other. When warm, the tap switches on primary of charging transformers or secondary rheostat should be adjusted to provide a trickle charge of 2 or 3 amperes into the battery. After a half-hour warm-up the excitation and output voltage will remain constant to a percent or less over several hours.

Alternator Bearings

Examination of the environment with a sensitive receiver will now show the radiation field to be quite low but still much too high for effective measurements of cosmic static. The remaining difficulties are associated with bearings. Every alternator has a small amount of eddy current leakage due to assymetry of the field windings. This eddy current

flows along the shaft, thru one end bearing, thru the frame and back thru the other end bearing. The balls or rollers in a ball or roller bearing will cut thru any lubricant and the resultant intermittent contact sounds much like ignition noise in a sensitive receiver. The cure is to stop the eddy currents. If sufficient room is available the bearing housing in the frame may be enlarged by boring. Insulating gaskets and bushings may be installed and a separate wiper applied at one point such as the center bore at the end of the shaft to keep this element at ground.

Several alternatives have been tried. Bronze bushing bearings inside of fibre cylinders are used on the present machine. Bakelite oil rings provide continuous lubrication. These oil rings will bump from shaft to housing at times. Thus metal oil rings cannot be used because of the intermittent flow of eddy currents. The bakelite oil rings are lighter in weight than the brass ones they replace. Adequate traction at the shaft may not be secured to make the ring turn properly. The correction for this is to make the new rings thicker by increasing the outside diameter or decreasing the inside diameter. Knurling the inside of the ring and lowering the oil level in the well to reduce flotation will also help.

Lignum Vitae wood bearings with bakelite oil rings were quiet but had a short life. Some of the new nylon bearings with pressure lubrication might be satisfactory. The self oiling type of porous bronze bearings pressed directly into the frame without insulation were electromagnetically quiet. This type had such poor bearing qualities that the shaft scuffed continually on the bearing. The steady contact allowed the eddy currents to flow without interruption and no disturbance was produced. However the life of such a bearing was very short.

Fan

Examination of the environment showed very little disturbance to remain. This was traced to the engine fan. It was driven by a rubber "V" belt and mounted on two cone roller bearings spaced about four inches apart. The earths field has a rather strong horizontal component in Hawaii. Apparently eddy currents were flowing in the fan due to this cause. The cure is either to drive the fan with a quiet motor or to fix the fan bearing. The latter was chosen and a 4-in. long bronze bushing bearing was installed. This stopped

Power Plant Radiation

(*Continued from page 137*)

the last trace of electromagnetic disturbance from the power plant. The fan is lubricated before each run of six to eight hours by a grease gun employing a high temperature grease. If it were necessary to operate continuously some better method of lubrication such as oil pressure or insulated bearings would be required on the fan.

There still remain some ball and roller bearings in the engine. These are associated with the water and fuel pumps, the governor and the valve operating system. However, all of these bearings are encased in large pieces of iron and the shafts extend little or not at all, so no disturbance is produced. Other engines may require additional alterations.

Flexible Coupling

Due to the earths field, eddy currents can flow thru the machine bed, engine frame, engine shaft, shaft coupling, alternator shaft, alternator frame and back to machine bed. Thus the flexible coupling between engine and alternator should be of the insulating type. Care is observed to see that no washers or bolt heads touch the opposite sides. If this happens a ticking disturbance is produced. The kinds of couplings employing balls and gears are to be avoided. All metal accessory parts must be bonded or insulated. These can include engine frame to machine bed, drip pan below, radiator to machine bed, various sections of fuel and oil lines which may have been separated by flexible joints for vibration control and which may rub on engine frame.

Alternator Slip Rings

The only remaining sliding contacts are the brushes on the alternator slip rings. If for any reason these rings have been removed and put back, they will probably be eccentric. A fine cut must be taken on a lathe to make them concentric with the bearings. The type of brush holder where the brush is bolted to a hinged joint is mechanically better than the type where the brush slips into a hollow case. In the latter type the brushes must fit snugly but not tightly in their cases to prevent wobble. Additional backing up springs may be necessary to make the brushes ride smoothly. After considerable use most brushes develop a feather edge on the trailing

side. Small bits of carbon will come off, cling to the slip ring and temporarily lodge under the leading edge of brush. This makes the brush bounce. The cure is to take out brushes at every service period of 40 to 50 hours and lightly sand all the edges to smooth round corners. Two or more brushes in parallel on each slip ring will be advantageous in maintaining good electrical contact.

It is probable that the slip ring brushes could be replaced by some type of mercury cup. The rings could then be thin disks. Both sides and edge would have to be carefully polished to remove any roughness which might throw the mercury out of the cups at high rotational speeds.

Engine Selection and Operation

Some electronic equipment is adversely affected by low frequency components in the power supply voltage. Thus an engine providing not less than sixty power strokes per second should be used. A four cylinder engine driving a four pole alternator at 1800 rpm or a six cylinder engine driving a six pole alternator at 1200 rpm are satisfactory. Theoretically, such plants can have a large amount of second harmonic in the output voltage. Actually, the inertia of the rotating mass is so large that the second and higher order harmonics are negligible. A direct drive must be used as any type of belt drive will introduce objectionable hunting and low frequency components into the output voltage.

Under adverse conditions of low pressure, low temperature and high humidity such as often prevail in the wet fogs atop Haleakala at an altitude of 10,020 feet the diesel engine may be difficult to start. This is because the electrical heater in the air intake manifold will not provide sufficient heat to overcome the environment. The remedy is to secure a small spray gun of the type used for moth proofing clothes. A starting fluid of the type used in the arctic is poured into the spray gun. This fluid has a high percentage of ether and must not be left in the gun or the effective component will rapidly evaporate. A few squirts of the spray gun into the air intake when the engine is cranked will provide immediate starting. If the fog is very wet an occasional sniff may be needed for a minute or two until the engine warms. Too much starting fluid will make the engine knock. The starting fluid must never be used when the manifold heater is on

Power Plant Radiation

(*Continued from page* 139)

or an explosion is certain to result.

For normal operation it is advisable to have the engine air intake directly behind the radiator to provide plentiful hot air as this makes the machine behave much steadier. Some of the engine hot water may be piped through a second radiator installed at a convenient place in the electronics room to provide clean, quiet and odorless heat without cost or trouble.

All the above has little to do with radio astronomy. However, if these practical matters are not properly attended to, no celestial radiations will be forthcoming. Actually, a public power line is no blessing when very weak radiation fields are to be measured because of the uncontrollable electromagnetic disturbances associated with the line. Also the regulation at the end of a long line may be very poor. On both of these matters a properly organized local power plant is much to be preferred. These studies are being supported by the Research Corp.

Books

(*Continued from page* 26)

emphasis on component circuits rather than overall systems.

Starting with an explanation of RLC element combinations and circuit response to simple waveforms, the text goes on to clamping, clipping and trigger circuits. Among the other sections in this very worthwhile volume are those covering cathode-ray tube circuits and multivigrators.

Storage Batteries

4th Edition by Eugene W. Vinal. Published January 1955 by John Wiley & Sons, 440 Fourth Ave., New York 16, N.Y. This vast revision covers, in addition to the scientific principles relating to storage batteries, production of nickel-cadmium batteries in the U.S., new types of silver oxide cells, application of batteries to radio-relay stations for long distance telephony, 24 v and higher voltages for use on airplanes, etc.

Report #1 on Experimental UHF Satellite Transmitter

A 30 page illustrated report on the installation and operation of KE2XPS, satellite TV station of WATR-TV in Waterbury, Conn., by Ben Adler, Chief Engineer and Thomas Friedman, Project Engineer, Adler Communications Laboratories, one Le Fevre Lane, New Rochelle, N.Y. Free upon request.

Higher Trancendental Functions (Vol. III)

Edited by A. Erdelyi, sponsored by California Institute of Technology. Published 1955 by McGraw-Hill Boo kCo., Inc., 330 W. 42 St., New York 36, N.Y. 292 pages, Price $6.50. This third of a three-volume series on advanced mathematics covers special functions, including automorphic, elliptic modular, Lame, Mathieu and spheroidal functions.

Junction Diodes

(*Continued from page 77*)

the diode under test, and which has a different scale factor for forward and reverse currents, such that a desirable scale factor is obtained for visual oscilloscope presentation. The voltage reading circuit is designed to produce a voltage at H, which is directly proportional to the voltage across the diode under test. This reading circuit is essentially isolated from the test circuit by a cathode follower.

The dynamic test is used to detect drift, flutter, hysteresis, and other abnormalities of instable diodes not previously noted during static measurements. This test screens out almost all diodes which would eventually cause erratic operation or failure in the field.

Germanium and Silicon

Germanium semiconductor devices are cheaper and far more widely manufactured than silicon devices. This is a result of much more difficult metallurgical processing required to obtain silicon since its melting point is so high—1420°C, as compared to 956°C for germanium.

Desirable diode characteristics are more easily obtained from germanium units since the diffusion coefficients for injected carriers are higher, due to the greater electron and hole mobility of germanium. Fig. 1 shows typical curves for representative germanium and silicon rectifiers. It can be seen that higher forward current is obtained with the larger junction area, and that the values for germanium are greater than those for silicon. With large-area alloyed junction devices, proper design can yield very high forward currents (in the order of several amperes) at a voltage less than one volt.

In the reverse direction, silicon junction rectifiers have reverse currents at least 100 times smaller than those for germanium. Also, it can be noted that the larger area diodes have a sharper "Zener" characteristic, that is, breakdown of the semiconductor diode, which is characterized by a rapid increase in back current, as the applied reverse voltage increases slightly beyond some critical value. The curve on the right-hand side of Fig. 1 illustrates a typical form of hysteresis, which is a type of diode instability. Its cause is due to various factors, some of which are unknown. Moisture has been found to definitely increase the hysteresis effect.

Junction Diodes

(*Continued from page* 141)

One of the most attractive features of silicon as compared to germanium, is the large energy gap (1.12 ev) between the valence and conduction bands. Due to this fact, the thermal production of electron-hole pairs does not seriously interfere with the impurity conductivity of silicon devices until temperatures in excess of 150°C are reached. In germanium, on the other hand, the energy gap is 0.75 ev and interference becomes troublesome at, from 60°C to 100°C, depending on the impurity concentration used. Thus, silicon devices will operate at considerably higher ambient temperatures than corresponding devices made with germanium.

Fig. 2 shows static characteristics vs. temperature, for typical small-area junction devices. For the two diodes shown, the germanium one has lower forward resistance and higher back resistance. It is interesting to note the change in characteristics due to temperature. There is no appreciable change in the forward curves with temperature, but the reverse curves show a decided deviation with germanium at 80°C, while no appreciable change with Silicon is noted until 150°C is reached. The back resistance of the germanium diode at −50v goes from 5 megohms at 25°C to 600 K at 80°C. At −50v for the silicon diode shown, the reverse resistance changes from about 500 megohms at 25°C to 4 megohms at 150°C. At their respective range limits, the units are still definitely usable rectifiers, but the trend is different depending on the type a semiconductor used in constructing the diodes.

Reverse Transient Response Time

For certain applications, customers require that special tests be made by the manufacturer. One of these special tests is reverse transient response or "recovery-time," which is a parameter very important to the operation of switching circuits in computers. This measurement evaluates the diode in a circuit (described by Ruhman, Woo and Kodis) similar to the one shown in Fig. 4. The diode is initially biased in the forward direction at some predetermined value of current when a negative voltage pulse is impressed across the diode. Ideally, the diode would immediately cease conducting,

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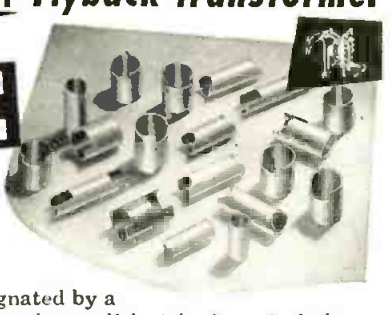

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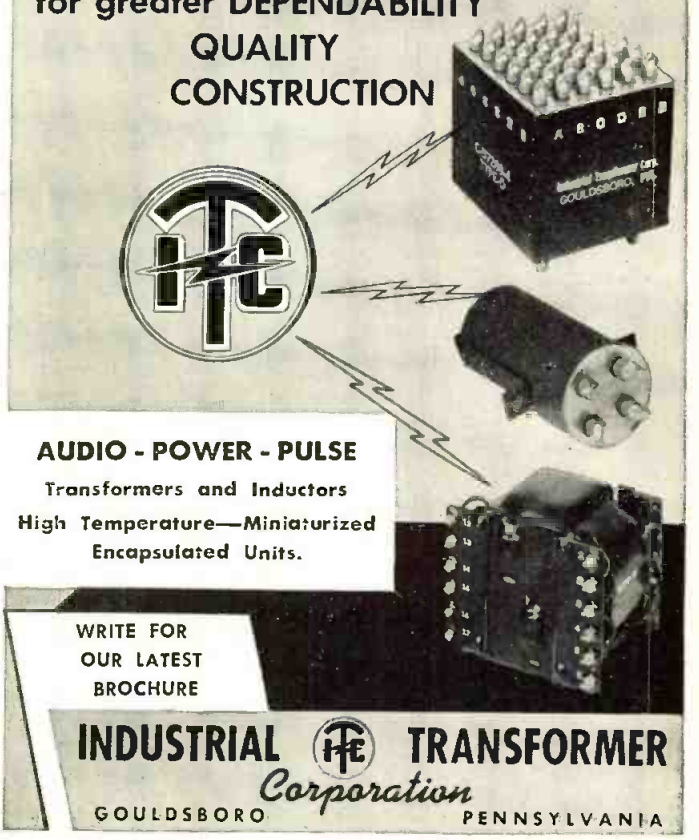

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Junction Diodes

(*Continued on page* 142)

except for a very small reverse current.

This ideal situation is not always the case when the current through the diode is observed with a high-speed oscilloscope. Due to the "hole-storage" effect, more or less inherent in all semiconductors, application of the cut-off pulse does not immediately result in the current going from, say 30 ma. forward, to a few micro-amps negative. Rather, a large negative peak current occurs for a time in the order of micro-seconds, and then it decreases to approach the steady state reverse current asymptotically.

In the lower half of Fig. 4, representative transient response time curves for various types of diodes are shown. In general, diodes with larger junction areas have the longer recovery times. A grown-junction diode may require 50 microseconds or more to return to full back resistance after receiving a negative voltage pulse (say −30 volts). The curves shown, are drawn from oscilloscope patterns of the type shown in the upper right-hand corner of Fig. 4.

It can be noted that a point contact silicon diode has no appreciable recovery time while the point contact germanium is fast, (about 1 μsec.) but does not have the high back resistance. For the larger area junctions, silicon has a large overshoot, but a rather quick recovery (about 2 μsecs.). The germanium large area type has a large overshoot, and is slow to recover to its final back resistance.

Noise

Low noise mixers are desirable for use in microwave radar, UHF TV, and other equipment, but they are mainly restricted to the point-contact germanium and silicon types,

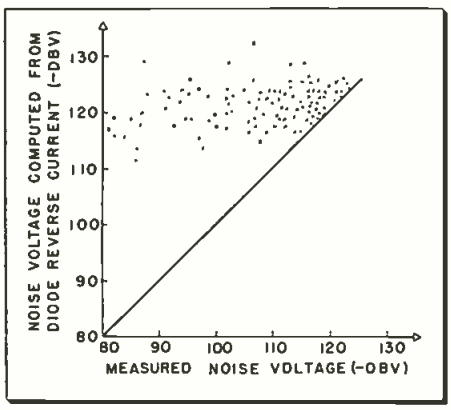

Fig. 5: Scatter diagram of diode noise

since the barrier capacitance and other degrading properties are less. However, noise at low frequencies is important in many applications.

The random fluctuations present in the current through a junction diode have been studied under reverse bias conditions for the grown, fused, and gold-bonded type germanium diodes. A lower limit for the fluctuation amplitude has been found to exist and to be in close agreement with the computed "shot" noise level.

In order to obtain a scale of measure which would provide a means to compare the noise generating characteristics of a large sample of units, the assumption was made that all of the reverse current represented carriers crossing the diode junction, a region not in thermal equilibrium. This assumption implies that the noise generated by a diode should have a fluctuation level given by the Shottky formula which gives the noise power as a function of the average reverse current through the diode.

Scatter diagrams of the type shown in Fig. 5 were constructed to determine any correlation that might exist between the measured noise

Junction Diodes

(*Continued from page* 145)

level and that computed from the diode reverse current. Most samples were found to exhibit a fluctuation or noise level in excess of the computed value; some were in very close agreement; and a very few were exactly as computed. It is interesting to note that no units, which had initially reasonable rectifying characteristics, were found to be, at the applied voltage, below the computed value.

From the data taken in the Research Lab, it was found that the random fluctuations of the reverse current in a junction diode are composed of two fundamentally different types of noise: shot noise due to carriers crossing junction, and excess noise, which is characterized by a spectral distribution, closely approximated by a 1/f relation.

The information obtained from scatter diagrams of the type shown in Fig. 5 indicated that diodes with measured noise amplitudes in agreement with their computed shot noise levels might be expected to display a flat noise spectral distribution, while those with noise levels above the computed values should approach the 1/f type distribution.

In an effort to obtain some relation between the excess noise and the static V-A curve, further investigation discovered that, in all cases when the noise amplitude of a unit is in reasonable agreement with the computed level, it has been found to be operating in a low current region of its dc. characteristics. All of the units that have been found to generate an excess of noise with a spectral distribution approaching 1/f have been operating at or near a region of high reverse current.

When a high excess of noise level is present at low applied voltages and low reverse currents, a substantial reduction in noise can be obtained by correctly etching the diode surface to prevent surface contamination causing undesired effects (inversion layers, etc.).

This information was presented at 1954 WESCON held in Los Angeles.

Relay Data

A 70-page brochure containing 23 technical papers originally presented at the Third National Conference on Electromagnetic Relays held March 9-11, 1955 at Oklahoma A & M College, Stillwater Okla. is being published. Copy can be obtained by writing on company letterhead to Potter & Brunfield Manufacturing Company, Inc., Princeton, Indiana.

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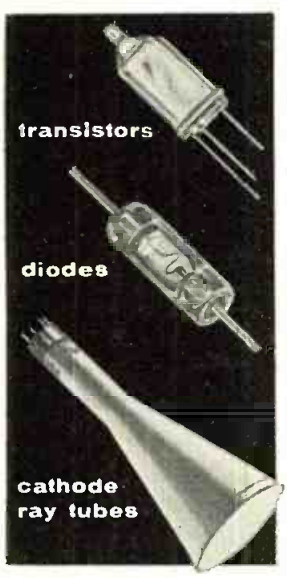

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Flight Simulators

(*Continued from page 70*)

Air Force Base, where the Military Air Transport Service trains advanced pilots, Curtiss-Wright has installed five of its flight simulators for the C-97 and C-124, both giant

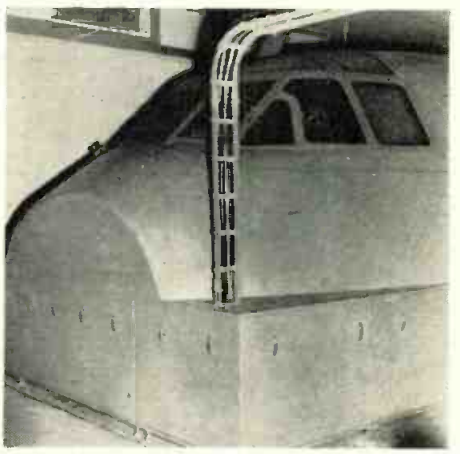

Fig. 5: Outside of simulator housing

transports. See Fig. 5. As shown in Table I, down time for 20,081 hours of actual training time was only 138 hours and 5 minutes, or less than 0.7%.

This low down time is the result of careful preventative maintenance. On one simulator, 80% of down time at first was attributable to tube failure. Periodic checking has cut this to about 10%. Additional design improvements should reduce this still further. For example, 6V6 servo drive tubes, which require somewhat high power outputs, will be replaced in new models with 6L6's which have greater power handling capabilities, thereby lowering failures in those stages.

Five types of inspection are rigidly enforced. The daily inspection consists of visual inspection of overall cleanliness, cabinets, servo locks and power rectifier tube glow. In addition, an operational pre-flight and flight check of the simulator is made.

For the 100-hour inspection, all daily check items are completed, the interior vacuum-cleaned, and amplifier plugs and relays examined for security and visible damage. Voltage checks are made of voltage regulator, thyratron, motor reference, and rectifier. A complete radio aids check of all systems is made for correct instrumentation, sound and position indications.

The 500-hour inspection includes all done in the 100-hour check, plus lubricating air conditioning motor and bearings, check fan belt, cables and mechanical control loading system for wear. Control loading pots are adjusted and cleaned, and relays

checked for burnt contacts. All switches and pots in the trouble cabinet are checked, as are all engine and flight systems not previously covered.

The 1000-hour inspection includes the 500-hour inspection, and motors and gear boxes are disassembled, cleaned and lubricated. All tubes are tapped lightly, and any flashes, shorts or servo jitter carefully noted.

The 5000-hour inspection includes all of the above plus additional details. A complete radio aids alignment is performed.

Obstacles

One of the main problems currently encountered in the flight simulator program is the fact that the manufacture and service test of a prototype simulator requires about three years. In order to have trained pilots available by activation date, it would require that necessary documents on a new type of craft be provided at least three years in advance. This is a difficult, or sometimes impossible task.

The fact that each aircraft type requires its own simulator presents an imposing task when we consider that the Air Force has about 22,500 planes and is ordering about 40 types, the Navy has over 13,000 planes and is ordering some 25 types, and the Army has over 3,500 planes and is ordering about 12 types.

The important point is that greater use is being made of flight simulators, providing better pilots at lower cost and with greater training safety. A comprehensive program of preventative maintenance has kept the down time on these computer devices to less than 0.7%, and design improvements are expected to cut this already small increment still further.

Microphonics

(*Continued from page* 73)

the band of frequencies from 30 to 10,000 cps, the maximum calculated departure from a 90° phase difference was 4°. A maximum error of 5° was measured.

Unfortunately, the sound pressure at the tube under test was not constant as a function of frequency when the loudspeakers were driven at constant voltage. It was therefore necessary to employ an auxiliary circuit actuated by a pilot microphone placed near the tube. This circuit used the fluctuations in the output of the microphone to vary

News of MANUFACTURERS' REPS

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Importer (Western Germany) seeking representatives for line of electrical and electronic alarm systems for plants, laboratories and commercial installations (Ask for R-5-4)

Manufacturer of hook-up wire seeks representatives in Texas, Oklahoma and Illinois. (Ask for R-5-5)

Printed circuit manufacturer is seeking representation in following areas: Washington, Oregon; Kansas, Missouri, Nebraska group; central states Montana, Idaho, Wyoming, Utah, Colorado, New Mexico (Ask for R-5-6)

Reps interested in a line of imported deposited carbon precision type resistors (Ask for R-5-7)

AC/DC Hipots, HV Test Sets, Corona Ionization Test Sets, production type insulation resistance testers for all areas except New England, New York, New Jersey, part of Pennsylvania, Delaware and Northern California (Ask for R-5-8)

Microwave receivers and test equipment for the following areas: Washington, Oregon; Montana, Wyoming; Michigan, Wisconsin, Minnesota; Kansas, Missouri, Nebraska, Iowa. (Ask for R-5-9)

G. S. Marshall Co., 40 S. Los Robles Ave., Pasadena 1, Calif., has added **Tway W. Andrews** and **Bryant C. Rogers** to its engineering sales staff.

Marty Bettan has been appointed National Sales Rep for Rogers Electronic Corp., manufacturers of transformers and coils. Reps appointed to handle line in areas noted are: **Barstow & Doran,** S. Calif., Ariz., Nev., Hawaii; Berthold Sales, Tex., Okla., Ark., La.; **Kenneth Brown,** Me., Vt., N.H., Mass., Conn., R.I.; **Maury Farber Assoc.,** upper N.Y.; **E. O. Hagestad,** Minn., N.D., S.D., NW Wis.; **J. E. Joyner, Jr.,** Fla., Ga., Ala., Miss., N.C., S.C., Tenn.; **H. G. Maerlender,** O., W. Va., W. Pa.; **Robert Milsk,** Mich.; **L. A. Nott,** N. Calif., W. Nev.; **S. Schacter,** Canada; **Weber Linz Assoc.,** S. N.J.; E. Pa., Del., Md., Wash. D.C.; **S. J. Wiley,** Ill., SE Wis.

R. J. Gibbons Electron Sales Co., 3051 N.W. Fourth St., Miami, Fla., has been appointed exclusive sales representative for antenna sales in Florida by **Peerless Products Industries,** 812-16 N. Pulaski Rd., Chicago 51, Ill. Mr. Gibbons is a charter member of the Florida Electronics Representatives Association.

Millard Leff, Ted Warshall, and **Herbert Freudman** have become members of **David Sonkin Associates,** sales engineers for manufacturers, Lucas Bldg., 10 Fiske Place, Mt. Vernon, N.Y., well-known manufacturers' representative organization.

Rollie Sherwood, formerly vice-president of Hallicrafters Co., recently organized Sherwood Sales, Inc., manufatcurers representative in the electronic fields, with offices and warehouse facilities at 230 N. Canal St., Chicago, and branch offices in Cleveland, New York, and San Francisco. **R. G. Sidnell,** veteran sales engineer, and **Robert E. Rathford,** formerly with General Dry Batteries, are principal members.

Jack Berman Co., 1141 S. La Cienega Blvd., Los Angeles, Calif., has been made Southern California and Arizona representative for H. H. Scott, Inc., 385 Putnam Ave., Cambridge, Mass., makers of high fidelity amplifiers, tuners, turntables, laboratory instruments, etc.

James C. Halliday Co., 2900 Spring St., Redwood City, Calif., will handle the H. H. Scott line in Northern California.

Irving J. Aron & Associates, Inc., 829 N. Marshall St., Milwaukee 2, Wis., **Gordon Sales Co.,** 14647 Seymour Ave., Detroit 5, Mich., **Manufacturers Sales Agency,** 307 Electric Building, Wilmington, N.C., and **Donald T. Hankins,** 161 Massachusetts Ave., Boston 15, Mass., have been appointed representatives for the tube and component parts department of American Elite, Inc., 7 Park Ave., New York, N.Y.

Russell F. Clark Co., 1404 Clark Building, Pittsburgh, Pa., has been appointed sales and service representative for Hammel-Dahl Co., 175 Post Rd. (Warick) Providence 5, R. I. and will cover Western Pennsylvania and part of West Virginia.

Kriegner Sales Co., 300 S. Broadway, Camdem 3, N. J. has been appointed representative for the UL approved mercury plunger relays made by Ebert Electronics Corp., 212-26 Jamaica Ave., Queens Village 28, N. Y.

New York Chapter of "The Representatives" is again sponsoring a special train to the May Electronic Parts Show in Chicago, scheduled to arrive May 15 at 8:00 AM. In conjunction with their 20th anniversary celebration, the reps are planning a gala affair aboard.

Microphonics

(*Continued from page* 149)

the amplitude of the signal reaching the phase splitter so that the sound pressure at the microphone was held reasonably constant.

Tubes were tested in a circuit (Fig. 3) in which all electrodes except the plate were heavily bypassed. Hence the signals generated by tube vibrations appeared exclusively in the plate circuit. These were amplified and applied to the vertical deflection plates of a special oscilloscope possessing a high-persistence screen. The horizontal sweep-circuit output of the oscilloscope was synchronized with the slowly changing frequency of the signal generator, so that the display on the screen represented the output of the tube as a function of the exciting frequency. A typical output display is seen in Fig. 4.

Isolated Impulses

Examples of the changes in the tube output resulting from isolated mechanical impulses are shown in Fig. 5. (In the final apparatus, the tube could be tapped between sweeps by means of a solenoid-operated tapper.) Fig. 7 shows output variations due to interruptions of plate voltage. When several curves differing in form from one another were obtained from a single tube, it was found convenient to superimpose them so that all frequencies of potential microphonic activity could be seen at a single glance.

Fig. 6 shows curves taken on a number of 12AV7 twin triodes. The photographs in each column refer to a single tube which has been tapped between sweeps. The bottom photograph of each column shows a superposition of the exposures in that column. Frequency markers may be seen at 200, 500, 1000, 2000, 5000, and 10,000 cps.

The tubes in groups 1 and 2 were fabricated from stock parts by two different assembly teams; all other manufacturing operations were identical. As can be seen from Fig. 6, disparity exists between groups. Since tubes produced under the same circumstances would be expected to have similar characteristics, it is clear that the factors determining the magnitude of the microphonic effect in a particular tube are quite subtle.

REFERENCES

1. E. G. Rowe, "Techniques of Trustworthy Valves," *Proc. IRE*, 10, October 1952, p. 1168.
2. W. Saraga, "The Design of Wide Band Phase Splitting Networks," *Proc. IRE*, July, 1950.

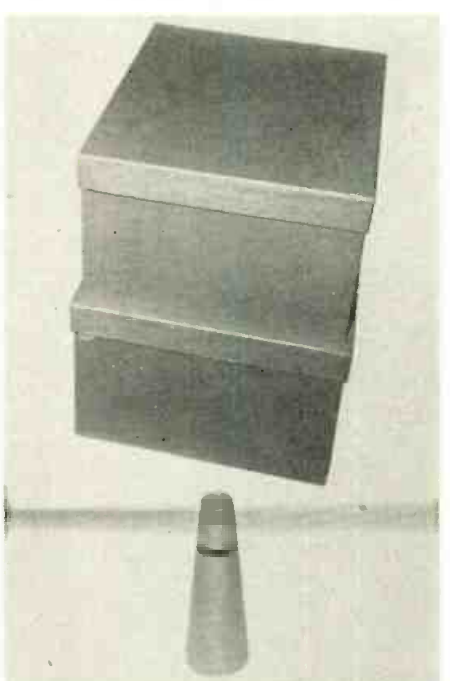
Magnetic Shielding

One of the exhibits not generally visited during the recent IRE convention because it was somewhat off the beaten path but which contained an exhibit of importance was that of the Perfection Mica Co. of 20 N. Wacker Drive, Chicago, Ill. Their new "coated shielding" offers an unusually effective magnetic barrier to stray radiation from dc on out to 20kc, the latter being mentioned as an upper limit only because 20 kc represents the extent of completed accurate measurements to date.

While the manufacturers will not reveal complete details of the process at the present time the shields are apparently of an inexpensive steel alloy coated with mica and ferrite particles suspended in a suitable binder. Varying the proportions of the coating also varies the effectiveness of the shield. An interesting and most important point about products made by this process is that unlike mu metal they apparently have no saturation points. The coating can be made conductive or non-conductive as desired and is not subject to damage by shock or vibrations. Products also do not have any orientation characteristics.

At present, the company offers no specific line of products although they have manufactured cathode ray tube shields and magnetron shipping boxes to customer specifications.

It is planned to continue in this customer manufacturing activity and to expand by allowing licenses to interested manufacturers for their own specific products.



(Top) Magnetron shipping boxes coated with new shielding material (Below) Mild steel, coated C-R tube shield is very effective

Flight Instrumentation

(*Continued from page 81*)

cally. Redundancy, precision, sensitivity and others must be numerically available before any evaluation for a display can be performed. The definitions indicated above are but logical suggestions and it is certainly possible that in the future, others may prove of equal or even greater value.

The only reason these qualities of communication are required is because the conditional probability curve can be other than a simple unity value. In common terminology, the channel is noisy. It becomes of value to examine the noise qualities so that they may be related to their effect on the qualities of communication. Noise can be defined as any unintended variation in any observed parameter. In general, noise can appear in four dimensions. Two of the special dimensions are obvious in terms of dirt on the instrument cover glass or light reflections from the display panel. Although it appears to be stretching it a bit, the third spacial dimension, noise, would occur if the pilot had dirt on his eyeglasses, or eye shields. Usually this spacial type of noise will be of little significance in comparison to temporal noise. Most of the noise encountered in the instrument communication probably are spurious fluctuations of the moving message generator, the pointer. Pilot training is intended to provide memory of certain distinctive properties of signal and noise so that, once trained, the pilot can exclude certain noise by sheer recognition. Mathematical studies of the effect of temporal noise and how it can be most effectively combatted will be seen from further discussion.

Part II will appear in the June issue.

RCA's 21AXP22's round metal three-gun color tubes being tested in lighthouses in the Lancaster Tube Div. plant See page 158 for additional details.

KAY *Mega-Sweep*

Wide Range, Wide Sweep

SWEEPING OSCILLATOR

Widest range of the Kay line of sweeping oscillators, the Kay Mega-Sweep provides continuous frequency coverage up through UHF-TV bands – 50 kc to 1000 mc. Widely used in radar system development and in alignment and testing TV and FM systems and components, as well as wide band IF and RF amplifiers and filters.

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Freq. Sweep: Sawtooth, adjustable to 40 mc. Repetition rate, 50 to 100 c/s.
RF Output: *High, approx.* 100 mv max into open circuit. *Low,* 5 mv into open circuit.
RF Output Control: Microwave attenuator continuously variable to 26 db.
Output Waveform: Less than 5% harmonic distortion at max. output.
Meter: Provides crystal detector current for peak output.
Regulated Power Supply: 105-125 v., 50 to 60 cps. Power input, 100 watts.

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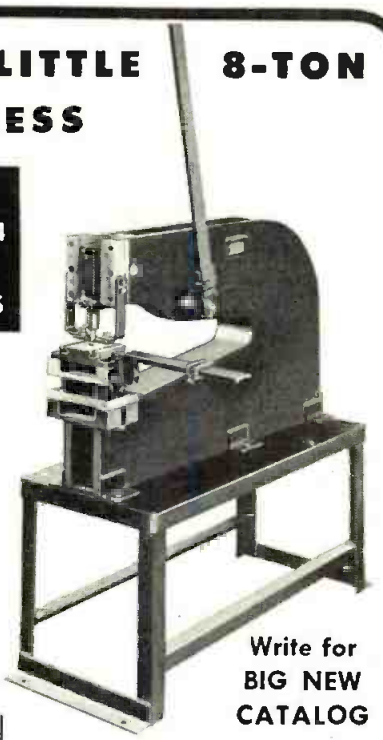
WHITNEY-JENSEN Nos. 31/32/33/34 DEEP THROAT LEVER PRESSES



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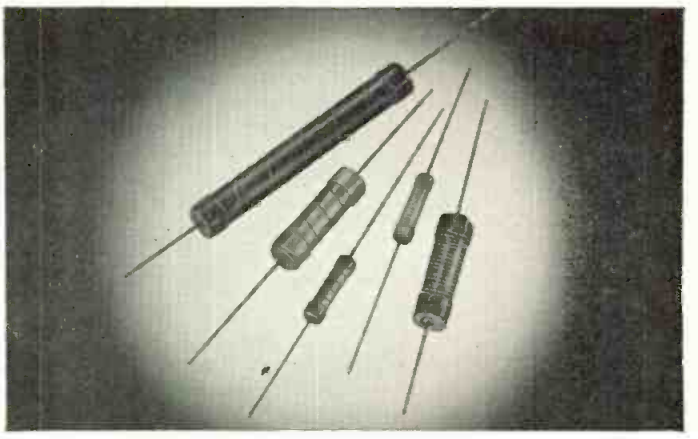

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When you need a precision resistor for really hard work, our Type N accurate grade is a likely job candidate.

We make it to a standard tolerance of 1% but we can tighten up if you wish. You can operate Type N's at ambient temperatures up to 140°C. with derating. Their noise level is so low, you'll have difficulty measuring it.

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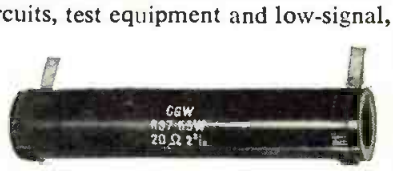
Stability means that the average change of resistance after 500 hours at maximum dissipation is less than 0.5%. A standard 5-second overload of 6.25 times rated power causes a permanent resistance change of less than .001%. Type N resistors have low capacitive and inductive reactance, too.

These accurate grade resistors overcome the inadequacies of conventional resistors in many advanced circuits. We recommend them to you for use in circuits where other resistors aren't up to the task or cost too much.

Specifically, you'll find these resistors most useful for radio and TV equipment, HF circuits, test equipment and low-signal, hi-gain amplifier stages. Their stability and ruggedness make special handling unnecessary. Made to MIL-R-10509A Specifications.

Fine as they are, Corning Type N Resistors cost remarkably little. For complete technical information and price lists, use the coupon.



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New Products Division

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Company.....
Address.....
City..... Zone..... State.....

1955 Aeronautical

(*Continued from page 75*)

Traveling Wave Tube Amplifier and Pulsed IF Frequency Measurements; *Julian Ayala—General Electric Company.*

The Philosophy of Design of Data-processing Systems; *R. L. Whittle—Federal Telecommunication Labs., Inc.*

A 30-Target Electronic Radar Simulator: Its Application to Human Engineering and Systems Research; *L. Schipper and J. Versace—The Ohio State University.*

NAVIGATION SESSION II

Biltmore Hotel—Main Ballroom

The Magnetic Drum as an Aid to Air Traffic Control and Weather Reporting; *G. E. Fenimore—CAA Technical Development & Evaluation Center.*

A Novel Holding Pattern for Inbound Airplanes; *C. E. Young—Cornell Aeronautical Laboratory, Inc.*

Analytic Approach to the General Air Traffic Control Problem; *L. J. Fogel, N. J. Cafarelli—Stavid Engineering, Inc.*

Evaluation of the Rho/Theta Transponder System for Air Traffic Control; *D. S. Crippen, J. E. Herrmann—CAA Technical Development and Evaluation Center.*

An Investigation of Ilas Beam Characteristics and Aircraft Tracks; *A. Tatz—Airborne Instruments Lab. and Capt. C. P. Thomas—Wright Air Development Center, USAF.*

A Broad Band Blue Lighting System for Radar Approach Control Centers; *C. L. Kraft, P. M. Fitts—The Ohio State University and A. Perong—Wright Air Development Center, USAF.*

CIRCUITS SESSION

Biltmore Hotel—English Room

A High Stability RF System for DME Interrogators; *M. Feller—Federal Telecommunication Labs., Inc.*

8.5-15 CM Plate Pulsed Reentrant Oscillator Circuits Using Pencil Triode Type 5893; *W. E. Babcock—Radio Corp. of America.*

Tem Mode Microwave Filters; *D. V. Geppert, R. H. Koontz—Sylvania Electric Products, Inc.*

A Wide-band Low-noise Amplifier for Millimicrosecond Pulses; *H. Kihn—Radio Corp. of America.*

A Precision Omnibearing Selector for the Test and Adjustment of Vor Receivers; *R. L. Olson—Collins Radio Co.*

AGREE Releases Reliability Abstracts and References

Dr. Albert F. Murray, Chairman of the Working Group on Reliability Publications of the Advisory Group on Reliability of Electronic Equipment (AGREE) reports that the following articles have been recommended as important reading for engineers involved in electronic reliability work:

Source: *Tele-Tech*, Oct. 1954, p. 77-79-130-33
Author: F. M. Dukat, Revg. Tube Div., Raytheon Mfg. Co., Newton, Mass.
Title: TRANSISTOR RELIABILITY IN LOW POWER AUDIO USES
An analysis of field failures in quantity produced transistors for their first year of service in hearing aids. 2% predicted as realistic industry reliability figure.
Availability: ASESA T D C

Source: *Aviation Week*, June 28, 1954, page 61, 64-66
Author: P. Klass
Title: STACK DESIGN SOLVES SIG TUBE PROBLEM
Radically different type of electron tube construction using stacked metal and ceramic elements permit fully mechanized assembly, improves receiving tube uniformity, performance and reliability, and raises operating ambient temperature to 300-400°C. Developments by Sylvania and Eitel-McCullough, Inc.
Availability: ASESA T D C

Source: *Electronics*, Jan. 1955
Author: Frank Rockett, Research and Eng. Div., Airborne Instruments Lab., Inc., Mineola, N. Y.
Title: NEW RELAY MATERIALS IMPROVE PERFORMANCE
Tungsten-carbide contacts, nickel-iron armatures, stainless steel springs, silicone damping fluids and self shielded cores are examples of the many new materials that have improved relay reliability, sensitivity, life and versatility for use in electronic equipment.
Availability: ASESA T D C

Source: *Ceramic Age*, Dec. 1954, p. 16
Author: A. M. Seybold, RCA Tube Div., Lancaster, Pa.
Title: IMPROVEMENT OF BASE ADHERENCE ON ELECTRON TUBES
Reiterates work of AD HOC Committee, gives details and results of tests on silicone cements and some recommendations.
Availability: ASESA T D C

Source: Army Information Digest—(to be published)
Author: R. Shepard, THERMIONICS Branch, SCEL
Title: ELECTRON TUBE RELIABILITY
This article has not yet been published but from information received it is to be a recapitulation of results achieved in various phases of the Tube Reliability project to date.

Source: *Westerner*—Bulletin of the West Coast Electronic Mfrs. Assoc.
Reliability is to be the subject of talk at the January meeting of the San Francisco Council on the WCEMA. Captain Rawson Bennett, Asst. Chief BuShips for Electronics is to be the speaker and is making a special trip from Washington for this purpose.

Source: *Electrical Manufacturing*—Dec. 1954, p. 69
Author: Editorial
Title: RELIABILITY AND AUTOMATICITY
As the degree of automaticity increases in integrated machine tools of transfer type, probability of electrical and mechanical failures increases. Electrical failures in the control system present considerably tougher problems. Solutions to these problems await development work in relays and contacts.
Availability: ASESA T D C

Source: *Tele-Tech*, Jan. 1955
Author: Advisory Group on Electron Tubes, Asst. Secy Def. Research & Dev.
Title: SERIES HEATER & FILAMENT STRINGS IN MILITARY EQUIPMENT
A review of "do's" and "don'ts" for reliable equipment designers. "Bus-bar paral-

leling" offers promising technique for transformerless type home TV receivers.
Availability: ASESA T D C

Source: *Automatic Control*, Dec. 1954
Author: Bibbero, Robert J. Tech, ed. *Automatic Control*
Title: RELIABILITY: A Yardstick for Dependable Control Equipment.
Simplest device usually most reliable. Know ratings of components. Reduce complexity and incorporate sound human engineering. Know the equipment environment and control it.
Availability: ASESA T D C

Source: *Automatic Control*, Dec. 1954
Title: Magnetic Amplifiers have a long History
Extensive development of magnetic amplifier techniques in Germany from 1937 to 1945 because mil requirements called for unusually durable, simple and reliable amplifiers. Extensive research and dev there on the push-pull type single phase saturable reactors circuits as magnetic amplifiers for various servo applications.
Availability: ASESA T D C

RCA Readies Lancaster for Color-TV Tube Production

Last month press representatives were invited by RCA to visit their Lancaster Pa. plant and to witness the operation of new facilities for the sole manufacture of the 21AXP22, a three-gun, round, metal design now finalized as the production model. Production at present is about 2500 tubes per month and by next August, when all production facilities have been completed, output can be stepped up ten times or more to about 30,000 per month.

Mr. W. W. Watts, Executive Vice President of Electronic Products and Dr. C. B. Jolliffe, Vice President and technical director, both expressed great optimism at the prospects for increased activity in color-TV this fall. Mr. Watts pointed out that with capacity to produce color-TV tubes commercially, the new simplified color-TV receiver design soon to be announced, and with the expanded scheduling of color-TV programs to include daytime presentations as well as more evening presentations, RCA was now ready for any color-TV demand. Other set and tube makers are reported to have evidenced considerable interest at the greatly increased facilities designed to hasten the day of full commercialization of color.

C. Price Smith Manager of Color Kinescope Engineering and Harry Seelen, Manager of Color Tube Production pointed out the technical features of the 21AXP22 and outlined reasons for finalizing on this design. Round tubes it was pointed out make for ease in production and hence represent a lower cost factor. Metal tubes were selected because of the inherent strength of metal coupled with faster processing times possible (as contrasted to all-glass construction) improved shielding, and lighter weight. The new tube weighs 24 lbs. as compared to 37 lbs. for an equivalent sized all-glass unit. The curved photo-etched mask now employs more than 300,000 holes and this, in conjunction with improved phosphors and tighter production tolerances, has enabled a considerable increase in light output. Tubes now produced are unconditionally guaranteed for one year with a 15 month date coding to allow three months in supply.

TELE-TECH ADVERTISERS — MAY, 1955

While every precaution is taken to insure accuracy, we cannot guarantee against the possibility of an occasional change or omission in the preparation of this Index.

INDUSTRY NEWS

Don Fox, formerly with Ossman & Associates, Rochester, N. Y. and Hawthorne Electronics of Portland, Ore., has been appointed sales manager of Waveline, Inc., Caldwell, N. J. manufacturers of microwave equipment.
American Machine & Foundry Co., Electronics Div., announce the appointment of Marvin Hobbs as Director of Marketing.

Hazard E. Reeves, president and chairman of the board of directors of Reeves Soundcraft Corp., has announced the election by the board of two executive vice-presidents and one new vice-president. **Frank B. Rogers, Jr.**, a vice-president since 1951, becomes executive vice-president in charge of Soundcraft operations, and **Homer W. Clapper**, president of Bergen Wire Rope, a Soundcraft subsidiary, becomes an executive vice-president of Soundcraft in charge of that division. **William H. Deacy**, was elected a vice-president in charge of sales engineering.

F. Rogers, Jr.

W. Deacy

The directors of the Radio Receptor Company, Inc., elected **Hugo Cohn** as president to succeed **Ludwig Arnson.** Mr. Arnson is retiring after thirty-one years in that office but will continue as a director and consultant. **Harold R. Zeamans** was elected secretary-treasurer.

Kenneth V. Curtis has rejoined Raytheon Manufacturing Co. as marine products planning manager. He previously held the postiton from 1945 to 1953.

The appointment of **S. Sydney Minault** as General Manager of the Equipment Division has been announced by **Mr. R. S. Morse**, President of National Research Corporation, Cambridge, Mass.

R. S. Fenton, vice-president in charge of sales and engineering; Frank Newberg, manager of manufacturing; Edward Watermulder, administrative manager; comprise the new "reinforced" management team at Permoflux Corp., Chicago 39, Ill. Mr. Newberg and Mr. Watermulder are new members filling newly created posts.

Do you want more information about PRODUCTS advertised in TELE-TECH & ELECTRONIC INDUSTRIES

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are using space in this issue to acquaint you with their products. Perhaps you want more information on some of them—on one or two, or possibly a score. You can cover all of your needs with the cards below. They are convenient and postfree.

Use the convenient postage-free cards below to get information quickly about products listed here—all advertised in this issue

301 Ace Engineering & Machine Co.—Sheet metal R.F. enclosures
302 Acme Electric Corp.—Plastic encapsulated transformers
303 Adams & Westlake Co.—Mercury relays
304 Aerovox Corp.—Ceramic-cased capacitors
305 Aircraft Radio Corp.—Signal generator & course checker for aircraft
306 Airdesign, Inc.—Industrial & Military transformers
307 Alford Manufacturing Co., Inc.—Slotted-ring TV-transmitting antenna
308 Amelco, Inc.—Universal continuity meter
309 American Lava Corp.—Ceramic & metal-ceramic parts
310 American Phenolic Corp.—Rack & panel connectors
311 Amperite Co.—Delay relays, ballast regulators
312 Arnold Engineering Co.—Powder cores, High Q toroids
313 Artos Engineering Co.—Automatic wire cutter-stripper
314 Audio Devices, Inc.—Recording tape & accessories
315 Barker & Williamson, Inc.—Coils, filters, delay line chokes
316 Bayside Watch Tool Co., Inc.—Spiral speed reducer
317 Bell Telephone Labs—Silicon research
318 Bendix Aviation Corp., Red Bank Div.—"Reliable" double triode
319 Berlant Associates—Tape recorders
320 Berndt Bach, Inc.—Sound-on-film equipment
321 Blaw-Knox Co.—Antenna towers
322 Burke & James, Inc.—Lenses, photo equipment
323 Burnell & Co., Inc.—Subminiature & standard toroids
324 Burroughs Corp., Electronic Instrs. Div.—Pulse units
325 Bussmann Manufacturing Co.—Fuses, fuse clips & holders
326 Cannon Electric Co.—Plugs, audio connectors
327 Century Lighting Co.—Studio lighting, wireless mike
328 Chicago Telephone Supply Corp.—Variable resistors for printed circuits
329 Cinch Manufacturing Co.—Vacuum tube sockets
330 Cinema Engineering Co.—Accurate, wirewound resistors
331 Citation Products Inc.—Precision parts & assemblies
332 Cleveland Container Co.—Laminated phenolic tubing
333 Communication Accessories Co.—Transformers, reactors, magnetic amplifiers
334 Computer Co. of America, Bruno-New York Inds. Corp.—Lab standard DC voltmeters
335 Cornell Dubilier Electric Corp.—Mica capacitors
336 Corning Glass Works—Low-power resistors
337 Corning Glass Works—Glass capacitors, trimmers, resistors
338 Corning Glass Works—Film-type resistors
339 Cunningham, Son & Co., Inc., James—Crossbar switches
340 Dage Television Div., Thompson Products Inc.—
341 Daven Co.—Miniature ceramic switch
342 Eisler Engineering Co., Inc.—Indexing turntables
343 Eitel-McCullough, Inc.—Radial-beam power tetrode
344 Electra Manufacturing Co.—Deposited carbon resistors
345 Electro Motive Manufacturing Co., Inc.—Miniature dipped mica capacitors
346 Electronic Tube Corp.—Dual-channel scope
347 Electro-Voice, Inc.—Dynamic microphone
348 Elgin National Watch Co., Ordnance Div.—Dynamic, ribbon & carbon microphones
349 Fairchild Camera & Instrument Corp.—Precision potentiometers
350 Fairchild Recording Equipment Corp.—3-speed direct-drive transcription table & drive
351 Federal Telecommunication Labs.—Engineering personnel
352 Ford Instrument Co.—Analog to digital converters
353 Freed Transformer Co., Inc.—Inductance bridge, megohmmeter
354 Garde Manufacturing Co.—Insulators & connector heads
355 Gates Radio Co.—Broadcast transmitters
356 General Electric Co.—Germanium transistors for HF and audio use
357 General Precision Lab., Inc.—TV cameras & studio equipment
358 General Radio Co.—Sweep drive for slotted lines
359 Gertsch Products, Inc.—Frequency meter, frequency divider
360 Gertsch Products, Inc.—Standard ratio transformer
361 Giannini & Co., G. M.—Rotary steppers
362 Globe Industries, Inc.—Miniature motors
363 Gudebrod Bros. Silk Co., Inc.—non-slip lacing tape
364 Helipot Corp.—Paper on pot noise
365 Heppner Manufacturing Co.—Speakers, transformers
366 Hermetic Seal Products Co.—Hermetic condenser seals
367 Houston Fearless Corp.—Crab-type dolly for film or TV
368 Hughes Aircraft Co.—Semiconductor products
369 Hycor Co., Inc.—Variable attenuators

Listings continued on next page

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Listings continued from preceding page

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370A Industrial Radio Corp.—Portable 2-way radio
371 Industrial Transformer Corp.—Audio, power, pulse transformers
372 International Rectifier Corp.—Selenium rectifiers
373 Jersey Specialty Co., Inc.—Wire
374 Johnson Co., E. F.—Variable & fixed inductors, tower lighting filters
375 Jones Div., Howard B., Cinch Mfg. Corp.—Barrier terminal strips
376 Kahle Engineering Co.—Tube & diode production machinery
377 Kanthal Corp.—Resistance wire
378 Kay Electric Co.—Wide range sweeping oscillator
379 Kester Solder Co.—Flux core solders
380 Klein & Sons, Mathias—Pliers: long nose, cutting & chain nose
381 Kurz-Kasch, Inc.—Instrument & control knobs
382 Mallory & Co., Inc., P.R.—Multiple carbon controls
383 McAlister, Inc., J. G.—Lighting equipment
384 Measurements Corp.—2-400 mc standard signal generator
385 Melpar, Inc.—Engineering personnel
386 Methode Manufacturing Co.—Tube accessories, hardware
387 Microdot Div., Felts Corp.—Miniature cables & connectors
388 Minnesota Mining & Mfg. Co.—Magnetic recording tapes
389 Mueller Electric Co.—Miniaturized alligator clip
389A National Fabricated Products Inc.—Silicon function diodes, sockets
390 National Vulcanized Fibre Co.—Vulcanized fibre, laminated plastics
391 Onan & Sons, D. W.—Standby electric plants
392 Peerless Div., Altec Lansing Corp.—Standard output transformers
393 Perkin Engineering Corp.—Tubeless power supplies
394 Phaostron Co.—Metal-cased multimeter
395 Philco Corp.—TV b-w and color film scanner
396 Plastic Capacitors, Inc.—Polystyrene capacitors
397 Polarad Electronics Corp.—Microwave signal generators
398 Polarad Electronics Corp.—12,400 to 50,000 mc test equipment
399 Polytechnic Research & Dev. Co., Inc.—Standing wave detector
400 Potter Co.—Capacitors & radio noise filters
401 Precision Paper Tube Co.—Paper tubing, dielectric papers
402 Presto Recording Corp.—3-speed turntable, tape recorder
403 Pyramid Electric Co.—Hermetically sealed capacitors
404 Radio Condenser Corp.—Low cost UHF tuner
405 Radio Corp. of America—Aluminized picture tubes
406 Radio Corp. of America—Plug-in broadcast amplifiers & preamps
407 Radio Materials Corp.—Disc ceramic capacitors
408 Raytheon Manufacturing Co.—TV & 2-way radio microwave links
409 Raytheon Manufacturing Co.—RF transistors
410 Reeves Soundcraft Corp.—Extra play recording tape
411 Remington Rand Inc.—Engineering personnel
412 Republic Steel Corp.—Antenna towers
413 Resinite Corp.—Transformer coil forms
414 Shallcross Manufacturing Co.—Wirewound, deposited & ceramic resistors
415 Sprague Electric Co.—Miniaturized wirewound resistors
416 Sprague Electric Co.—Electrolytics for wiring boards
417 Stackpole Carbon Co.—Fixed composition resistors
418 Standard Electronics Corp.—TV transmitting equipment
419 Sylvania Electric Products Inc.—Engineering personnel
420 Sylvania Electric Products Inc.—Tripolar crystal diodes
421 Sylvania Electric Products Inc.—Color TV receiving tubes
423 Tektronix, Inc.—Cathode-ray oscilloscopes
424 Telechrome, Inc.—Color TV film & test equipment
425 Thermador Electric Mfg. Co., Div. Norris-Thermador—Transformers
426 Tinnerman Products Inc.—Fasteners, chassis nuts
427 Tower Construction Co.—Microwave Towers & reflectors
428 Transradio Ltd.—Low attenuation cable
429 Triad Transformer Corp.—Subminiature audio transformers
430 Tung-Sol Electric Inc.—Electron tubes
431 United Transformer Co.—High fidelity transformers
432 Varian Associates—Reflex klystron for airborne radar
433 Vibrapower Co., James—DPDT chopper
434 Weckesser Co.—Plastic cable clips
435 White Dental Mfg. Co., S. S.—Molded resistors
435A White Dental Mfg. Co., S. S.—Air abrasive cutting unit
436 Whitney Metal Tool Co.—8-ton lever press

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NOT GOOD AFTER JULY 1, 1955

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Despite its small size, this switch is extremely rugged and has been designed to withstand all types of field service. Coin silver contacts, rotors and slip rings are provided for low and uniform contact resistance and excellent electrical characteristics. Ceramic parts are silicone impregnated to function under extreme humidity. Sturdy solder terminals are supplied for wiring.

Single pole style has 18 shorting type contact positions available. 2 or 3 pole types may also be obtained. Several sections may be "ganged" by adding supplementary wafers Flash-over voltage at 60 cycles is 1000 volts peak . . . current carrying capacity is 2 amperes.

This sturdy, high-quality switch is precision produced . . . will give years of service in fine commercial and military equipment. DAVEN's expert engineering staff is at your service for help with special problems or orders to your specifications. Write today for further information.

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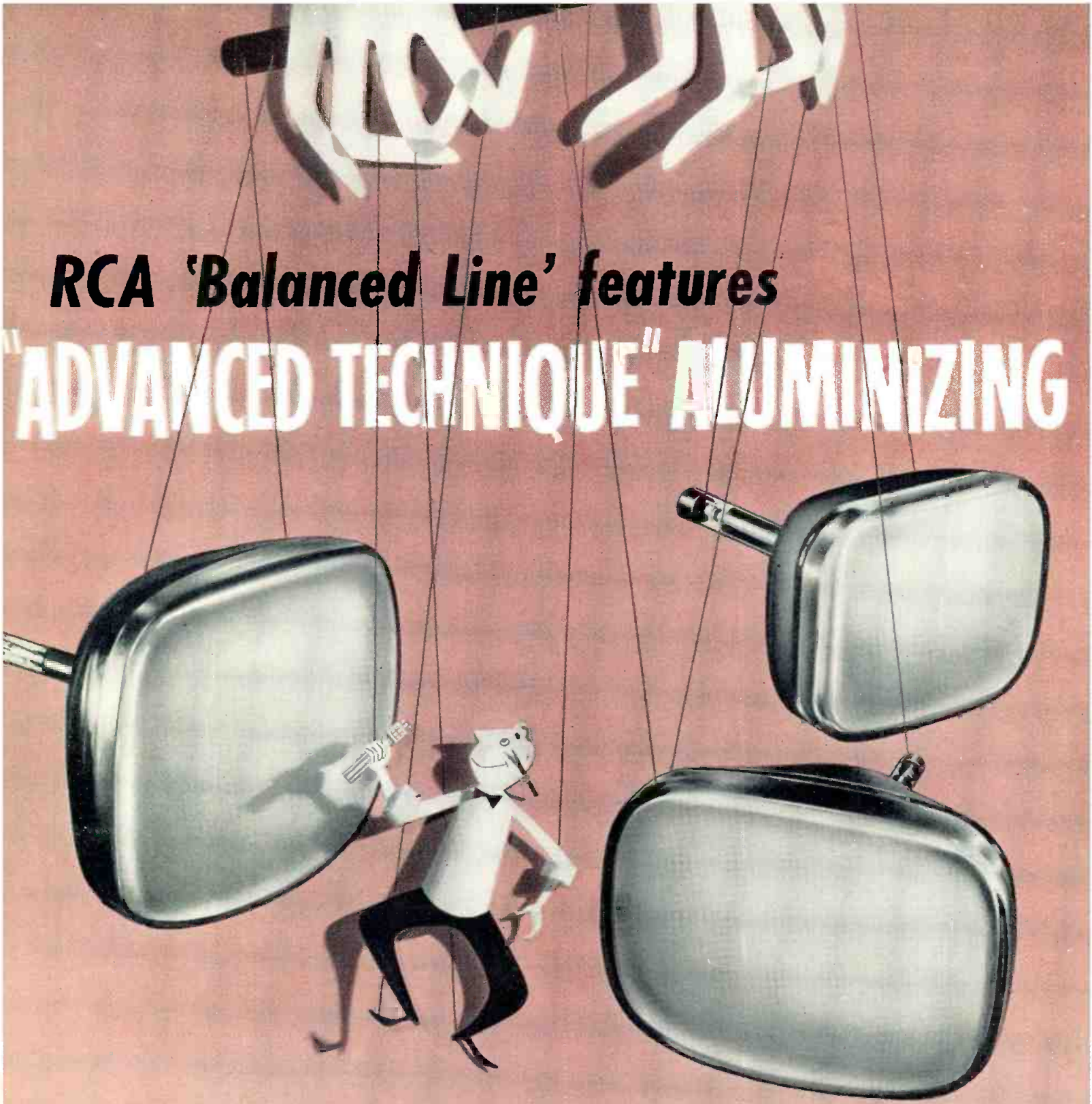
179 Central Avenue, Newark 4, N. J.

WORLD'S LARGEST MANUFACTURER OF ATTENUATORS

RCA 'Balanced Line' features

"ADVANCED TECHNIQUE" ALUMINIZING



NEW 24-INCH Aluminized Picture Tubes—RCA-24CP4-A, RCA-24DP4-A, and RCA-24YP4—round out the RCA 'Balanced Line' for the new look in *your* receiver line.

These new tubes bring you the advantages of RCA "Advanced Technique" Aluminizing—an example of the forward thinking, planning, and engineering that make RCA Tubes famous for quality.

See for yourself how RCA top-quality aluminized picture tubes emphasize clarity and sharp detail in your new set designs. See your RCA Field Representative for your needs.

For technical data, write RCA, Commercial Engineering, Section E50Q, Harrison, N. J.

RCA "Advanced Technique" Aluminized Picture Tubes

type	diagonal deflection angle	focus
21ALP4-A	90	E
21AMP4-A	90	M
21ATP4	90	E
21AVP4-A/21AUP4-A	72	E
21AWP4	72	M
21YP4-A	70	E
21ZP4-B	70	M
24CP4-A	90	M
24DP4-A	90	E
24YP4	90	E

E = low-voltage electrostatic M = magnetic

RCA®

RADIO CORPORATION of AMERICA

ELECTRON TUBES **HARRISON, N.J.**